Knowledge Management in the Brazilian Agribusiness Industry: a Case Study at Centro de Tecnologia Canavieira (Sugarcane Technology Center)

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Abstract: Investigates and analyzes “Knowledge Management” (KM) practices effectively implemented in the Brazilian agribusiness industry. The main objective is to investigate and analyze the conceptions, motivations, practices, metrics and results of a KM process in a genuine Brazilian firm. The qualitative research strategy used was the study of a single case with incorporated units of analysis, and two criteria were observed for the judgment of the quality of the research project: validity of the construct and reliability. Multiple sources of evidence were used and data analysis consisted of three flows of activities: data reduction, data displays and conclusion drawing/verification. The results confirmed the presuppositions and the firm of the study is a benchmark for a KM process in the context of Brazilian organizations. The conclusions suggest that organizational knowledge cannot be managed, it is just promoted or stimulated through the creation of “Ba” or an enabling context. It was also identified that the main challenges facing organizations committed to KM in Brazil have its focus on change management, cultural and behavioral issues and the creation of an enabling context that favors the creation, use and sharing of information and knowledge.

Keywords: knowledge management; strategic information management; enabling context or “Ba”; knowledge management conceptual umbrella metaphor; KM in agribusiness

1. Introduction

The emergence of a technological and economical paradigm based on innovation, knowledge and knowledge, as well as the growing consolidation of technologies such as microelectronics, information technology and computer networks bring complex and multifaceted issues to surface facing contemporary organizations. This transition of the “old rigidity of the atoms to the fluidity of the bits” in organizations lights up many discussions concerning the profusion of new terminologies created in the information era. Therefore, contemporary organizations face new terms such as “knowledge management”, “communities of practice”, “strategic intellectual capital management”, “competitive intelligence”, “organizational learning” and many others. These different perspectives reflect different conceptions of organizational knowledge and organizations themselves, besides a growing need of meticulous analysis about the upcoming opportunities for gaining competitive advantages through strategic use of information and knowledge. In this particular arena, KM arises both as an opportunity and an oxymoron, depending on how it is conceived, analyzed, practiced and measured for its results concerning the organizations’ core-business and readiness to compete. ALVARENGA NETO (2002, 2005, 2008) and MARCHAND & DAVENPORT (2004) suggest that most of what it is called “knowledge management” (KM) is actually information management. They also affirm that KM is more than simply information management due to the fact that it includes and incorporates other concerns such as the creation, use and sharing of information and knowledge in the organizational context, not to mention the creation of the so called “enabling context” or “enabling conditions”, among others. Hence, information management is just one of the components of KM and a starting point for other KM initiatives and approaches.

Debates like these, associated with the lack of a conceptual definition and all the controversy surrounding the term KM, motivated a research study concerning how a Brazilian firm from the agribusiness industry understands, defines, implements, practices, measures and evaluates KM, what motives led it to those initiatives and what it expected to achieve with it. The basic presuppositions were two, respectively: (i) most of what it’s referred to or named “Knowledge Management” is actually “Information Management” and information management is just one of the components of KM. Consequently, KM is more than simply information management due to the fact that it includes and incorporates other aspects, themes, approaches and concerns such as the creation, use and sharing of information and knowledge in the organizational context, not to mention the creation of the so
called “enabling context” or “enabling conditions”, among others; (ii) a conceptual model or map can be formulated based on three basic conceptions: (a) a strategic conception of information and knowledge, factors of competitiveness for organizations and nations; (b) the creation of an organizational space for knowledge or the enabling context – the favorable conditions that should be provided by organizations in order for them to use the best information and knowledge available; (c) the introduction of such strategy in the tactical and operational levels through the several managerial approaches and information technology tools, which are susceptible to communication and orchestration. The results of such study will be presented in this paper.

2. Knowledge management: Models, maps and conceptual trials

A conceptual KM model or map can be formulated based on three basic conceptions: (i) a strategic conception of information and knowledge - as proposed by CHOO (1998) - factors of competitiveness for organizations and nations; (ii) the creation of an organizational space (in the tactical level) for knowledge, the enabling context or “Ba”: the favorable conditions that should be provided by organizations in order for them to use the best information and knowledge available - as suggested by VON KROGH, ICHIJO & NONAKA (2001); (iii) the introduction of such strategy in the operational level through the several managerial approaches and information technology tools, which are susceptible to communication and orchestration, metaphorically named here as a “KM conceptual umbrella”;

2.1 A strategic conception for information and knowledge in organizations

CHOO (1998) asserts that the “knowing organizations” are those that use information strategically in the context of three arenas, namely, (a) sense making, (b) knowledge creation and (c) decision making. Concerning (a) sense making, its immediate goal is to allow the organizations’ members the construction of a mutual and shared understanding of what the organization is and what it does. Strategic reflections must be done concerning the organization’s mission, vision, values and culture, allowing its members to bring meaning to their lives and jobs. An ambitious and challenging vision or state of the future reveals the organization’s intention and it is extremely valuable, contributing to communicate the types of knowledge that are welcomed and will be nurtured. Sense making’s long term goal is the warranty that organizations will adapt and continue to prosper in a dynamic and complex environment through activities of prospect and interpretation of relevant information that allow them to understand changes, trends and scenarios about clients, suppliers, competitors and other external environment actors. Organizations face issues such as the reduction of uncertainty and the management of ambiguity. Competitive, competitor and social intelligences, environmental scanning, marketing research and activities alike are organizational initiatives that aim at constructing meaning about issues for which there are no clear answers. TABLE 1 presents the organizational sense making process through an information perspective:

<table>
<thead>
<tr>
<th>Information Needs</th>
<th>Information Seeking</th>
<th>Information Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>What are the new trends in our industry?</td>
<td>Environmental scanning</td>
<td>Reduction of uncertainty and management of ambiguity: collective interpretation</td>
</tr>
<tr>
<td>What are the core competences of our competitors?</td>
<td>Information systems</td>
<td>Shared knowledge construction</td>
</tr>
<tr>
<td>What do our clients value?</td>
<td>Researches</td>
<td>Decision Making</td>
</tr>
</tbody>
</table>

(b) Knowledge creation is a process that allows an organization to create or acquire, organize and process information in order to generate new knowledge through organizational learning. The new knowledge generated, in its turn, allows the organization to develop new abilities and capabilities, create new products and new services, improve the existing ones and redesign its organizational processes. TABLE 2 supplies an analogy between knowledge creation models and permits inferences between their differences and likenesses.
Table 2: Knowledge creation processes (CHOO, 1998, p.130)

<table>
<thead>
<tr>
<th>KNOWLEDGE PROCESSES</th>
<th>KNOWLEDGE CREATION PHASES (NONAKA &amp; TAKEUCHI 1995)</th>
<th>KNOWLEDGE-BUILDING ACTIVITIES (LEONARD-BARTON 1995)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Generative Processes:</td>
<td>Sharing tacit knowledge</td>
<td>Shared problem solving Experimenting and prototyping</td>
</tr>
<tr>
<td>Generating new knowledge</td>
<td>Creating concepts</td>
<td></td>
</tr>
<tr>
<td>------------------------------</td>
<td>------------------------------------------------------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>Productive Processes:</td>
<td>Justifying concepts</td>
<td>Implementing and integrating new processes and tools</td>
</tr>
<tr>
<td>operationalizing new knowledge</td>
<td>Building an archetype</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cross-leveling knowledge</td>
<td>Importing knowledge</td>
</tr>
<tr>
<td>Representative Processes:</td>
<td>Cross-leveling knowledge</td>
<td></td>
</tr>
<tr>
<td>Diffusing and transferring new knowledge</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The third component of CHOO’s (1998) model involves (c) decision-making. The firm must choose the best option among those that are plausible and presented and pursue it based on the organization’s strategy. Decision making process in organizations is constrained by the bounded rationality principle, as advocated by MARCH & SIMON (1975). Many inferences can be made upon the decision theory, CHOO (1998) and also MARCH & SIMON (1975) list a few of them:

- the decision making process is driven by the search for alternatives that are satisfactory or good enough, rather than seeking for the optimal solution;
- the choice of one single alternative implies in giving up the remaining ones and concomitantly in the emergence of trade-offs or costs of opportunity;
- a completely rational decision would require information beyond the capability of the organization to collect, and information processing beyond the human capacity to execute.

2.2 The creation of an organizational space for knowledge, the enabling context or “Ba”

The creation of organizational knowledge is, in fact, the augmentation of knowledge created by individuals, once fulfilled the contextual conditions that should be supplied or enabled by the organization. This is what VON KROGH, ICHIJO & NONAKA (2001) call “Ba”, enabling conditions or enabling context. “Ba” is needed in the tactical level in order to bridge the existing gap between strategy and action. In this context, the understanding of the word “management” when associated with the word “knowledge” should not mean control, but promotion of activities of knowledge creation and sharing in the organizational space. Hence, KM assumes a new hermeneutic perspective – from knowledge as a resource to knowledge as a capability, from knowledge management to management towards knowledge, from knowledge management to a management from and to knowledge. NONAKA & TAKEUCHI (1995) and VON KROGH, ICHIJO & NONAKA (2001) list the many elements of “Ba”, namely: creative chaos, redundancy, layout, organizational culture and human behaviour, leadership, intention or vision of future and empowerment, not to mention organizational structure and layout, among others.

2.3 The “KM Conceptual Umbrella” metaphor

The “KM Conceptual Umbrella” metaphor assumes that below its boundaries, many themes, ideas, managerial approaches and IT tools concerning information and knowledge in the organizational context are addressed and susceptible to communication and orchestration. It’s imperative to highlight a few of them, such as, ‘strategic information management’, ‘intellectual capital’, ‘organizational learning’, ‘competitive intelligence’ and ‘communities of practice’. It’s exactly the interrelation and permeability between those many themes that enable and delimitate the upbringing of a possible theoretical framework which can be entitled “knowledge management”. Feedback is achieved by classifying the themes below the “KM conceptual umbrella” in the model proposed by CHOO (1998). Competitive intelligence and environmental scanning are initiatives – managerial approaches and IT tools - that drive the strategic concept sense making into action. That is, sense making is a strategic
conception and, e.g., competitive intelligence, an action-driven managerial approach - a way to turn strategy into action is by using the right managerial approach or IT tool that can be found in the “KM conceptual umbrella”. Communities of practice, strategic information management and organizational learning fit into the thematic of knowledge creation and so on.

FIGURE 1 represents and summarizes the integrative conceptual map used both as a theoretical framework and a guide for field research and data collection:

![Figure 1: KM: an Integrative Conceptual Model proposition (Alvarenga Neto, 2008).](image)

Last but not least, it’s desirable to recur to CHOO (2002) once again for the closing of this section, as he suggests a conceptual framework that could be useful for the comparison of possible information and knowledge management strategies. CHOO’s starting point is the “Johari Window”, an approach that describes the dynamics of human interaction and communication and has its genesis in the first names of its inventors, namely, Joseph Luft and Harry Ingham. His arriving point is the proposition of the “Windows of Knowledge Management”, as shown in TABLE 3:

**Table 3: Windows of knowledge management (CHOO, 2002, p.261)**

<table>
<thead>
<tr>
<th>We know what we know</th>
<th>We know what we don’t know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provide Information Access</td>
<td>Directed Information Seeking</td>
</tr>
<tr>
<td>Facilitate Knowledge Sharing</td>
<td>Promote Knowledge Creation</td>
</tr>
<tr>
<td>Intranets, Portals, Taxonomies, Benchmarking</td>
<td>Competitive Intelligence, R&amp;D, Market Research</td>
</tr>
<tr>
<td>We don’t know what we know</td>
<td>We don’t know what we don’t know</td>
</tr>
<tr>
<td>Information Auditing</td>
<td>Environmental Scanning</td>
</tr>
<tr>
<td>Knowledge Mapping</td>
<td>Knowledge Discovery</td>
</tr>
<tr>
<td>Communities of Practice, Knowledge Networks</td>
<td>Scenario Planning, Future Search, Dialogue</td>
</tr>
</tbody>
</table>
3. The method

In order to study the visions and concrete initiatives of Brazilian firms in the knowledge management field, a single case study in a firm of the agribusiness industry was realized, aiming at leaving behind the purely terminological discussion, which is innocuous and naive. The analytical model was divided in five analytical categories as guidelines to field research, namely: (i) reasons or motives that lead the organization to KM initiatives; (ii) the firm’s definition or understanding of KM or/and KM’s concepts; (iii) aspects, managerial approaches and tools considered under the aegis of the firm’s KM area, program or project (“KM Conceptual Umbrella”); (iv) main results related to or generated by KM initiatives.

A *sine qua non* condition in choosing the organizations envolved two important aspects, respectively: (i) a genuinely brazilian firm, with 100% brazilian capital and (ii) the fact that the firm should already had KM implemented and, for this matter, as a primary target, CTC - Centro de Tecnologia Canavieira (Sugarcane Technology Center) was a perfect fit. The qualitative research strategy used was the study of a single case with incorporated units of analysis and two criteria were observed for the judgment of the quality of the research project: validity of the construct and reliability. Multiple sources of evidence were used – semi-structured interviews, documental research and direct observation - and the proposal of MILES & HUBERMAN (1984) was adopted in order to analyze the data collected in the field. Their proposal consists of three flows of activities: data reduction, data displays and conclusion drawing/verification.

The field research was realized in the city of Piracicaba, São Paulo, Brazil, in the period between March, 19th, 2005 to April, 12th, 2005. The updates to this study were completed in March, 2008. CTC is a non-profit civil association with its headquarters located in the city of Piracicaba, in the Brazilian federative state of São Paulo. Its main objective is to contribute to the growth and economic development of Brazil through research, development and diffusion of (i) new technologies applied to agricultural, logistics and industrial activities of the sugarcane and alcohol industries, (ii) development of new varieties of sugarcane and (iii) pest control. CTC is the market leader in its business in South America and one of the world’s leading players.

The results of this single case study will be presented in the lines below.

4. Results’ analysis

4.1 Main reason or motives for the adoption of KM initiatives

The main reasons or motives for the adoption of KM in the organization of this study concerned the following aspects:

- Lack of practices of protection and sharing of information and knowledge, leading the organization to a constant reinvention of the wheel and continuous duplication of efforts;
- Problems with data/information collection, treatment, organization and dissemination, indicating lack of strategic information management;
- Recognition that both information and knowledge are the mains factors of competitiveness of modern times;
- Need for the creation of an organizational space for knowledge, also knows as “Ba” or “enabling conditions”, vis-a-vis the need to address cultural and behavioral issues.

Evidences and testimonies collected in field interviews confirm the statements above:

“[…] each part, area or department of our firm had idiosyncratic methods for storing and managing knowledge… […] nowadays the firm is concerned with knowledge because knowledge is the main factor of competitiveness. […] there were problems with information retrieval.” *(CTC’s Coordinator of Technology Transfer)*

“[…] I think it was a threat: the entrance of new competitors in the market, mainly in the external market, […] and the need to do faster researches and face the new competitors: Australia, India and South Africa. […] we had a huge knowledge loss with downsizing and retirements.” *(CTC’s Knowledge Manager)*
“ [...] with turnover and downsizing, we had a huge critical knowledge loss… (CTC’s CEO)

“ [...] in today’s world, changes are a constant and the speed in which they occur is getting faster and faster. [...] a firm’s decision about managing its knowledge is not simply about choosing an IT product or service. It requires cultural and behavioural changes of its workers. The tools used for this process are needed, but they are only tools. In order for a firm to succeed, it’s imperative that its KM process implementation comes along with programs that stimulate cultural and behavioural changes.” (Documental Research, CTC, 2005)

4.2 Organizational definition for KM

There was a lack of consensus concerning a definition for KM in the organization of this study. Nevertheless, a few terms were common in the answers of interviewees (content analysis), namely, process, information, knowledge, innovation, tacit-explicit knowledge conversion, registration, sharing, organizational culture, access and use, among others. Here are a few testimonies of interviewees that confirm this assertion:

“ [...] there is no consensus of what KM is or should be in the organization – it’s a challenge. [...] there’s a delimitation of performance areas: information treatment, tacit knowledge, enabling of sharing… [...] KM is a process, it has phases but no end. [...] process that aims to enable information and knowledge sharing, intangible assets protection, (sic) where knowledge is focused”. (CTC’s Knowledge Manager)

“ [...] it’s not very clear, but it’s all that is managed for obtaining knowledge, innovation”. (CTC’s Chief Executive Officer)

In spite of that, the mission, critical success factors and objectives of CTC’s KM process were well delineated, as shown through documental research:

“ [...] CTC’s KM process: (i) Mission: support the acquisition of competitive advantage through identification, capture, storage, protection, organization and sharing of critical knowledge to CTC’s business […] (FIGURE 2) (ii) Critical Success Factors: (a) clear definition of the strategy and scope of CTC’s KM process, (b) definition of performance indicators, goals and metrics, (c) identification of critical knowledge relevant to CTC’s business, (d) corporate commitment in the stimulus and continuous use of knowledge, (e) definition of IT infrastructure for storage and dissemination.” (Documental Research, CTC, 2005)
4.3 Managerial approaches and tools considered under the “KM Conceptual Umbrella”

The next step was to investigate the theoretical proposal entitled “KM conceptual umbrella”. Henceforth, the interviewees were asked to answer which aspects, managerial approaches and tools were considered under the aegis of the KM area, program or project in their firm. Here’s a comprehensive summary of the answers: (a) environmental scanning, competitive intelligence, market research, (b) strategic information management, electronic document management, process mapping, (c) intellectual capital management, competencies and people management, intangible assets, (d) communities of practice – both real and virtual, (e) organizational learning, including e-learning, (f) decision making support and (f) creation of the enabling conditions or “Ba”.

“[...] KM is an strategic area hooked to the directorship, providing information to support decision making processes, it’s directorship’s advisory” (CTC’s Knowledge Manager)

“[..]to implement a rigorous taxonomy for all the organizational content.” (Documental Research, CTC, Alvarenga Neto, 2005)

The interviewees were also inquired about the emphasis or priority aspects of KM in their organization. Data analysis revealed that the starting point for KM initiatives – strategic information management – was reaching a stage of concept maturity, with consciousness that it is a permanent process. The organization of this study was putting its efforts at advancing in aspects related to sharing, organizational culture and the creation of “Ba” or the enabling conditions. It’s imperative to highlight the existence of many initiatives that are genuinely Brazilian initiatives, adopted to address the creation of “Ba”, such as the “Cultural Moment” at CTC. CTC’s Cultural Moment is one of the main activities promoted for the creation of “Ba”. It’s simply a meeting invited by top managers with the purpose of discussing critical issues in the productive chain of the agribusiness industry. Everyone is invited and FIGURE 3 brings an example of one of the many invitations for the “Cultural Moment”:

![Image of Invitation for CTC’s ‘Cultural Moment’](https://example.com/invitation.png)

**Figure 3**: Invitation for CTC’s “Cultural Moment” (Alvarenga Neto, 2008) - “Cultural Moment – Theme: Biosafety – Goal: to share information and tacit knowledge about relevant themes to CTC and the sugarcane industry. Come share with us! Knowledge Management”

4.4 A closer look at main KM practices in the Brazilian organizational context

In order to present the main practices and experiences of KM in the Brazilian organizational context, they will be grouped into six categories, that is to say: (a) environmental scanning, competitive intelligence, market research and activities alike, (b) strategic information management, electronic document management, process mapping and information technology (IT), (c) intellectual capital management, competencies management, and intangible assets, (d) communities of practices – real and virtual, (e) organizational learning and (f) the creation of the enabling context or ‘Ba’.

(a) environmental scanning, competitive intelligence, market research and activities alike:
formal and structured processes: clippings, market research, competitor intelligence, competitive intelligence, environmental scanning, benchmarking, information systems and databases. At CTC, pursuing the goal of establishing spectral behaviour patterns capable of identifying and quantifying cultivated areas with registered varieties of sugar cane, geoprocessing and satellite pictures are used (FIGURE 4);

informal and unstructured processes: international trips, internet, rumours, networking and personnel's field work.

Figure 4: Use of geoprocessing and satellite images at CTC, Brazil - Landsat ( Alvarenga Neto, 2008).

(b) strategic information management, electronic document management, process mapping and information technology (IT):

strategic information management, electronic document management, process mapping: electronic document management (FIGURE 6), workflow, establishment of central data repositories for all organizational content, taxonomies and ontologies, selective information dissemination processes, corporate libraries, archival and documentation centres, digital libraries, content management, project management, processes management, public archival mapping, among others;

information technology (IT): networks, intranets (FIGURE 5), softwares, digitalization, information security management, data bases.

“[..]the main KM projects at CTC: Document Management System – its goal is to create a unique repository to all documents, in order to provide sharing and facilitate access to explicit knowledge; development of an EDM – Electronic Document Management: the organizational memory was digitalized and taxonomies were defined (today: 15,000 documents stored), an average of 200 documents are included per month.” (Documental Research, CTC, Alvarenga Neto, 2005)

(c) intellectual capital management, competencies management, and intangible assets:

intellectual capital management and intangible assets: patents, royalties and registrations;

competencies management and retirement programas attendance;

programs/systems of ideas and suggestions: ideas that strengthen the core competencies of the organizations and its knowledge portfolio (FIGURE 7);

expertise locations systems, also known as Yellow Pages;

(d) communities of practices:

communities of practice: meetings, technical update sessions, chats;
virtual communities of practice – virtual: workers are part of both internal and external communities; use of chats, conference calls, videoconference, news, knowledge libraries, discussion forums: best practices sharing and collective learning.

(e) organizational learning: a strong correlation between organizational learning and intellectual capital was revealed. Here’s a comprehensive list of organizational learning practices:

- organizational support towards continued education: scholarships granted to workers in order to pursue MBA and PhD degrees, language studies, among others. Workers are released from work for the period of time and still received their full wages;
- study groups and technical update sessions;
- ‘e-learning’;
- corporate universities and partnerships with universities;
- best practices databases/systems.
- training and development programs, self training centers and training programs with humans resources, marketing and information technology.

(f) the creation of the enabling context or ‘Ba’: the results point out to relevant efforts towards the comprehension and creation of a favorable organizational context.

- layout;
- creation of organizational meeting pointings for conversations, information and knowledge sharing and learning. In this sense, there are genuine brazilian initiatives, such as the “Cultural Moment” at CTC (FIGURE 3).
- organizational culture and values;
- creative chaos, empowerment, open management policies;
- tolerance towards ‘honest mistakes’. 

Figure 5: CTC’s intranet - (Alvarenga Neto, 2008).
4.5 Results of KM initiatives

At last, the main results related to or generated by KM were nominated by the interviewees: (i) innovation cycle reduction and faster time-to-market solutions; (ii) market share and portfolio increase; (iii) facilitation of expertise and people location; (iv) creation of an organizational memory and repository; (v) increase in the learning capacity and (vi) ability to anticipate competitors’ actions and movements. In the last couple years, CTC had an increase in its number of employees and high skilled professionals were hired. These professionals have high academic degrees such as masters and PhD degrees, but little professional experience. The existing systems such as EDM, Corporate Library and Information Systems had an exponential increase in use and proved the effectiveness of
CTC’s KM initiatives. These “old documents” were a highly important source for the newcomers and helped in their training and knowledge of CTC's business.

5. Conclusions

This paper’s main goal was to investigate and analyze the conceptions, motivations, practices and results of KM effectively implemented in a Brazilian firm of the agribusiness industry. Far from proposing a definite solution or a hermetic model, it hoped to contribute for a better understanding of the field, its borders, scopes and connections. A KM integrative model/map was elaborated starting from that proposed by CHOO (1998), associated to the “Ba” or enabling conditions proposition conceived by VON KROGH, ICHIJO & NONAKA (2001), in addition to the several managerial approaches and tools metaphorically denominated as the “KM conceptual umbrella”. These three ideas interconnected are contributive for the construction of a theoretical framework as a starting point. Another corollary of this work assumed the task of confirming this integrative conceptual KM framework through the discussion and analysis of a Brazilian research with Brazilian organizations committed to KM. Both the presuppositions and the theoretical framework presented in the literature review (FIGURE 1) were confirmed. This framework integrates the strategic, tactical and operational levels of the organizations concerning KM initiatives, e.g.: the strategic concept “sense making” is driven into action by using managerial approaches or tools for this purpose – found in the “KM Conceptual Umbrella - such as competitive intelligence, market research or environmental scanning; the strategic concept “knowledge creation” is driven into action by using managerial approaches or tools such as “strategic information management”, “intellectual capital” and “communities of practices”, among others. From strategy to action, “Ba” is needed to bridge the gap as it creates the favorable context for creativity, innovation, empowerment and creative chaos, among others. It is interesting to observe that the managerial approaches and tools considered in the “KM Conceptual Umbrella Metaphor” are also interconnected: strategic information management is the starting point that can lead to the strategic management of intellectual capital, the organization of communities of practice, the startup of organizational memory and organizational learning and so on.

It was also identified that the main challenges facing organizations committed to KM have its focus on change management, cultural and behavioral issues and the creation of an enabling context that favors the creation, use and sharing of information and knowledge. Another remarkable challenge is the proposal or creation of a group of metrics and/or performance indicators to evaluate KM. CTC is a leading Brazilian firm with a mature KM process. It’s also a benchmark for other Brazilian firms concerned with KM or KM processes. The conclusions suggest that KM is an oxymoron, perhaps an impossibility. Knowledge as such cannot be managed, it is just promoted or stimulated through the creation of a favorable organizational context. The word “management” when associated with “knowledge” must be apprehended as promotion or stimulus for the creation and sharing of organizational knowledge and KM assumes the meaning of a management from and to knowledge. There is strong qualitative evidence of a major shift in the context of the organizations contemplated in this study: from “knowledge management” to the “management of ‘Ba’ or the enabling conditions” that favors innovation, sharing, learning, collaborative problem solution, tolerance to honest mistakes, among others. KM is highly political, demands knowledge managers and is an endless process that needs to be aligned with the organizations’ strategy and highly in tune with leadership premises. KM is not the same as information technology (IT), but it can be a process supported by information technology. Not all KM initiatives need IT, as demonstrated by CTC with its “Cultural Moment” initiative. It’s recommended to test this model and also KM practices in small and medium firms in the Brazilian organizational context.

References


Success Factors in Implementing Knowledge Based Systems

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Abstract: The various dimensions of the problems of productivity and technology cannot be found in technology alone, but rather there are also human factors that either facilitate or constrain the ability of firms and workers to adopt and implement new technologies. This paper discusses the factors that contribute to Knowledge Management Systems effectiveness. Through a case study and literature reviews a general framework has been delineated. This framework describes dimensions involved in the adoption of technology at both the users and organisational level.

Keywords: information communication, technologies, technology adoption, information, social software, social aspects, knowledge management systems

1. Introduction

Due to the current changing business environment, organisations are facing challenges of global competitiveness. The quest for competitiveness and sustainability has led to recognition of the efficient use of information and communication technologies as a vital ingredient for survival and profitability in the knowledge-based economy. Furthermore, organisations are confronted more and more with issues such as rapid technological changes, shortened product lifecycle, downsizing, and high market volatility. In order to cope with these challenges, organisations need to be able to manage the highly distributed diversified knowledge. Knowledge is seen by many as a key source of competitive advantage and innovation in organisations. Challenges rely on the identification of crucial knowledge that improves the business process (Edvinsson & Malone, 1997). Thus, it is recognised that companies need to take care of their most important assets which is the organisational knowledge.

Knowledge is defined as information in context with understanding to applying that knowledge (Brooking, 1999). In addition, knowledge is seen very subjective, because it depends on the beliefs, values, intuition and the emotions of the individual (Sunassee & Sewry, 2002). It is necessary to recognize the different types of knowledge in order to expose its potential contribution to the performance of the organization (Pemberton & Stonehouse, 2000). The wide-based knowledge definitions highlight the presence of several forms of knowledge; tacit, explicit, implicit and systemic knowledge at the individual, group and organisational levels (Davenport & Prusak, 2000; Dixon, 2002; Inkpen, 1996; Nonaka & Takeuchi, 1995; Polanyi, 1958).

Explicit knowledge has a tangible dimension that can be easily captured, codified and communicated (Firestone, 2001). In contrast, tacit knowledge is linked to intuition, emotions, beliefs, know-how, experiences and values. The distinction between tacit and explicit knowledge is important since their management is quite distinctive and requires different knowledge management initiatives.

Knowledge management (KM) initiatives are expanding across all types of organizations and companies worldwide (Ribière, Bechina Arntzen, & Worasinchi, 2007). The KM project implementation can be very different; it ranges from building knowledge based repositories to social software deployment. Several documented benefits resulting from the successful implementation of KM have been published (Alavi & Leidner, 2001; Becerra-Fernandez, Gonzalez, & Sabherwal, 2004; Coleman, 1998; Jennex & Olfman, 2004).

Even though a number of research studies have outlined the importance of the use of Information Communications Technologies (ICT) as enablers for knowledge management practices, there are still...
some issues concerning the socio-technical factors influencing the success of the KM implementation (Chua & Lam, 2005; Kaweevisultrakul & Chan, 2007). Despite the fact that many current implementations of KM initiatives are based on highly advanced information technologies, there are still challenges to cope with in order to ensure the effectiveness and efficiency of such KM initiatives. Several studies and surveys having investigated the reasons leading to the KM initiative failure, highlighted that organizational culture and others psycho-social factors play an important role to the KM success (E&Y, 1996; Knowledge Management Review, 2001; Tuggle & Shaw, 2000).

The earlier KM implementations focused strongly on the Information Communication Technology (ICT), however today most of the researchers and practitioners recognise the importance of the “soft” dimensions of KM initiatives (Anantatmula, 2005; Gee-Woo, Robert W. Zmud, Young-Gul, & Jae-Nam, 2005; Ribière, 2005).

It is commonly agreed that although there are plenty of technical solutions supporting different knowledge processes such as knowledge creation, representation, storage, and sharing and so forth, there is still a need to understand the factors impacting not only the acceptance of the knowledge management systems (KMS) by the knowledge worker but also their efficient usage.

Questions arise as to what motivates individuals to use information communication technologies in their workplaces. What is the motivational gap between people at various age groups and education backgrounds? Are the benefits of technology fully realised?

This research paper discusses the challenges and issues encountered while using the information communication for implementing knowledge management initiatives. The next section investigates the motivations and encountered challenges for technology use, while section three presents a general framework encompassing success factors for a knowledge based system effectiveness implementation.

2. Challenges in the use of ICT in working environment

The last decade, Internet and the World Wide Web emergence have brought a revolution in the way people communicate and interact with each others. The accessibility and interconnectivity they offer answer to more capability and opportunities. Furthermore, it is recognized that Web-enabled tools have transformed work processes in ways that are important and pervasive. In testimony the large number of software used in workplace such for instance SAP, Oracle, Microsoft and so forth.

The penetration of new technologies in the workplace has generated new type of issues and challenges. For example, selection and adoption of technology is a complex process that is based on a number of alternatives including technological choices, perceived benefits, cost based models and organizational strategies (NAE, 1991). However technology itself needs adaptation to organizational goals and strategies (Laulmann, Nadler, & O’Farrell, 1991).

Motivations for technology use are both intrinsic and extrinsic. Adaptability of technology to user needs user confidence and motivation to its adoption. Kanter’s has identified five characteristics of successful technology adoption, the five Fs - Focused, Fast, Flexible, Friendly and Fun (Rosabeth Moss. Kanter, 1990).

Dias (2002) has identified three motivation factors for using technology, namely; perceived usefulness, perceived ease of use and perceived enjoyment (Dias, 2002). Dias (2002) argues that “information technology implementation is an intervention we make in order to improve the effectiveness and efficiency of a socio-technical system”.

Effectiveness of information or knowledge based systems has been a research theme within the academia. In testimony there is a plethora of work related to this topic (Nakayama & Sutcliffe, 2008; Park & Kim, 2005).
The factors influencing the effectiveness of such technical systems are defined by the system quality, information quality. Therefore new scales and measures, along with continued research into organizational effectiveness and user satisfaction have been investigated (DeLone & McLean, 1992; Scott, 1995).

Recognition is now given to the fact that a successful implementation of knowledge based systems at enterprise level is strongly influenced by the quality of content, technical quality and by the user’s commitment to the use of that technology. It has also been recognized that new technologies are often not optimally utilized, or inefficiently used. The underutilization problems are linked to diverse factors and these ultimately undermine business performance.

The role of the people in the introduction of new technologies is increasingly becoming a major focus of research. Although technology per se is a product of engineering it is also part of a larger system which includes other input and output components. These inputs and outputs are required in the design, building, and operation of new technologies. As Laumann et al (1991) have noted “technology is fundamentally an organizational and human endeavour linking what is theoretically possible to what happens in the laboratory, in the design shop, in the operating room, in the office or in the plant floor”. This is a departure from historical perceptions where engineers have assumed that implementing technology means that people will adapt and learn to use the new equipment.

Social scientists have recently added new dimensions on the implementation of technology by recognising factors such as organizational decision-making, the characteristics of new workplace technologies, worker satisfaction, workers’ skills and motivation for adaptation of those technologies, organizational structures and management roles. The organisational structures form a centre in which all other factors operate. Work procedures, rules and organisational chart govern daily work environment.

In the context of this paper, it is important to determine the factors related to the users and the implementation of knowledge Management systems. The next section describes a case study that helps us to gather enough data to understand the success factors that play a role in the adoption of technical systems.

3. A model of success factors involved in knowledge based system

3.1 Context of study: Åmot Municipality, Norway

Reinvention of the public administration has become a key motive to achieve in order to cope with the pressures to innovate that the government is facing. Today the government is expected to not only provide better services to the citizens, but also to guarantee social cohesion, to improve the transparency and accountability and to use / apply efficiently the information and communication technology. In other words, public sectors need to move towards an innovative e-government. Today, it is well acknowledged that knowledge and its management are the drivers fostering innovation in the public sectors. There are many KM initiatives but the common challenge resides in achieving a
synergy by integrating people, processes and technology. The picture 2 highlight some of the technologies and KM practices used in the public sector in Norway.

![Diagram](image_url)

**Figure 2:** Processes, technology and people components interaction adapted to the public sector source (Arntzen Bechina 2007)

A case study was done to establish knowledge on what Åmot Municipality in Norway needed to pursue in order to improve the business processes and their administrative routines leading to provision for innovative services to the citizens and the companies. The research project had following objectives:

- Assessment of knowledge management practices in Åmot municipality
- Assessment of the way Information and Communication technologies were used by the civil servants in performing daily tasks
- Determination of the knowledge processes needed for improving the business processes.

In the framework of this paper, we focused on the second objective. The aim being to investigate the factors influencing the use and the success of several software applications used in the framework of managing knowledge.

We adopted qualitative and quantitative approaches. Several interviews were conducted with the top and middle managers of the municipality. The main aim was to understand the work routines in the municipality and how the use of the information communication was perceived by the employees. We designed a web survey that was sent to the municipality employees. In order to ease the process of collecting data from several departments of the municipality, we decided to design an online questionnaire that was sent directly by e-mail. The choice proved convenient for respondents and improved response rates.

The web survey was developed in cooperation with managers in the Municipality. In order to improve the response rates, a two-phase web mail survey was performed. A proper system of reminder was set up in order to minimize non-response. Experiences from surveys of organizations show that people reluctant to answer are biased towards lower computer usage compared to the more disposed respondents. Therefore, we asked the managers to inform as well the employees that they needed to check their email and send the responses of the survey.

Furthermore, we were aware that the respondents of the public sector might need more time to reply. This is due to the somewhat larger and more complex organization, where for example addressing the respondent internally requires more time.

Surveyed individuals were able to complete the questionnaire in less than ten minutes. The interface was designed in such a way to ease the progress monitoring. No respondents dropped out prematurely. Also in order ensure maximum confidentiality no user name or password was required to access the online questionnaire. There were a total of 63 respondents, 32 males and 31 females.
From the literature reviews and a first round of a data set collection, we present in the next section a framework encompassing factors that will contribute to understand the adoption of technologies to a larger extent with a special focus on the knowledge management systems.

3.2 Findings and discussions

Technology itself, even when it is not intended as a communications product, serves as communication medium between the users (P. S. Adler & T. Winograd, 1992). Communicative interactions also inform the users of their day-to-day operations as they deal with challenges that continually arise on the technology's potential. Every technology thus has communication embedded on it. And this is even more valid for knowledge systems such as discussion forum, social software, Web 2.0 where the dimension of interaction and participation is the core of their functionality. This is an important aspect that dictates the decision by management to invest in technologies.

However, this is not the main factor. Others factors at the organisational level that contribute to the KMS effectiveness are related to leadership, training, clear business strategy, aligning business goal with the technologies, collaboration , adaptive culture. They are represented in the bottom of the figure 3.

Communication is also very crucial in the implementation of any technology. Very often different segments of people might share an interest in the implementation of new technologies at workplaces. However as Laulmann et al. (1991) have observed, very often engineers and consultants, scholars, work managers and union representatives, despite their common interests in the implementation of new technologies, do not often meet and talk together. There are language barriers across the groups either within or across. Very often there are conflicting goals and expectations, theoretical interests of scholars versus the day-to-day concerns of managers, technological priorities of engineers versus the human resources priorities of personnel managers and labour leaders; underlying values of autonomy or control, individualism or collaboration. Conflicting interests of the stakeholders are so acute in that every specialist has his/her rigid way of thinking within the confines of his/her discipline, have different priorities and methods. Sometimes the differences and perceptions are so acute that finding an optimal solution is impossible.

The role of leadership in the successful implementation of Knowledge Management Systems should be considered. Leadership is central in the implementation of technological change. Leadership often comprises of managers, union leaders, executives and professional. The decision to implement technological changes is often a management decision accompanied by professional consultation.

The Cultural framework for implementation depends on the organisational structure and the flow of decision-making. The degree of involvement, transparency, shared vision and goals are essential prerequisites for successful implementation of KMS. Management styles create or limit spaces for participation, provide psychological support to employees, provide training opportunities for the employees who are in any case the ultimate users. The cultural context is therefore crucial for KMS. The level of involvement of employees appears to be an important factor in the implementation of KMS. It becomes more important in relation to other factors such as psychological preparedness to implement KMS. As Laumann et al (1991) have noted the opposite to employee participation would be resistance. Quoting Van de Ven they provide a summary of why people resist change.

Training and incentives: training is also a necessity for the successful implementation KMS. Technology has several implications on the job skills; they can either upgrade or degrade skills. They can also make certain skills redundant. Incentives and rewards can also be used as an inducement for training, motivation etc.

Organizational structure and environment /context have a strong influence on implementation of ICT. In their chapter on The Usability Challenge, Adler & Winograd (1992) note that all too often, new technologies are introduced into the workplace without sufficient planning for their implications for their workforce. Sometimes managers adopt policies that trigger reaction from employees, in the form of resistance to new technologies or reorganization, distrust of managers. At the same time as newer technologies are developed and implemented, they encounter usability challenges. Employees' distrust of managers stems from the fear of losing that their work would be taken over by technology, that their skills would be made redundant as a result of investments in technology. At the same time as Adler & Wonograd (1992) have noted, managers are often reluctant to give any guarantees that
protect employees against layoffs due to fears that such guarantees undermine their managerial authority. In reaction the workers unions often insist on clinging to existing job descriptions and skills requirement.

One factor concerns the alignment of the ICT with the business goals, quite often companies have different units using different software or technologies that’s inhibit the data sharing between tools. Therefore an overall ICT strategy is needed.

It is evident, that embedding human factors in system designs is a valuable tool for addressing some of the challenges in KMS: It takes into cognisant of the fact that interaction between human and technology takes place within an environment – physical, socio-cultural and organisational. Theses factors are presented on the top of the framework (figure 3) and contribute to the user satisfaction that will contribute to the KMS effectiveness.

**Figure 3: Factors enabling KMS effectiveness**

Chen & Sharma (2002) have noted how users of the system are facing more challenging dynamic working conditions and have to adapt to these changes immediately. They classify KMS users as either dedicated users or casual users. Dedicated users are those who spend considerable time in various programs and are therefore more comfortable and known to the system, whereas casual users make use only of a particular program and that too occasionally and would never become friendly to the system. Therefore casual users often have many problems and questions about the system and might become critical of the system refusing to accept it (Chen & Sharma, 2002). They suggest a human-centred interaction design which puts users’ needs first, technology second. Designs should be human centred and in accordance with the user’s tasks, needs, capabilities, learning abilities, backgrounds, motivations and work styles. Human factors while a necessity for user-oriented designs also present challenges.

Employee conception of **user-friendliness**, defined in terms of the time it takes to learn to use new technology and the potential benefits is also a determinant factor in the employees’ eagerness or reluctance to use new ICTs. A system **usability** criterion is defined by Alder & Wonograd (1992: 7) as ‘the extent to which it supports the potential for people who work with it to understand it, to learn, and to make changes.

**Learning and training** is essential in the adoption of the systems. Quite often top management or IT department are asking employee to use specific software but do not provide adequate training. Therefore, sometimes the systems implementation is proved to be a failure because people do not have the right **skills**. While designing a system, it is important to integrate the notion of **enjoyment**. In
order to encourage the use of systems, some companies have set up some rewards mechanism that proved to be efficient.

The success of KMS therefore hinges on the interplay between these factors. These determinant factors can be construed with a system theoretic perspective, whereby one considers all the elements or part of a whole system, instead of a reductionism perspective where one considers individual parts separately.

4. Conclusion

In recent years researchers agree that the implementation of technological innovation rests largely on readiness for change and that human factors are crucial for this change as change is not always perceived positively (Rosabeth Moss. Kanter, 1991). Human factors are defined as knowledge of human abilities and limitations to the design of systems, organizations, jobs, machines, tools, and consumer products for safe, efficient, and comfortable use.

This paper has presented an ongoing research study investigating the factors ensuring the effectiveness of knowledge Management Systems. A model of factors contributing to a successful implementation of knowledge based system is presented.

The organizations’ desire to achieve competitive edge in world markets is a growing concern for managers and academics alike. As the National Academy of the Engineering Staff (1991) has observed, ‘as has always been true when greater efficiency and higher productivity are desired, managers have turned to new, sophisticated workplace technologies. New technologies, however, have not proved to be a panacea for all the problems of productivity’ (NAE, 1991).

Reference


www.ejkm.com 217  ISSN 1479-4411


Leadership Imperatives of the Information Age

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Abstract: Information is becoming the engine, resource, and commodity that drives the economy and social institutions, as well as our personal and professional lives. Because we are living in a unique period of human history, we may not appreciate the scope, speed, and impact of Information Age change. Framing six characteristics of the Information Age, this paper suggests resulting imperatives for leaders who must create and lead Information Age organizations. They must leverage human and other resources, and solve today’s complex and wicked problems to achieve organizational and cross-boundary goals. Global engagement, no longer limited by time or space, is enabled by worldwide information communication and technology networks that are instant, non-hierarchical, and dynamic. Smaller devices, tagging, and the integration of media and sources foster communication, collaboration, and innovation, along with new expectations for ourselves and others to be “always on” and responsive. In this dense information environment leaders face the danger of heightened decision uncertainty in a sea of meaningless, fragmented but apparently inter-connected data. Increasingly complex, chaotic, fragmented, interdependent wicked problems require new cross-boundary perspectives and deeper understanding. In the Information Age solo action focused on control of resources is giving way for former competitors to create win-win partnerships. Dynamic human networks are replacing, complementing, and competing with hierarchical organizations as powerful systems for communicating, sharing, and organizing. The authors, faculty members at a U.S. Government graduate institution, explore the essential elements of the Information Age and their imperatives for leaders, especially government leaders, who can create and lead organizations in this new environment.

Keywords: Information age, leadership, wicked problems, human networks, globalization, technology

1. Introduction

The challenges of leading government organizations are not changing but the context is. The technological, economic, and social changes of the Information Age bring a host of new imperatives with significant implications for government leaders. Globalization and the continuing rapid development of information and communication technology (ICT) are causing rapid changes in the information and decision environments. The evolving nature of resource control and of human networks requires and enables executives to lead in new and often transformational ways to accomplish organizational goals. This paper explores the essential elements of the Information Age and identifies opportunities and challenges for leaders, especially government leaders, who can create and lead 21st Century organizations.

2. Globalization

Globalization is the driving force behind many challenges and opportunities facing Information Age government leaders. Globalization is "a process of interaction and integration among the people, companies, and governments of different nations, a process driven by international trade and investment and aided by information technology" (Globalization101.org 2008). First, globalization calls into question the very role of the Federal government. In policy areas such as trade and financial regulation, the government has ceded much of its authority to the global marketplace (Lynn 2005). In other policy areas, such as poverty reduction and health care, for-profit and non-profit organizations are taking on what used to be government roles. Companies are now doing a multitude of tasks that used to be performed by government employees. These trends pose challenges for government leaders (Friedman 2000). They must determine the role of the government and how the government can work with other players in furthering the country’s interests. A second fundamental challenge for Information Age Leaders relates to how government organizations can work effectively in the new global environment. Two areas in particular provide Information Age Leaders with unique opportunities and challenges: media and human capital. Globalization relies on ICT that enables rapid communications and information dissemination. The result is a dramatic change in the world of media. Intense competition among media outlets creates a 24/7 news culture that is always looking for a new story. Rumor and opinion are gaining credibility while investigative reporting is becoming increasingly scarce. In this environment, government leaders are under tremendous pressure to avoid bad media
exposure and to garner positive media attention. To achieve these goals, Information Age leaders need more training and experience in dealing with the newest set of media tools such as blogs, Internet videos, podcasts, and websites.

Globalization has a tremendous impact on human capital. Demographic trends and immigration flows require government leaders to deal with a changing pool of citizens (or "customers") and employees. Problems that used to be considered purely internal increasingly have an international dimension. Leaders need to become adroit in dealing with different races, cultures, religions, and age groups. They also need to reconsider how work gets done. Many government agencies still use Industrial Age processes to accomplish tasks. These processes are not a good fit for an era of flat structures, cross-boundary collaboration, out-sourcing, and virtual environments. Government agencies need to take the cue from other organizations that are leveraging Web 2.0 technologies, new organizational structures, and more flexible processes to operate effectively in a globalized world. For example, government leaders may wish to consider more flexible work arrangements for people who have reached retirement age but wish to continue contributing. Leaders may also look for more efficient and effective ways to rotate personnel between public and private sectors.

3. Information and communication technology

Pervasive ICT is another imperative in the environment of Information Age leaders. While communication technology is not a 21st Century phenomenon, the instantaneous and global reach of billions of communication devices has reached dramatic proportions (Willis 2008). Information is increasingly obtained via broadband, wireless, and hand-held consumer devices that transmit real-time text, audio, and video. The maturation of RSS [really simple syndication] feeds to push subscribed material, migration to Internet Protocol Version 6 (IPV 6) with its near infinite availability of Internet routing addresses, along with the simultaneous migration to Web 2.0 and beyond, are changing the texture and impact of collaboration. Economic, political, and geographic boundaries are nearly irrelevant, as are age, social status, and positional power. The leadership landscape is being altered by today’s smaller devices, the ability to tag individuals as well as the smallest manufactured components, and the integration of various media for all life's activities. The commoditization of technology is witnessed by its omnipresence in back-rooms, board-rooms, and back-packs. In our plug-and-play society, ICT is an invisible enabler that facilitates dialog among the members of the Virtual Generation (Prentice & Sarner 2008).

Government leaders use a variety of communication channels to get their messages across, to engage their stakeholders in dialog, and to hear and to see the world through the eyes of their constituents. Governmental organizations use extranets and intranets to communicate their missions and priorities to their workforce as well as to various organizational stakeholders including the general public. The White House, political candidates, and the U.S. Department of Navy, for example, communicate their organizational stories and priorities using podcasts and blogs. An array of government websites are interactive, thereby allowing reading, hearing, or viewing of information, as well as asking questions, casting opinions, and commenting on public policy proposals. The rapid downloading via RSS feeds, as well as the 24/7 media cycle, and ubiquitous digital cameras increase opportunities for government transparency as well as the broadcast of leadership missteps and misstatements through pictures such as prisoner mistreatment in Abu Ghraib Prison, Hurricane Katrina victims in New Orleans, and the conditions of Fort Bragg barracks. Today every citizen can have near immediate access to worldwide press and elected leaders. This has implications for the nature of work and accomplishing the mission, as well as the value of effective communication as a leadership competency.

Second, ICT change individual social and organizational relationships. Today, ICT is less about controlling and enabling transactions and more about enabling social interaction (Austin et al. 2007). A decade ago websites provided either information or enabled a transaction; today websites nurture multi-directional dialog. Peer and lateral relationships are becoming, in many cases, more important than hierarchical relationships and centralized control (Willis 2008). ICT is the means by which people “discover, innovate, team, lead, learn, and relate to one another” (Austin 2008 p. 3). It is expanding the reason and expectations of relationship building while broadening opportunities to enrich conversation and collaboration. With increasing peer-to-peer collaboration, and much of this via virtual teams, developing communities of trust with agreed-upon governance are increasingly important (Heiser 2007). For the Virtual Generation, ICT is a means to interact socially through various channels while seeking the ever powerful “we” as opposed to “me” (Prentice & Sarner 2008)
In the Information Age, leadership is less about being the smartest expert, than being the connector or the trusted mediator for tackling complex critical problems.

Third, omnipresent ICT increasingly blurs work time and work space. The nature and definition of work are changing. Offices are increasingly a source of community, not just a physical location for bounded work. Personnel are increasingly mobile and virtual. Having employees in sight is being replaced by a focus on activities and outcomes facilitated by networks organized to achieve organizational goals. An associated challenge for leaders with virtual networks of employees is to provide flexible access that maintains information security (Morello 2007; Wennergren 2008). Another challenge is the development of appropriate human capital performance measures focused on the organization’s mission, rather than industrial measures such as hours in the office.

4. Information environment

In the first two weeks following the September 11th World Trade Center and Pentagon terrorist attacks, the U.S. Federal Bureau of Investigation (FBI) asked the nation to provide potential leads to the case; the response was an avalanche of information. Over 260,000 tips were received from concerned citizens via the Internet and phone calls in the first 21 days. As a result, approximately 4,000 agents were re-assigned nationwide to assist in chasing these leads (Fox News 2001). The FBI found itself immediately jumping from a condition of information under-load to overload, prototypical of the new information environment faced by Information Age leaders.

ICT advancements (e.g. faster processors, larger memories, ubiquitous sensors, wireless channels and next generation Internet) have driven an explosion of data with no foreseeable lessening, because Moore’s Law is holding true (Wikipedia 2008). Besides technological pressures, other social, legal and purely emotional drivers contribute to our penchant for amassing greater and greater quantities of data. For instance, estimates are that over 90% of all the scientists (data collectors and knowledge creators) who have ever lived are alive and producing information today (Goodstein 1994). From an Information Age leadership perspective, our information environment is dominated by avalanches of data and populated by consumers with growing information appetites. Many terms are used to describe overload: info-glut, data smog, info-bog and so on. Regardless of the label used, overload (Toffler 1971) can be defined as a syndrome in which the amount of data per unit time subjectively exceeds an individual’s, an organization’s, or even a government’s capability to process it without stress, error, or other performance or decision-making costs. The phenomenon of overload has become a pervasive information danger for Information Age leaders, their organizations, and for governments. Our capacity to create, digitize, and store data may even exceed our ability to process, understand, or make use of it. While the ICT revolution enables nearly instantaneous access to data, enduring human limitations, both individual and collective, constrain the digestion of these data and therefore their ultimate utility. "Where is the wisdom we have lost in knowledge and where is the knowledge we have lost in information?" (Eliot 1934).

Consequently, global demand is growing for meaning-making tools for all of these new data, i.e., transforming data into real, usable information and intelligence. Sophisticated search engines like Google, social networks like Wikipedia or My Space, and video repositories like YouTube are popular because they help individuals make sense of the increasing mass of data. It is essential for Information Age leaders to recognize the insidious dangers posed by overload and to transcend their effects by melding new knowledge tools with cross-boundary organizational models and enhanced information-sharing practices.

5. Changing decision environment

As a result of globalization and the evolving information environment, the decision environment is also changing. The decision environment is the collection of information, alternatives, goals, values, and preferences available at the time of the decision (Harris 1998). Gathering and analyzing such information is always constrained by time and resources resulting in some level of uncertainty about outcomes and unintended consequences of decisions. To reduce uncertainty, leaders develop decision-making processes, structures, and communication channels.

Information Age technical and social developments create opportunities for government leaders to improve the quality and speed of decisions and performance (Morello et al. 2006), if they can overcome outdated decision models resulting from stove-piped organizational structures and restricted information sharing. Authoritarian decision making by single individuals no longer works...
because of data overload and increasingly complex, often global, cross-boundary problems. In the flatter inter-connected enterprise, many people have the capacity and power to contribute to decisions by collaborating and sharing information across organizational boundaries. Analytical tools such as data mining, modeling and simulation, and predictive analytics using real-time data feeds (Fenn, McGee & Prentice 2006) allow leaders to make sense of the data available. Leaders need to become as adept at using Information Age tools as they are in performing business functions.

The changing decision environment is also characterized by what are called wicked problems. Wicked problems lack a clear way to define the problem (Conklin 2006; Rittel & Webber 1973). Attempts to describe or clarify the problem involve developing possible solutions to the problem and each attempt at a solution reveals more aspects of the problematic situation, requiring additional solutions. No final solution can be evaluated as either right or wrong. Every wicked problem is unique because of its many factors and perspectives and its dynamic social context. The presence of multiple stakeholders with different views on what the problem is and on what to do about it should be a good indicator to an Information Age leader that a problematic situation is more wicked than tame and requires more resolution than solution.

Wicked problems require leadership (Grint 2005). Neither crisis style command-and-control nor basic management works for problems that cannot be fully defined. A more effective response is to study the wicked problem using active methods such as experiments, pilot projects, and prototypes. This means creating conditions in which underlying patterns can emerge and seek cross-boundary perspectives in order to gain shared understanding and shared commitment to possible solutions (Conklin 2006). Leaders must develop the environment for building shared understanding of the issues and commitment to the process of working out a resolution by asking questions and by listening (Grint 2005). The leader must influence others to face up to their responsibilities in resolving the wicked problem, and keep them focused on the task for as long as it takes. Developing an appreciation for the changing decision environment is clearly one of the imperatives for Information Age leaders.

6. Enterprise resources

For most Industrial Age enterprises, the proven way to maximize the three golden keys to success - reliability, predictability, and stability - has been to secure independent and separate control over necessary resources, people, their intellectual capital, finances, time, etc., and not to give these away at any price. In the Information Age, reliability, predictability and stability are unrealizable goals (nor arguably are wholly desirable given exponential trends in technology). Furthermore, globalization of markets, money, information, ideas and people has created increasingly independent economies, public and private sector activities and results. As an engine of globalization, ICT is disaggregating the boundaries of the enterprise, spawning new networks of partners and forms of collaboration.

The complexity and inter-connectedness of the age means that most government enterprises are regularly engaged with wicked problems in which boundaries are ill-matched to the authorities and resources of agencies charged with managing them (Kettl 2006; Horn 2003). In such operating environments, conventional zero-sum game strategies of fighting for control of resources that may have worked for Industrial Age organizations are increasingly inadequate. In today’s dynamic, turbulent, and consumer-driven environment, organizations must develop the capacity to adapt their processes and products and services with quicker cycle times and access counter-intuitive sources of resources. Successful enterprises are those that can constantly reconfigure their resources to build newly-relevant capacities in response to sensed or foreshadowed changes or that can shape the emergent environment. (Haeckel 1999).

Organizational leaders in the Information Age need to be aware of the increasing, broadening resource options, possibilities, and alternatives for their enterprises. Indeed, given the defining environmental characteristics of our age - unpredictability, uncertainty, complexity, interconnectedness, and variability - they need to be open to the idea of leading their enterprises as dynamically changing tailored-to-task combinations of resources. Such resource combinations are being catalyzed and enabled by developments in ICT. In response, leaders must integrate enterprise values, value propositions, structures, and processes that allow the organization to collaborate with obvious and unanticipated partners. It is through such collaborative behavior that sufficient resources are pooled to achieve results shared in common with others.
Opportunities are opening up for enterprises to garner necessary resources by employing increasingly feasible, but nonetheless counter-intuitive strategies. Leaders must rethink the nature of the enterprise to encompass new partners and stakeholders who add value for a whole that is greater than its parts. To leverage resources for the benefit of all participants, they often create innovative coalitions of participants across boundaries, sometimes with traditional competitors, for varying durations. These real-time plug-and-play coalitions seek win-win-win with “easy to do business with” becoming a critical success factor. By sharing and synergizing resources leaders seek to develop adaptable and agile organizations that can respond to the unanticipated. To build agile organizations leaders must systematically develop organizational capacity to sense the environment in a timely manner. They can then re-align resources dynamically to continue to change plans, resources, or products.

Strategic Information Age leaders are pro-active, not just reactive, and are prepared to exploit opportunities to shape the environment as well adapt to it. They focus some attention on the management of today’s enterprise, but most of their attention on its future. They build capacity by “shifting the mix” to invest in the future through the organization’s people and capabilities through experimentation, blue-skying, anticipating and responding to changes in the environment as they transform the organization. Too often the urgent crowds out the important and future-focused, to the detriment of capacity building. Strategic leaders realize that resources will always be limited, and that they must leverage their precious resources through creative collaboration and investment in future capabilities.

7. Human networks

Leadership in the Information Age requires cross-boundary, inter-agency collaboration with networking as a core strategy. Fluid evolving networks are becoming an organization’s lifeblood. They flow formally and informally to internal and external nodes of knowledge that both leaders and followers have cultivated for just-in-time reach. Many new workers entering the government workplace are natural networkers, continuously reaching out in person and electronically, sharing, and collaborating socially and professionally 24/7 (Laurent 2008). They know the power of networking, teaming, dialoging, sharing, and leveraging the virtual world. They thrive in organizations that encourage and reward these strategies, and withdraw from those cultures that control or forbid them. Successful leaders recognize, value, and leverage the talents of the new workers to operate in service to their organizations.

Networking and collaboration challenge the traditional power and role of the hierarchy. While there will always be hierarchies as well as a legitimate need for them, their characteristics are being redefined to meet the challenges of the Information Age. Hierarchies can no longer be so vertical, rigid and dense, but must become right-sized, limber, and lean. Tempo and complexity no longer allow the time for formalized decision packets to pass through myriad wickets up the internal chain for debate, guidance, sign off, and decision. Leaders need to communicate explicitly their intent and develop trust in their followers; followers must understand and embrace the intent, knowing they are empowered to make decisions affecting the entire organization. Information Age hierarchies expect and empower those in their organizations to build their networks, have confidence they can exploit the human and technological levers needed, and take the responsibility associated with the empowerment and expectation. "Flattened hierarchies and networked relationships change the sources and uses of power" (Stewart 2001). Information Age leaders know when and where to distribute the power effectively to foster agility and synergy for responsive decision making, and for attracting and mentoring emerging leaders.

Leaders need to acknowledge that networking promotes transparency. Every public leader and their actions are prime targets for scrutiny at warp speed (Williams & Tapscott 2008). In our wired networked global neighborhood, hierarchy and protocol are no longer effective strategies for maintaining privacy. Technology and the democratization of information keep leaders living in glass houses with lights brightly lit. Leaders who align their organizations and themselves with the mission, hold fast to the highest level of integrity, communicate their intent in both words and actions, and follow through on their promises will take advantage of their glass houses. Today’s newest generation of government employees is the first generation weaned on ICT. They are tech savvy networkers (Fritzson, Howell & Zak helm 2008), innovators and collaborators, who value choice (Williams & Tapscott 2008). Being tech savvy is not just knowing ICT; it is knowing how to leverage the potential of ICT to create and shape. Tech savvy workers are very creative in making ICT work for them in
ways not previously envisioned. They use it to build networks, cross boundaries, collaborate, multi-
task, and create. They leverage technology as global workers who demand diversity in thought and
product. They will not stay in government if they are not challenged (Ballenstedt 2008). Effective
Information Age leaders ensure access to ICT for the new generation of workers, and encourage its
exploitation to support the organization's goals.

Freedom and breadth of choice are core values of the members of this generation. The Internet has
whetted their insatiable appetite for choices so they can customize their jobs, products, and services.
(Williams & Tapscott 2008) The old model, in which today's leaders rose successfully, is
characterized by relatively well defined job descriptors and endpoints, buffer time for reactive
behavior, risk-averse cultures, and rewards for rule following. Today these same characteristics
impede growth, survivability, recruitment, and retention of top talent. Younger workers are constantly
searching for ways to improve, with the tenacious drive and talent to maneuver outside the pre-
defined lanes. They are global network builders who embrace the power of collaboration, from which
comes new ideas, directions, and choices. Leaders face a challenge: stay with the pre-set and lose
the new employees who start looking in about six months (Hardy &. Gillies 2007), or entrust the
workplace to the innovators to shape and move the organization and engage them.

8. Conclusion
The authors of this paper posit six characteristics of the Information Age, and their associated
imperatives for leaders, particularly government leaders who seek to lead in this dynamic
environment. The Information Age needs savvy leaders who possess expertise in cross-boundary
communication and collaboration, and evolving ICT to face the challenges and opportunities of the
future. These Information Age leaders must demonstrate the traditional characteristics of great
leaders, such as courage, integrity, and vision, but to create and lead Information Age organizations
they must also be adept at leveraging information in complex decision environments, exploit new
communication strategies and global influences, and collaborate and expand their perspectives to
encompass the broader enterprise.

Disclaimer
The views expressed in this paper are those of the authors and do not reflect the official policy or
position of the National Defense University, the Department of Defense, or the U.S. Government.

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Knowledge Asset Potential vs. Vulnerability: Balancing Risks

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Abstract: The intersection and common elements of the fields of knowledge management (KM) and competitive intelligence (CI) are receiving growing attention, particularly in the latter discipline. Not only are the two areas similar in terms of managing knowledge resources, albeit of different types in most cases, but the presence of competitive intelligence activities begs the question of how widely knowledge assets should be developed and shared, as well as how and whether said assets should be protected. One framework for developing a strategy to balance knowledge development with knowledge protection suggests that there are specific risks (knowledge management or KM Risk and competitive intelligence or CI Risk) that move in alternate directions as knowledge is developed and shared more widely. Previous work has measured KM potential/risk and CI risk in a variety of industries, theoretically providing industry participants with a tool to more strategically develop and protect knowledge assets. This paper continues that work, including not only the industry evaluations but in-depth analyses of firms within those industries, allowing for even deeper insights concerning optimal KM/CI strategies. These insights are drawn from evaluation of the circumstances surrounding each industry and representative firm, including the nature of the knowledge assets (explicit/tacit), their complexity, and their specificity (stickiness). In a sense, this is an illustrative study, providing a template for how an individual firm can evaluate its own circumstances and better manage its knowledge assets. This paper provides another step forward in establishing a framework to help firms in discovering optimal strategies for developing and protecting knowledge by extending the discussion from industries to specific firms. Continuing to draw on the same framework that defines the KM and CI tradeoff, this paper examines illustrative firms in each KM/CI situation, reviewing their circumstances and their relative place in the industry vis a vis KM and CI. From this result, we can continue to develop and refine theory and practice concerning how and when KM is practised as well as how and when CI activities are deployed and defended.

Keywords: intellectual capital, knowledge management, competitive intelligence, risk, strategy

1. Background

Knowledge as a source of competitive advantage is a concept core to the fields of knowledge management (KM) and intellectual capital (IC). But while better management of knowledge assets can certainly aid organisational performance, spreading those assets too widely can also leave an entity open to losing valuable proprietary knowledge to competitors. Our Strategic Protection Factor (SPF) framework (Rothberg & Erickson 2005) looks to identify and assess the risks involved in developing vs. protecting knowledge assets, and here we add to the evidence supporting this framework. In doing so, we can better understand the circumstances surrounding an individual firm's decision on how far to develop its IC as well as the steps it should take for IC protection.

As noted, the KM/IC field is built on the concept that more knowledge development and better distribution of knowledge can lead to competitive advantage (Stewart 1997; Grant 1996; Quinn 1992). As a result, organisations benefit from managing their knowledge assets better than do their competitors. If they can identify, develop, capture, and leverage their intellectual capital more effectively than the competition, they should see better organisational performance and better financial results (Marr & Schiuma 2001). From a slightly different perspective, any given firm must develop and share its knowledge assets to their fullest potential if it is to keep up with competitors actively engaged in KM. Managing knowledge assets to potential is becoming increasingly necessary to ensure competitiveness.

But there is a flip side to this. Both centralisation of knowledge and the subsequent distribution and wide availability of knowledge make it more vulnerable to competitors. Competitive knowledge can itself be a valuable knowledge asset (Andreou & Bontis 2007; Erickson & Rothberg 2000), so other firms, unsurprisingly, are constantly looking to obtain proprietary knowledge from competitors and built their own knowledge stores concerning those targeted competitors. Consequently, organisations...
need to attend not only to building but also protecting their own valuable proprietary knowledge assets (Liebeskind 1996; Zander & Kogut 1995). Competitive intelligence (CI) activity is growing (American Society for Industrial Security 1999) and just as KM can lead to competitive advantage, so also can better CI, by either obtaining competitive knowledge or defending one’s own knowledge from those competitors (Bernhardt 2002; Cappel and Boone 1995).

The result is a dilemma for firms committing to knowledge management strategies. Not developing and/or not leveraging knowledge assets to the fullest degree could leave an organisation at a competitive disadvantage to other firms doing a better job at KM. Alternatively, developing and leveraging knowledge assets beyond the capabilities of the firm to protect them could leave an organisation at a competitive disadvantage to competitors with advanced CI operations. Where is the optimal balance between knowledge asset development and knowledge asset protection?

The full theoretical development of this trade-off is found in Rothberg & Erickson (2005). The concept is illustrated graphically in Figure 1, where (Intellectual) Capital Management Risk, what we’ve been calling KM Risk, declines as knowledge is shared more widely. In other words, the risk of being left behind by competitors better managing knowledge assets, better realising the potential of their knowledge, will go down as a firm does a better job of managing its own knowledge. Competitive Intelligence Risk, on the other hand, increases as knowledge is shared more widely—the risk of valuable proprietary knowledge leaking into competitors’ hands. More individuals with more access to more knowledge assets spells vulnerability as CI operations invariably look for the weak link. So knowledge spread can dramatically increase CI Risk. Once you have the two opposing risks, there are decisions to make based on competitive environment. From this perspective, knowledge management becomes strategic, as organisations need to assess their risk perspectives and adopt an appropriate balance between the risks in terms of their KM development and protection. For any given firm, the optimal point on the total risk curve represents an appropriate balance reflecting minimal organisational risk, some combination of the two opposing risk curves.

Figure 1: Risk trade-off (source: Rothberg & Erickson (2005))

But a key point is that this risk assessment is firm specific, unique to its environment and circumstances. In some nations, knowledge assets are more or less important and protection is easier or harder to obtain. In some industries, knowledge assets are more or less important and protection is easier or harder to obtain. And some firms have their own unique issues as well, possessing the experience and/or resources to manage this issue well or not. The result is that some firms, in given national, industry, and organisational circumstances, need to aggressively pursue knowledge development. Others don’t. Some firms have particular protection concerns. Others don’t. The position of the curves and the resulting optimal point can vary widely depending on the
environment, and organisations need to carefully assess their unique circumstances if they are to choose an appropriate, balanced knowledge management strategy.

2. Conceptual framework and methodology

The Rothberg & Erickson framework presents a generic representation of the risk curves, but they could conceivably be anywhere on the graphical grid. To simplify, consider four extremes, essentially the four quadrants of the grid, characterised as strategic protection factors (SPF's):

- SPF 45: High KM Risk/High CI Risk (northeast of generic optimal point)
- SPF 15: High KM Risk/Low CI Risk northwest of generic optimal point)
- SPF 30: Low KM Risk/High CI Risk (southeast of generic optimal point)
- SPF 5: Low KM Risk/Low CI Risk (southwest of generic optimal point)

High/Low has to do with distance from the origin, so SPF 45 would be in the upper right quadrant, SPF 5 in the lower left. The different scenarios are developed fully in Rothberg & Erickson (2005) and subsequent work, but in short:

SPF 45: High KM Risk/High CI Risk reflects a situation where knowledge is both critical to success and highly vulnerable to competitive intelligence. Many industries and companies in this situation are in situations where intellectual property (patents and such) and other knowledge assets are widely employed and pursued though with close attention to protection.

SPF 15: High KM Risk/Low CI Risk is an environment where knowledge is important for competitive advantage but not particularly vulnerable to competitive incursions. The knowledge is often specific to the originating firm or highly complex and so difficult to use outside of its original environment without accompanying knowledge that it is almost pointless for competitors to bother appropriating it. Industries or companies where strong brands, installed competitive advantage with strong first-mover advantages (production or IT systems), or other barriers to copying would be indicative of this situation.

SPF 30: Low KM Risk/High CI Risk concerns circumstances where knowledge is hard to share but is extremely easy to copy once distributed. As a result, knowledge development is relatively unimportant for the originating firm, but even a little bit escaping into competitive hands can be a critical loss. While this seems an oxymoron, the situation characterises industries and firms wherein there is often a required spark of creativity for new products. This spark is difficult to share and teach throughout the firm. But those creative ideas can be extremely easy to copy once incorporated into a product that competitors can analyze or reverse engineer. Financial services, utilities, and other such industries reflect these circumstances.

Finally, in an SPF 5: Low KM Risk/Low CI Risk situation, knowledge development and protection are both relatively unimportant. There is little advantage to investing in a knowledge management system and little point in protection either, as knowledge is difficult to transfer. Any environment where knowledge is highly tacit would reflect this circumstance. Industries or firms dependent on individual creativity or genius (arts, fashion, craftsmanship) would qualify. Knowledge management systems are almost pointless, and competitive intelligence operations would have little value either. These scenarios are intuitively appealing and have some theoretical and anecdotal support. The question is whether empirical data backs up them up. In past work, we developed measures for KM Risk and CI Risk, gathered data from the Fortune 500, and combined and sorted the data by industry. We then arranged the industries according to the four proposed scenarios to see who fell into which category.

A basic measure for intellectual capital and thus a good proxy for how far knowledge assets need to be developed is market to book value, or shareholders' equity. This is a variation on Tobin's q and commonly used in the literature (Tan, Plowman & Hancock 2007). A high value for the industry indicates that a high level of intangible assets is common among high-performance firms, so it is then a reasonable inference that substantial IC is necessary to compete in the industry. We chose to use market value to book value as a ratio (rather than difference) as our measure for KM Risk. A higher ratio indicated higher KM potential and thus higher KM Risk. To keep up in an industry with a high level of intangibles, a firm is well advised to develop its own knowledge assets to their fullest.
On the competitive intelligence side, CI employment is a reasonable proxy for CI activity and risk in an industry. We obtained the Society of Competitive Intelligence Professionals (SCIP) membership database and were able to pull out this information by firm. Aggregated by industry, high SCIP membership per firm value is indicative of high CI Risk for all firms in that industry (i.e. competitors, as a whole, employ a lot of CI staff). Note that even though the absolute numbers are fairly small (often just a SCIP member or two in fairly large companies), SCIP professionals will often have a substantial operation, not necessarily or even typically containing other SCIP members, working under them. So a member or two can be a sign of fairly substantial activity. An additional and alternative measure is also gathered by SCIP, the months employed by the firm on CI activity. We have included that in the present analysis as well.

Previous work included industry figures from databases for four years, from 1993-1996. We took the firm totals for market/book ratio (KM Risk) and SCIP members (CI Risk) and averaged them by industry. Given different representation in different industry segments and cases in which industries with similar SIC numbers down to three or four digits were actually very different and needed division, the actual aggregation is by 2, 3, or 4-digit SIC number, depending on our personal judgement. The results reported also include only those industries with at least four firms, minimising the impact a single firm might have on the industry results. After sorting the data by KM Risk, we divided the industries into two groups. We've used different dividing points between high and low KM Risk in different studies. For the illustrative purposes of this study, we set the dividing points at 5.0 for KM (above 5, high KM Risk, below 5, low KM Risk). For CI Risk, we set the dividing line at 2.0. These choices are not material to the analysis and could be adjusted, based on new evidence or analysis, with no change to the value of the conclusions.

3. Results

As noted, these details reflect previous studies reported elsewhere (available upon request). These studies have been extremely useful in identifying which industries fall into which SPF category. This specific study/analysis, however, extends the previous work and has more to do with particular firms as exemplars of the meaning of a particular SPF. Results are illustrated in Figure 2.

SPF 45, again, has high KM Risk and high CI Risk. SPF 45 industries include pharmaceuticals, aircraft, telecom, laboratory instruments, and a number of other obvious candidates. The level of intellectual property and affiliated knowledge required to invent, produce, and market drugs, aircraft, and other such products is evident and translates directly into knowledge management concepts. Similarly, because the knowledge is so readily defined, so explicit, it is readily copied by competitors.

As befitting this study, consider Merck (SIC 2834) as an exemplar of a firm for SPF 45. The 1996 value of our database for KM Risk in this industry is 7.74, market capitalization to shareholders' equity. The 1996 value for CI Risk is 5.07 (man-months for CI activity were 47.29). Merck's values were 6.35 and 3 (with 30 man-months). What does this indicate? For the year in question, Merck was somewhat below the industry average in terms of its success in employing knowledge (6.35 vs. 7.74). Alternatively, Merck obviously operates in an industry with extensive competitive intelligence activity (5.07 is very high across all industries, as is 47.29 man-months) so CI Risk is also very high. But Merck's own CI operations are somewhat below the industry average, with 3 SCIP members and 30 man-months.
Figure 2: SPF framework and illustrative firms

From the standpoint of strategy, Merck, in 1996, would likely want to give thought to its KM strategy and operations. Working below the industry average for application of knowledge is a dangerous place to be in any industry, but particularly in one so dependent on knowledge assets. Alternatively, Merck is very at risk from CI activity while likely benefiting at a rate less than the industry average from its own CI operations. For purposes of competitiveness, the firm should consider expanding both KM and CI activities while being sure to protect its own knowledge assets.

Contrast this with an example from SPF 15. SPF 15 has high KM Risk, but low CI Risk. So knowledge is important to develop and share, but is hard to competitors to employ, even if they do get hold of it. As noted earlier, this is often because of extraneous factors such as strong brands, installed base, unique resources, or other competitive aspects that preclude other firms from effectively employing the knowledge. Software (SIC 7371-2) is a typical industry and Microsoft an exemplar firm. The 1996 KM Risk for the industry registered 4.79 while CI Risk was 0.83. So knowledge made a big difference as measured by market capitalization to shareholders' equity while competitive intelligence was fairly muted at 0.83 SCIP members per firm. For Microsoft, the values were 12.21 and 2.0. SCIP man-months were 6.43 and 13 for industry and firm, respectively. Several things are apparent within these results. KM Risk remains very high, as was the case in the earlier industry, though Microsoft compares very favourably with its industry group, having a much higher market cap to equity value (12.21) than competitors (4.79). Microsoft, not unexpectedly appears to be doing something right in terms of managing its knowledge assets relative to the industry. The threat posed by competitive intelligence activities is considerably lower compared to pharmaceuticals however, with CI Risk less than 1.0 (and man-months under 7.0). Within the industry, Microsoft actually appears very aggressive in its CI activities, with SCIP membership/CI Risk of 2 and man-months of 13. Microsoft is apparently gaining great returns from KM, including its CI operations, while having little to fear from the CI actions of others.

SPF 30 refers to a situation with low KM Risk and high CI Risk. Knowledge is often tacit and hard to share within the firm but quickly copied once incorporated into products or processes. So bright ideas come along, and firms find it difficult to effectively copy that spark of creativity internally. But the ideas are often incorporated into products that may be very easily copied if competitors can analyze them and learn their details. So a financial portfolio strategy, for instance, may be a bright new idea that rarely comes along. But if competitors learn what the investment breakdown is in that portfolio, they can quickly and easily copy the strategy. For SPF 30, Computers (SIC #3571) is an illustrative industry to discuss. The 1996 industry totals are 2.91 for KM and 2.79 for CI, with 19.86 man-months of SCIP activity. HP is an exemplary firm. HP had a market cap to equity ratio of 4.76 (KM Risk), well above the industry average, suggesting very effective management of knowledge assets relative to competitors, even though the KM potential was lower compared to other industries (recall that pharmaceuticals was 7.74). On the other hand, the firm faces a relatively high CI threat, with average SCIP membership at 2.79 (vs. 0.83 for software). Given the industry averages, however, HP appears to be quite aggressive in its CI activities, with membership at 15 and man-months at 83—high by almost any comparison, even for their relatively high industry. Given industry conditions, HP competes at an aggressive level in both KM development and KM protection but still does not rise to the level of KM development required in an industry such as pharmaceuticals.

SPF 5 refers to low KM Risk, low CI Risk industries. As before, low KM Risk implies knowledge that is difficult to leverage internally, often highly tacit. And it remains tacit and difficult for competitors to take and effectively employ as well. For SPF 5, heavy machinery (SIC #351-6) is a good example, an industry without a lot of new knowledge development. KM Risk and CI Risk are both low for this category, with values of 2.85 and 1.36. SCIP man-months for the industry are 12.29. For Caterpillar, however, an effective competitor in the category, the market cap to equity ratio is 4.48, considerably above the industry average and showing effective management of knowledge assets. This takes place in an industry environment with low CI activity, but Cat is fairly aggressive, with its own CI operation registering at 5 members and 45 man-months. As noted throughout this analysis, these numbers are appropriate to the industry but also recognize the potential of operating with a higher regard for knowledge development and protection than competitors. Given the promise from KM and CI for competitiveness, one would expect Caterpillar to benefit from its more aggressive approach to both knowledge development and competitive intelligence.
4. Discussion and conclusions

Understanding the circumstances of knowledge management and knowledge protection will become an increasingly important strategic challenge for contemporary firms. Developing knowledge assets can be incredibly important for success, but the degree of development necessary appears to vary widely by industry. A particular firm may want to develop knowledge to a greater degree than direct competitors, but too far beyond competitive needs may result in little marginal advantage. Similarly, firms need to be cognizant of the degree of competitive intelligence activity within their industry and operate accordingly in terms of knowledge sharing and installing protection mechanisms. Given that, however, individual organizations need to consider their own abilities to conduct competitive intelligence and construct and support a CI operation appropriate to their resources and needs.

Further work will continue to identify and define the conditions defining the potential for KM and CI success as well as appropriate strategies given such circumstances. As noted earlier, different types of knowledge and industry conditions may call for more or less development of knowledge assets. Similarly, different circumstances will call for more secure protection schemes and/or more aggressive competitive intelligence operations. The scholarly literature suggests that we may be able to better define the variables in terms of tacit/explicit, complexity, and specificity. And from an application perspective, the better we can define for individual firms how to evaluate their specific situation and craft appropriate knowledge development and knowledge protection strategies. Each step brings us closer to identifying measurable factors that can dictate knowledge strategies.

And, again, this is a step forward in advancing the concept that developing knowledge assets is not a matter of as much as possible but of strategy. Knowledge may be developed and shared to a greater or lesser degree. In some industries, aggressive development of knowledge assets is critical, in others less so. So investing in and administering substantial KM systems should be a matter of strategic intent. Similarly, pursuing knowledge assets of others and protecting one's own is a matter of environment and degree. In some circumstances, aggressive competitive intelligence is critical as is a substantive knowledge asset protection strategy. In others, both are less important. As with knowledge development, knowledge protection is a strategic decision based on circumstances. We continue to work on the theory underlying these development and protection decisions.

Acknowledgement

The authors gratefully acknowledge the cooperation of the Society of Competitive Intelligence Professionals which provided some of the data used in this study.

References

Enhancing the Reusability of Inter-Organizational Knowledge: an Ontology-Based Collaborative Knowledge Management Network

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Abstract: Researchers have developed various knowledge management approaches that only focus on managing organizational knowledge. These approaches are developed in accordance with organizational KM strategies and business requirements without the concern of system interoperability. The lack of interoperability means that heterogeneous Knowledge Management Systems from different organizations are unable to communicate and integrate with one another, this results in limitation to reuse inter-organizational knowledge. Here, inter-organizational knowledge is defined as a set of explicit knowledge formalized and created by other organizations. In this research, a collaborative inter-organizational KM network is proposed to provide a platform for organizations to access and retrieve inter-organizational knowledge in a similar domain. Furthermore, ontology and its related mediation methods are incorporated in the network. The concept of ontology enables organizations to explicitly represent their knowledge of a specific domain with representational vocabulary in terms of objects and their interrelated describable relationships. Although different organizations may possess their own set of ontologies, the mediation methods that include mapping, merging and integration are capable of reconciling the underlying heterogeneities of ontologies. In this way, it is possible for the participant organizations to reuse inter-organizational knowledge within the network even though there are fundamental differences among organizations in terms of KMS structures and knowledge formats. The retrieved inter-organizational knowledge could then be used to support knowledge creating, storing, dissemination, using and evaluation of the organizational KM process. In addition, a selection framework is also proposed to assist organizations in choosing suitable ontology mediation approaches, ranging from mapping approaches, levels of automation, mediation methods to matching techniques. While knowledge engineers could reuse inter-organizational knowledge to create and evaluate organizational knowledge, general users are benefit from the effectiveness and efficiency in searching for relevant inter-organizational knowledge within the network.

Keywords: knowledge management, ontology, mapping, merging, integration

1. Introduction

Knowledge is recognized as one of the most important management assets in organizations because knowledge enables organizations to utilize and develop resources, enhance competitive ability and develop substantial competitive advantage. Failure to manage knowledge effectively would result in the loss of organizations’ priceless inspiration and creativity (Coulson-Thomas 1997). Knowledge Management (KM) has emerged under this circumstance with the purpose of preserving and capitalizing on organizational knowledge. As illustrated in Figure 1, KM is achieved by organizing formal, direct and systematic process to create, store, disseminate, use and evaluate organizational knowledge using the appropriate means and technologies (Leung and Lau 2006). There are four methods to create organizational knowledge by means of interaction between explicit and tacit knowledge, namely, socialization, externalization, combination and internalization (Nonaka et al. 2001). The second and third stages of KM, store and disseminate, are often linked with technologies. Explicit knowledge created is collected and stored in some sort of database or knowledge base in which the users can access using “search and retrieve” tools (Alavi and Leidner 1999). The retrieved knowledge can then be used by knowledge workers to add value to current business process, create new knowledge and solve existing problems (Bailey and Clarke 2001). The fifth stage of KM is knowledge evaluation; incorrect or outdated knowledge is either eliminated or replaced by valid knowledge.

However, it is shown that some of the KM approaches, ranging from industrial specific to theoretical, are incapable to cooperate with the current distributed knowledge environment, especially those that are designed to manage organizational knowledge, for example, the re-distributed KM framework...
developed to manage organizational help desk knowledge (Leung and Lau 2006). These approaches are tailor-made according to individual organizational KM strategies and business requirements without the concern of system interoperation. The lack of interoperability means that heterogeneous knowledge management systems (KMSs) from different organizations are unable to communicate, cooperate and reuse knowledge with each other. Wagner and Buko (2005) argue that knowledge-sharing in an inter-organizational network allows a richer and more diverse body of knowledge to be created compared to sharing knowledge in one single organization.

Figure 1: Knowledge management process

The non-collaborative KMSs have several disadvantages. In terms of knowledge workers, they have to spend a lot of time and effort to look for relevant knowledge from different KMSs because they are often required to access knowledge from other knowledge sources in order to complete their works. In terms of knowledge engineers, they have to spend a lot of resources in creating and updating organizational knowledge even though same knowledge is available in other KMSs. As external source of knowledge is essential for organizational performance, a new inter-organizational KM practice is required to enhance the interoperability among independent KMSs and to encourage the sharing of knowledge across organizational boundaries in their business networks (Oinas-Kukkonen 2005).

Unfortunately, the absence of a common language or standardization has created a barrier to prevent the collaboration of KMSs (Sheth 1999). Hence, this research proposes the use of ontology and its related mediation methods which possess knowledge reusability and mismatches reconcilability to fill this gap. This paper describes the concept of ontology and its related mediation methods. We investigate the application of the above concepts in the development of the proposed collaborative inter-organizational KM network that provide mechanisms of reconciling inter-organizational knowledge. The investigation includes the reusability of the reconciled inter-organizational knowledge in supporting the organizational KM process. The rest of the paper is organized as follows. Section 2 discusses the background of ontology and its mediation methods. Section 3 presents a detailed review of ontology mediation methods. An ontology-based inter-organizational KM network is proposed in Section 4. Finally, conclusion is given in Section 5.

2. Background of ontology and mediation methods

The concept of ontology can be applied to solve the interoperation problem in the distributed KMS environment. Ontology, a branch of philosophy, was borrowed by artificial intelligence community and defined as an explicit specification of a conceptualization while a conceptualization is an abstract, simplified view of the world that we wish to represent for some purpose (Gruber 1993). By representing domain specific knowledge with vocabularies in terms of objects and their interrelated describable relationships in a common ontology, one KMS can communicate with others in spite of the underlying system, syntax and structural heterogeneities, thus allowing the involved systems to understand incoming request and the returned knowledge because they are using the same set of vocabularies in the ontology (Mentzas et al. 2001).

Unfortunately, it is problematic to expect all individuals and organizations to agree on using one or even a small set of ontologies (de Bruijn et al. 2006). On one hand, it is lengthy and non-trivial to define and maintain a large globally shared ontology; on the other hand, this approach may hinder a system from reflecting its actual business requirements due to the fact that design of the system is restricted by terminologies defined in the ontology (Visser et al. 1998). Researchers such as Berners-Lee et al. (2001) state that there would be a large number of small domain specific ontologies developed by communities, organizations, departments or even individuals. While multiple ontologies
approach allows system to be designed according to its actual requirements without committing to a particular set of terminologies, the heterogeneity caused by multiple ontologies has become an obstacle for the interoperation of systems (Visser et al. 1998). As organizations and individuals are expected to develop their own ontologies of different languages, scopes, coverage and granularities, modelling styles, terminologies, concepts and encodings, it is therefore unfeasible for one system to understand and reuse other ontologies unless the ontologies are reconciled in some form. The above inconsistent problems caused by multiple ontologies are commonly termed as ontology mismatches.

To reuse other ontologies of different types, ontology mediation is required to reconcile mismatches between heterogeneous ontologies so that knowledge sharing and reuse among multiple data sources can be achieved (Predoiu et al. 2006). There are three major kinds of ontology mediations: mapping, merging and integration. Ontology mapping is a process of relating similar concepts and relations from different ontologies to each other in which the correspondences between different entities of the two ontologies are formulated as axioms in specific mapping language (de Bruijn et al. 2006). Three are two common approaches used to establish mapping between ontologies. The first approach is to relate all ontologies to a common top-level ontology so that different ontologies are mapped together indirectly by the top-level ontology as illustrated in Figure 2a (Wache et al. 2001). Conflicts and ambiguities can be resolved since concepts used in different ontologies are inherited from the common ontology. However, this approach has three major drawbacks. First, constructing a large-scale common top-level ontology from scratch is never a simple task. Second, this approach can only be adopted in a relatively stable environment where maintenance is minimal because a substantial amount of resources and overheads are required to maintain a common top-level ontology. Third, established mappings between local ontologies and top-level ontology can easily be affected by the elimination and addition of local ontologies as well as modification in either local or common ontologies because local ontologies are related indirectly with each other through the common ontology.

The second approach is one-to-one mapping. This approach requires mappings to be created between each pair of ontologies as shown in Figure 2b (Predoiu et al. 2006). The lack of a common top-level ontology in this approach makes it possible to adopt in a highly dynamic environment. This advantage may be offset by the lack of common terminologies, thus increasing the complexity of defining mapping between local ontologies.

Figure 2: Two mapping approaches

The second type of ontology mediation is merging. Unlike mapping that links two separate ontologies together in a consistent and coherent form, ontology merging creates a new ontology (in one subject) by unifying two or more different ontologies on that subject and it is usually hard to identify regions of the source ontologies from the merged ontologies (Pinto and Martins 2001). As compared with mapping that keeps the original ontologies unchanged, merging requires at least one of the original ontologies to be adapted so that the conceptualization and the vocabulary match in overlapping parts of the ontologies (Ding et al. 2002). Theoretically, it is more efficient and effective to merge existing ontologies than to build a large ontology from scratch. Practically, the process of ontology merging is more than just simple revisions, improvements or variations of the source ontologies.

One of the most important phases in the process of ontology mapping and merging is ontology matching. In general, ontology matching can be defined as the process of discovering similarities between two ontologies with the purpose of establishing semantic relationships in between (Predoiu et al. 2006). It determines the relationships holding between two sets of entities that belong to two
discrete ontologies. In other words, it is the process of finding a corresponding entity in the second ontology for each entity (for example concept, relation, attribute) in the first ontology that has the same or the closest intended meaning. This can be achieved by analysing the similarity of the entities with the “compared” ontologies in accordance with a particular metric (Ehrig and Sure 2004). Ontology matching can be processed exploiting a number of different techniques, for instance, string-based, language-based, constraint-based, linguistic resources, alignment reuse, upper level formal ontologies, graph-based, taxonomy-based, repository of structures and model-based technique (Shvaiko and Euzenat 2005).

Finally, the third type of ontology mediation is integration. Pinto and Martins (2001) define ontology integration as a process of building an ontology in one subject reusing one or more ontologies in different subjects. It is always possible to identify regions of the source ontologies from the integrated ontologies. Source ontologies may need some sort of refinements before they can be aggregated, combined and assembled to form the resultant ontology. It is also important to include ontology integration in the early stage of the ontology building process, preferable during conceptualization and formalization, so as to simplify the overall ontology building procedure.

3. Ontology-based collaborative inter-organizational knowledge management network

Knowledge created from external source plays a very important role in supporting organizational activities but many KMSs as well as KM frameworks and practises are designed simply to manage organizational knowledge. The collaboration problem of heterogeneous KMSs could be resolved by annotating explicit knowledge in the form of machine processable metadata using ontology. Although individual organizations possess their own set of ontologies, the mediation methods are able to reconcile the underlying heterogeneities of ontologies. In this way, the concept of ontology and mediation enables organizational KMSs to understand incoming request and the returned knowledge, thus making it possible for them to collaborate and communicate with each other. We propose to develop an ontology-based collaborative inter-organizational KM network to provide a platform for organizations to access and reuse inter-organizational knowledge with a similar domain. Here, inter-organizational knowledge is referred to as a set of explicit knowledge formalized and created by other organizations. In the network, the formalized inter-organizational knowledge is reusable such that it can be retrieved by any organizations to support individual KM processes in terms of creating, storing, disseminating, using and evaluating knowledge.

Each network should only contain knowledge of a specific domain to ensure the knowledge workers can retrieve relevant any knowledge effectively. For example, an IS network should only provide knowledge in the domain of IS. Once an organization recognizes the need for a particular type of knowledge, the organization can invite other organizations that possess the knowledge of similar domain to establish a network together. When this network of knowledge has matured, other organization which needs to use the knowledge may choose to join the network instead of establishing its own individual knowledge network. Within a network, each organization must commit to a mutual agreement to allow other participants to access an agreed portion of ontology and the associated knowledge repositied in its knowledge base. Besides, a single organization can commit to more than one network of different domains. For instance, library A may choose to commit to networks of IS, economics, mechanical engineering, education and chemistry.

3.1 Selection framework for ontology mediation

Before we continue to describe the proposed network, the participant organization first needs to make four important decisions related to ontology mediation. Figure 3 shows a way to select ontology mediation method. The first decision is to decide whether to adopt top-level ontology or one-to-one method as the network-level mapping approach. As this decision is based on network level, the organizations as a whole may need to negotiate and compromise in order to select the most appropriate mapping approach for the benefit of the entire network. The decision process should include a thorough assessment in the aspects of resources, expertise and frequency of modification. The top-level ontology approach can only be applied to an environment where the maintenance effort is minimal. Whenever a modification is performed in one of the ontologies in the network, the shared ontology at the top-level ontology approach may require a complete reconstruction. The organizations must also ensure that they have sufficient resources and expertise to build the shared ontology; otherwise, the one-to-one approach should be selected.
The second decision is to determine whether to perform mediation automatically or semi-automatically. Mediation can be performed semi-automatically which requires the support of automatic tools as well as human intervention. Examples of support that can be provided by automatic tools include post-mediation verification, validation, critiquation as well as conflicts recognition and resolution. Although semi-automatic mediation could have a better performance than the manual approach in terms of accuracy, it still substantially relies on human efforts and can be time consuming. As semi-automatic tool is not capable of supporting mediation on-the-fly, it would be ideal to perform mediation automatically. Unfortunately automatic tools are unable to detect and interpret concepts that do not have a close correlation, and it may also fail to handle any unforeseeable situations as the tool is designed to perform mediation under specific pre-defined condition.

Figure 3: Selection matrix for ontology mediation

The third decision is to decide whether to adopt merging, mapping or integration as the chosen mediation method for each organization. Each organization can choose one or more methods based on its own need. The concept of mapping enables ontology to be developed in response to its actual business requirement and is more suitable to be applied in a dynamic business environment where ontologies are required to modify frequently. Unless ontology has undergone major modification, otherwise simple modification such as deleting concepts from an ontology, may only be needed to
update the mappings accordingly. Alternatively, merging is an appropriate method for creating an ontology that combines common views of multiple source ontologies. The merged ontology could act as 1) a single ontology used to substitute individual source ontology, 2) a shared ontology used in top-level ontology mapping approach, or 3) an organizational ontology that includes all possible views of other organizations’ ontologies. Unlike merging, integration selects only appropriate modules from individual source ontologies to form an integrated ontology. Thus, integration is an appropriate method for organizations to construct tailored ontologies based on individual needs.

The final consideration is to decide whether to adopt single or multiple matching techniques. Organization must take into consideration the execution duration, the level of acceptable matching accuracy and the level of resources for implementation. In general, multiple strategies are expected to generate more accurate result than single matching technique. The choice of aggregation algorithm and cut off point also plays an important role in determining the level of matching accuracy. When choosing multiple strategies as its matching technique, the organization must conduct a series of experiments with the purpose of finding a combination of multiple strategies, aggregation algorithm and cut off point in order to produce the most accurate result. Compared to single matching technique, multiple strategies are relatively difficult to design and implement and it also requires longer execution time.

3.2 Operation of the Inter-organizational knowledge management network

Conventionally, technology has very limited contribution in knowledge creating stage, but ontology merging tool provides a practical way to create knowledge by combining two or more ontologies together in the network. This can be achieved on both network and organizational level. On the former level, merging tool is capable of creating a shared ontology for top-level mapping approach that contains common views of all organizational ontologies in the network. On the latter level, organization can create its own domain specific ontology by merging relevant ontologies from other organizations within the network. Other than that, ontology integration tool allows an organization to create its own knowledge by integrating relevant parts of ontologies from other organizations into its own ontology building process. As a result, both merging and integration tool enable organizations to reuse not only the contents of other ontologies but also their associated inter-organizational knowledge which were stored in other knowledge bases.

Knowledge dissemination tool allows user to retrieve and use knowledge from organizational knowledge repository. If user cannot find suitable organization knowledge, s/he has to seek from other external sources. This can be achieved by creating mappings among ontologies of different organizations either semi- or automatically with the support of ontology mapping tool. The established mappings allow one KMS to access KMSSs of other organizations in the same network in order to search for relevant knowledge. In addition, inter-organizational knowledge can be reused to support knowledge evaluation process in KM. This is accomplished by setting up dedicated mappings between two or more ontologies. Once a piece of the inter-organizational knowledge is updated, this inter-organizational knowledge will be translated into a suitable format and delivered from source knowledge base to the target automatically via the pre-established mappings. To demonstrate the reconcilability of ontology mediation and reusability of inter-organizational knowledge in the network, let us take a look at the following example.

Assuming University A realizes that there is an increasing demand for IS related knowledge. However, this demand cannot be satisfied with current collection of publications in the library. Consequently, University A decides to invite knowledge providers and libraries of other organizations to establish a network that contains IS related literatures. Among all, libraries from University B, University C and University D as well as Publisher ABC and Publisher XYZ agree to join. Except for University D, all other participating organizations possess ontologies. Figure 4a shows a partial view of the classification ontology adopted in the library of University A. In this ontology, the publication concept has concepts that include book, journal, proceeding and thesis as its subclasses and each subclass is described by a set of properties such as International Standard Book Number (ISBN), International Standard Serial Number (ISSN), and publisher. Concept category and its subclasses are used to distinguish publications into different subjects such as concept computer, medical, commerce, computer science and so on. Given that this network only supports IS related knowledge, therefore the library of University A is willing to share publication that belongs to concept computer and its subclass information systems. As a publication may contain chapters written by different authors, the ontology reflects it by including concept book chapter, journal paper as well as conference paper and
their related properties as an extension of concept book, journal and proceeding respectively. Figure 4b shows a partial view of the classification ontology in Publisher XYZ. There are three major concepts in this ontology, that is, concept book, journal and proceeding. Each concept has a set of publication details (such as issue and edition), contains a set of literatures and belongs to one discipline (such as information systems). The above three components are represented by concept publication details, literature and discipline respectively. Similar to University A, Publisher XYZ has also agreed to share literatures that are classified under the concept information systems.

Figure 4: Partial view of the classification ontology adopted in (a) library of university A and (b) publisher XYZ

Round rectangular nodes represent concepts.

Rectangular nodes and labels arcs represent properties.

After careful consideration, the six organizations have reached a mutual agreement not to adopt top-level ontology as the network-wide mapping approach. This decision is based on the fact that there will be other organizations which will join the newly established network, so the shared ontology built for the top-level ontology mapping approach may require to undergo a series of reconstructions. At this moment, the organizations prefer to use one-to-one mapping approach but they agree to review the mapping approach once the network becomes stabilized. Although they have sufficient expertise and resources to build and reconstruct the shared ontology, it is not cost effective to do so. In addition, the reconstruction works will definitely affect the stability and performance of network-wide mediation because the shared ontology will be mapped by all other ontologies as a reference point.
As the library of University D does not possess ontology, the library has to create one in order to fulfill the requirement of joining the network. Instead of building the ontology from scratch, the library decides to reuse ontologies from other organizations and integrate them into its own development process using ontology integration method. However, the chosen ontologies must be similar to the library’s actual classification in terms of publication and discipline in order to minimize the degree of modification. For instance, the concept publication and its subclasses in the ontology of University A are more appropriate than those defined in Publisher XYZ as the subclass thesis; book, journal and proceeding defined in the ontology of University A are very similar to the actual classification used in the library of University D. Thus the library reuses only a portion of the two ontologies that include the concept publication and its subclasses derived from the ontology of the University A as well as the concept discipline and its subclasses derived from the ontology of Publisher XYZ (see Figure 5). In the ontology development process, the library of University D can reuse not only the ontologies of other organizations, it can also do so for the inter-organizational knowledge associated with the instance of the integrated ontology. As illustrated in Figure 5, the softcopy of the thesis described by
the instance of the integrated ontology, thesis “Turning User into First Level Support in Help Desk: Development of a Web-based User Self-help KM System” in discipline IS, can be captured from the knowledge base of the University A and stored in the knowledge base of University D. This integrated ontology created by the library of the University D has resulted in additional function. By establishing dedicated mappings between the integrated ontology and its ontology providers (that is, the ontologies of University A and Publisher XYZ), the associated publication captured in the knowledge base of University D can be automatically updated as long as there is an revised version generated from the ontology providers. In this case, when the thesis “Turning User into First Level Support in Help Desk: Development of a Web-based User Self-help KM System” has undergone a minor revision in the knowledge evaluation process, the revised thesis will not only be stored in the knowledge base of University A, it will also be broadcasted to other KMS through the dedicated mappings that includes the knowledge base of University D.

To allow general user to retrieve inter-organizational knowledge, organizations are required to establish mappings between its own ontology and ontologies of other organizations in this network. As shown in Figure 6, each broken line represents a mapping between a pair of concepts or properties that belong to two different ontologies. Making use of string-based and linguistic resources matching techniques, two similar concepts from the ontologies of the UOW and ACM are mapped with each other, for instance, two identical concepts (such as journal) and two properties that are synonyms (such as section and chapter) are mapped together. The mapping details of the two ontologies are summarized in Table 1.

Table 1: Mapping summary of the ontology of the university A and publisher XYZ

<table>
<thead>
<tr>
<th>XYZ Ontology</th>
<th>A Ontology</th>
<th>Matching Reason</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concept</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Journal</td>
<td>Journal</td>
<td>Identical</td>
</tr>
<tr>
<td>Literature</td>
<td>Journal Paper</td>
<td>Synonym</td>
</tr>
<tr>
<td>Discipline</td>
<td>Category</td>
<td>Synonym</td>
</tr>
<tr>
<td>Information Systems</td>
<td>Information Systems</td>
<td>Identical</td>
</tr>
<tr>
<td>Property</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ISBN/ISSN</td>
<td>ISBN/ISSN</td>
<td>Identical</td>
</tr>
<tr>
<td>Issue</td>
<td>Issue</td>
<td>Identical</td>
</tr>
<tr>
<td>Editor</td>
<td>Editor</td>
<td>Identical</td>
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<tr>
<td>Publisher</td>
<td>Publisher</td>
<td>Identical</td>
</tr>
<tr>
<td>Keyword</td>
<td>Keyword</td>
<td>Identical</td>
</tr>
<tr>
<td>Author</td>
<td>Author</td>
<td>Identical</td>
</tr>
<tr>
<td>Section</td>
<td>Chapter</td>
<td>Synonym</td>
</tr>
<tr>
<td>Page</td>
<td>Page No.</td>
<td>Identical</td>
</tr>
</tbody>
</table>

In Figure 6, a user is searching for suitable journal papers by filling in data on title, publisher and keyword fields on the “knowledge searcher” which is designed to be used as a search interface for the KMS at the library of University A. Since the KMS cannot provide journal that satisfies this query, the system begins to search other KMS including Publisher XYZ. The mappings allow the KMS of Publisher XYZ to understand the incoming query. For example, the details provided in the title, publisher and keyword fields on the search interface are similar referring to the concepts journal, property publisher and property keyword that belong to the ontology of Publisher XYZ. As long as the requested journal is available in the knowledge base of Publisher XYZ, it will be delivered to the search interface of University A. Subsequently, the journal will be displayed as if it is retrieved from its own knowledge base. In other words, the entire inter-organizational knowledge retrieval and displaying mechanism are performed in a “black box” manner.
4. Conclusions

The organization based KM approaches have caused collaboration problem in which organization is not capable of reusing inter-organizational knowledge even though the required knowledge is available in other organizations. An ontology-based collaborative inter-organizational KM network is proposed to solve the problems. To establish the network, a selection framework is proposed to assist organizations in selecting suitable ontology mediation approach. The knowledge reusability and mismatches reconcilability of ontology and its related mediation methods enable organizational KMSs to understand incoming request and the returned knowledge, thus making it possible for them to collaborate and communicate with each other. By annotating knowledge explicitly in the form of machine processable representation, organizations joining the network can access, retrieve and reuse domain specific inter-organizational knowledge to support the five stages of organizational KM

Figure 6: Inter-organizational knowledge retrieval and reusing process
process. While knowledge engineers could reuse inter-organizational knowledge to create and evaluate organizational knowledge, general users are benefit from the effectiveness and efficiency in searching for relevant inter-organizational knowledge.

References


Designing a Strategy Formulation Process for New, Technology-Based Firms: a Knowledge-based Approach

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Abstract: In the knowledge-based economy the nature of what is strategic has been modified along with the importance of knowledge and its management. One of the most important implications of these changes is the expansion of resources and products that are globally tradable, highlighting the importance of knowledge as the key economic resource of lasting competitive advantage. As a consequence of this shift in the economy, an increasing number of industries are moving from the closed innovation model to the open innovation model that created porous boundaries between the innovative company and its surrounding environment, changing the inter- and intra-organizational modes of coordination. In an environment where knowledge is the key economic resource and the open innovation model is applied in more and more industries, we are experiencing the increasing importance of the New Technology-Based Firm (NTBF). NTBFs face a number of difficulties mainly associated with a lack of resources and entrepreneurial skills and in order overcome the difficulties NTBFs strive towards flexibility while accelerating the development and commercialization processes by creating and/or entering business networks. By adopting a knowledge-based view for NTBFs and consequently placing knowledge in the centre of a systemic innovation model, knowledge networks constitute an asset for NTBFs. As this new form of cooperation takes multiple and often unpredictable forms it is thus essential to develop strategy formulation tools and processes that can help NTBFs to face their challenges. Until now little attention has been given to the development of strategy tools and processes tailored for the requirements of NTBFs. The present paper presents a concept to cope with NTBFs' by developing a generic process for strategy formulation. In this respect, an action research project was initiated. The proposed concept was initially designed, although not exclusively, for a Greek NTBF, Astrofos Ltd. The author, who is coordinator of the incubator where Astrofos is sited, is acting as a strategy consultant for the firm and has taken part in all its major decisions since summer 2007. In order to build the strategy formulation process, this paper proposes a mapping technique that attempts to depict a NTBF’s tangible and intangible transactions as well as the strength of ties between the focal NTBF and its partners and the complexity of the knowledge. In developing the mapping technique, we have used a combination of the concept of weak ties, derived from social network analysis, with the notion of complex knowledge, as this combination was initially proposed by Hansen (1999). Additionally, a set of questions is proposed that have to be answered in order to pass from knowledge identification to knowledge transfer, from a strategic point of view. In this regard, the presented methodology constitutes an effort, on the one hand, to study the emergent patterns in what is considered to be a chaotic or disordered system and, on the other, to stimulate the creation of new patterns in the system that would be consistent with the NTBF’s strategy.

Keywords: new technology-based firm (NTBF), innovation, strategy formulation process, value network, mapping technique, social network analysis, knowledge complexity

1. Knowledge-based economy and the open innovation model

In the rapidly changing environment of the knowledge-based economy we are experiencing “structural changes … in the economies of advanced developed countries”, modifying the nature of what is strategic and highlighting the importance of knowledge and its management (Teece 1998). One of the most important implications of the changes posed by the knowledge-based economy is the expansion of resources and products that are globally tradable, highlighting the importance of knowledge as the key economic resource of lasting competitive advantage (Teece 1998; Nonaka and Takeushi 1995; Drucker 1985).

Since the mid-80s a new systemic model of technological innovation has emerged, incorporating a number of factors (e.g. externalities, transferability, modularity, network structure, etc.) not included in the previously dominant linear model (Autio, 1997). In this regard, innovation is viewed as a systemic, irreversible (Pavitt, 1990) and knowledge-centric (Nonaka and Takeushi 1995; Drucker 1985) process influenced by the institutional environment (Braczyk et al. 1998).

As a consequence of this shift in the economy (and theory), an increasing number of industries are moving from the closed innovation model, in which companies generate, develop and commercialize their own ideas, to the open innovation model, in which companies commercialize both their own ideas as well as innovations from other firms (Chesbrough 2003). According to the open innovation model, i) the innovation process becomes more complex and fragmented, ii) the actors are...
increasingly heterogeneous, as well as being more interdependent, and iii) the period from conceptualization to commercialization is shorter. This model has created porous boundaries between the innovative company and its surrounding environment, changing the inter- and intra-organizational modes of coordination and triggering new answers to Coase’s question as to “what determines the boundaries of the organization” (1937). Networks of heterogeneous players with non-common interests (and often non-rational in the neoclassical sense) are no surprise in the modern innovation process. Bazaar governance (Demil and Lecocq 2005), the “private-collective” innovation model (von Hippel and von Krogh 2003), communities of practice (Wenger 1998) and “co-opetition” (Brandenburger and Nalebuff 1996) are some of the concepts which have been developed to describe the changing modes of coordination.

With knowledge being the centre of this non-linear innovation model, knowledge networks constitute a new asset for the company. This new form of cooperation, which has succeeded the technology networks, takes multiple and often unpredictable forms (Lengrand and Chatrie 2001) in the open innovation model. While technology networks seem “frontierless” from a technoglobalism perspective (Archibugi et Michie 1995) this may not be the case for knowledge networks. Evolutionary economists, who emphasize the importance of tacitness and cumulativeness of knowledge, localized learning, and externalities associated with proximity and the importance of national and/or regional systems of innovation, claim that geography and proximity still matters for innovation (Cassiolato and Lasters 1999). As discussed below, this latter position seems to serve well as a theoretical base for New, Technology-Based Firms.

2. Research question

In the knowledge-based economy, where the open innovation model is being applied in more and more industries, a great deal of attention is being given to New, Technology-Based Firms (NTBF), which have gained an increasing role in the innovation process.

From an entrepreneur's point of view, innovation constitutes a high-potential entrepreneurial effort (Schumpeter, 1996) and an NTBF can definitely be viewed as such. Additionally, the emergence of a new environment that has served to increase the potential return of NTBFs has expanded the interest for this type of organization. A great number of business intermediaries such as technology brokers, technology transfer institutions, high-tech marketers, liaison offices, incubators, etc., that support NTBFs and their networking requirements have been multiplied in the recent years. Furthermore, due to perception that NTBFs contribute to the technological renewal of economies, develop the national technology base and contribute to growth and new jobs (Autio and Yli-Renko, 1998, Wennekers and Thurik, 1999, DG, 2002), the interest in NTBFs is also reflected in most of the related public policies of the developed countries. As explicitly illustrated by Acs and Audretsch (2001), most public policies have progressively shifted from the question on “Should we break up, regulate, or simply take over General Motors, IBM, and US Steel?” to that of “How can we grow the next Silicon Valley?”

NTBFs have also attracted the attention of an increasing number of scholars who have implicitly or explicitly highlighted the importance of knowledge in their creation, formation and development. However, apart from a few exceptions (Luggen, 2004), since the first appearance of the term NTBF (Little, 1977) there has been relatively little research on the development of tools that would support the business strategy formulation of NTBFs following a knowledge-based approach. The present paper presents a concept to cope with the challenges of NTBFs by developing a generic knowledge-based process for strategy formulation. The development of the process is part of a greater action research project that aims to develop and implement the process with the collaboration of a Greek NTBF, Astrofos Ltd. The author, who is coordinator of an incubator where Astrofos is sited, is acting as a strategy consultant for the firm and is taking part in all the major decisions made since summer 2007. The proposed strategy formulation process has been developed on the basis of bibliographical research, a significant number of interviews and informal discussions with entrepreneurs and people involved in the business incubation industry in Greece, France, Finland, Spain, Germany and United States as well as interviews and informal discussions with Astrofos members. Both the methodological approach of the research and the empirical findings from a longitudinal application of the methodology are the subject of forthcoming papers.

The paper is primarily addressed to NTBFs managers and consultants who support NTBF. It is also addressed to policymakers who design and implement programs, measures and support organizations that are aimed at helping NTBFs.
3. Defining new, technology-based firms

According to the classification proposed by Rickne and Jacobsson (1996), apart from the age of the company, there are three ways to distinguish NTBFs from other firms: the nature of the firm's product and/or services, the patenting intensity and the level of employee education/competence. However, none of the above criteria are universal. This paper adapts Laranja and Fonte's definition (1998) of NTBFs as “young small companies founded by an entrepreneur or a team of entrepreneurs with a strong educational or professional background which are involved in the development, application and commercial exploitation of an innovative idea based on technological know-how”. Adopting this definition it is worth mentioning a few relevant points. The first is that we are referring here to firms that are relatively new and small and do not have strongly institutionalized internal processes. Consequently, such organizations are not as path dependent as bigger and older structures and are thus much more adaptable. The second point is that it is more frequent to find NTBFs in fast-moving industries in which short product cycles are likely to drive the establishment of network partnerships in order to reposition products rapidly and respond quickly to changing market conditions and technological developments (Powell, 1990). The third point is that not all NTBFs are aggressively growth oriented and this is often related to the size of the niche they are serving (Autio 1997) and the personal ambition of entrepreneurs to retain control over the firm (Jones-Evans 1998). The fourth point is that NTBFs may be characterised by small windows of opportunity, such that all may be lost if investments are not made at the appropriate time (Luggen, 2004). The final point is the recognition that social capital density has a positive impact on the creation and sharing of intellectual capital (Yli-Renko et al. 2001, Nahapiet and Ghoshal, 1998).

4. Knowledge-based view for NTBF

NTBFs can compete with large firms in the global frontier because of their “shorter communication channels within the firm, the more ad-hoc nature of their decision making, their flexibility in reacting to changing markets and new business opportunities, and their ability of exploiting information and knowledge from outside the firm” (Schuetze 2001). Taking into account that it would be inefficient and highly unlikely for this type of firm to integrate all the required knowledge and resources, much of the information and knowledge required (scientific, technical and market) comes through networking (Schuetze 2001). Turning this argument upside down, Powell (1990) argues that firms more likely to engage in network arrangements will be those needing to exchange difficult-to-codify, knowledge-intensive skills that are best transferred through processes of collaborative information sharing.

Adopting the "knowledge-based view of the firm", a view that challenges the perception of the boundaries of the organization (Sveiby, 2001), the base of the competitive advantage of a NTBF in forming its “innovative capability” is: i) its members’ knowledge, ii) the firm’s capacity to combine this knowledge with external knowledge and to integrate it into its innovation process, and iii) the firm’s capacity to commercialize its knowledge-intensive results. The management of a NTBF’s most precious assets, its knowledge and competencies, either from the organization itself or the external environment, becomes strategically important. By recognizing, either implicitly or explicitly, the strategic importance of both internal and external knowledge and competencies, NTBFs are transformed into extremely porous organizations that have to manage the "quantity and quality of their openness" when establishing and maintaining knowledge networks.

5. A knowledge-based strategy formulation for NTBFs

A knowledge-based strategy formulation should start with the competence of people which can produce value in two directions: by transferring knowledge from internal and external resources and then converting it into useful knowledge for the organization they belong to. The strategy-formulation issues are concerned with how to utilise the leverage and avoid blockage that prevent the sharing and creation of new knowledge. The key to value creation lies with the effectiveness of such transfers and conversions (Sveiby, 2001). Drawing on the findings discussed in the previous paragraphs it is evident that NTBFs’ most precious assets, namely knowledge and competencies as well as the way these are formed across the boundaries of the organization in order to create value, need special consideration when formulating a NTBF’s strategy.

The aim of this paper is to develop an easy-to-use management tool that will take into consideration these NTBF characteristics. The tool will permit the construction of a flow diagram with which one can depict tangible and intangible exchanges of a focal NTBF. In this respect, decision makers can easily identify where value is created in a NTBF in order to position the company in the future. For the
visualisation of exchanges, the HoloMapping technique, initially proposed by Allee (2003), is used to a large extent. Additionally, special consideration is given to the mapping of the exchange of intangible goods which constitutes the core of the company’s competencies. Assuming that more knowledge sharing is no guarantee of improved performance (Haas and Hansen, 2007), it is necessary to identify the nature of knowledge flows and from the NTBF in order to assess the best possible way the “quantity and quality of the NTBF’s openness”. In this respect, for the illustration of the intangible exchanges the paper builds upon the combination of the concept of weak ties from social network analysis with the notion of complex knowledge, as this combination was initially proposed by Hansen (1999). Hansen (1999) draws on product innovation literature and social network research in order to consider knowledge sharing among people from different teams as a dual problem of i) searching for useful knowledge and ii) transferring this knowledge across these teams while taking into account the complexity of knowledge that is transferred. In his work, Hansen (1999) developed this framework for large multiunit firms in order to explain knowledge sharing across organizational subunits. It is argued that this approach can easily be adapted to NTBFs, structures where the organizational boundaries are blurred and the relations between NTBFs and external partners are frequently stronger than relationships of different business units of the same large company.

6. The knowledge search problem

The first step when searching for useful knowledge in an NTBF is to look in the company. Taking into account the NTBF’s limited resources and given the fact that most NTBFs have a knowledge focus in a specific knowledge area, in many cases an NTBF member will look at his own or his company’s network. As discussed earlier, in order to commercialize their knowledge-intensive innovative products and/or services NTBFs maintain a network of persons and organizations with whom they maintain relations. These connections can be strong or weak and maintaining them requires effort and resources. Hansen (1999) argues that three aspects influence the decision to maintain weak or strong ties: knowledge redundancy, cost and organizational adaptation. Regarding the first aspect, Granovetter’s seminal work (1973) is used to argue that NTBFs with numerous weak ties are likely to have a more advantageous search position because their nodes in the network are likely to provide non-redundant complementary knowledge. Hansen (1999) argues that non-redundant knowledge can be either i) knowledge that can be directly used or ii) knowledge about where and how to find useful knowledge. The second aspect, cost, is positively related to strong ties as it is considered costly to maintain direct relations with other organizations or persons. The third aspect, network binding, is closely related to the notion of loose coupling (Weick, 1976 in Hansen, 1999), which helps explain the problem of autonomy versus connection in a network. “Organizational entities that are not tightly linked to other entities are more adaptive because they are less constrained by the organization system of which they are part” (Hansen 1999). On the one hand, NTBFs need connections to other organizations because they need to benefit from knowledge residing elsewhere, and on the other, autonomy is important for product innovation. Consequently, NTBF’s managers have to trade-off between autonomy and connection in regard to the overall business strategy.

7. The knowledge transfer problem

Once the useful knowledge is identified, it has to be transferred to the focal point. Hansen (1999) identifies two problems why there may be a transfer problem: willingness and ability. If the knowledge transfer is among the members of the focal NTBF, the small size of the firm “solves” the problem informally in most cases. In the case that the knowledge transfer is with persons or organizations outside of the NTBF, i) the transfer has to be feasible and ii) the external partner “has to be convinced” to share his knowledge.

The ability to transfer knowledge concerns both the “sender” as well as the receiver (Cohen and Levinthal, 1989) and is positively related to the complexity of knowledge. Hansen (1999), based on the work of Winter (1987) and Kogut and Zander (1995), argues that the main dimension of complex knowledge is its level of codification, “the degree to which the knowledge is fully documented or expressed in writing at the time of transfer”. Although not identical, knowledge with a low level of codification corresponds closely to the concept of tacit knowledge upon which NTBFs can better build their competitive advantage compared to larger firms (Koskinen and Vanharanta, 2002). An aspect of the complexity of knowledge is its modularity. According to Fodor (1983), modularity is the notion that complex systems can be partitioned into a set of autonomous modules. The level of modularity is determined by the extent i) the input for each module is limited to the necessary and sufficient information required for the module’s task and ii) any particular module is affected by the operation
(and output) of other modules. The extent of the modularity of the transferred knowledge determines the interaction among the parties that are sharing knowledge. In the case of non-codified and highly dependent knowledge the receiver has to first share knowledge (that might also have a significant scientific or commercial value) before the requested knowledge is transferred. This interaction might also be a continuous process and not a one-off interaction. The more non-codified and more dependent the requested knowledge, the stronger the required interaction and vice versa.

8. Knowledge search and knowledge transfer problems combined

The above-presented positions were supported by empirical findings by Hansen (1999), who demonstrated that knowledge transfer is facilitated among partners with weak ties when the exchange implicates knowledge with low levels of complexity. On the other hand, strong ties are required for the exchange of knowledge with high levels of complexity. These results were used for the development of the mapping technique presented further below. Considering the strength of ties and the complexity of the transferred knowledge as important aspects of the knowledge- and competency-creation process of an NTBF, these aspects were incorporated into the strategy formulation process.

9. The importance of proximity

The flow of knowledge between actors of the innovation process is, in spite of the changes posed by the emergence of the knowledge-based economy, heavily influenced by geographical proximity. Gertler et al. (2000) argue that “close proximity between innovation actors and organizations strongly facilitates the creation, acquisition, accumulation and utilization of knowledge rooted in inter-firm networking, inter-personal relationships, local learning processes and ‘sticky’ knowledge grounded in social interaction”. Taking it a step further, a number of authors claim that the emergence of the knowledge-based economy, and changes in the architecture of the innovation process have actually increased the value of proximity for innovation. Along these lines, Sonn and Storper (2008), who analyzed US patent citations between 1975-1997, concluded that “the proximity in the creation of economically useful knowledge appears to be becoming even more important than was previously the case”. Storper and Venables (2004) strengthening this argument, affirming that face-to-face meetings, which are facilitated by proximity, can reduce moral hazards in the relationship which are extremely uncertain, such as in the formation of collaborative projects to develop new knowledge, where complete contracts are impossible and bureaucracies too costly. In this regard, relationships, which depend on face-to-face meetings and consequently proximity, are the key untraded interdependencies that allow the actors of the innovation process to coordinate (Storper, 1997).

Following Johnson, Siripong and Brown (2002), who argued that distance should be defined as a discontinuous variable with distinctive threshold values, it is claimed that the most important threshold is the distance beyond which face-to-face exchange of knowledge is not possible at least once a day.

10. Mapping technique presentation

The technique presented below attempts to visualize the flow of tangible and intangible transactions or activities (which hereinafter are referred as transactions) among the different actors implicated in the business life of an NTBF. To a large extent it is based on the HoloMapping Technique (Alle, 2000, 2003) that maps the “value network” of an organization by depicting the patterns of tangible and intangible exchanges. In addition to the “value network” approach, the proposed technique, developed exclusively for NTBFs, also seeks to depict the strength of ties between the actors of a transaction as well as the complexity of knowledge that is transferred (in the case where the deliverable is intangible).

In the proposed mapping technique the focal NTBF is presented as a circle in the centre while its members are presented as ovals. Organizations and persons that have interactions with the focal NTBF are presented as squares and ovals respectively. Partners interacting with the focal NTBF and that are geographically located at a driving distance that permits frequent face-to-face interactions, are presented within certain boundaries. For the European environment we consider these boundaries as the regional level and for the US environment the county level (Fig. 1).
The actors of the system are engaged in transactions that are presented as arrows originating from one actor and ending to another. A text on the arrow describes the item involved in the transaction (hereinafter referred as deliverable) which can be either tangible or intangible. Transactions depicting tangible deliverables are distinct to those depicting intangibles deliverables (Fig. 2).

**Figure 2: Transaction of the exchange map: tangible vs. intangible exchanges**

Actors that are entering into a transaction have a relation with certain strength. The weakness (or the strengthens) of the ties between the implicated actors is depicted distinctively (Fig. 3).

**Figure 3: Transaction of the exchange map: strong vs weak ties**

For the transactions that have intangible goods as deliverables, consequently implicating the transfer of knowledge, the technique integrates the codifiability of the transferred knowledge. Intangible deliverables that integrate knowledge transfer with low levels of codification are depicted differently than intangible deliverables that integrate knowledge transfer with high levels of codifiability (Fig. 4).

**Figure 4: Transaction of the exchange map: strong vs weak ties**

In order to measure i) the strength of ties in the transaction of tangibles and intangibles deliverables and ii) the complexity of knowledge involved in the exchange of intangibles, a questionnaire initially developed by Hansen(1999, Hansen 2002) is used.

The aim of the technique is to give a clear and “easy-to-read picture” of the NTBF. With the output from this procedure the NTBF’s decision makers can:

- draw the “value and knowledge network” of the company
- identify gaps and discontinuities in the exchange of knowledge
- assess the level of autonomy and connectedness

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1 For reasons of space, the questionnaire is not presented as an appendix to this paper.
• direct the growth of the company in the future

The map produced is practically a snapshot, at a given moment, describing the exchanges that have occurred over the previous six months of the NTBF’s business life. This snapshot can (and should) be compared with other snapshots of different points of time. In this respect the above-presented technique can be used as a practical framework to assess the role of knowledge in relation to strategy.

11. Strategy formulation process

In the knowledge-based society, where the open innovation model is being applied in more and more industries, the innovative firm is taking more and more open forms in order to create (or to be integrated) in the innovation process. By opening its innovation process (or tapping into another firm’s innovation process), the firm builds porous boundaries in order to combine its own knowledge and competencies with those of others. Assuming that i) knowledge is the centre of the value-creating process of a NTBF and ii) that NTBFs, by definition, follow what von Krogh et al. (2000) call advancement strategies, the search and transfer of what is conceived as useful knowledge as well as its conversion into new added-value knowledge is of a major strategic importance.

The scope of the proposed methodology is to stimulate the identification, transfer and utilisation of useful knowledge as part of the overall business strategy. The first step is to identify useful knowledge among the employees as well the stakeholders of the NTBF. Identifying useful knowledge inside the a NTBF does not require further discussion as internal relations are “clear, visible” and often flat. However, identifying useful knowledge in the external environment is not as simple: relations have to be considered, knowledge complexity has to be assessed and the extent to which this knowledge transaction can be transformed, if necessary, into a mutually beneficial exchange has to be examined. A number of questions have to be answered in order to proceed from the knowledge identification to the knowledge transfer.

Who has the requested knowledge? This question is not only a “who knows what” question which is more relevant when searching among the members of the NTBF but also a “who knows the whereabouts of the requested knowledge?” which is more relevant when the requested knowledge lies outside the firm.

What are our relations with the actor holding the requested knowledge? The second question seeks to identify ways to strengthen ties in the relation with the actor/partner holding the requested knowledge. What drives this relationship? Is it based on friendship, a strategic alliance, a mutually-beneficial business relationship, or a potential partnership etc.?

What is the nature of the requested knowledge? The third question is related to the knowledge complexity that determines the ability to accomplish the knowledge transfer. Knowledge complexity is not objective. On the contrary, it has to be regarded within the framework of a specific knowledge transaction, between specific persons in a specific context. In this respect, the nature of knowledge is determined by the transfer ability of both the “sender” and “receiver”, in a specific context and in a specific time frame.

How can we transfer this knowledge and what is the compensation requested for this transfer? The fourth question is related to the willingness of the “knowledge owner” to share his knowledge and the “price” for it. It is worth mentioning that in many cases the knowledge-transfer process can not be predetermined and this depends heavily on the complexity of knowledge and the absorptive capacity of the receiver, making the transfer and its recompensation difficult to predetermine. Additionally, the “price” varies largely depending on the nature of the relationship between the sender of the receiver (e.g. the price for valuable advice given by a small manufacturer to a NTBF during the R&D phase can be the “promise” that, if the product reaches the market, the manufacturer is responsible for producing it).

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2 One of the two main explanations why there may be a problem in transferring knowledge is willingness of the source to share its knowledge (Hansen, 1999) that is determined by the relationship of the two parties as well as the context in which the potential transfer occurs. In large organizations where “not everybody has a (at least social) relationship with everybody” the reasons of the unwillingness to share knowledge (inability, competition, lack of time etc.) are not necessary clear to the “knowledge seeker”. On the contrary in small organization reasons for willingness or unwillingness to share knowledge are “clear and visible.”
Apart from compensation, are there additional costs associated with the transfer? The fifth question tries to examine the non-monetary cost associated with the transfer of knowledge. As mentioned earlier, a NTBF’s resources are limited and valuable, and the cost to absorb a knowledge transfer might prove costly in terms of man days of key members of the NTBF. Additionally, in many cases a NTBF has to “give up” valuable knowledge in order to absorb new knowledge. In this case trust plays an important role.

Does this knowledge transaction contribute to the formation of a “collaborative” competitive advantage? The final, and probably the most crucial, question concerns the examination of the probability that this knowledge transaction is part of the formation of a knowledge-based strategic alliance forming a sustainable competitive advantage that is difficult to imitate. If this is the case then it becomes very crucial to “protect” and stimulate this relationship.

12. Concluding remarks

In everyday business life, the above-mentioned questions are often difficult to answer per se. What this paper terms “useful” or “requested” knowledge is in many cases not clear for the knowledge “seeker” and this is especially the case during the product development phase, a phase that dominates the day-to-day work of a typical NTBF. To this difficulty we have to add the fact that relations and knowledge are not “things” but evolving processes. In this respect, “no one agent can own knowledge, rather it is an emergent part of the social process of interaction” (Higgins and Southern, 2007). In this respect, a NTBF is viewed a living and evolving system with socially constructed dynamic and changing relationships and interdependencies.

The increasing importance of formal and informal collaborative arrangements and their result, namely the NTBF’s porous boundaries, have raised far-reaching implications for management. Insights from the evolutionary complexity theory suggest two respective principles (Mandeville, 2005): i) facilitation of self-organization and ii) access to and management of complementary knowledge.

Networks are best understood as complex systems in which none of the economic agents (including managers) has direct control (Hearn et al., 2003). Adding to the complexity of networks, the assumptions that: i) knowledge is socially constructed and ii) the creation of new knowledge introduces additional uncertainty and complexity, the resulting consequence is the incapacity to impose order (Mandeville, 2005).

Under these conditions, what is the role of the manager? Byrant and Wells (1998 cited in Mandeville, 2005) suggest that the approach should be process-oriented, focusing on system design. This includes recognizing that self-organization is a vital process in complex systems. “Thus the appropriate role for managers is to help shape and create contexts in which appropriate forms of self-organization can occur so that desirable patterns can emerge. These contexts can be both within the firm and/or include other firms. Managers can help shape the parameters that define the appropriate context, while allowing the details to unfold” (Mandeville, 2005). In this respect, the innovative firm is a living and evolving system with socially constructed dynamic and changing relationships and interdependencies, and its managers, rather than being an “external” controller of human behaviour, are part of a system that is codetermined by their actions (Tsoukas, 2003). Managers of knowledge-intensive organizations are today more like football trainers in that they are setting the goals and ensuring smooth and effective linkages between actors of a dynamic network that has to find self-organizing patterns in a dynamic and ever-changing environment (Tsoukas, 2003) than managers that have to set-up processes which include top-down orders and bottom-up reports. Activities that form the backbone of a NTBF’s strategy should be aimed at improving the capacity-to-act of people both inside and outside the firm.

Consequently, the proposed methodology is not viewed as a linear roadmap that a NTBF manager has to follow in order to come up with easily applicable strategic decisions that determine cause and effect. On the contrary, it is an effort, on the one hand, to study the emergent patterns in what is considered to be a chaotic or disordered system and, on the other, to stimulate the creation of new patterns in the system that would be consistent with the NTBF’s strategy.

The presented methodology is specially designed to address the needs of NTBFs, companies with a limited number of employees, partners and stakeholders. In this regard, the methodology presented here is not suitable for bigger organizations, as the mapping effort and the resulting complexity of
relations do not produce a valuable result. It must also be noted that the paper is part of a wider research project that will explore further how to apply the proposed methodology to a number of NTBFs.

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Mobile Knowledge Tool-kit to Create a Paradigm Shift in Higher Education

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Abstract: One of the main objective of educators is to identifying inspiring and interactive approach to learning, and to encourage students to be more receptive and co-operative in the classroom. To help educators in achieving these goals we employed constructivist epistemology and constructivist cognitive psychology, together with the use of Mind Maps and Mobile Knowledge (M-K) Toolkit. The toolkit can serve as the foundation for a new kind of integration of Internet resources and all classroom, laboratory, field experiences, and when used with “expert skeletal” Mind Maps to scaffold learning. It is our thesis that good theory-based use of the appropriate technology can increase the benefits of using Mind Maps in education and lead to dramatically improved education. In this paper we first explored the Mind Maps Concept, then we presented and explained the advantages of M-K toolkit and how this can support mind mapping and integration of a whole array of learning experiences. In the last section we presented two case studies to provide the evidence of how the M-K toolkit and Mind Maps can lead to education paradigm shift and enhance the outcome of the learning experience in higher education.

Keywords: mind map, higher education, mobile knowledge, m-k toolkit

1. Introduction

Visual learning is a proven teaching method in which diagrams such as concept maps, mind maps, tree diagrams, organization charts and spider diagrams are used to help students of all ages think and learn more effectively. They are all used for storing, processing, organizing and presenting information graphically. These techniques are used across the curriculum and at all Key Stages in the UK. The most popular is Mind Mapping.

The use of visual learning techniques, such as mind mapping, is achieving growing recognition in education. Whether we believe that the mind is organized into left and right-hand sides, or whether it is a less organized structure of various skills, mapping utilizes a greater part of the brain, resulting in more effective thinking. Imagination and association are the keys to high-level memory and creative thinking and mapping supports this. With many students being visual or kinaesthetic learners, this approach makes the teaching more enjoyable and effective and the learning more successful and fun. It is an educational win–win that multiplies its benefits over time and with use.

Concept maps and mind maps are quick to review and it is easy to refresh information in the mind just by glancing at one. Remembering the shape and structure of a visual diagram can provide cues necessary to remember the information within it. They engage much more of the brain in the process of assimilation and connecting facts than conventional notes or summaries.

Mind maps have been used in all facets of education, training and business. With the fundamental goal of fostering learning they have been shown to be an effective tool for displaying students’ prior knowledge, summarizing what has been learned, note taking, aiding study, planning, scaffolding for understanding, consolidating educational experiences, improving affective conditions for learning, teaching critical thinking, supporting cooperation and collaboration, and organizing unstructured knowledge content. There is today almost a universal agreement that every learner must construct her/his own knowledge structure, or cognitive structure, through her/his own efforts. The commitment to building a powerful knowledge structure must be the learner’s commitment. There is less universal recognition that knowledge structures are built primarily through meaningful learning, and by contrast, rote learning or simply memorizing information contributes little to building a person’s knowledge structure. (Novak 1993)
Vygotsky’s studies showed that there was a level of cognitive development that allowed a learner to advance in understanding of a given domain of knowledge without coaching and a higher level of understanding beyond which the learner cannot advance without coaching. He called this range of understanding the zone of proximal development. (Vygotsky 1978)

Mind maps have many applications in educational, and business situations, including notetaking, brainstorming (wherein ideas are inserted into the map radially around the center node, without the implicit prioritization that comes from hierarchy or sequential arrangements, and wherein grouping and organizing is reserved for later stages), summarizing, revising, and general clarifying of thoughts. One could listen to a lecture, for example, and take down notes using mind maps for the most important points or keywords. One can also use mind maps as a mnemonic technique or to sort out a complicated idea. Mind maps are also promoted as a way to collaborate in color pen creativity sessions. (Farrand 2002)

Software and learning technique research have concluded that students find the techniques of Mind Mapping to be useful, being better able to retain information and ideas than by using traditional ‘linear’ note taking methods. (Pressley 1998)

2. The mind map concept

A mind map is a diagram used to represent words, ideas, tasks, or other items linked to and arranged radially around a central key word or idea. It is used to generate, visualize, structure, and classify ideas, and as an aid in study, organization, problem solving, decision making, and writing. It is an image-centered diagram that represents semantic or other connections between portions of information. By presenting these connections in a radial, non-linear graphical manner, it encourages a brainstorming approach to any given organizational task, eliminating the hurdle of initially establishing an intrinsically appropriate or relevant conceptual framework to work within. (Buzan 1991)

Mind maps (or similar concepts) have been used for centuries for learning, brainstorming, memory, visual thinking, and problem solving by educators, engineers, psychologists, and people in general. Some of the earliest examples of mind maps were developed by Porphyry of Tyros, a noted thinker of the 3rd century, as he graphically visualized the concept categories of Aristotle. Ramon Llull also used these structures of the mind map form.(Buzan 2000)

The semantic network was developed as a theory to understand human learning and developed into mind maps by Dr. Allan Collins and M. Ross Quillian during the early 1960s. Due to his commitment and published research, and his work with learning, creativity, and graphical thinking, Dr. Allan Collins can be considered the father of the modern mind map.

The mind map continues to be used in various forms, and for various applications including learning and education (where it is often called as ‘Webs’, 'Mind webs', or 'Webbing'), planning, and in engineering diagramming. (Nast 2006) When compared with the earlier original concept map (which was developed by learning experts in the 1960s) the structure of a mind map is a similar, but simplified, radial by having one central key word. A mind map is similar to a semantic network or cognitive map but there are no formal restrictions on the kinds of links used. (Buzan 2000)

The elements are arranged intuitively according to the importance of the concepts and they are organized into groupings, branches, or areas. The uniform graphic formulation of the semantic structure of information on the method of gathering knowledge, may aid recall of existing memories. Mind Map reinforces teaching strategies that encourage learning through multiple intelligences. The use of strong imagery, keywords and topic interlinking supports visual, linguistic, logical and auditory learning and the activity involved in producing Mind Maps strengthens kinaesthetic learning.

The nature of Mind Mapping is skill based rather than content driven which encourages the development of cross-curricular skills such as creativity and problem solving in addition to subject specific knowledge. In this manner, learning becomes more dynamic and enriching when Mind Map is used to supplement traditional classroom delivery methods. (Williams 2000)

3. The M-K toolkit

As mobile technology has become very common, it is no surprise that personal computing has become a vital learning tool by this time. Educational institutes have commenced a trend of
integrating PDAs into their teaching practices (mobile learning). With the capabilities of PDAs, teachers are now able to provide a collaborative learning experience for their students. They are also preparing their students for possible practical uses of mobile computing upon their graduation. PDAs and handheld devices have recently allowed for digital note taking. This has increased student’s productivity by allowing individuals to quickly spell-check, modify, and amend their class notes or e-notes.

Educators are currently able to distribute course material through the use of the internet connectivity or infrared/Bluetooth file sharing functions of the PDA. With concerns to class material, textbook publishers have begun to release e-books, or electronic textbooks, which can be uploaded directly to a PDA. This then lessens the effort of carrying multiple textbooks at one time.

Several mobile Mind Maps packages have been developed specially for PDA devices, but the lack of Buzan’s concept has been noticed. Our proposed system suggests a free hand tool using the stylus not based on menus or tree architecture.

The toolkit study technique improves ability to learn and help students clarify thought processes. Utilizing the mind’s ability to understand and remember visual information is a key element in the mind mapping technique.

By actively inspiring students through a brain-friendly, interactive approach to learning, Mind Map encourages them to be more receptive and co-operative in the classroom. It can also make lessons more spontaneous, creative and enjoyable, both for the educator and the students.

Note taking is generally the initial step in a study process and, k-m toolkit provides a graphical user interface that combines flexibility with structure. Students add new information elements to a map as, knowledge of a chosen subject increases.

Making presentations and working in groups is an expected part of group or team studies. Being able to logically and easily present and distribute insights to others increases a student’s overall study efficiency. The K-M toolkit helps students to:

- Improve note taking
- Structure thinking processes
- Aggregate and process information
- Logically present findings and summaries to others
- Knowledge sharing
- Collaboration

The M-K toolkit has been designed with the objective of supporting collaboration and sharing. The client-server architecture, together with a server where any Internet user can create a folder and construct, copy or publish their Mind Maps, facilitates the sharing of Mind Maps and collaboration during Mind Map construction (Cañas 2003). Additionally, a Mind Map Server can easily be installed in a classroom or school to facilitate collaboration locally.

Collaboration is supported at several levels. If two or more users attempt to edit the same Mind Map at the same time, the program will –with the consent of the users—establish a synchronous collaboration session where the users can concurrently modify the map and communicate via a chat window. Peer review and collaboration are facilitated through annotations (post-it notes) that can be added to map after selecting the portion of the map to be annotated, and through discussion threads.

The M-K tool supports the construction of “knowledge models”: sets of Mind Maps and associated resources about a particular topic (Cañas 2003). Through simple drag-and-drop operations students can link all types of media (images, videos, text, web pages, documents, presentations, etc.) and Mind Maps, whether theirs or constructed by others, to their Maps. These resources can be located anywhere on the Internet. Novak and Gowin (Novak 1984) have depicted the act of mapping as a creative activity, in which the learner must exert effort to clarify meanings, by identifying important concepts, relationships, and structure within a specified domain of knowledge. Knowledge creation
Electronic Journal of Knowledge Management Volume 7 Issue 2, (255 - 260)

requires a high level of meaningful learning, and Mind Maps facilitate the process of knowledge creation for individuals and for scholars in a discipline (Novak, 1993).

4. Case studies

Case Study 1: The curriculum of the Faculty of Medicine, University of Colombo, Sri Lanka emphasizes the need for self-directed learning and deep learning. The objective was to evaluate the effectiveness of using mind maps as a self-learning method for the new entrants to the Faculty. Seventy-four new entry medical students were randomly selected and assigned to two equal groups based on their high school performance. (Mind map vs. self-selected study technique). A text on iron deficiency anaemia was selected as self-study material. The mind map group was given a 30-minute lesson in the technique. Both groups were exposed to the study text for a 45-minute period and were requested to answer four structured essay questions based on the study text. The average mark of the entire group was 34.4%. Majority (97.1%, N=34) from the mind map group felt that it is useful to summarize information and 87.9% want to study further about mind mapping.

Case Study 2: Mind Map can assess patient and staff understanding of key concepts. This evaluation method was implemented with a group of eight nursing students in a home healthcare agency. Adapting environmental assessment criteria identified by Narayan and Tennant (Narayan 1997), students gathered data for a mapping assignment. Mapping techniques were individualized to match client needs. Students presented their completed maps to their peers, using the map to illustrate and discuss their assessment data, the relations among the data, and its effect on the health and wellbeing of the client.

In Figure 1, the central image is the integument, with axons (branches) representing concepts to be addressed when teaching staff/caregivers essential information needed to maintain healthy skin. Arrows are used to show a relation among concepts, and in this case the arrows are drawn to connect circulation and repositioning, and repositioning and shearing of skin, designating a connection, association, or relation among these critical concepts in healthy skin.

Figure 2 illustrates a Mind Map designed to teach community concepts to orientees or student learning about home and community concepts. When describing the community, the educator uses arrows to identify relations among health and educational status, economics, age, and safety. Symbols are used in Figure 2 to cue the staff educator to emphasize critical content.

Figure 1: Mapping of teaching content of the body’s integument including the relation between circulation and repositioning and repositioning and shearing of the skin
Figure 2: Health in the community is shown as having a relation among age, safety, educational status, and economics.

Figure 4 shows an example of a mapping used to teach home care clients their medication interactions. This map depicts a medication information handout that shows drug interactions. This educational handout can be reviewed with the client and left in the home for future reference.

Figure 4: Tricyclic antidepressants interact with cardiac and duodenal ulcer medications

5. Conclusion

By combining the visual learning technique of Mind Mapping with the portability and power of PDAs, the authors believe the strategy will be particularly attractive and useful to students who are motivated by new learning formats based on technology.

We presented initial results of the M-K toolkit development efforts aimed at creating instructional activities focused on Mind Maps that enhance the development of higher order thinking skills, analyzing, evaluating, elaborating, knowledge sharing and collaboration. Mind Mapping is a strategy that should be embraced by educators and students as new teaching and learning tools to support the
The M-K toolkit study technique improves ability to learn and help students clarify thought processes. Utilizing the mind’s ability to understand and remember visual information and portability are a key element in the mind mapping M-K toolkit technique.

By actively inspiring students through a brain-friendly, interactive approach to learning, the M-K toolkit encourages them to be more receptive and co-operative in the classroom. It can also make lessons more spontaneous, creative and enjoyable, both for the educator and the students.

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Dynamic Knowledge Management Toolkit

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Abstract: An important aspect of knowledge management is the implementation of methods to share the unstructured knowledge of expert practitioners within an organization. The existence of unstructured and dynamic knowledge represents a challenge to experts due to the dynamic and non-sequential nature of such knowledge.

In order to make such knowledge sharable, it is necessary to have both an effective elicitation method and a useful representation toolkit. In this paper we describe a Dynamic Knowledge Toolkit (DKT) that is used in knowledge elicitation and representation based upon Knowledge maps. Knowledge Maps content is different from the more general information in typical reference material and that is organized quite differently than standard textbook knowledge or mainstream hypermedia learning systems. These knowledge models tend to be large and complex with interwoven themes and rich interconnections of the concepts based on the expert's highly articulated mental model of the domain. Knowledge Maps have been used in all facets of education, training and business. With the fundamental goal of fostering learning and knowledge sharing they have been shown to be an effective tool for displaying prior knowledge, summarizing, planning, scaffolding for understanding, consolidating experiences, improving affective conditions for critical thinking, decision making, supporting cooperation and collaboration, and organizing unstructured knowledge content. We describe the use of the toolkit in a case study on the capture and representation of local weather forecasting knowledge. We also show how Knowledge maps can be used to support activities such as the preservation of institutional memory, the "recovery" of expertise that might reside in less accessible forms such as archived documents, for performance support, and for other knowledge-intensive pursuits such as weather forecasting or crisis management.

Keywords: knowledge elicitation, knowledge modeling, knowledge sharing, knowledge maps

1. Introduction

The knowledge elicitation, representation, construction, retrieval and demonstration have been conceived as a sequential process with a pre-defined goal. The existence of unstructured and dynamic knowledge represents a challenge to experts due to the dynamic and non-sequential nature of such knowledge.

In order to make such knowledge portable and sharable, it is necessary to have an effective elicitation method, a useful representation scheme, and a Knowledge Management System to demonstrate and share such knowledge.

Knowledge Maps have been used in all facets of education, training and business (Novak 1984). With the fundamental goal of fostering learning and knowledge sharing they have been shown to be an effective tool for displaying prior knowledge, summarizing, planning, projects management, scaffolding for understanding, consolidating experiences, improving affective conditions for critical thinking, decision making, supporting cooperation and collaboration, and organizing unstructured knowledge content.

The representation scheme described here is less formal and different from other ones such as PreSERVe method of knowledge modeling, concept maps (Michelini 2006; Gordon. 2000), and the like, in that it conveys rich knowledge content and also provides an organizing factor for other resources and media that are added to the organization of knowledge.

Also, knowledge Maps affords a more intuitive way to capture tacit knowledge than is required by formal schemes such as conceptual graphs (Sowa 1992), KADS (Moreno 2001) and Ontolingua (Gruber 1993) models. The next sections of this paper elaborate the Knowledge Maps method, the knowledge representation approach, and a case study from the domain of weather forecasting.
2. Knowledge organization using ontology and cognitive maps

Knowledge can come in a variety of forms structured, semi-structured or unstructured. In order to capture, represent, and organize this knowledge, we need to find away to group, index, or categorize it in some way. We could present schema conceptualizing a vocabulary of terms and relationships to present the knowledge. This is called ‘Knowledge Maps’ or ‘ontology’ (Jashapara 2004).

Current cognitive models of learning and thinking support the idea that individuals learn not by passively absorbing information but by actively trying to make sense of new information (Borich 1997). Each of us has a framework to explain how the world operates, and within that framework we relate new information to old. One example of active learning is cognitive mapping, a graphic technique that describes a large amount of information in a one-page “snapshot” representation. Used as a teaching strategy to enhance meaningful learning, a cognitive map graphically describes key ideas and helps the user view relations among concepts (Havens 1997). As an evaluation strategy, experts draw their own maps, identify concepts, and discuss their relation.

2.1 Knowledge map

One variation of knowledge map or ontology useful to integrating old and new knowledge is Mind Map, a graphics technique created by Tony Buzan (Buzan 2007). Used to assess higher order learning, Mind Map de-emphasizes memorization and focuses, instead, on the understanding and relation of ideas, thus promoting critical thinking skills (McCabe 1995; Oermann 1994; Oermann 1998).

Mind (Knowledge) Maps are graphs that are comprised of central Image that represents the core concept of knowledge, similar to the concept maps defined by Novak (Novak 1997). and the relationships among the sub-concepts on the branches. Concept Maps are used to form knowledge models by placing them in a radial organization and appending elaborating media onto the branches within each map. The resultant model of expert knowledge contains numerous unstructured sub-domain concepts, principles, and relations (Ausubel 1968).

2.2 The knowledge elicitation method

The actual elicitation of knowledge can take many forms that can be categorized broadly into those that are direct (in collaboration with the expert) and indirect (through study or inclusion of relevant information sources identified by the expert or knowledge engineer) (Waterman. 1986). Direct methods of knowledge elicitation are chosen from a variety of techniques based upon interviews, analysis of familiar tasks, and so-called contrived (or experiment-like) techniques (Hoffman 1995). The knowledge elicitation process leads to the creation of artifacts (knowledge maps, interview transcriptions, edited videos of the expert discussing a topic or making a point, etc.) that will be included in one knowledge Map.

2.3 The structure of a knowledge map

Knowledge maps provide an explicit, concise representation of what the expert knows about a non-structured knowledge domain. The mind map continues to be used in various forms, and for various applications including planning and in engineering diagramming.

When compared with the earlier original concept map (which was developed by learning experts in the 1960s) the structure of a mind map is a similar, but simplified, radial by having one central key word.

A mind map is similar to a semantic network or cognitive map but there are no formal restrictions on the kinds of links used.

The elements are arranged intuitively according to the importance of the concepts and they are organized into groupings, branches, or areas. The uniform graphic formulation of the semantic structure of information on the method of gathering knowledge, may aid recall of existing memories.

Figure 1 is a depiction of part of a knowledge map to weather forecasting station. As can be seen in Figure 1, the branches within the map are populated with icons that indicate sources of information
related to a given concept. An icon is provided for each of the various information sources such as text, graphs, photos, digital audio or video, links to Web pages, or other knowledge map. The icons appear at the branch in varying combinations to indicate the media containing information regarding the concept. When the user clicks the icon that represents one of these sources of information, a pop-up menu appears that presents links to the media of the selected type.

![Knowledge Model Diagram]

**Figure 1**: A depiction of a knowledge model from the domain of weather forecasting

A special icon representing other knowledge maps is used to indicate links within the model. The overall navigational scheme allows the user to start in a new knowledge map at a given location. The user can also examine the other concepts and links in the current map as they relate to the concept under consideration. Since these facilities all occur in the context of a Knowledge Map set, the user has great navigational flexibility throughout the knowledge Map.

Knowledge Maps contain content that is different from the more general information in typical reference material and that is organized quite differently than standard (sequential) textbook knowledge or mainstream hypermedia learning systems. These knowledge models tend to be large and complex (reflecting the complexity of real domains of knowledge) with interwoven themes and rich interconnections of the concepts based on the expert's highly articulated mental model of the domain. As such, these knowledge models contain highly contextualized, domain-specific knowledge that is more directly applicable to specific problem situations than much of the more generic knowledge that typically comprises instructional materials or references.

### 3. Case study on weather mapping and forecasting system

A weather mapping system is required to generate weather maps on a regular basis using data collected from remote, unattended weather stations and other data sources such as weather observers, balloons and satellites. Weather stations transmit their data to the area computer in response to a request from that machine.

The area computer system validates the collected data and integrates it with the data from different sources (Boose 1986). The integrated data is archived and, using data from this archive and a digitised map database a set of local weather maps is created. Maps may be printed for distribution on a special-purpose map printer or may be displayed in a number of different formats.

The meteorology community has a number of interesting knowledge management problems. Theirs is a domain that is characterized by an enormous number of data types and information sources, with
new ones continually becoming available. Forecasters work under conditions of significant uncertainty with very high stakes. Weather impacts on navigation, fishing and military operational missions are one of the most problematic areas the meteorology community faces. Furthermore, effects of local conditions can have significant impact on the weather. Knowledge of such local effects is gained by forecasters who have had extensive experience in a particular locale. However, the meteorologists’ careers typically unfold as a succession of land-based duty weather forecasting stations and assigned to certain geographical area, with an ongoing need to understand local effects on weather.

A knowledge modeling effort to demonstrate the feasibility of eliciting and representing local meteorological expertise was undertaken at the Training Meteorology and Oceanography Facility (TMOF) in Egypt (Hoffman 2001). Figure 1 depicts a small but typical part of the knowledge model that was created. The Knowledge Map labeled “Regional Weather Forecasting” is the top-level map for the model. In front of the top-level map is a more detailed one on the topic of thunderstorms in the Coastal region. Also appearing are other resources that have been accessed, including the text labeled "Thunderstorms,” graphics (Annual Frequency of Thunderstorms), satellite imagery, and a digital video of an expert discussing local seasonal variations in thunderstorms.

Knowledge elicitation for the creation of this model primarily utilized knowledge mapping as a scaffold for structured interviews (Coffey 1999). Several Knowledge Maps could be created on topics such as the local climate, the effects of the Red and Mediterranean seas on the weather, the various seasonal regimes, fog, thunderstorms, hurricanes, frontal passage, and the local authority's tools and products were created from several iterations of interviews with meteorologists. The knowledge Toolkit was developed iteratively with review of the Knowledge Maps after each wave of elicitation, and the assessment of potential resources that could be included in the representation.

Many pre-existing resources such as graphics from the personal collections of the forecasters, links to useful Web sites, etc., were identified and incorporated into the model. Additionally, all the materials from the "Local Forecaster's Handbook" were included. Other information such as the Standard Operating Procedures of the installation was attached at appropriate places in the model. A substantial amount of digital video was created from experts’ discussions of topics of interest (thunderstorms, hurricanes, fog, etc.) and included

As the project proceeded, verification was performed in two ways. First, the emerging knowledge model was reviewed with the experts to monitor how the model was structured by the Knowledge Maps. Second, independent verification of the Knowledge Maps was performed. An independent expert worked through all the elicited Knowledge Maps, looking for poorly described phenomena and errors. A study of this part of the process showed that experts could evaluate the propositional content in Knowledge Maps at the rate of approximately 7 propositions per minute. The typical map size was approximately 47 propositions. Approximately 10% of the concepts and linking phrases were changed.

Resource-appended Knowledge Maps make useful, highly accessible learning resources. Subsequent to the creation of the meteorology model described here, several new meteorologists at the installation of new weather forecasting station used the system as part of their Sub-regional Forecaster Training Course.

4. Summary and conclusions

This paper contains a report on a Dynamic Knowledge Toolkit for Knowledge elicitation, construction and verification. The paper also discusses the use of the toolkit to create a Knowledge Maps that captured expert knowledge pertaining to local effects on weather forecasting station.

A software Toolkit entitled Dynamic Knowledge Toolkit (DKT) has been developed to provide the capability to capture, model, and view unstructured knowledge. The client software allows the Knowledge Maps themselves to be created and populated with other resources such as text, graphics, video, Web pages, etc. The DKT server allows all these resources to reside across multiple machines and to be edited or browsed from any machine that is running the DKT client program.

With DKT, knowledge models may be shared throughout an organization and may be accessed anytime and anywhere that permits a connection to the server where the knowledge maps reside. Knowledge Maps can be evolved dynamically and shared across the organization.
References


Questioning the Positive Effect of External Knowledge Transfer Incurred by Industry Attractiveness: the Case of Mobile Virtual Network Operators (MVNOs)

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Abstract: The contribution of knowledge transfer to an organization’s overall performance outcomes has become one of the central themes of investigation among the theorists and scholars in the field of knowledge management. This paper questions the positive effect of external knowledge transfer on an organization’s financial performance, taking into account that even coordinated knowledge transfer is time consuming and likely to impair the performance outcomes when the conditions appropriate for obviating the inherent difficulty of knowledge transfer are not established. Its aim is to examine the fundamental role of the attractiveness of industry as a main moderator in an external knowledge-transfer activity which takes place between two parties in an alliance. Consistent with prior work on knowledge management this study argues that transfer costs are determinative factors for an organization’s performance and include: (i) the considerable amount of time spent searching in order to identify the appropriate new knowledge required, (ii) the effort to effectively distribute this knowledge between the parties of an alliance and (iii) the time needed for the external knowledge to be implemented effectively to an organization’s daily processes. The case to be examined is that of organizations which are in great need of obtaining and using new knowledge to achieve business model innovation. This kind of organizations is more likely to be affected by search and transfer costs since they are trying to reduce time-to-market entry, thus, achieving first mover advantage. A plausible source of knowledge for these organizations (knowledge seekers) is the formation of strategic alliances with organizations which not only possess the required knowledge (knowledge keepers) but also operate in attractive environments. An attractive environment, among others, is liable to frequent entries of new players and this may not give time to such organizations to elaborate and effectively utilize the knowledge that is externally derived. These assumptions are shaped on an overarching conceptual framework, which identifies the role of the attractiveness of the industry and delineates research propositions, taking the Mobile Virtual Network Operators (MVNOs) as a case study. To determine the attractiveness of the mobile telecom industry we apply Porter’s five forces framework and then we draw on a number of interviews which allows us to provide data suggesting that with an increase in the number of new entrants in the mobile telecom industry, an increase in the amount of knowledge derived externally may reduce the organization’s ability to increase its performance outcomes.

Keywords: external knowledge, knowledge transfer, industry attractiveness, strategic alliances

1. Introduction

In the era of knowledge economy, most researchers have placed great emphasis on the contribution of knowledge – either in its codified or non-codified format - to an organization’s overall performance outcomes. Indeed, they have argued conceptually or supported empirically that organizations with the ability to effectively manage the knowledge already possessed or that acquired from outside, gain a better claim to superior innovativeness (Davenport and Prusak, 1998), superior effectiveness and efficiency (Argote and Ingram, 2000) as well as superior customer responsiveness (Darr et al., 1995). Focusing on the knowledge transfer process which allows an organization to obtain knowledge from outside its boundaries, it is posited out that for such a process to be effective, thus enabling organizations to make valuable use of new knowledge acquired from outside, the whole process should be conducted under specific conditions, namely to take place within time constraints and in a coordinated sequence of actions.

Seeking knowledge from outside an organization’s boundaries has become one of the principal activities for the majority of organizations which are in great need of obtaining and using new knowledge in order to effectively and economically develop new products (product innovation), apply new methods of delivering services (service innovation) and/or redefine an existing product, service or process (business model innovation), aiming at the further maximization of their business (Damanpour, 1991; Davenport et al., 1996; Chesbrough and Rosenbloom, 2002). Both scholars and practitioners have simultaneously supported that the transfer of knowledge external to the firm has a...
direct and positive effect to an organization's overall performance (Ancona and Caldwell, 1992; Hansen, 2002; Dushnitsky and Lenox, 2005).

Although the ability to gain access to and allocate external knowledge often promises organizational success (as it has been found to improve organizational performance), the implementation of knowledge acquired from outside may lead to the opposite effect and as Haas and Hansen (2005) posited out “... may hurt organizations”. A plausible explanation could be the tendency within some organizations to obtain knowledge sourced outside unquestioningly, combined with a failure to subject incoming knowledge to sufficiently rigorous analysis. In addition, factors, such as the attractiveness of the industry in which organizations wish to maximize their business, often do not ensure effective knowledge implementation. Closely related to these knowledge-elaborating obstacles is the trend followed by many brand companies to offer innovations to their customers without previously possessing the relative knowledge. The acquisition of external knowledge alone, however, is not always adequate to secure an organization’s maximization of its business.

2. Questioning the positive effect of external knowledge transfer

2.1 Stating the problem

The amounts of knowledge sourced outside organizations’ boundaries are found to be influential for the innovative actions they undertake. In most cases that have been empirically investigated, obtaining knowledge – either codified or non-codified – from various external sources has a direct positive impact on organizations’ performance (Arrow, 1974; Cohen and Levinthal, 1990). That is to say by acquiring knowledge from outside, organizations obtain considerations for, elaborations on, and modifications to the existing knowledge that broaden and add considerable value to the ongoing growth of knowledge. Thus, organizations have the opportunity to allocate, assimilate, and effectively use the amounts of the necessary knowledge they previously lacked in order to innovate.

However, the positive effect of external knowledge transfer on an organization’s performance outcomes followed by the effective exploitation of the new knowledge is related to specific factors which may disable the potential benefits that the externally derived knowledge may offer. Consistent with prior work on knowledge management, it is argued that, among others, search and transfer costs determine the effectiveness of a knowledge transfer process between two parties. Specifically, the considerable amount of time an organization spends searching in order to identify the appropriate knowledge required, along with the effort to effectively obtain and share this knowledge with another organization, as well as the time needed for the incoming knowledge to be implemented effectively to an organization’s daily activities in order for the later to innovate, may be detrimental to an organization’s performance.

Several studies have analyzed the difficulties in transferring either codified or non-codified knowledge (Zander and Kogut, 1995) arguing that such difficulties influence the time needed in order for a new product to be developed. Generally, in the knowledge transfer costs literature the project completion time is regarded as one of the main factors which contribute to an effective knowledge transfer process. Hansen (1999) considered the nature of the relationships between subunits (strong vs. weak ties) in an organization and their impact on knowledge search and transfer efforts. Additionally, the significance of time constraints for the incoming knowledge to be implemented effectively was discussed by Edmondson (2003) in her study on action teams whose members have to deal with unpredictable situations.

These elements sum up the complexity of the utilization of knowledge acquired from sources external to an organization indicating, at the same time, that its effectiveness is the outcome of different factors related either to the external or the internal organizational environment. Taking this prior work one step further and questioning the positive effect of external knowledge transfer on the organizational level, this study focuses on the moderating role of the industry attractiveness in an external knowledge transfer procedure which occurs between two parties within a strategic alliance.

2.2 The conceptual framework

Drawing upon the existing empirical and conceptual work and aiming to expand this prior research, an overarching conceptual framework of the situated perspective of organization’s performance is proposed which identifies the role of the industry attractiveness, taking the Mobile Virtual Network
Operators (MVNOs) as a case study. More specifically, what is examined is the extent to which the industry’s attractiveness – as an external environment parameter – moderates the effective use of both codified and non-codified knowledge transferred between two parties in an alliance. The case to be examined builds on the need of organizations to maximize their business by effectively and economically achieving business model innovation. To do so, the aforementioned organizations, which play the role of knowledge seekers, need to obtain, among other things, specific knowledge (either codified or non-codified) possessed by other organizations which are leaders in the specific domains (e.g., mobile telecoms) and which play the role of knowledge keepers operating in attractive environments. In practice, knowledge seekers lacking such knowledge seek to secure alliances with knowledge keepers in order to embrace the knowledge required.

Hence, this kind of organizations is more likely to be affected by search and transfer costs since they are trying to reduce time-to-market entry, thus, achieving first mover advantage. Additionally, it is posited out that an attractive environment is liable to frequent entries of new players and this may not give time to such organizations to elaborate and effectively utilize the knowledge that is externally derived.

What is proposed as a moderating factor is the aforementioned industry attractiveness. Such a factor has a significant effect on the utilization of knowledge acquired from outside the organization. This rationale is depicted in the framework presented below (Figure 1), which provides a conceptual situated perspective of the organization’s performance influenced, in this case, by the new knowledge that is externally derived.

Figure 1: The situated perspective of organization’s performance

2.3 Research propositions

The propositions developed here aim at shaping considerations for new research and insights into knowledge management problems. The issues to be addressed concern the negative effects of the incoming knowledge on organizations’ performance outcomes and are as follows:

2.3.1 External Knowledge (EK)

According to the existing theory of knowledge management, possible sources from which an organization can extract the required knowledge may be distinguished into two broad groups (Souitaris, 2001, Caloghirou et al., 2004). The first group includes available sources of knowledge such as technical reports, patent databases, conferences, scientific publications and use of internet, whilst the second group includes sources which occur after coordinated efforts on the part of organizations for establishing linkages. Specifically, such sources are found to be the Academic and Research sector (i.e. University-industry cooperation) (Cohen et al., 2002), mergers and acquisitions or strategic alliances (Capron et al., 1998; Ahuja and Katila, 2001), recruitment and selection of highly skilled personnel or even investments in corporate venture capitals. To gain access to such sources, though, the collaboration between organizations must be secured in order for a knowledge transfer process to take place.
It is assumed that the knowledge which an organization obtains from a strategic partner in an alliance contributes to product, service or business model innovation, which in turn, increases its performance. The valuable contribution of knowledge acquired in an alliance and its relationship to performance outcomes, in terms of growth, innovation rate and survival, has already been investigated by management scholars (Inkpen and Beamish, 1997; Grant and Baden-Fuller, 2004). These studies illustrate the direct positive effect of external knowledge acquisition on an organization’s performance.

However, prior knowledge management literature lacks evidence to support factors which obstruct the beneficial outcomes for an organization which implements knowledge that is externally derived. Consequently, there is a need to examine whether or not the acquisition of external knowledge is a secure source of competitive advantage for organizations that seek to gain access to new business. Besides, external knowledge should be examined by taking into account other factors, without following the tendency of past research to unquestionably accept the one-dimensional nature of knowledge that is externally derived.

The present study defines as external knowledge the knowledge - either codified or non-codified – which an organization (knowledge seeker) acquires from its strategic partner (knowledge keeper) and proposes that the external knowledge may increase an organization’s chances at increasing its performance. Where this paper differs, regarding this point, from prior work is that it questions the positive impact (viewed in a holistic manner) of external knowledge acquisition on performance outcomes (measured by objective performance indicators). Thus, it proposes the situated perspective of organizational performance which has rarely been discussed earlier in the knowledge management field. This is reflected in the following propositions:

- Research Proposition 1: The extent to which the external codified knowledge that an organization obtains from its strategic partner increases its performance outcomes.
- Research Proposition 2: The extent to which the external non-codified knowledge that an organization obtains from its strategic partner increases its performance outcomes.

2.3.2 Industry Attractiveness (IA)

Based on previous work on knowledge management, it is assumed that in order for the transfer of new knowledge acquired from outside organizations to be useful and effective and thus enable organizations to gain the first mover’s advantage, it should take place within time constraints in a coordinated sequence of actions (e.g., Hansen, 1999; Edmondsom, 2003). Taking into account that the knowledge transfer process, even if it is coordinated, is by nature time-consuming and likely to impair the expected performance outcomes, the appropriate factors for obviating the inherent difficulty of knowledge transfer should be established.

Transfer costs could be a determinant factor for organizations which are willing to maximize their business by delivering new services and entering new industries characterized as attractive (i.e. they demonstrate future profit potential and growth) (Hofer and Schendel, 1978 in Wernerfelt and Montgomery, 1986; Porter, 1980; 1985; Ramarwamy et al., 1993). More specifically, search and transfer costs include the considerable amount of time spent in order to identify the appropriate new knowledge required as well as the effort to effectively assimilate the incoming knowledge. Organizations which lack previous knowledge and experience in the new domain they wish to enter are more likely to be affected by search and transfer costs since they are trying to reduce time-to-market entry, thus gaining the aforementioned first mover’s competitive advantage. It is also posited out that an attractive industry is, among others, liable to frequent entries of new players and this may not allow the necessary time for inexperienced organizations to elaborate and effectively utilize the knowledge that is externally derived.

- Research Proposition 3: The extent to which the industry attractiveness moderates the effective use of the external knowledge that an organization acquires from its strategic partner.

2.3.3 Performance outcome

Various performance measures, in terms of objective (e.g., financial rates) and subjective indicators (e.g. reputation or customer loyalty), have been proposed by many researchers in order to measure innovative efforts but they have rarely been used by researchers in the field of knowledge management to measure performance outcomes related to knowledge utilization.
It is estimated that the performance outcome of knowledge seekers might be based on objective financial indicators (e.g. revenues, Average Revenue Per User (ARPU), number of subscribers and years of operation) (Subramanian and Nilakanta, 1996) which were also collected from various valid sources, as described earlier in this paper. Subjective performance measures are not taken into consideration since they might potentially confound the research outcomes of this study. Generally speaking, the utilization of customer loyalty or reputation are found to be indicators which are not applicable to business ventures such as the case of the business model innovation examined in this study.

3. Methodology

3.1 Data collection and analysis

Data for this study has been divided into two main categories: primary and secondary data. Primary data has been collected through thirty semi-structured interviews at the workplace of the interviewers, each lasting 90-120 minutes approximately. Interviews were recorded and taped in order to extract qualitative process data which were further interpreted through qualitative deductive content analysis (theory driven proposition testing). Secondary data has been collected from specialized archival sources such as telecom journals and newsletter, Internet sources and annual reports.

The qualitative sampling (i.e., Subject Matter Experts (SMEs), Informants and Gate Keepers (GKs)) for this study is purposive (not random). It was selected using the dimensional sampling strategy in order to decide upon a purposive sample composed of knowledgeable, reliable and well-informed participants (Johnson, 1990). In this case, the risk of the great uniformity that such participants may exhibit has also been taken into consideration (Pelto and Pelto, 1975). The interviewees consisting of ten SMEs (i.e., consultants in the sector of mobile telecoms who possess a thorough knowledge of the formation of MVNOs), twenty Informants (i.e., senior level managers who had contributed to the MVNOs operation and had been directly involved in the transfer of external knowledge from their strategic partners) and five GKs (three experts and two academics).

The process was conducted in three phases. As an initial guide for the entire interviewing process, phase one involved ten grounded open-ended interviews, with the SMEs in order to obtain basic information concerning (i) telecom industry current status and trends (ii) MVNO concept, market and operations and (iii) MVNO technical – technology issues. After appropriate information and data being collected, an interview protocol of thirty six guided questions was developed which was also consistent with the existing knowledge management literature. This interview protocol was used in phase two, where informants were contacted with a specific target to form an interpretation of primary data by selecting evidence and juxtaposing it with the expectations from the related literature as well as our conceptual estimations. Informants were not asked to fill in any questionnaire instead we used the questionnaire as a manual to direct the twenty semi-structured interviews with them. In phase three a panel of GKs was set up with a view to testing reliability (i.e., data quality checks for bias, deceit and informants’ applied cognitive background) as well as internal validity (i.e., the linking of presented data with prior or emerging theory) and external validity (i.e., the consistency of findings with the theory and the situation experienced).

3.2 Findings of the interviews

The study supports the claim that the transfer of external codified or non-codified knowledge from knowledge keepers to knowledge seekers, in the context of a strategic alliance, enhances the performance of the later, though this effective outcome is moderated when the whole process occurs in an industry that is characterized by high attractiveness.

The interpretations of interview data extracted from SMEs linked evidence to knowledge management theory and led us to define external knowledge in its non-codified format as the personal knowledge possessed in the form of advice or insights by people involved in the examined case (e.g. experts, senior employees). Such knowledge is a source of information concerning customer care services, billing processes, managerial practice and policies and tricks of sales. Similarly, external knowledge in its codified format, consisting of either electronic or hard-copy documents (i.e., executive reports, newsletters, manuals) gives information, among others, about market share growth, lost client rate and investment project evaluating speed.
Data extracted from the interviews with the Informants was classified into two themes related to the aforementioned research propositions. Informants responded to a set of questions evaluating the extent to which the external codified knowledge and the external non-codified knowledge which an organization obtains from its strategic partner in an alliance increases its performance outcomes. Concerning the external codified knowledge transfer, the majority of the respondents identified a significant positive relationship between the codified knowledge that is externally derived and organizational performance outcomes. Indeed, a significant percentage of informants relied heavily on the explicit knowledge in cases of technology transfer as opposed to theorists (e.g., Nonaka, 1995; Spender, 1993) who ventured to suggest that non-codified knowledge is more valuable than codified knowledge. Other informants dealt with codified and non-codified knowledge not as two different and distinct kinds of knowledge but as two interdependent kinds, a view which Polanyi (1966) strongly supported in his seminal work. Specifically, they recognize that the non-codified knowledge possessed by people outside an organization constitutes the necessary background for the development and interpenetration of codified knowledge that is also externally derived. Without the accessibility to know-how, hints and advice of the informants, explicit knowledge cannot be implemented effectively.

Concerning the external non-codified knowledge, Informants supported its positive effect on the performance of an organization which derived the necessary knowledge from its partner in an alliance. However, they argued that the effectiveness of the external non-codified knowledge on an organization’s performance is depended, to a great extent, on the willingness of knowledge keepers to share this knowledge with the knowledge seekers and transfer it within the appropriate time constraints. Additionally, it was indicated that the extensive participation of knowledge keepers in the knowledge transfer activities, in terms of personnel movement, training, formal and informal communication channels, scheduled meetings and replicating techniques, has a considerable effect on the efficiency of the knowledge transfer process. Issues of knowledge transferability were also discussed followed by a consensus that the codified knowledge - by its nature – is more easily articulated and transferred between individuals and organizations than non-codified knowledge (Kogut and Zander, 1992). The subject-related quotations from the interviews are in the box below.

| The codified knowledge that is externally derived increases the performance of organizations in the case of technology transfer |
| The external non-codified knowledge constitutes the necessary background for the development and interpenetration of the external codified knowledge. |
| The effectiveness of the external non-codified knowledge on an organization’s performance depending on the willingness of knowledge keepers to share the knowledge that possess |
| The extensive participation of knowledge keepers in the knowledge transfer activities has a considerable effect on the efficiency of the non-codified knowledge transfer process. |
| The codified knowledge - by its nature – is more easily articulated and transferred between individuals and organizations than non-codified knowledge. |

Industry attractiveness of the mobile telecom industry was measured using Porter’s five forces model, which provides a structured approach for examining the external environment of an organization. The data of the conducted interviews with the informants confirmed our estimations using the five forces analysis. Specifically, the conducted Porter’s analysis indicated that the mobile telecoms industry is fairly attractive both for knowledge keepers and knowledge seekers. Informants confirmed the moderating role of industry attractiveness in the knowledge transfer process especially for the strategic group of knowledge seekers. Such a role is justified in terms of the frequent entries of new players, the bargaining power of the knowledge keepers to share the required knowledge as well as the knowledge seekers’ dependence on knowledge keepers to effectively implement such knowledge. The subject-related quotations from the interviews are in the box below.

| Rivalry among existing competitors |
| In contrast to the traditional mobile telecom market, the market liberalization created a significant number of players, thus MVNOs have a great number of competitors. |
| Diversity among the competitors is based on the different services they offer, the segments they target, the market position they possess. |
| MNOs strategic stakes are higher than MVNOs (capital investments) and concentrated on the mobile services |
| The mobile telecommunication industry is growing very fast. |
| Low fixed costs. |
| Existence of differentiation and switching costs. |
| Lack of capacity in large investments. MVNOs rent this excess capacity from MNOs (which they have high licenses and infrastructure costs). |
Weak exit barriers: low specialized assets, low fixed costs of exit, low emotional barriers, low governmental and social restrictions, average strategic interrelationship costs.

Threat of substitutes (product or services)

(i) 2.5 G services (sufficient for business and consumer needs) ii) 4G services (not in services – is coming soon, iii) 3G services (freedom of mobile multimedia access – uncertainty for investments), iv) WLAN (is seen as a complementary technology rather than a substitute.

Bargaining power of buyers

The market segments that the MVNOs target or wish to target determine the revenues.

The offerings of MVNOs differ in terms of the different pieces of telecoms value chain owned by MVNOs.

Buyer’s switching costs: Low for the pre-paid tariffs, low for the residential customers, low for changing operator, relatively high for long-term contact subscribers (who are locked-in with an operator).

High profitable buyers.

There is no ability to backward integration.

Customers have an ongoing easy access to the information concerning the prices as well as the various offerings of the various MVNOs across the world.

Bargaining power of suppliers

The main suppliers for the MVNOs are the MNOs

Importance of the customers’ industry for the suppliers, in terms of selling extra capacity increases their revenues

Importance of suppliers’ product for the buyers’ business, in terms of network quality

Suppliers’ switching costs and product differentiation, depending on the commercial agreement and contract duration

Barriers to entry

General and administrative costs, billing, joint costs (brand names, know-how).

Product differentiation, in terms of the offering of the existing MVNOs.

Capital requirements: Depending on the business model represented by an MVNO.

Average switching costs.

There is no threat of access in distribution channels

Governmental policy (Licenses requirements): NRA: realizes the importance of competition in telecom industry, monitors and controls the relationships between national operators and potential entrants, allows permission access of MVNOs to 3G network.

Upon completion of the primary data collection an extensive control followed in order to ascertain that the primary data are in accord with the secondary data. More specifically, we have estimated that the performance outcome of knowledge seekers might be based on objective financial indicators (e.g., revenues Average Revenue per User (ARPU), number of subscribers and years of operation) (Subramanian and Nilakanta, 1996) which were also collected from various valid sources, as described earlier in this paper. Informants confirmed that their estimations for the performance of knowledge seekers were consistent with the proposed objective financial indicators; meaning that the transfer of the external knowledge (codified or non–codified) causes a temporary increase in these indicators. Such an increase soon levels out or there is even a decrease in these rates, after a period of time, which could be consistent with the impact of industry attractiveness on the knowledge seekers.

4. Discussion

The results from this study support that organizations which are in great need of obtaining and using new knowledge - which they temporarily lack - in order to gain access to an attractive industry might be affected by search and transfers costs and consequently mar their chance of gaining the first mover advantage.

The research evidence indicates that, in terms of search costs, this kind of organizations primarily face the difficulty of not only pinpointing but also to approaching and persuading a knowledge keepers in order to form a strategic alliance. In these cases, the brand name of the knowledge seeker is one of the determinative factors for the formation of such an alliance. Other factors are found to be negotiation-partners agreement and successful previous partnership. Even organizations with strong brand names are also affected by search costs in their attempts to enter high attractive industry environments. A plausible explanation could be potential market players, namely other knowledge seekers wishing to enter the same industry. The implication here is that an increase in the number of knowledge seekers wishing to join such industries, along with the considerable time needed to approach and form a strategic alliance with a knowledge keeper, decreases the possibility of knowledge seekers gaining the first mover advantage.
The latter could further be discussed by taking into consideration the transfer costs. Even when knowledge seekers secure the appropriate knowledge needed through the formation of an alliance, this alone is not adequate to promise an effective knowledge transfer followed by a successful implementation of the incoming knowledge. Knowledge seekers usually lack not only the appropriate knowledge needed in order for them to maximize their business to new markets but also the appropriate cognitive background to implement the external knowledge that is externally derived. Thus, the willingness on the part of knowledge keepers to distribute the appropriate knowledge along with the appropriate knowledge transfer mechanisms which are developed and implemented by both parties in a knowledge exchange relationship, should also be considered of significant importance.

The implication in relation to the knowledge keepers’ willingness to transfer the knowledge they possess, is that an attractive industry can change the rules of the agreements between the two parties in an alliance, especially when stronger brands claim the same source of knowledge. It may be further suggested that the implementation of appropriate transfer techniques and tools are vital when time-constraints are considered to be determinative factors for superior performance outcomes. The effective implementation of appropriate knowledge transfer tools and mechanisms may give organizations which are in great need of external knowledge a time advantage over their competitors.

The present evidence suggests that not only the time spent on the transfer of codified knowledge obtained but also the time spent on the exchange of non-codified knowledge can be more harmful for organizations that face the difficulty of effectively interpreting and exploiting the incoming knowledge. Organizations with the appropriate cognitive background (such as organizations operating in similar sectors) can easily elaborate the external knowledge obtained from their strategic partner. The lack of cognitive background may prove detrimental when, the industry an organization wishes to enter is characterized by high attractiveness, an industry where the speed of the implementation of new knowledge that promises the launch of a new product, service or business model before the competitors determines the success of this new business venture.

The transfer of knowledge which is externally derived provides organizations with the ability to redefine their existing product, service or process, thus creating, in this case, MVNOs. In other words, knowledge seekers without the acquisition of the specific knowledge are not in a position to maximize their business. Consequently, from this point of view, an external knowledge transfer positively affects the performance of knowledge seekers. However, issues concerning the codified ability of the knowledge that one partner in an alliance holds, the transferability of the external knowledge required along with the willingness of the knowledge keepers to share and transfer the amounts of knowledge they possess, influence the effectiveness of the knowledge transfer within the two parties. These further affect the performance of knowledge seekers.

5. Concluding remarks

The framework of the situated perspective of organization’s performance provided exemplifies the role of a moderating factor, namely the industry attractiveness, in the context of knowledge transfer in a strategic alliance and its effect on a knowledge seekers’ performance which acquires knowledge from its partner. The rationale behind such a suggestion is that industries of high attractiveness affect negatively the process of knowledge transfer occurring in an alliance. Constraint factors, namely search and transfer costs obviate the effectiveness of the knowledge either codified or non-codified that is externally derived. Perhaps, the most important requirement is that a better understanding of the way the proposed moderator and organizational performance outcomes are linked will expand the existing limited research on the costs and benefits of organizational knowledge. The research scheme developed aims at achieving these objectives. However, empirical testing is needed to enrich the support of our claims.

References


Assessing the Drivers of Virtual Knowledge Management Impact in European Firms’ Performance: an Exploratory Analysis

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Abstract: E-Business is a phenomenon that has progressed over the past decades at record speed, with considerable promise and hype. It has been embraced with varying degrees of enthusiasm and impact by both large and SME firms. Parallel with its development, E-Business has attracted research interests, seen in a plethora of new modules, programmes, models and tools. Knowledge Management (KM) is one tool that has seemed to gain a more relevant role, especially as managing knowledge becomes increasingly important to all companies. Appropriate KM practices within organisations can be seen as one of the prerequisites of enhancement of continuous performance improvement in the internet-based context. Thus, our aim is to develop a conceptual framework related to KM practices in a virtual context and to identify the nature of the relationship existing in those knowledge-driven elements and performance achievements. This paper aims to bridge the gap between the KM and e-business performance-related literatures from the viewpoint of European firms by establishing a model tested in European companies. For this purpose, we used a structural equation modelling analysis. The results show that KM has a positive impact on the maximization of e-business performance and that some elements individually have a positive influence on e-business performance. As limitations of the study, we consider the need for more research into this field and the inclusion of new elements such as technological readiness and management support to KM initiatives. The present study advances knowledge on the nature of the relative importance of different components of Internet-based KM as drivers of e-business performance and reinforce its importance as an integrated e-business tool.

Keywords: virtual knowledge management, e-business performance, European firms, information and communication technology

1. Introduction

In today’s digital economy, rapid access to knowledge is critical to the success of many organizations (Liao, 2003). One of the major challenges that firms face is managing competitive advantage through the development of strong relationships with all stakeholders. In this context, Knowledge Management (KM) becomes an important part of the global solution.

However, as noted by Takahashi and Vandenbrink (2004) and Zhang and Zhao (2006), KM needs to be regarded as more than simple information gathering in order to take advantage of its competitive potential. Despite the academic research and organizational practices developed around this concept, there is still a lack of conceptual basis necessary to develop the measures of KM contribution in business success, especially regarding its contribution to Internet-based environments. The objective of this paper has been to gain a clearer understanding of the fundamental issues related to this topic.

In this line of research, the present paper discusses the results of an exploratory survey conducted among a large sample of European companies. Using a structural equation analysis, we explore the relationship between e-business performance and KM initiatives, trying to identify the main drivers of virtual KM.

This paper has six sections and is organised as follows. Section 1 contains a brief background for this research. Section 2 presents the definition and process of develop knowledge inside an organization. Section 3 defines virtual KM, its advantages and its differences from traditional KM.

A virtual KM evaluation framework is developed in section 4. In the last two sections we conclude our study, reiterate the major points and suggest avenues for further investigation.
2. Data, information and knowledge

During the last decades there has been an ever-growing interest within the fields of databases, information systems, and knowledge-based systems (Aamodt and Nygärd, 1995). How should data, information, and knowledge be characterized so that their differences — and other relationships relevant for high achievements in the Internet environment — are identified?

The distinction between data, information and knowledge has been discussed for centuries in general, and within the database and information systems and marketing communities for several years. Nothing has resulted in a final conclusion. Between 2003 and 2005, a study titled “Knowledge Map of Information Science” tried to bridge this gap, collecting more than one hundred different definitions of data, information and knowledge. The conclusions present by Zins (2007) pointed to the existence of five different models (see Figure 1).

![Five models of data, information, and knowledge](image)

**Figure 1:** Five combinations of data, information and knowledge source: Adapted from Zins (2007)

Looking closer at each of these concepts, a base for our own model can be established. However, in describing these three concepts, it is not these researchers’ intention to give a complete or historical review of the available literature. Davenport and Prusak (1998) have defined data as a set of discrete and objective facts about events. Using this definition, a crucial idea emerges: all firms need data, and to some of them, data can be critical. However, data only describes a part of the phenomenon without providing any kind of interpretation or support basis for actions. Even though data by itself has little or none relevance for firms, it is primordial material for information creation. The same authors note that people can transform data into information through the addition of value in diverse forms: contextualized, categorized, calculated, correct and condensed. Thus, information consists of those significant regularities residing in the data that agents attempt to extract from it. In this sense we can summarize that information is an extraction from data that, by modifying the relevant probability distributions, has a capacity to perform useful work on an agent’s knowledge base (Boisot and Canals, 2004).

As pointed out by several authors (see, Table 1) the relation between information and knowledge is a source of much confusion and misunderstanding. For instance, Maholtra (2000) interprets knowledge in terms of its potential for action and its link to performance, as opposed to information as external phenomenon that only has potential for improvements.

According to Alavi and Leidner (1999), the concept of knowledge has its origin and use in the mind of people and circulated within organizations (Nonaka and Takeuchi, 1995), becoming integrated with internal process, norms and practices (Davenport and Prusak, 1998). Since Nonaka and Takeuchi’s 1995 discussion of the distinction between explicit and tacit knowledge, which enforced Polanyi’s 1966 discussion, researchers have tried to define KM.

Thus, this research paper relies upon the knowledge definition presented by Davenport and Prusak (1998), which considers 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. It originates and is applied in the minds of the knowers. In organizations,
it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices, and norms”.

**Table 1**: Some definitions of knowledge and information source: Adapted from Stenmark (2002)

<table>
<thead>
<tr>
<th>Author(s)/ Year</th>
<th>Information</th>
<th>Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wigg (1993)</td>
<td>Facts organised to describe a situation or condition</td>
<td>Truths and beliefs, perspectives and concepts, judgements and expectations, methodologies and know-how</td>
</tr>
<tr>
<td>Aamodt and Nygård (1995)</td>
<td>Information is interpreted data</td>
<td>Knowledge is learned information</td>
</tr>
<tr>
<td>Nonaka and Takeuchi (1995)</td>
<td>A fluid of meaningful messages</td>
<td>Commitments and beliefs created from these messages</td>
</tr>
<tr>
<td>Spek and Spijkevet (1997)</td>
<td>Data with meaning</td>
<td>The ability of assign meaning</td>
</tr>
<tr>
<td>Davenport and Prusak (1998)</td>
<td>A message meant to change receiver’s perception</td>
<td>Experience, values, insights and contextual information</td>
</tr>
<tr>
<td>Choo et al (2000)</td>
<td>Data vested with meaning</td>
<td>Justified, true beliefs</td>
</tr>
<tr>
<td>Le Coadic (2004)</td>
<td>Information is knowledge recorded on a spatiotemporal support.</td>
<td>Knowledge is meaningful content assimilated for use.</td>
</tr>
</tbody>
</table>

Increasingly, companies will differentiate themselves on the basis of what they know, how they process information and how they collect the data. Several models have attempted to explore the issues of knowledge discovery, knowledge classification, knowledge acquisition, learning, pattern recognition, artificial intelligence algorithms, and decision support. In the last two decades, the Internet has shown its enormous potential as a tool for KM, revealing a new dimension that will be presented in the next section.

### 3. The virtual knowledge management

Many claim that knowledge is a major factor driving business-level capabilities. Hence it is the most important source of competitive advantage (Nonaka and Takeuchi, 1995). Awad and Ghaziri (2004) stated that information and knowledge are critical to companies’ performance. However, these authors suggested that capturing and transferring best practices is not enough to achieve success, especially in an Internet-based context.

The expansion of Internet and e-commerce technology allows firms to establish new forms of creation knowledge, and provides them opportunities to improve their capability to manage and use knowledge (Siau, 2000). Through the Internet, vast amounts of information concerning customers, suppliers, markets, and supply chains can be effortlessly gathered, while information about company processes, products, and services can be easily disseminated to the public.

Takahashi and Vandenbrink (2004) suggested that the problem facing top decision-makers in the ubiquitous information society will be how best to organize the knowledge cycle. One of the challenges is to share the knowledge with inside entities who value it, and to do so organizations must create and deploy knowledge management systems (KMS).

KM is one of the leading strategic areas being explored and adopted by companies (Schwartz et al., 2000; Grossman, 2006), especially by those who have invested in the Internet as a new channel and marketplace.
According to Stojanovic and Handschuh (2002), the main function of a KM system is to capture and disseminate new sources of information. From this point of view, the Internet is a font of information. By using the Internet, companies implement a knowledge-acquisition and knowledge-sharing system, one that meets the requirements and specifications of unique and complex systems. It will match customer requirements to product characteristics (Ratchev et al., 2003) and allow the acquisition and maintaining of competitive advantages (See Figure 2). Furthermore, in this digital society, corporations need to adapt both knowledge management systems and business strategy in order to use digital information effectively and to take advantage of Internet possibilities (Takahashi & Vandenbrink, 2004).

Like many other information system implementations, KM is strongly linked in the literature to a sales and marketing perspective (Zhang & Zhao, 2006). For this research, we will consider KM as a combination of marketing tactics, knowledge-sharing, methods and technology. It can be used to gain and maintain competitive advantages in a global marketplace such as the Internet and simultaneously cut down organizational layers.

As Malhotra (2000) suggested, the traditional KM model emphasizes convergence and compliance to achieved pre-specified organizational goals. On the other hand and according to several authors, virtual KM emerged from the Internet, and web technology facilities are used to implement KM solutions. Nevertheless, the concept of use of information technology as the key enabler of KM is not a new idea.

From the literature review performed, we consider virtual KM as an Internet-based business strategy integrating every area that touches the data gathering. These areas include sales and support services, the overall consideration of enhancing performance of people and processes with major contributions from new electronic technology (Internet, email, chat rooms, e-forums), and data transformation into information, i.e., extranet and other internal process and knowledge-sharing (intranet, extranet, LAN, WAN, VPN). Table 2 presents the differences between KM and virtual KM).

In this context, online companies are embracing knowledge management as a major element of corporate strategy. Online technological applications allow a rapid and low-cost access to data, faster and easier processing of the information and, above all, a greater level of knowledge sharing. However, the adoption of KM systems by online organisations implies a complex restructuring of all organisational elements and processes. This in order to achieve the competitive advantages through the use of virtual KM systems. The virtual KM can be define has the incorporation of online technologies in the cycle of knowledge in order to enhance the KM processes.

The ubiquity era also gave another dimension to knowledge, decreasing the impact of several elements in the way firms use effectively knowledge, such as: size (Davenport and Prussak, 1998); industry; time and location. Through the presence online, any firm can achieve a global position and act in the global market, been the knowledge treatment a potential source of competitive advantages. Nevertheless, the application of KM in the traditional form is not enough to embrace all the challenges and opportunities that come along with Internet. Drawing from the literature on virtuality, we identified six discontinuities – geography, temporal, cultural, work practices, organization, and technology- that when fully applied to KM become the bases to the virtual KM. Thus, virtual KM can be considered as the convergence of a technology approach with a business value approach.

4. Evaluation framework and hypotheses

The digital era bring with it enormous challenges that firms can embrace, especially if we consider the facility associated with the gathering of information about customers, suppliers, markets, and supply — and the easy processing of information about company processes, products, and services, which can also be easily spread to the public. Even though academic researchers and practitioners alike praise KM adoption (Schwartz et al., 2000), perhaps the most significant gap in the literature is the lack of large-scale empirical evidence showing that KM makes a difference to organizational performance — in particular at an Internet-based organization. The assumption underlying the use of virtual KM is that by locating and sharing useful knowledge, organizational performance will improve, particularly in the digital environments.

Following the literature reviewed in the previous section, we developed a research model (see Figure 2). It proposes virtual KM that will be positively associated with a set of intermediate outcomes that we call “KM practices”, and will be positively associated with online organizational performance. For that
purpose we use a structural equation model with latent variables. This model consists of two sub-models: the measurement model and the structural equation model.

![Research model](image)

The primary research questions to consider are these: What is the degree to which an organization engages virtual KM — in particular, technological KM practices — has a positive impact in online organizational performance? And is virtual KM, in turn, positively related to online organizational performance? Besides measuring the convergence of a technological approach with a business value approach, our aim is to discover the direct nature of the relationship between KM practices and online organizational performance.

The validation of the measurement model is done by using Confirmatory Factor Analysis (CFA). We will see later that the observable variables (indicators) we selected are measures of three latent variables (factors). We assume that these three KM practice factors each have a direct effect on the virtual KM and upon online corporation performance. Therefore, we assume that the online corporation performance is explained not only by the virtual KM, but also by a general KM practices factor that is concerned with the gathering of data, information process and knowledge-sharing.

Therefore, it is postulated that the considered indicators measure three different and positively correlated latent variables or factors (hypothesis H1). Each factor is supposed to contribute directly to the determination of the online corporation’s performance (hypotheses H2 and H3). Besides these direct effects, it is also assumed that there is an indirect effect via virtual KM (H4). In sum, the four research hypotheses are the following:

- **H1:** The indicators considered define three positively correlated factors;
- **H2:** The KM practices factor positively and significantly determines the online corporation performance;
- **H3:** The factor concerned with KM practices positively and significantly determines the virtual KM;
- **H4:** The KM practices factor positively and significantly leads online corporation performance through virtual KM application.

Awad and Ghaziri (2004) pointed out that KM awareness benefits the entire organization and that it relies on developing a KM environment inside and outside the firm — one that permits a generation of new knowledge, i.e. the transfer of existing knowledge and its application to new products, services and process. Davenport and Prusak (1998) considers that KM focuses on processes and mechanisms for locating and sharing knowledge possessed by an organization or its external stakeholders. Based on this, we define KM practices as the group of technological efforts carried out by the organization in three different dimensions: data gathering, information process and knowledge-sharing. In total, we identified twelve KM practices. Each has been suggested elsewhere as being
important for effective virtual KM (Gold et al, 2001; Malhotra, 2000; Awad and Ghaziri, 2004; Schwartz et al., 2000; McKeen et al, 2005; Tiago et al, 2007; among others).

In Internet-based practices, most traditional financial and accounting methods of evaluation are not suitable as the only forms of performance measurement. This is due to the fact that there are some intangible, indirect and even strategic benefits that need to be considered (Grembergen and Amelinckx, 2002). From the literature review, it is found that KM has been linked positively to non-financial performance measures such as quality (Mukherjee et al., 1998; McKeen et. al, 2005; Tiago et al., 2007), innovation (Francisco and Guadamillas, 2002), productivity (Lapre and Wassenhove, 2001), and sales (Tiago et al., 2007). In fact, the expected results are that KM simultaneously influences many different aspects of organizational performance. The work of Gold et al. (2001) presents a combination of two dimensions as enablers of effective performance improvements: knowledge infrastructure and knowledge-processing capacity. Other frameworks have been presented, but the specific interface between virtual KM and e-business has not been addressed from the organisational point of view. So we will follow in the last authors’ steps, using as performance measures elements of both infrastructure and processing dimensions.

In identifying KM practices as antecedents to virtual KM and online organizational performance, we attempted to include factors that have been previously tested by others authors (see for example, Gold et al., 2001).

5. Methodology and results

The data used to test our research model comes from the e-Business W@tch annual survey (2005). This data was collected in a large survey about e-business in European enterprises. Considering that this study examines the status of adaptation of virtual KM by companies, the original sample was limited to firms having e-business activities and companies adopting KM practices. So, our work sample of 5,218 cases constitutes a heterogeneous sample of companies in terms of industries, fields, size, business model and country. The data covers 7 European countries (Czech Republic, France, Germany, Italy, Poland, Spain and the U.K.). Distribution of firm size, measured by the number of employees, shows that almost half of the firms are micro- and small-size firms (around 50,7%). The industry distribution of the responding sample is approximately similar to the original sample. The two less heavily represented sectors in the sample are the aerospace industry and manufacture of pharmaceuticals, with 3.1% and 10,2% respectively, closely followed by all the others. More information about the sample is presented in Tables 3, 4 and 5 in the appendix.

The model was estimated by the Maximum Likelihood method in the AMOS package. The model goodness of fit may be considered acceptable according to the values of some goodness-of-fit index, although the chi-square test statistic ($\chi^2 = 626,4; df =117; \text{p-value} = 0,000$) is significant, implying a bad fit. However, as is well known, this test has serious limitations — namely its dependence on the sample size and on the number of indicators. In general, for large sample sizes the chi-square statistic is significant, and in the present case the sample size is very large (n = 5,218). For that reason, it is usual to evaluate the goodness of the fit by a set of index, also presented in Figure 3. After global model fit has been assessed, the numerical results were evaluated in order to test their support of the research question. The numerical results can be obtained directly from the path coefficients of the structural model presented in Figure 3. We refer to standardised coefficients that account for scale effects and serve as indicators of the relative importance of the variables.

The measures for global model fit included in Figure 3 suggest that our model fits the underlying data well (Hair et al., 1998). All the paths were statistically significant.

A curious fact is related to hypothesis H2, where the results show that KM practices competencies explain 11 percent of the variance in online corporations’ performance, in accordance with Hair et al. (1998). Thus, this finding gives no empirical support to the concept that online performance can be improved by the use of the three basic components of KM practices: data gathering; information process and knowledge-sharing. With this consideration in mind, hypothesis H2 is rejected.

On the other hand, the three dimensions used to compose the KM practices are all significant and explained 100 percent, 100 percent and 55 percent respectively regarding the variance in the KM practices construct. As a result, hypothesis H1 is not rejected. Nevertheless, a reference needs to be made regarding the relative lower value achieved in terms of knowledge-sharing.
The results also show that virtual KM explains 51 percent of an online corporation’s performance, implying that our hypothesis H3 is confirmed.

### Key for significance measures:

- **: \( \alpha > 0.10 \)
- ***: \( \alpha > 0.05 \)
- ****: \( \alpha > 0.01 \)
- #: for model identifiably, this path coefficient was set to 1 in the unstandardized case.

### Table: Estimation results

<table>
<thead>
<tr>
<th>Measure</th>
<th>Value</th>
<th>Suggested</th>
</tr>
</thead>
<tbody>
<tr>
<td>RMSEA</td>
<td>0.033</td>
<td>&lt; 0.05</td>
</tr>
<tr>
<td>NFI</td>
<td>0.900</td>
<td>&gt; 0.9</td>
</tr>
<tr>
<td>IFI</td>
<td>0.913</td>
<td>&gt; 0.9</td>
</tr>
<tr>
<td>CFI</td>
<td>0.913</td>
<td>&gt; 0.9</td>
</tr>
</tbody>
</table>

### Figure 3: Structural equation model and estimation results

The data gathering, information processing and knowledge-sharing combined are not significantly important for the direct determination of an online corporation’s performance. However, these items have an indirect effect on the performance via their positive influence on the virtual KM. So, hypothesis H4 is not rejected.

KM practices and virtual KM are only part of the equation; the construct of online corporation performance must also be measured. All of the non-financial factors used show a positive and significant relationship. This provides empirical support for the theoretical views that state that online performance needs to be measured using new criteria, and not exclusively finance-based criteria.

### 6. Discussion and conclusions

Knowledge Management has presented several difficulties in the traditional IT environment, basically related to the constrained form of sharing the knowledge. In the present ubiquitous information context, KM seems to be an easier and promising tool, especially when used in its global version. As the literature review showed, there have been only a few works examining KM practices and virtual KM contributions to online performance from a corporate perspective. Moreover, the majority of these works were confined to specific industries and confined to small data samples. The goal of the current study was therefore to answer the following questions: What is the degree to which an organization engages virtual KM — in particular, technological KM practices — has a positive impact in online organizational performance? And is virtual KM, in turn, positively related to online organizational performance? With this study, we attempt to contribute to bridging the existing research gaps. We do so by presenting results from an empirical investigation based on a cross-industry survey, which covers seven European countries.

The findings shown above, as reported by respondents in the case companies, demonstrate the kinds of applications they really need or value, how KM practices are used and valued, and the ways in which virtual KM can help to achieve higher levels of online performance, considering a new set of non-financial measurements. Considering the results, we can find evidence to confirm most of the hypotheses that we formulated regarding the impact of virtual KM in online corporations’ performance. First, the data supports our conceptualisation for the KM practices construct: data gathering, information process and knowledge-sharing. Within this, all elements have a positive impact on the maximisation of KM practices. Secondly, the findings allow us to conclude that virtual KM has a positive impact on online performance, which was expected considering the existing literature on this
matter. There is no evidence of a threshold effect between the three KM practices components and online performance, something that has not been noted previously.

According to these results, the concept of virtual KM as an important e-business tool is reinforced. Thus, the relationship between virtual KM and online performance follows the positive relationship found in some earlier studies. One of the managerial contributions of this work is the discovery that managers should consider the use of virtual KM to improve everyday online processes — and should also be aware that the simple use of the KM practices is not enough to achieved higher performance levels. However, a cost–benefit analysis should be made to assess the return on the investments made in KM, since we only considered the upside of this initiative. Until KM becomes an ingrained and standard tool of e-business, the need to define measurement criteria will continue in order to support the corporate implementation and maintenance of such systems.

Further work is clearly needed to examine the interaction between virtual KM and online performance over time or in small sets of the sample. Doing so would allow us to find out if the relationship is equally strong in all countries and which contextual factors affect this relationship.

This research produces some useful insights, leaving still a number of issues for future research. One of these issues is related to the possibility of extending the study in order to consider the impact of other elements of virtual KM, such as technological readiness and management support. Similarly, this study could be expanded through the application of a panel data methodology that would determine the evolution of virtual KM contribution to online performance among European companies.

Acknowledgement

This paper is based on data provided by the European Commission and the e-Business W@tch and funding for this work is granted by FCT – CEEApla, Research Center for Applied Economics.

Appendix

Table 2: Distribution of the sample by country

<table>
<thead>
<tr>
<th></th>
<th>France</th>
<th>Germany</th>
<th>Italy</th>
<th>Spain</th>
<th>UK</th>
<th>Czech Republic</th>
<th>Poland</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food and beverages</td>
<td>80</td>
<td>80</td>
<td>86</td>
<td>82</td>
<td>75</td>
<td>85</td>
<td>83</td>
</tr>
<tr>
<td>Textile industries</td>
<td>80</td>
<td>76</td>
<td>81</td>
<td>81</td>
<td>75</td>
<td>85</td>
<td>83</td>
</tr>
<tr>
<td>Publishing and printing</td>
<td>80</td>
<td>80</td>
<td>79</td>
<td>82</td>
<td>75</td>
<td>84</td>
<td>83</td>
</tr>
<tr>
<td>Manufacture of pharmaceuticals</td>
<td>76</td>
<td>83</td>
<td>81</td>
<td>81</td>
<td>75</td>
<td>54</td>
<td>82</td>
</tr>
<tr>
<td>Manufacture of machinery</td>
<td>77</td>
<td>80</td>
<td>84</td>
<td>81</td>
<td>75</td>
<td>85</td>
<td>83</td>
</tr>
<tr>
<td>Automotive industry</td>
<td>80</td>
<td>80</td>
<td>81</td>
<td>81</td>
<td>75</td>
<td>85</td>
<td>83</td>
</tr>
<tr>
<td>Aerospace industry</td>
<td>39</td>
<td>38</td>
<td>23</td>
<td>15</td>
<td>25</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Construction</td>
<td>80</td>
<td>81</td>
<td>80</td>
<td>83</td>
<td>75</td>
<td>84</td>
<td>83</td>
</tr>
<tr>
<td>Tourism</td>
<td>80</td>
<td>80</td>
<td>82</td>
<td>82</td>
<td>76</td>
<td>84</td>
<td>83</td>
</tr>
<tr>
<td>IT services</td>
<td>78</td>
<td>80</td>
<td>82</td>
<td>82</td>
<td>75</td>
<td>84</td>
<td>84</td>
</tr>
<tr>
<td>Total</td>
<td>750</td>
<td>758</td>
<td>759</td>
<td>750</td>
<td>701</td>
<td>750</td>
<td>750</td>
</tr>
</tbody>
</table>

Table 3: Distribution of the sample by size

<table>
<thead>
<tr>
<th></th>
<th>Micro</th>
<th>Small</th>
<th>Medium</th>
<th>Big</th>
<th>NA</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>France</td>
<td>236</td>
<td>172</td>
<td>265</td>
<td>49</td>
<td>28</td>
<td>750</td>
</tr>
<tr>
<td>Germany</td>
<td>253</td>
<td>178</td>
<td>256</td>
<td>67</td>
<td>4</td>
<td>758</td>
</tr>
<tr>
<td>Italy</td>
<td>293</td>
<td>179</td>
<td>232</td>
<td>51</td>
<td>4</td>
<td>759</td>
</tr>
<tr>
<td>Spain</td>
<td>280</td>
<td>202</td>
<td>210</td>
<td>58</td>
<td>0</td>
<td>750</td>
</tr>
<tr>
<td>UK</td>
<td>249</td>
<td>183</td>
<td>228</td>
<td>41</td>
<td>0</td>
<td>701</td>
</tr>
<tr>
<td>Czech Republic</td>
<td>240</td>
<td>183</td>
<td>240</td>
<td>87</td>
<td>0</td>
<td>750</td>
</tr>
<tr>
<td>Poland</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>750</td>
<td>750</td>
<td>5218</td>
</tr>
<tr>
<td>Total</td>
<td>1551</td>
<td>1097</td>
<td>1431</td>
<td>353</td>
<td>786</td>
<td>5218</td>
</tr>
</tbody>
</table>
References


The Role of Knowledge Flow in the Thai GUIN Version of the Triple Helix Model

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Abstract: The "triple helix" model is considered as being a spiral model of innovation contributing to the country and regional improvement by fostering interactions between academic, industry and government. This model highlights the ties between the three parties at different stages in the process of knowledge capitalization and flow. Although, this model has proven to be effective in some countries, some questions remain regarding its effective implementation in Thailand. This paper presents an adapted version of the helix model that could contribute to development of ties among stakeholders through strategic alliances. The success key factors leading to an economic development mission by universities are as well discussed.

Keywords: triple helix model, knowledge capitalization, Thailand, research network, innovation, university-industry interaction, framework G-U-I-N

1. Introduction

Thailand is a developing country and as such it is encountering fierce competition due to globalization. Political plan outlined by the government, stresses the need for Thailand to balance its objectives and target toward “the Sufficiency Economy Philosophy”. One of the focuses of the country is oriented not only toward improvement of the economic structures for trade, production, and tourism but as well towards Science and Technology development advancements.

The Ministry of Science has conducted researches on factors affecting Thailand moving towards a Knowledge-based society. The following issues were identified; Although, R&D budget is specified at 0.4% of the GDP, the real figure showed that only 0.18% was spent in 2003 and 0.24% in 2005 (Krisnachinda, 2004). The figure is quite low compared to the 3.17 % of Japan or even to the 0.68% of Malaysian (IMD, 2007).

In addition, the number of researchers in Thailand is very low compared to other countries. For example, in Thailand the proportion of researchers is 5.7 for 10,000 people, compared to 44.8 in Korea, 65.5 in Taiwan, and 70.2 in Japan.

Since Thailand has invested less in R&D and lags behind other countries, some industries of Thailand have lost a significant competitive advantage towards their global competitors. Recently the Thai government has decided to invest more in R&D, and it is trying to encourage private sectors to invest more in R&D. Private sectors do recognize the needs and benefits they can gain from developing their R&D activities but the main question remains on how to do it?

One solution would be to look closely on how the Thai Government, private sectors and research institution could collaborate together in other to stimulate the Knowledge-based economic development. Among the most popular initiatives, we could mention the triple helix model developed by Etzkowitz and Leydesdorff (1995). The “triple helix” model of university, industry and government is emerging in different regions, countries at various steps of developments and with different socio-economic patterns (Etzkowitz, 2002).

University should be seen as strong actor in economical development through incubators facilities or as scientific/technological pools for Industry.

Governments can help/facilitate the relationship between University-Industry by offering collaboration incentives but also by “pressing academic institutions to make a more direct contribution to wealth...
creation” (Etzkowitz and Leydesdorff, 1995). Not only governments but also international and multinational programs (UN, OECD, World Bank, EU) do support economical developments based on this model. Government can provide mechanisms to encourage collaborative R&D among companies, research institutions and universities in order to address knowledge-based economy issues.

Etzkowitz, Dzisah, Ranga and Zhou (2007) introduced the Triple Helix Model III (Figure 1), which showed the relative interdependence of each party. This interaction enhances the best mixed functions and institutions.

**Figure 1**: Triple Helix Model

Policy makers and researchers commonly agreed on the necessity of establishing knowledge flow between academia and Industry as one of the most promising factors to strengthen economic development and to foster innovation capability (Hofer, 2004, Hofer, 2005).

Although, it is recognized that companies need to invest in in-house Research and Development (R&D) with the purpose to gain competitiveness, studies show that firms must be connected not only to the open science community but must be as well strongly engaged in research collaboration (Cockburn and Henderson, 1998, Brennenraedts et al., 2006, Sandelin, 2003).

The idea and concepts associated with university-industry partnerships are not new and it is commonly agreed that universities are an important source of new knowledge for industry (Agrawal, 2001a). In the US, some of the most prestigious universities (e.g, MIT) were established more than one century ago to support close research relationships between University and Industry (U-I) (Matkin, 1990).

The Partnership (U-I) has been considered as one of the main factors contributing to successful US innovation and growth the past two decade (Hall, 2004).

There is plethora of research studies on identifying and analyzing cultural, technical, legal and macro-organizational factors governing the success of University-Industry (U-I) collaboration (Hermans and Castiaux, 2007, Leuven and Oosterlinck, 2005, Sandelin, 2003).

success/effective R&D collaboration between university-industry is summarized in Table 1. For Starbuck (2001) collaborating successfully means doing the right thing, doing it well, rewarding success, and feeding back knowledge from the experience.

We will not describe in much more details these factors since most of them are self explanatory. As Hofer (2005) suggests it is also important to consider the motives for collaboration in order to better understand the driving forces of each party. Based on Hofer’s research (2004, 2005) the motives of knowledge transfer for universities are mainly financial and legal (based on their mission). The objectives for industries are mainly related to profits and to increase their stakeholder values (Kremic, 2003).

Table 1: Main factors affecting successful/effective U-I collaborations

<table>
<thead>
<tr>
<th>Type of research involved (basic vs., applied – technical/non-technical)</th>
<th>Different organizational structures</th>
<th>Differing time horizons of the 2 sectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staff resources available</td>
<td>Different objectives – Aligning technical and business goals</td>
<td>Institutional reward structures</td>
</tr>
<tr>
<td>Brand of university</td>
<td>Prior or current project with company competitors</td>
<td>Lack of collaborative structure</td>
</tr>
<tr>
<td>Prior industrial relationships</td>
<td>Lack of motivation</td>
<td>Handling conflicts of interests and commitment</td>
</tr>
<tr>
<td>Not knowing each others</td>
<td>Low qualifications</td>
<td>Preserving academic freedom</td>
</tr>
<tr>
<td>Not being allowed to work with each others</td>
<td>Lack of trust(s)</td>
<td>Maintaining intellectual property and confidentiality</td>
</tr>
<tr>
<td>Not wanting to work with each others</td>
<td>Different cultures</td>
<td>Dealing with financial challenges</td>
</tr>
<tr>
<td>Not being able to work with each others</td>
<td>Lack of understanding on how the counterpart organization (I or U) operates</td>
<td>Absorptive capacity</td>
</tr>
</tbody>
</table>

In order to better understand and to represent the forces driving the barriers and enablers of successful U-I relations, different models were developed.

Wang and Lu (2007) developed a strategic framework of successful knowledge transfer between U-I in China. A typology of four types of U-I interactions is represented using a 2x2 matrix. One axis represents the knowledge gap (Low or High) which refers to the degree of institutional proximity as well as the level of mutual understanding across organizational boundaries. The second axis represents the level of knowledge stickiness (Low or High) indicating the complexity and difficulties associated with the process of technology transfer (Wang and Lu, 2007) as depicted on figure 2.

Another matrix, using the same axes, describes the different modes of interactions and activities necessary for knowledge transfer and commercialization to happen based on each quadrant. This framework is interesting since it clearly highlights the fact that not all U-I interaction are the same and that based on the type of relation different approaches and strategies might need to be used in order to succeed.

Since U-I relationships are mainly based around knowledge transfer processes, some frameworks were created based on the well accepted SECI model of Nonaka (2003). The knowledge spiral of Nonaka represents the four knowledge transfers associated with tacit and explicit knowledge. Johnson and Johnston (2004) extended the original SECI model to inter-organizational context of U-I collaborative R&D projects. A sample of 25 U-I project were used to test the model. Their findings validate the fact that the SECI model can also be applied to inter-organizational U-I collaborative R&D projects but they discovered that all of the four knowledge conversions processes must be implemented to fully succeed. Hermans and Castiaux (2007) studied the applicability of the SECI model to U-I knowledge flows occurring in the specific case of U-I collaborative research projects ("exchange relationships in formal research projects undertaken by university researchers and other
university partners” (Agrawal, 2001b)). Once again the SECI model demonstrated to be an appropriate approach to represent not only intra but also inter organizational knowledge transfers.

Figure 2: Typology of U-I interaction and knowledge stickiness (Wang and Lu, 2007)

Although, the large amount of literature related to the linkage U-I, it is not obvious that the various suggested models or framework are suitable for the Thailand context. There is a still a stringent need for research to assess and understand the success factors for such partnerships in Thailand. In our research study, we focused on delineating a framework (G-U-I-N: Government, University, Industry and Networks) encompassing the main factors that could make U-I relationships more successful in Thailand. Knowledge capitalization and flow is considered as an important enabler of this framework.

The next section describes the context of study in Thailand and the adopted methodology with the aim to identify the challenges and issues related to research collaboration between Industry and universities. The last section, based on data finding and literature review, outlines a general model for a successful G-U-I-N Partnership and discusses the implication of the implementation of such model in Thailand.

2. Context of study

2.1 Background

Thai companies are currently looking for ways to remain competitive and sustainable, they are considering Research & Development (R&D) as an important activity to boost their innovative capabilities (Sumitra and Thongprasert, 1997).

Private sectors do recognize the needs and benefits they can gain from developing their R&D activities. Many innovations could not have happened without academic research outcomes (Beise and Stahl, 2004). However many issues or concerns need to be tackled carefully and especially since university – industry relationship is increasing further such for instance, difference attitude toward the Intellectual Property Right (IPR).

Krischinda (2004), conducted a study about the IPR in Thailand and highlights that although the first IP Laws were set in 1979, there is still no Government’s Law on IP partnership. Memorandums of Understandings (MOU) and project contracts are the only legal documents used for University-Industry partnership practices. These documents state the agreements about the ownership of IP assets, the sharing of work benefit, time terms, work secret practice, and permission on some
publishing or work disclosure. The latter, goes against the spirit of academics for an open science community by preventing or academic work to be published (R. Florida, 1999).

Thai universities are in a transition phase, shifting from traditional universities to modern universities. Capital and labor are no longer the main factors that drive the Thai economy; “Knowledge and Innovation” are becoming key actions in a knowledge-based economy. Thai Universities play an important role in safeguarding, producing, and distributing knowledge to the Thai society (Igel and Numprasertchai, 2003).

Thai universities are divided into two types: public and private universities. Public universities get financial support from the government, while private universities do not. Private universities depend mainly on student tuition fees. Managing a private university in Thailand is a constant challenge. The education sector in Thailand is becoming competitive not only among Thai universities but also among foreign universities. Many foreign universities, from different parts of the world, are coming to Thailand to establish collaboration with Thai universities under different forms such as exchange students and exchange faculty members. Therefore, the education cooperation among foreign universities and Thai universities is now growing.

The growth rate of the population of Thailand and the social structure are also changing. The birthrate in Thailand, like in many others countries in the world, is decreasing directly impacting the number of students getting into the university. The number of universities increasing and the number of students decreasing makes the education sector more and more competitive. In other words, universities are still running with the same fixed costs with less income resulting in administration nightmares.

Thai universities have to find new sources of incomes to survive and a closer collaboration with the private sector might be a solution for universities to generate additional revenues by capitalizing on their intellectual assets. However, it is as recognized that there are issues preventing an effective R&D collaboration between University and Industry (Igel and Numprasertchai, 2005).

In the past, faculty members in Thailand conducted researches based on their expertise without thinking about benefits or commercialization of the research outputs. Faculty members contribute their knowledge to the society for free. Thai faculty members normally distribute knowledge in an untargeted way (general target) as described in Table 2. Most of the time the research is abandoned on the shelf of the library or laboratory and it is only used for academic purpose.

**Table 2: U-I knowledge transfer adapted from Hermans and Castiaux (2007)**

<table>
<thead>
<tr>
<th>Direction</th>
<th>Distribute Knowledge to General Target</th>
<th>Distribute Knowledge to Specific Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>University ▽ Business Sector</td>
<td>University ▽ Business Sector</td>
</tr>
<tr>
<td></td>
<td>Explicit Knowledge</td>
<td>Explicit Knowledge and Tacit Knowledge</td>
</tr>
<tr>
<td>Channels</td>
<td>Magazine</td>
<td>Consulting works</td>
</tr>
<tr>
<td></td>
<td>Newspaper</td>
<td>University and Industrial Collaboration</td>
</tr>
<tr>
<td></td>
<td>Formal Meeting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Journal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conference proceedings</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Patent</td>
<td></td>
</tr>
</tbody>
</table>

Recently, the Thai Ministry of Education decided to cooperate with the Department of Industrial Promotion to promote research cooperation between universities and private sectors. They started the project by inviting private companies to propose research questions corresponding to their company needs. The second step consisted at looking for universities which had the potential to conduct research and who could answer the companies’ research questions. Two parties which belong to the government and the company will provide funding support, and the university will allow faculty members to spend time to do research. Professional proposals from foreign countries will be given a higher priority. This is the starting point in Thailand for knowledge sharing between universities-industries and research networks. Such collaboration will allow universities to switch from untargeted knowledge transfers to a targeted one, enabling interactions and dialogues between the two parties (Cf. table 2).
Thai universities are slowly starting to partner with private sectors in research project cooperation, consulting projects and practical training for students. As Davenport et al. (1999) suggested, Universities and Industries should start to work on gradually complex and demanding projects that will allow to respect cultural differences, to gain collaboration experience and more importantly to build trust. Thailand adopted such approach.

Furthermore, five years ago, the Board of Higher education of Thailand decided to make quality assurance a priority for all universities in Thailand. It defined Key Performance Indicators (KPI) to measure the quality of Thai universities. Three years ago it defined a new main KPI associated with the implementation of knowledge management. Many Thai Universities were strongly invited to implement a Knowledge Management plan. The fact that Thai universities are now implementing QA and KM makes them operate in an environment that is closer to the business world. It might also become a factor that will make industries realize that universities are becoming more open and flexible and that they might now be ready to engage into more complex and advanced collaboration and R&D projects.

The following section describes the cases study of the furniture Industry, it represents a good illustration of the incremental approach taken by Thailand. It contributed to the delineation of specific framework identifying factors hampering U-I collaboration.

3. Research methodology

3.1 Data collection

For the purpose of this research project, we selected 4 companies in the furniture industry sector and one governmental organization (the department of Trade and Industry). The four companies are family business companies and are clearly labor-intensive. They depend heavily on Thai craftsmanship and local materials such as wood, bamboo and rattan.

The empirical investigation aimed to explore the process of collaboration between companies and universities in Thailand. The purpose was to determine the factors facilitating or inhibiting such partnerships and leading to the specification of a collaborative framework. Another purpose was to understand the knowledge capitalization and flow from Academia to industry and its limitation. With the aim to comprehend such complex interactions of the U-I linkage, the adopted research methodology for collecting data was based on the combination of various approaches, such as qualitative methods encompassing in-depth interviews, and reviewing various documents from the selected organisations.

Several focused and semi-structured interviews were conducted with different managers, executive people, researchers, teachers, and policy maker. According to the respondent profile, questions were opened or closed.

The questions focused on knowledge process flow in U-I linkage, interaction level between the two institutions, outcomes exploitation, Intellectual property Right, expectation from both parties, challenges and tensions encountered while collaborating, scientific research publications, effectiveness of such partnerships, type of support provided by industry to University, expected role of the government, and so forth.

A second set of data was collected using an ethnographical approach based on a long-term observation of a group and participation in that group. This concerns more the universities with the researcher’s participation.

Finally, further data were collected by analysing a variety of documentation including scientific and technical reports, internal notes, research contracts, collaboration agreements, newsletters, Memorandum of Understanding, students internship agreement, literature reviews and so forth.

3.2 Finding and discussions

The Thai Furniture Industry is now on a decline for many reasons. Firstly, it is due to the decreasing market shares in international markets. The Thai Furniture industry is financially dependent on the international markets, and it is now facing strong competitions. The major competitors in the
international market are China and Vietnam. Thai companies cannot compete with these two major players due to the fact that these countries have lower labor cost. In addition, the Thai furniture industry has not continued to improve the quality of products and designs and it lost the high end markets to other competitors. Furthermore, Thailand does not have concrete plans to improve the quality of raw materials, especially woods.

Some large firms are suppliers of the well-known furniture chains abroad, such as IKEA, Wal-Mart, and TARGET. These large firms are able to survive in the competitive markets because they have strong relationships and long term contracts with large retailers. They produce mass products and export them with lower prices due to economy of scales. For these companies, improvement in technology and engineering processes are considered as key success factors for the business. Moreover, the large-sized firms are aware that research and development is a necessity and therefore some works in that direction are already on their way.

Medium sized companies have little possibilities to exploit this competitive advantage. Medium-sized firms are the dominating group in the furniture industry in term of number of firms in Thailand. In order to be able to compete both at national and international level, medium-size firms need to understand the rules and the issues that will allow them to gain market shares. The key success for this group is innovative product development and respect of distribution deadline. Several strategies are considered. For example, studying the need of specific groups of customers and designing customized products in order to satisfy those specific markets. Managers and owners of this type of business mentioned that even though they are aware that creating product corresponding to user’s requirement is crucial for their business, they still cannot afford to hire someone dedicated only to product design. Therefore, the only way for them to introduce new ideas of products is to provide internship options to students specialized in product design. This type of collaboration should be perceived as a win-win situation. Firms benefit from this cooperation due to lower costs compared to setting up their own R&D departments. Professors and students benefit by gaining business experiences and also by earning some additional incomes.

In addition, by strengthening such collaboration beyond a simple network connection, it should be easier to apply for some research funding support provided by some universities or governments. Considering the pole of existing expertise within Thai Universities, it is important to define more formally the mechanisms fostering collaboration between Universities and Industry.

Some current experiences clearly demonstrate the benefits of having such bilateral collaboration and cooperation. For example, if a professional Thai institution for Agricultural sectors conducts research on raw material improvements, the furniture industry will definitively benefit from it. In addition, the university could also develop specific curriculum or teaching program such as: forestry management. This type of education could fulfill partially the company’s needs in term of availability of local competences. Furthermore, government offices such as the Royal Forest Department have a long history of research. A research division focuses on developing method and technology dedicated to forestry and wildlife. Therefore, we believe that this governmental office could help universities and furniture companies to establish partnerships by sharing their own experience and by providing mechanisms enhancing such collaboration.

For the production and manufacturing processes, there are numbers of Thai Universities that have expertise area in industrial productions and that could easily provide knowledge and advice to Thai companies.

We believe as well that the Federation of Thai Industries could largely contribute to the establishment of Industry–University linkage. The Thai Furniture Association is very well aware of problems and issues encountered by SME’s. By playing the interface between universities and the national governmental body, it could easily expose these issues and promote U-I collaborations.

One important issue mentioned during the interviews of managers of SME’s furniture manufacturing is related to the lack of means to reach international markets. Since most Thai universities have affiliation with overseas universities, they could seek assistance in gaining expertise and knowledge from their foreign counterparts.
The furniture case study might look very simple but for an emerging country like Thailand it is an important stepping stone that will lead to more advanced and complex collaborative projects in various fields.

4. The G-U-I-N model

Based on our literature review and based on the needs of Thailand in term of R&D partnerships we developed the G-U-I-N (Government, University, Industry, Networks) framework depicted on Figure 3. The large horizontal arrow at the center represents the R&D relationship/partnership between University and Industry. For this relationship to start a catalyst is needed. This catalyst, in the case of Thailand, comes primarily from the Government but it some cases can also be provided by multinational programs (e.g., European Union, OECD, World bank, UN, ...). For this relationship to succeed, the objectives, goals and strategies of all parties must be aligned and some metrics of success must be defined from the beginning in order to monitor the progress and success of the relationship all along the project. If the different parties don’t trust each other the relationship cannot be effective and successful. Trust must be gradually developed and maintained all along the R&D project and it will also facilitate future project relationships. The R&D relationship will be based around knowledge discovery and knowledge transfer processes, so knowledge (tacit & explicit) must be properly managed (codified, shared, transferred, maintained, ...) that is the reason why the SECI model of Nonaka (2003) is represented at the center of the relationship between all parties. In our current competitive time and due to the inter-disciplinary nature of most of the current R&D Projects (e.g., biotechnology, alternative energy, ...) universities need to collaborate/partner with other national and/or international universities in order to cover the full spectrum of knowledge required to complete such projects. We define such linkages as research Networks.

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**Figure 3:** G-U-I-N Framework

AG: Aligned Goals, Objectives, and Strategy  
SECI: Nonaka (2003) spiraling model (Socialization, Externalization, Combination and Internalization).  
MNP: Multi-National Programs (European Union, OECD, World bank, UN, ...) sponsorships  
G: Government sponsorship  
N/I RN: National & International Research Networks (University collaborations, Research projects, Institutes, Faculty exchange program, visiting Professors, Research fellowships, Post-Doc, MOU, Joint academic programs, ...)  
EN: Enterprise Network (Partners, Suppliers, Stakeholders, Customers, Contractors, competitors (coopetition), ...)

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On the other side, industries might also need to involve their partners, suppliers, customers, contractors or even their competitors in such project. We describe this linkage as the Enterprise Network.

The interaction between all these parties cannot succeed without some key enablers. The enablers can be categorized in two groups: individual and organizational. People involved in such U-I R&D partnerships must be motivated to do and must be provided with an enabling environment to conduct fruitful research and collaboration. Based on our literature review and based on our personal experience, we believe that participants should be fully supported by their institution to participate in such projects and that they should be given as much time as required to achieve their objectives. In the case of universities, too often professors involved in such projects still have to teach or participate in various committees or administrative works which distract them for their research project. Reward (of all types, and designed based on the need of each individual) should also be implemented to encourage the various types of participants. Learning will also be an important individual factor, since people want to grow from such experience by acquiring new knowledge and skills. Last but not the least, intrinsic motives must drive the motivation of each individuals, particularly on the academic side. Forcing academics to join a research project/team, if they don’t really see a clear value/benefit from them, will end up in failure.

The enablers on the organizational side are also very important. As mentioned before, the business world and the academic world operate in completely different ways and have completely different values, beliefs and traditions. Both parties are aware of this culture differences and they need to be open and flexible enough to accept them and to take advantage of this diversity. In order to successfully engage into such “culture clash” both parties must be prepared and that’s where leadership and training play an important role. Information and Communication Technologies will enable the U-I relationships by providing supportive and collaborative tools, particularly when the different members of the various networks (University and Enterprise) might be based in different regions or countries. Finally, knowledge Management (KM) processes and practices must be implemented to capture, store, maintain and distribute knowledge associated with the R&D project. Igel and Numprasertchai (2004) conducted some initial research in Thailand regarding the role of KM in university R&D projects. Their findings show that KM helped university research organizations to manage their projects more efficiently (time, cost and quality) and to extend their potentials through close interactions with external partners.

KM can also help in term of learning from successes and failures. Best practices, lessons learned and other mechanisms can be put in place to capture the experience associated with projects so time is not wasted reinventing the wheel and mistakes are not repeated. We also think that the use of Communities of Practice (CoP) could be a valuable tool to involve all the parties described on the G-U-I-N framework. The length limitation of this paper limits us to develop in more details each aspect of the framework but it will be source of future publications.

5. Conclusion

Knowledge management is currently considered as an important strategy to move Thai universities forward and to help Thai industries to become competitive again. Universities in Thailand now are in the transition period. Most universities are shifting themselves from teaching-based universities to research-based universities. Therefore, universities are called up now to play a more active role in Knowledge-based economy.

In today’s economy, knowledge is the main source of innovation. It requires to be captured and combined with other knowledge coming from different sources (disciplines, networks, …) in order to foster innovation. Managing such processes as well as the proper knowledge transfer between the various players in U-I R&D relationships is critical. We developed a framework (G-U-I-N) that we believe includes the most important factors necessary for the successful collaboration between Universities and Industries.

The financial involvement of the firm, long term partnership condition, trust building, patents opportunities and potential valuable outcomes of the research are all conditions for a successful U-I linkage .

www.ejkm.com 295  ISSN 1479-4411
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