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THESIS

AN ANALYSIS OF SYNERGIES OF IT-APPLICATIONS AND KNOWLEDGE MANAGEMENT STRATEGIES WITH REGARD TO ORGANIZATIONAL CHANGE

by

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13. ABSTRACT (*maximum 200 words*)

The increasing complexity of political, regulatory, and technological changes confronting many commercial as well as non-profit organizations has made radical organizational change and adaptation a central research issue. Along with these research issues a new awareness with regard to organization-internal existing knowledge and the necessity to exploit and mange this knowledge to the benefits of the organization has been arising as well.

In an era of forth-coming new advanced information technologies on a nearly day-to-day basis and the increasing awareness and willingness to incorporate knowledge management strategies, organizational leaders and upper management have been craving increasingly for a beneficial combination of the latter with their efforts to implement changes successfully within their organizations.

This thesis will analyze various organizational change strategies in order to provide a clearer understanding of the impact/ influence of current IT-solutions exploiting existing knowledge within an organization to the benefits of successful organizational change efforts and strategies.

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AN ANALYSIS OF SYNERGIES OF IT-APPLICATIONS AND KNOWLEDGE MANAGEMENT STRATEGIES WITH REGARD TO ORGANIZATIONAL CHANGE

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TABLE OF CONTENTS

LIST OF FIGURES

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LIST OF TABLES

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EXECUTIVE SUMMARY

Organizational change and a new awareness with regard to organization-internal existing knowledge and the necessity to exploit and mange this knowledge to the benefits of the organization has been arising. A range of organizational change strategies available to the corporate world; and growing expense numbers of organizations do indicate the increasing demand for more advanced and sustaining information technologies.

Mutatis mutandis, superimposing IT-applications will not make any organizational change effort successful and does not provide the essential grounds for effective knowledge management per se. However, IT-applications can help capture, organize, visualize, and transfer knowledge. They should be used to store, maintain, and protect knowledge where desired or appropriate due to an organization's interest.

The following three aspects management of any organization should realize and view as key factors playing a major role in the time to come:

1. Commitment to change, even though it is a time-consuming effort.

2. Choose a change strategy and explain to employees why change is necessary.

3. Use the total knowledge base of the organization and allow time to gather this knowledge.

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I.   INTRODUCTION

A.   WHY THIS THESIS?

1.   The Problem Definition

The analysis of synergies of Information Technology (IT) applications and knowledge management (KM) strategies with regard to organizational change efforts has become an important issue for both researchers and practitioners (Davenport et al., 1996; Bhatt, 2002). The key in KM is to grasp the total knowledge base of an organization and hence make it a successful management tool. However, the problem is that management does not take advantage of the tacit knowledge residing within their organization, especially within its employees.

2.   The Solution Proposed in This Thesis

Since there are different solutions to different organizations, it is hardly possible for management to make a confining decision about the fundamentals of IT applications and knowledge management issues with regard to a chosen organizational change strategy. This thesis reflects issues of organizational change strategies in combination with an interpretation of the impact and influence of current IT-solutions exploiting existing knowledge within an organization. It will further examine whether it makes sense to distinguish between different types of knowledge and how they can be captured and made explicit. Moreover, this thesis will provide a questionnaire helping to improve the understanding of the role of tacit knowledge and identify tacit knowledge as a crucial strategic organizational asset allowing it to be made visible, i.e., explicit, to an organization.

3.   Consequences If the Problem is Not Solved

Neglecting or relegating tacit knowledge to the background of an organization will lead to the loss of a strategic asset and lead to the potential mismanagement of organizational knowledge (Polanyi, 1966; Johannessen et al., 2001). If that is the case, any organizational change effort is based only on explicit knowledge and hence will not reach the total potential of an organization's knowledge base in order to make change happen as a way to gain competitive advantage. Not allowing tacit knowledge to be an

integrative part of the total organizational knowledge base will add additional costs to organizations since tacit knowledge is an asset embedded in individuals/employees, the organizational structure and culture itself and can not be seen, hence not be used by anybody within an organization. Applications of information technologies can help extracting this type of knowledge, make it visible, and therefore turn it into a valuable asset of an organization.

If this chance is not taken seriously, vital knowledge facilitating and guaranteeing both an organizations' success and even its existence might be lost forever.

B.   BACKGROUND

The complexity of changes organizations facing today have made organizational change a central research issue of the 1990s and challenges organizations to find new resources to make these changes happen in order to gain and sustain competitive advantages (Ford and Ford, 1995; Greenwood and Hinings, 1996; Bloodgood and Salisbury, 2001; Boudreau, 2002). One key resource gaining increasing attention by management is knowledge in general (Hauer, 1999; Bhatt, 2002; Boudreau, 2002; Grupp, 2002). Both organizational knowledge and individual knowledge have been increasingly considered and emphasized by management in order to make these resources add value to their organizations.

The practice of knowledge management, however, is commonly degraded to the pure implementation of new IT-systems neglecting individual and organizational knowledge as a strategic organizational asset (Carayannis, 1998; Kautz und Thaysen, 2001). However, to fully understand how knowledge can be managed successfully and facilitate organizational change, the distinctive characters of the knowledge being managed will be specifically pointed out and referred to. The reason is that a successful change strategy has to take the total organizational knowledge base into consideration as well as to recognize how to foster it.

II.   MANAGING ORGANIZATIONAL CHANGE

A.   INTRODUCTION

Because of the inherent instabilities in the business as well as in the political environment today, many organizations often find themselves facing the need to change their mode of operation and the way they interact with each other (Bloodgood and Salisbury, 2001). The increasing complexity of political, regulatory, and technological changes confronting organizations has made organizational change and its adaptation one of the major research issues in the past decade (Argote et al., 2003; Greenwood and Hinings, 1996). Managers of all branches are facing new and persistent challenges every day. They have to move and guide their organization and simultaneously ensure their organizations' competitiveness in an increasingly competitive market.

However, one could argue, that with the help of change models and theoretical and empirically proven change strategies every manager should be able to manage change. But that is not the case. Organizational life is often more sophisticated and thus far from being able to be represented by models. So, this chapter will not describe any change models or strategies in particular; it will rather present a range of managerial issues with regard to change management in general. Managers far too often have a tendency to stick to oversimplified ideas or tools and are often led adrift by the momentum of the change originally initiated (Hafsi, 2001).

1.   The Task of Managing Change

This paper differentiates between two meanings with regard to managing change. One meaning of managing change refers to the structured and planned way of how changes are managed. Hence, the aim is to effectively implement new methods and systems in an ongoing working organization. This also implies that these changes lie within the organization's control although change-triggering events might have come from outside the organization. The meaning of change management proposed here is the

reaction/ response to change over which the organization has little or no control (e.g., legislation, social and political upheaval, actions by competitors, economic shifts) (Nichols, 2000).

Also,

> …Change management is about dealing with the busting loose from an existing orientation (Greenwood and Hinings, 1996; Johnson, 1987; Miller, 1982,1990).

However, this fact should not make one forget that in any change process the important factor is people. People are the *sine qua non* of any organization (Nichols, 2000). Moreover, they come characterized by all manner of sizes, shapes, colors, intelligence and ability levels, gender, sexual preferences, national origins, first and possibly second languages, personalities and even personal priorities. This is just a small selection of all the dimensions along which people can vary. Nevertheless, a change manager does have to deal with all of them. The two most essential qualifications are communication and interpersonal skills. The latter is found in literature also described as both cultural and social competency. People within an organization need guidance from management to understand the reasons for change. Hence, they have to be communicated to the people by management. However, this is not an easy task; management will meet resistance among its employees who do not want to accept and adapt to changes and new ways of operations within "their" company or department.

2.   Resistance to Change: A Major Challenge for Management

Resistance from people to both intentional and outside-triggered change is one of the greatest challenges a manager can face (Greenwood and Hinings, 1996). However, the prevailing nature of change is one of constant reproduction and reinforcement of existing modes of operations and organizational thought. Change is not difficult solely because of weak organizational learning (Kanter, 1983; Johnson, 1987), but because of the difficulty of mobilizing internal support (Tichy, 1983; Fombrun, 1992). In addition, Greenwood and Hinings (1996) argue that

> The rigidity of tight coupling and high structuredness produces resistance to change.

4

At the heart of change management lies the change problem, i.e., some future state to be realized, some current state to be left behind, and some structured, organized process for getting from one to the other (Nickols, 2000). However, the change problem itself might be large or small in scope and scale, affect one or more divisions or departments of an organization, and it might focus on just a few individuals or groups of people. The latter have to be on board in order to make the change effort and process a success. Weiss (2002) explains:

> There are two sides to the issue, both of which a manager must address. One has to do with the facts and background causing the change. The second one has to do with the transition – the psychological shift people have to undergo in order to make the new way work.

The key aspect is that management has to explain the change. Management has to tell people as clearly as possible why the change and what kind of change has to be made, and how and who this change will affect and when it is going to happen. This will not always provoke positive feelings among the employees; therefore, management should psychologically be prepared to meet these feelings and be able to realize and accept that some changes will not be seen positively, regardless what management says or does.

There is an important point to be made at this stage of the discussion: both the people resisting and the people accepting the change intention are the most valuable people for the change effort to become successful. The reason is that these people are the knowledge experts in their particular domain within the company and do know – even if they might not yet be aware of it– how to make this change turn out to benefit not only the organization but themselves as well.

Before this discussion takes the next step, it has to be mentioned that management should be able to reflect their own interpersonal skills in an open manner. Management will have to learn to speak Systems, Marketing, Manufacturing where appropriate, Finance, Personnel, and even Legal. Management has to learn to see things and upcoming changes in particular through the eyes of its employees as the "knowledge-carriers." This is achieved by widely communicating the need for change and getting as much feedback as possible from employees, including what they think are the current problems and what should be done to solve them (McNamara, 1999). This will help to define and state its

change/ mission goals as accurately as possible enabling employees to acknowledge and understand management's strategic vision.

3.   Change Management and Change Strategies

Change can be managed in a variety of ways, from purely top-down to highly participative (Conger et al., 1999). As Bartlett and Ghoshal (1998) point out, changing behavior does not come easily to large organizations, but is the key to achieving patterns and processes of self-renewal (Quinn and Snyder, 1999). Models about change management are limited by nature due to their incapability to reflect real life environments. This paper will use an empirical rather than a theoretical approach. Hence, the focus on parameters every organization has to cope with and make decisions about on an almost daily basis.

To begin with, people are social beings, will adhere to cultural norms, and values either established by themselves or adapted from social companions and their environment. Change itself is not only a transition between two states but is also based on redefining and reinterpreting existing norms and values within the organization. This *normative-re-educative* change management strategy cannot obscure the fact that change is also based on the exercise of authority and even the imposition of sanctions if deemed necessary; the reason might sound oversimplified, it is, however, valid: people are basically compliant and will generally do what they are told or can be made to do. In a military environment this will largely be the case. Still, this depends heavily on the type of people management is dealing with. In the German forces there are three main reasons why orders might not be given in the first place or complied with at all: an order has no official reasoning, the order would offend humanitarian rights, or thirdly offend human dignity.

The introduction of IT into an organization invariably involves organizational change, and resistance to change is commonly observed (Yap, 1989). A worker at the manufacturing line e.g. probably responds to any change efforts differently than a software developer or marketing expert. A secretary, however, might adapt to new ways of operations earlier and more easily than the department head of finance. Thus, it is important for any manager to have a good feeling and a sound level of appreciation that

6

people of different levels of intelligence as well as of intellectual performance have different ways to react to, assimilate and accommodate themselves with change intentions and efforts.

Moreover, any intentional change depends on the level of top management's commitment, the type of intervention used, people's readiness for change, the level of resistance, or the organization's culture. Producing intentional change is to be understood as developing a framework for considering change as a communication-based and communication-driven phenomenon (Ford and Ford, 1995). In this context, communication can obviously be seen as a tool for announcing and explaining change, preparing people for the positive and negative effects of the change (Jick, 1993), increasing other's understanding of and commitment to the change (Beckhard and Pritchard, 1992), and reducing confusion about and resistance to change (Kotter and Schlesinger, 1979).

Secondly, change involves the reallocation of resources such as time, money, business priorities, and manpower (Glover et al., 2002). Organizations have four primary choices in strategies for change. One is that they may only *reconfigure existing resources* already owned by the organization, and use them in a new way (Bloodgood and Salisbury, 2001). An example is a company changing its hierarchical organizational structure into a matrix structure (Schierenbeck, 1993) using the same engineers but assigning them to projects with other types of personnel such as other engineers and even non-engineering personnel. This type of organizational structure not only facilitates closer coordination between different functional areas, but also provides easier communication across departmental or divisional borders within the company. However, this kind of organizational structure needs coordination efforts for communication among teams and project groups.

Communication plays a vital role in a structured organization of any size. The structure shown in Figure 1 below is an example of how the channels of communications and interpersonal interaction could be rearranged, shortened, and improved by using a matrix structure. This kind of structure, however, needs a clear distinction between competencies and responsibilities of the different functional areas. Moreover,

management must provide useful means to facilitate and enhance ways of communication via project team building, cross-functional meetings, and IT-applications, such as shared databases and intranets. Figure 1 shows an interpretation of the matrix structure within Procter & Gamble (P&G), one of the largest manufacturers supplying grocery retailers and wholesalers with seven different product channels in 1994 (Clark, 1995). The flow of information was minimal for most channel members such as manufacturers, distributors and retail stores in the early 1990s at P&G, and mostly conducted via voice telephone, paper mail, and face-to-face communications (Clark, 1995). P&G implemented a common database for product pricing and product specification for its customers and experienced not only a reduction in invoice deduction for retailers, but also a decreasing number of billing errors, billing disputes and reduce costs throughout the entire ordering process (Clark, 1995). This case shows that organizational changes were initially seen as innovations of the currently used information systems helping to eliminate all processes that didn't deliver value to brand-loyal customers (Clark, 1995).
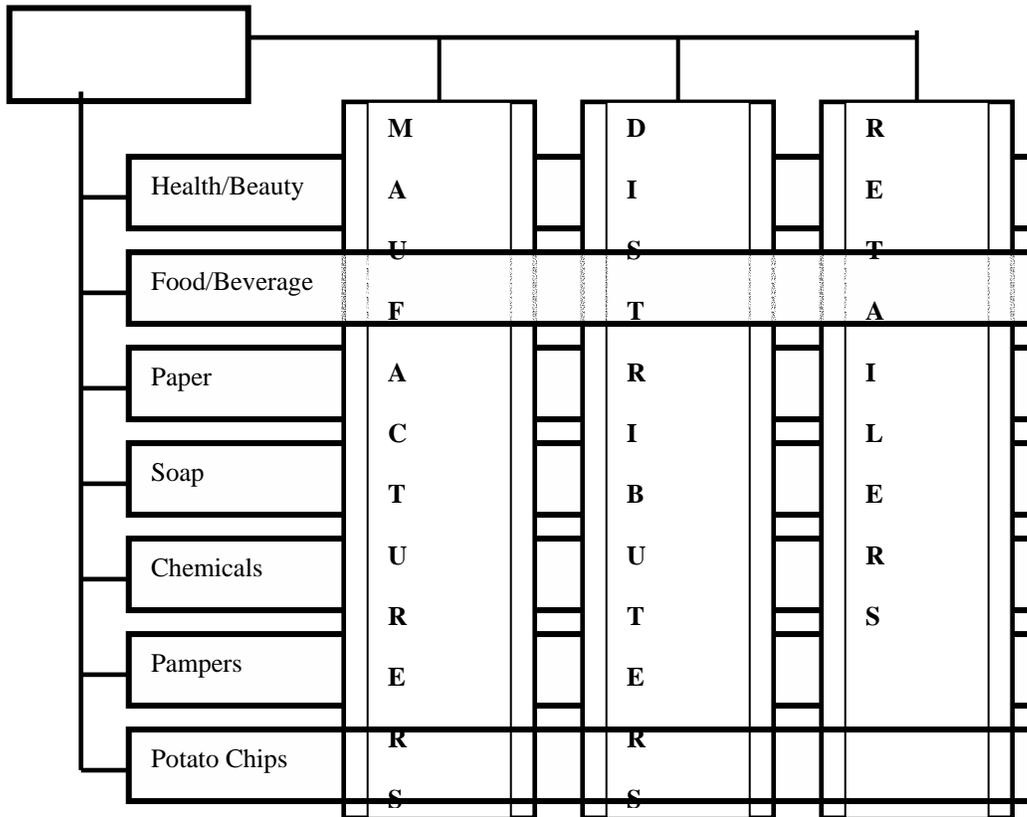
Figure 1: Interpretation of a Matrix-Organization at Procter & Gamble (Clark, 1995)

A second way for a change strategy is to *reconfigure with new resources* (Bloodgood and Salisbury, 2001). Already owned and newly acquired resources by an organization are involved in this scenario. An organization combines these resources in order to enhance the efficiency and effectiveness of current operations by purchasing new computer hardware or software upgrades and integrating them into ongoing work- and production flows (Barney, 1991). In the end, an organizational structure is reconfigured around the new mix of resources to accommodate them, while at the same time the new hardware or software is customized to the existing organization. However, there is no 'one size fits all' solution (Carayannis, 1998) of computer hardware or software. Management would have to identify the true needs of the organization using knowledge and experience from its employees and functional experts. This, again, is mainly accomplished by communication.

It seems to be a fact that superimposing technology on organizations is not the answer to cope with limited resources such as cognitive overload, intellectual bandwidth or available time. Mismatched information technologies and organizational settings have often given rise to what is termed *the information technology productivity paradox* (Brynjolfsson, 1993/94). Current productivity measures do not seem to show an impact from new computer and information technologies. While investments in information technologies have grown dramatically and probably will continue (since 1999 the rate of growth of investment in IT has fallen but it is still positive) it seems to be true that information technology does not affect productivity.

This is, however, a false paradox because both industry and society have not yet experienced the full scale of benefits and values from recent and future information technology developments as far as productivity gains are concerned. Any national economy is neither fully the old mechanized economy nor yet the new digital economy. While there seems to be little evidence of a relationship between IT and productivity, there is also little evidence that computers are unproductive. In particular, the general assumption that there must be a paradox is because adequate productivity measurements have not been found yet.

Most productivity metrics are oriented around counting things: number of employees, pounds of produced nails, or number of checks processed in a bank. As long as computers allow companies to produce more of the same product at decreasing costs, the common metrics work well. But managers' leading incentive to purchase IT hardware and software is to cut costs and increase productivity, hence a value-adding infrastructure (Brynjolfsson, 1993/94; Carayannis, 1998).

In banking for example, the quirks of productivity measurement can be seen. Automated Teller Machines (ATMs) reduced the number of checks banks process; by measures, the bank's output, and productivity decreased. However, the increases in convenience ATMs have created are not taken into consideration by conventional productivity metrics, while their costs are. At an aggregate level, banking labor productivity is measured as the ratio of an output metric to number of employees. But since the aggregate level of the true output of banks is difficult to measure, most

conventional analyses will show that labor productivity has been flat. One can easily count the costs of computer investments, but has difficulties in assessing and valuing intangible benefits, particularly those that take time to be realized; in that case IT can look like a bad investment. One major challenge for the future is to think of performance measures as a proxy for Return of Investments (ROI) instead of conventional metrics. However, unless there is no proven concept for an existing relationship between IT and productivity one might have to live with this pseudo paradox.

The simple implementation of IT-applications does not guarantee that employees will start communicating with each other because they now have this new equipment at hand. The introduction of IT into an organization is not just a matter of purchasing and installing pieces of equipment (Yap, 1989). Employees and people in general are very much influenced by their social context, even if their personal perception of this fact is quite contrary (Thomas et al., 2001).

> Employees will ignore, underuse, or even subvert the most sophisticated technology of collaboration if they do not trust and respect each other, or if there is a lack of mutual interest in common goals. The valuable potential of electronic knowledge tools can only be realized in an environment that encourages and rewards their use….(Carayannis, 1998)

Putting IT-applications into an area without examining and understanding the current business processes that a system is designed to affect is risky and can finally result in wasted resources (Barr, 2002).

Acquiring new resources without reconfiguring them is the third strategy presented here (Bloodgood and Salisbury, 2001). This strategy implies that an organization simply buys new resources (i.e., new hardware or software) and uses them as the manufacturer designed them. An organization following this approach does not focus on the use of existing and owned resources. It simply uses the newly acquired resources to gain increased efficiency and effectiveness. In the 1980s, General Motors (GM) for example bought robots for its production and assembly lines. Keeping its original organizational structure essentially unchanged, GM fully adopted the way these robots were designed to operate by their manufacturer and integrated them into their

11

existing organizational structure (Vasilash, 1998). While the mere integration of ready-to-use technology in this case might have been fairly uncomplicated, the organizational efforts to make this approach a success are greater than originally thought. People at the production and assembly line were skeptical about their new automated work environment and were not yet ready to adjust their work processes as quickly as management had hoped. Management realized it had to provide learning time and training time for its employees to accommodate the fusion of people and technology on a satisfying basis in order to make the change process successful (Vasilash, 1998).

The fourth change strategy presented here is called *business as usual* (Bloodgood and Salisbury, 2001). This strategy implies that the organization does not change its current ways of operations significantly and continues activities as they have always been practiced. This strategy, however, involves some minor changes in some operational or functional areas, but for the most part no significant material or procedural adjustments are made. This strategy may be suitable for small and economically, at least on a national scale, insignificant companies with a well-settled ring of customers in a non-technological challenging branch. Nevertheless, even the simple lack of basic computer skills can be a major drawback when trying to meet the high-technology challenges of a particular professional domain (Barr, 2002). But many times an organization also fails to change because of inertial forces acting to restrict potential adjustments (Hannan and Freeman, 1984). The we-have-done-it-always-that-way-why-should-we-change-it-now-syndrome is at least a convention. Almost everyone has met it in either his personal or professional experience. Moreover, existing stories, over time developed habits, and the "we have done it this way for years" (Lucarelli and Peters, 2001) syndrome quoted repeatedly about change management related issues form an additional barrier.

Carayannis (1998) notes that individuals and organizations alike are faced with a flow of information and data in an often-changing working environment due to increasing competitiveness on the markets. In this context IT applications can be considered as an assistant technological infrastructure capturing, filtering and organizing these streams of information and data. In connection with reorganizing an organization's way of operations internally and its way of communication with its external contacts such as

clients, customers and business partners or tenants, IT-applications themselves are not the key components to solve the issue. There is a more hidden potential in any type of organization, i.e., organizational knowledge.

4.   Knowledge as a Strategic Asset of an Organization

A resource for organizations to sustain competitive advantages is knowledge (Mascitelli, 2000; Bollinger and Smith, 2001; Bloodgood and Salisbury, 2001; Johannessen et al., 2001; Lucarelli and Peters, 2001; Bhatt, 2002). A look at the current economic situation mirrors how fast and easily products become obsolete and are replaced by new ones. Markets shift constantly and fast due to regional and global political developments as the crises in Afghanistan and Iraq after September 11th 2001 in New York City have shown. One way to ensure economic growth and competitive advantage for organizations in an increasingly competitive and globalized environment, where resources are available everywhere to almost everybody, is to create new knowledge in combination with changing the organization's structural face and current way of running business by using the appropriate mixture of IT-applications.

Knowledge and specifically organizational knowledge is to be treated by any organization as an endogenous component of future economic development. Moreover, employee-know-how and organizational knowledge are said to possess the characteristics of strategic assets (Barney, 1991; Amit and Shoemaker, 1993; Michalisin et al., 1997; Lucarelli and Peters, 2001). Bollinger and Smith (2001) are in line with this statement: they argue that knowledge is a strategic asset because it fulfils the four criteria of being a) valuable, b) rare, c) inimitable, and d) non-substitutable, hence, making knowledge a strategic asset for an organization.

Knowledge is *valuable* because both already accessible and newly created organizational knowledge result in improved products, processes, technologies, or services (Carayannis, 1999; Mascitelli, 2000; Bollinger and Smith, 2001). Employees leaving the organization take their knowledge, resources, skills, and experiences with them (Smith, 2001). Even after employing a number of experts an organization may still not gain its full potential in solving organization-wide complex problems such as organizational change (Bhatt, 2002). Therefore, knowledge is also *non-substitutable*. In

13

addition, the synergy of teams cannot be replicated representing distinctive competence, which is non-substitutable (Bollinger and Smith, 2001). Knowledge is built and dependent on prior specific organizational knowledge and experiences of current and past employees (Bollinger and Smith, 2001) and, hence, knowledge is *rare*. In the same context, knowledge is *inimitable*. No individual and no organizational group thinks or functions in identical ways (Bollinger and Smith, 2001; Thomas-Hunt et al., 2003). Each individual contributes his or her knowledge based on personal experiences and perceptions of organizational problems (Thomas-Hunt et al., 2003). Phillips (2003) and Wittenbaum (1998) argue similarly stating that

> The heterogeneity implicit in many organizational groups may clearly influence the differential contribution of knowledge by members.

The next chapter will provide a first insight into what types of knowledge are available for exploitation and how they can be extracted from within the organization in order to gain and sustain a competitive advantage and hence a solid stand in the knowledge era.

III.   KNOWLEDGE MANAGEMENT AND ORGANIZATIONAL KNOWLEDGE

A.   INTRODUCTION TO KNOWLEDGE MANAGEMENT: A DEFINITION

Knowledge Management (KM) is often seen as a means of capturing, organizing, and retrieving information, evoking notions of data mining, text clustering, databases and documents (Thomas et al., 2003). People, and managers in particular, understand KM as getting the right information to the right people at the right time. However, this perception is shortsighted. The reason is that the key to a change strategy employed by an organization to exploit organizational knowledge is the KM strategy (Sveiby, 1997; Wernerfelt, 1987). Moreover, this definition of KM provides little insight into which people are the right people.

A distinction must be made here between knowledge and information. Information is to be interpreted as factual (Saviotti, 1998), whereas knowledge establishes generalizations and correlations between variables (Saviotti, 1998). Knowledge that could be easily thought of as factual or mathematical is in fact shaped by social and cultural assumptions (Thomas et al., 2003). Knowledge is bound up with human cognition, and created, used, and disseminated in ways that are deeply interwoven with the social milieu and working environment of people.

The way people conduct their work, however, involves communication among loosely structured networks and communities of people. Understanding the work being done involves identifying the social practices and relationships operative in a particular context (Thomas et al., 2003). This is called the concept of community of practice:

> A community of practice is defined by common tasks, methods, goals, or approaches among a group of people (Wenger, 1998).[1]

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[1] A community of practice is defined by common tasks, methods, goals, or approaches among a group of people. In his work Wenger shows, the vital role that social relationships and processes play in enabling people to meet productivity targets while adhering to corporate policies. He also describes how new workers come to master a body of knowledge through a sort of apprenticeship or "legitimate peripheral participation" in the activities of a group of experienced workers.

Wenger shows in his work the vital role that social relationships and processes play in enabling people to meet productivity targets while adhering to corporate policies. He also describes how new workers come to master a body of knowledge through a sort of apprenticeship or "legitimate peripheral participation' in the activities of a group of experienced workers." For example, a newly assigned company commander or department manager is introduced and accompanied by his/her colleagues during his/her first weeks of duties hence allowing the newcomer to ask questions about terms of operations, distribution of assigned authority and organizational relationships among the various departments or units and their personnel.

> Knowledge in general has become the predominant basis for the effective utilization of many important resources (Penrose, 1959).

Managing this knowledge effectively has become essential not only to gain, but also to maintain competitive advantage (Hansen et al., 1999). However, in order to completely understand the character and facets of the knowledge being managed, management should be aware that:

> In today's enterprises often cognitive Taylorism prevails, i.e., the knowledge is very strongly carved up and must be united again. One must work against this carving up, if one wants to improve the working processes. (Englert, 2002; translated by the author of this thesis).

Many definitions are to be found about knowledge in general and organizational knowledge in particular. Examples of definitions of *knowledge* are: (a) Knowledge is organized information applicable to problem solving (Woolf, 1990). (b) Knowledge is organized and analyzed information in order to make it understandable and applicable to problem solving or decision-making (Turban, 1992). (c) Knowledge is the whole set of insights, experiences, and procedures, which are considered correct and true. Therefore, they guide the thoughts, behaviors, and communication of people (van der Spek and Spijkervet, 1997). Knowledge encompasses the implicit and explicit restrictions placed

upon entities, operations, and relationships (Sowa, 1984). Human knowledge specifically can be considered from the simple fact that:

We can know more than we can tell (Polanyi, 1966).

Knowledge is both of an intellectual and a practical kind; both the "wissen" and "können" of the Germans, or the "knowing what" and "the knowing how" of Ryle (1949) are typical examples that there is more with regard to the total knowledge base available to an organization.

In this context, *organizational knowledge* is often seen as the sum of human-centered assets, intellectual property assets, data infrastructure, and market assets (Brooking, 1996). Organizational knowledge is processed information embedded in routines and processes enabling action. However, it is also knowledge captured by the organization's systems, processes, products, rules, and culture (Myers, 1996). Another more practically oriented definition of organizational knowledge is ingrained in most traditions of Western Management: any organization is a machine for 'information processing' (Nonaka, 1998). According to this view, the only useful knowledge is formal and systematic, i.e., hard data and unified principles. However, there is more useful and valuable organizational knowledge to exploit than merely the explicit part, viz. tacit knowledge (Johannessen et al., 2001; Thomas et al., 2001).

In the following, a more distinctive differentiation will be made with regard to the types of knowledge available to an organization for exploitation. The question what role each type plays and how IT-application(s) can help capturing, analyzing, and finally making them available to the organization is taken into closer consideration as well as the question, how any KM-strategy is to be favored with regard to organizational change needs.

B.   A DISTINCTION BETWEEN TACIT AND EXPLICIT KNOWLEDGE

Information can be considered as tangible and usually can be easily transferred (Lucarelli, 2001). Knowledge, in contrast, is intangible (Lucarelli, 2001). A number of authors have proposed knowledge typologies such as Carayannis (1998), Johannessen et al. (2001), Lucarelli (2001), Nonaka (1998a) and Polanyi (1966). However, the most

common distinction between knowledge types is the one between tacit and explicit. Both terms have to be considered as part of a whole, the total knowledge base of an organization.

Any organization owns not only data and information explicitly stored on different media, but also contains information which can be turned into explicit and hence beneficial knowledge. This is called tacit knowledge. The two open questions what tacit and explicit knowledge actually are and how both types can be explored to help succeed an organizational change effort are to be answered next. Also, the thought about how modern IT-applications might be able to enhance the harnessing of tacit and explicit knowledge will be taken into closer consideration.

The first of the two most common classifications of the total knowledge base is *explicit knowledge* that can be relatively easily described by means of symbols such as numbers, letters, and hence can be digitalized (Nonaka, 1998). Explicit knowledge can easily be stored and retrieved from files or documents, forwarded by hand, orally, or electronically, copied or hidden. Explicit knowledge is almost always readily accessible, as well as documented into formal knowledge sources that are often well organized (Carayannis, 1998). Moreover, explicit knowledge can be transferred form one location or person to another at relatively low cost (Nelson and Romer, 1996; Spender and Grant, 1996), which at the same time implies one major drawback: explicit knowledge is inherently easy to imitate and replicate. If this is true, explicit knowledge cannot be considered and remain as a key factor for organizations to gain competitive advantage. Hence, the appropriability of returns from this type of knowledge is limited by spillovers into the public domain (Mascitelli, 2001). This fact includes the paradox of 'knowledge channels' as well, since channels can enhance learning within organizations on the one side, but can be appropriated by outsiders on the other side as well (van Meijl and van Tongeren, 1999). Since explicit knowledge is most of the time formal and systematic (Nonaka, 1998), it can be easily communicated and shared; examples are product specifications, a scientific formula, a computer program, a conversation, or any other operational connotation or media.

Tacit knowledge is difficult to describe (Polanyi, 1966). A range of definitions might give some closer insight into its meaning. First of all, tacit knowledge is highly personal (Polanyi, 1966), difficult to formalize and hence difficult to communicate to others. Secondly, tacit knowledge is enclosed in action, linked to concrete contexts and is difficult to digitize (Johannessen et al., 20019). Howells (1996) defines tacit knowledge as follows:

> Tacit knowledge is non-codified, disembodied know-how that is acquired via the informal take-up of learned behavior and procedures… tacit knowledge does not involve the generation and acquisition of tangible products and processes, or the more formal element of intangible knowledge flows associated with specific research, technical or training programs.

One cannot grasp tacit knowledge but can only experience it. Fleck (1996) describes tacit knowledge as a subtle level of understanding often difficult to put into words, a trained recognition and perception, a good feeling for the technology. Tacit knowledge is an intrinsic part of the individuals' mental make-up, is very hard to either get hold onto or even imitate and is deeply rooted in action and an individual's commitment to and in a specific context. Nonaka (1998) takes an empirical approach by describing tacit knowledge as partly consisting of technical skills – The kind of informal, hard-to-pin-down skills captured in the term "know-how."

Ryle (1949), and Nonaka and Teece (2001) called this "knowing how." They argue, that 'knowing how' is learned by practicing, i.e., by doing things. Inevitably, such knowledge is therefore often characterized as merely practical knowledge, based on the assumption that it is inferior to the theoretical kind. "Thinking" is a kind of doing and differentiating between "knowing how" and "knowing what" does not support a simple separation between practice and theory. In summary, tacit knowledge can be described as the unknown wisdom, an individual's "sleeping intuition" triggered off when good judgment is needed in a specific situation and it is known as "common sense."

Nevertheless, knowledge is seldom completely tacit, or completely explicit. In most cases, a piece of knowledge can be placed between these two extremes of being

tacit or completely explicit (Saviotti, 1998). However, knowledge is always at least tacit in the minds of those who create it. The process of codification, i.e. making a piece of knowledge explicit, is required, because knowledge creation as such is a collective enterprise requiring communication between individuals.

Traditionally, knowledge can be considered a public good because it is impossible for its creator to prevent it from being used by an economic subject who is not willing to pay anything for it (Schierenbeck, 1993). However, no one could use even a completely codified piece of knowledge at zero cost. It is only possible if the economic subject knows the code for it. Reducing the cost of communication is then to be considered as important as the fact that both the transmitter as well as the recipient need to be able to speak the same "language."

Although the tacit knowledge of each individual is personal and unique, employees can absorb much of the expertise of others through socialization, apprenticeship, and collaboration (Dutta, 1997). The core of all these types of social interactions, however, heavily depends on the communication skills on both sides, the subject matter experts and their peers. Nevertheless, tacitness can be harmful (Boudreau, 2002a) when one restricts the desired knowledge flows between individuals, groups, or even organizations although difficult for competitors to copy.

Moreover, it seems to be a fact that knowledge does not flow easily within organizations. Barriers exist between departments and divisions, between inside and outside, and even between individuals. Socially connected and socially isolated members within an organizational group use different mechanisms to achieve and maintain acceptance within the group (Thomas-Hunt et al., 2003), attenuating their willingness to share uniquely possessed knowledge. Knowledge is not exchanged freely among individuals possessing different characteristics, experiences and values (Thomas-Hunt et al., 2003; Thomas-Hunt and Gruenfeld, 1998).

Many knowledge-based accounts oversimplify the internal structure of a firm and underestimate its internal diversity when it comes to the ability of adding value to an organization by organizing knowledge (Brown and Duguid, 2001). No organization is a unitary 'knowledge entity or system.' If that were the case, the knowledge flow would

meet with no obstacles. However, literature about organizational knowledge flow is full of laments about the difficulties of moving insights from one department to another, e.g., from customer service to sales, from line management to staff, from top to bottom and vice versa. When it comes to change management, most organizations meet communication difficulties among peers and across functional borders within their own developed organizational structure.

In conducting business, it is difficult to avoid changes imposed by external forces such as political turmoil (Glover, 2002), regional and global competition, industrial consolidations and mergers and continuously emerging new technological developments Weiss, 2002). Downsizing, rightsizing, re-engineering, and outsourcing of functional areas of support functions or areas of operations demand management to take charge and control change. Since resistance to change can easily be used as an excuse for failure rather than a motive force for success, the key to successfully managing change crystallizing out is knowing how to listen and respond – i.e., how to communicate.

Changes in organizations may be expected to trigger off additional, unplanned changes in other areas. This involves an entirely new set of decision makers, and employees being affected will have to follow the ongoing change process through the stages of already established conversational developments. In a successful conversation for understanding, however, the participants are supposed to determine and learn what the change process is supposed to produce and what actions are appropriate to make it happen. Within this conversation, the participants will use the total knowledge base of the social group even if not consciously. This leads to the following question why tacit knowledge plays a critical role in the change process.

As in fact many organizations of all branches seem to invest in new technologies, the same new IT-applications are limited to the transfer of explicit knowledge. This may relegate tacit knowledge to the background, in spite of its strategic importance (Johannessen et al., 2001) leading to the mismanagement of the total knowledge base itself. Since organizational knowledge in general has become the most critical resource

21

for companies and organizations alike, it is increasingly important for management to improve the understanding of both the meaning and role of tacit knowledge within an organization.

1. The Strategic Importance of Tacit Knowledge for Organizational Change

From an organizational view, tacit knowledge stored in the employees' heads is only one part of the whole knowledge base. In addition, knowledge often lies not with individuals, but is distributed among an ensemble of people working together (Nonaka & Teece, 2001). Thus, social groupings such as communities of practice and project teams can merge the tacit content of their members into a powerful source for breakthrough innovations. The ability of organizations to form such knowledge-sharing groups may be more important to long-term competitive advantage than the most commercially successful innovations (Mascitelli, 1999) as the example of P&G has shown above. A second example is NP, a small Danish Software Development Company, having a high degree of internal communication and social interaction, also outside office hours (Kautz and Thaysen, 2001). The case of NP shows that IT may provide direct assistance for acquisition, distribution, and storage of information, but in terms of practical and social knowledge can only implicitly support the processes and circumstances enabling knowledge creation and sharing among employees (Kautz and Thaysen, 2001). It is a knowledge facilitator but not a knowledge creator.

A method called "Aufgabenbezogener Informationsaustausch," or AI, meaning task-oriented exchange of information, was developed under the former head of state of the former German Democratic Republic, Erich Honecker, in the early 80s (Englert 2003). Scientists of the Psychological Institute at the Technical University of Dresden reencountered this method when searching for a strategy suitable for work process optimization. They concluded after various surveys and tests within companies of AI that if employees get a serious chance to exchange work experiences with their colleagues on a regular basis led by an independent (sometimes external) moderator, performance, motivation and job satisfaction as well as the relationship with the organization itself increase (Englert, 2003). They state that these discussion groups are more successful in

transferring tacit knowledge if group members come from different functional areas, management, and work levels. As such, the widespread organizational knowledge (called "cognitive Taylorism"(Englert, 2003)) can be brought together enabling the optimization of change processes needed for optimizing work processes. Having said this, the competitive advantage of organizations rests as well on the possession and exploitation of the newly gained knowledge and not only on its differential ability to transform it into economic results (Saviotti, 1998).

The intractable nature of tacit knowledge and the fact that it is difficult and even costly to transfer holds the seeds of a powerful strategic advantage for organizations and companies. The long-term benefits derived from increasing an organization's tacit knowledge base, could therefore be seen as almost perfectly excludable from rivals (Saviotti, 1998). Unfortunately, many times the possessor of the tacit knowledge is unaware of its existence, due to its implicit nature (Bloodgood and Salisbury, 2001). Hence, the management of this type of knowledge is difficult to process within an organization given the fact that it is also difficult to express it explicitly to others.

Examples of tacit knowledge include implicit organizational routines (Nelson and Winter, 1982) such as those used for creating new product designs, marketing or competitive strategies, contingency plans, or the current way of operations in an organization. These routines are generally not codified; rather they occur through institutionalized interactions taking place within the organization or company. These interactions between individuals, groups of people, departments, divisions, and even different organizational entities only slowly enable any change strategy to progress, sometimes without the conscious awareness of the change manager himself.

Polanyi (1966) argues that the portion of individual knowledge that is readily accessible to us is only a small fraction of our total knowledge base. Consequently, the knowledge that can be easily expressed, written down, transferred verbally or in other explicit forms is only the tip of the intellectual iceberg. Hence, individuals process the majority of the total knowledge base largely unconsciously. The entire process of any performance, from the decoding of any explicit knowledge to the delicate adjustments of

physical or mental craftsmanship is accomplished below the level of consciousness. Only through years of practice a novice might be able to master any instrument or skill close to perfection.

It is this tacit knowledge enabling organizations to deal with organizational change; the challenge, however, for organizations is to make this type of knowledge at the personal level explicit at the organizational level in order to ensure collective reflection. In this way management can gain information necessary for a change effort to succeed. As people are the *sine qua non* of any organization, so is their total knowledge base, which exists mostly in a tacit form. Although tacit knowledge "on its own" does not produce helpful innovations and ideas (Johannessen et al, 2001) with regard to organizational change efforts, the entire knowledge base, the tacit part included, for the individual company is developed in a social and cultural context. Sweeny (1996) argues:

> In the past, organizational innovation tended to be the force driving technological and social change. The indications are that social forces will determine technological and organizational change in the long wave.

Achieving organizational change is to be understood as developing a framework for considering change as a communication-based and communication-driven phenomenon. Change does not follow a well-defined path (Jick, 1991) and only rarely an organization knows exactly where it is going and how to get there. Since change implicates the alteration in the nature of the relationship between organizational elements and people (Glover et al, 2002), it is these people and their knowledge that has to be taken into consideration when organizational changes are about to be introduced and implemented.

However, most companies have failed to grasp a basic truth: continuous improvement and that change involves continuous learning (Ayas, 1996). This learning process does not happen naturally and must be managed carefully. Although one might argue that it also requires commitment and continuous investment of resources—even if a return on investment is not evident and the price of learning is considered being too

high—it must be compared with the cost of ignorance. The latter can be demonstrated by repeating old practices that lead to repeated failures.

Most of the organization's knowledge lies in the tacit knowledge carried in the heads of its members (Ayas, 1996; Nonaka, 1998). Favorable change outcomes are correlated with the degree to which managers' decisions and actions take the organizational context and the behavior of people into consideration (Hafsi, 2001). Management must balance these to avoid the 'drift to trivia.' Values as they become part of an organization's identity give shape to its behavior, constituting the organization's identity, and providing it with a distinctive character (Ayas, 1996). For example, at Hydro-Québec, a major utility owned by the Government of Québec, facing a long change process form 1973 until 1996, a long-term study found out that:

> The sheer "logical" power of formulating change strategies pushes away any other "non-logical" considerations, thus forcing the search for position at the expense of both organizational dynamics and of people in the community. (Hafsi, 2001)

Both an established organizational identity and a set of values can form a barrier to change if not taken into consideration by management and hence,

> …leads to a false sense of intellectual superiority which closes the mind of many to the powers and the merits of others, either of inferior formal education or of education in other fields. This produces a kind of conceit. It leads to a serious misjudgment of the importance of personal experience and of deliberately acquiring it. …Many men have a hard time discovering that mental skill is often a superior substitute for mental toil, though they see this perfectly as non-physical work. (Barnard, 1936)

The close connection between people's tacit knowledge and their behavior can be explained by the fact that people are not only affected by the hard configuration of resources, structural arrangements, and organizational goals, but largely by unseen, taken for granted social processes, values and norms, and leadership styles.

The social interaction between individuals is the vehicle to make tacit knowledge explicit and visible. Throughout an organization it enables members to feel part of a

whole subject to change. Individuals are the only raw material for a so-called 'learning capacity', since organizations ultimately learn via their individual members. Management support as well as top-down pressure is essential for both the implementation of any organizational change and the commitment of learning.

In summary, the human based knowledge potential, specifically the intractable nature of tacit knowledge, are great challenges for management to get hold onto and harness them for the benefits of organizational change efforts. However, change creates opportunities for those who are prepared to innovate (Parden, 2001). Age, position, or rank is no longer a limiting factor for personal achievement. Management has become aware that change occurs more smoothly, when not only the right incentives are put in place, but also when it appreciates that tacit knowledge and intuitively understood ideas are made explicit to everyone involved in the change process.

2. Characteristics about Articulable and Non-Articulable Tacit Knowledge

The emphasis on tacit knowledge as a strategic competitive factor has emerged along with the increasing globalization (Thurow, 1997; Argote et al., 2003; Argote and Ingram, 2000; Helfat 2000) and hyper-competition (D'Aveni, 1994) in the economy. The knowledge theory (Grant, 1996; Argote et al., 2003) and the dynamic capability approach (Barney, 1991; Busch et al, 2003; Grant, 1996; Penrose, 1959; Teece, 1984) have described parts of its development. Still, there hasn't been developed a generally binding theory about tacit knowledge, its components, and its impact on the total knowledge base.

Although tacit knowledge developed in social and cultural contexts (Johannsen et al., 2001) is far less known than codified or explicit knowledge (Busch et al, 2003), and is difficult to measure (Boudreau, 2002b; Schneider, 2003), attempts have been made to quantify it (Boudreau, 2002a; Busch et al., 2003; Saviotti, 1998). Sternberg (1997) provides an additional differentiation about tacit knowledge. He considers it to comprise the following attributes:

> *First*, tacit knowledge is procedural in nature. *Second*, tacit knowledge is relevant to the attainment of goals people value. *Third*, tacit knowledge is acquired with little help from others. Knowledge containing these three properties is called tacit because it often must be inferred from

actions or statements…the intention or content of the tacit knowledge concept is not fully captured by the meaning of the lexical item tacit. Tacit knowledge is typically implied rather than stated explicitly – but there is more to the tacit knowledge concept than this most salient feature.

Realizing that a significant portion of the knowledge needed to complete organizational tasks is distributed across many individuals within an organization (Argote and Ingram, 2000) individuals in organizations are increasingly relying on teams as a mechanism for channeling individual members' knowledge into productive organizational outcomes (Lipnak and Stamps, 1993). Hence, organizational teams must be able to capitalize on their members' resources (Thomas-Hunt et al., 2003) by accurately capturing, weighing, and incorporating the task-relevant knowledge of members (Henry, 1995; Littlepage et al., 1997). However, the members' knowledge base consists of both articulable and non-articulable knowledge.

a.   *Articulable Tacit Knowledge*

Tacit knowledge has cognitive dimensions such as mental models, beliefs and perspectives (Nonaka, 1998) and therefore cannot be formulated in instructions, manuals or in databases and cannot be transferred via email, intranet, or Internet (Johannessen et al., 2001). Capturing tacit knowledge is a fundamental requirement of an effective knowledge management program (Casonato and Harris, 1999). However, capturing tacit knowledge remains a difficult task (Busch et al., 2003; Casonato and Harris, 1999; Nonaka, 1995). Whilst tacit knowledge is not explicit by nature, this does not mean that it is non-articulable in its entirety. Tacit knowledge can be codified over time (Busch et al., 2003; Polanyi, 1983).

In order to formalize tacit knowledge in general terms as in Weber's (1997) work into the ontology of information systems in general, articulable tacit knowledge (aTK) is part of the total tacit knowledge (tTK):

$$aTK \subseteq tTK$$

Moreover, both articulable and non-articulable tacit knowledge (nTK) are part of the tTK (Busch et al., 2003). Examples of articulable tacit knowledge are: know

27

how, culture, externalization, understanding, practice, face to face transfer, perception, common sense, imitation, observation, wisdom (Busch et al., 2003; Johannessen et al., 2001; Nonaka, 1998; Polanyi, 1983;Saviotti, 1997). These examples focus on making tacit knowledge explicit within teams experiencing a high level of organizational learning (Johannessen et al., 2001; Sorenson, 2003). This implies the need to create the foundation for trust (Boudreau, 2002) within the team and increasing team members' willingness to share their knowledge without the fear of losing ownership. However, groups often fail to maximize the contribution of all members (Stasser and Stewart, 1992).

At a private Midwestern university a study with 111 undergraduate students majoring in either engineering or business revealed that socially connected team members focus more on contributing the knowledge, possessed in common with those whom they are socially connected with, rather than sharing the knowledge they themselves uniquely possess (Thomas-Hunt et al., 2003). In other words, the socially connected team members are abridging their contribution. At the same time, socially isolated members participated more in discussions and expressed greater unique knowledge emphasis than socially connected team members (Thomas-Hunt et al., 2003). Hence, these people contribute more of their personal articulable tacit knowledge than socially connected team members. Schneider (1999) argues that more resources should be invested in the increase of the emotional intelligence of decision makers. Relying on formalized knowledge; e.g., numbers, a management's prime way to reduce complexity by taking refuge to data and thus depriving the organization of the richness of tacit knowledge.

This single study helps to realize that willingness to share information is not enough and that personal discomfort can prevent the free flow of articulating tacit knowledge between team members in an organization. This psychological bottleneck can have a similar impact on the successful extraction of non-articulable tacit knowledge for the benefit of organizational change efforts.

b.   *Non-Articulable Tacit Knowledge*

Parden (2001) argues that social interaction is an expression of the willingness to share knowledge and a facet of the coalition attitude necessary for full

participation in collaborative activities such as organizational teams. When it comes to the second part of an individual's total tacit knowledge - the non-articulable tacit knowledge (nTK) – Busch et al. (2003) have identified examples of what they consider as *in*articulable tacit knowledge: skill, experience, intuition, mental model, knowing, practical intelligence, non-awareness, emotion, know more than we can tell, insight etc. (Busch et al., 2003; Johannessen et al., 2001; Nonaka, 1998; Polanyi, 1966; Polanyi, 1983; Saviotti, 1997). Non-articulable tacit knowledge (nTK) is like articulable tacit knowledge (aTK) part of an individual's total tacit knowledge (tTK) is:

$$nTK \subseteq tTK$$

The total tacit knowledge is then represented by the sum of both articulable and non-articulable tacit knowledge:

$$\{aTK \cup nTK\} \subset tTK$$

The total knowledge base (tKB), however, consists not only of the total tacit knowledge (tTK), but also of the total explicit knowledge (tEK). The latter consists of forms of electronic and non-electronic documentation, written instructions, manuals, books, paper files and so on. Busch et al. (2003) call this aggregation of different explicit knowledge types *data*.

Both tTK and tEK comprise subsets of the tKB:

$$\{tTK \cup tEK\} \subset tKB$$

It is easy to transfer explicit knowledge between business units (Bresman et al., 1999; Johannessen et al., 2001; Mascitelli, 2000). In order to have the total tacit knowledge explicit, Nonaka (1995) argues:

Organizational knowledge is created through a continuous dialogue between tacit and explicit knowledge.

Organizational knowledge, including both parts, tacit and explicit knowledge, is developed in a social and cultural context (Johannessen et al., (2001) and social forces will determine technological and organizational change (Sweeny, 1996; Johannessen et al., 2001). Nonaka (1995) sees tacit knowledge embodied in the meeting

between individuals and the culture they belong to. Individuals communicate their knowledge and experience to their peers and unconsciously make use of their total tacit knowledge. In addition, tacit knowledge cannot be studied without regard to the explicit part of the total knowledge base (Johannessen et al., 2001). Senker and Faulkner (1992) underline this view. Hence, when tacit knowledge is made explicit it should be subject to collective reflection within an organizational team. A remaining question is what unique factors are making tacit knowledge different from explicit knowledge? Stamper (1998) argues that the factors that make tacit knowledge unique are

> …essentially the 'emergent factors' of sense and meaning. They are part of the pragmatic level: usage by us, and the social level: understanding by us, the users.

Sense in this context means, that people need to develop a feeling for the need (i.e., the pragmatic level) and have to grasp the meaning (i.e. the social level) of tacit knowledge. Busch et al. (2003) argue that it is Stamper's *sense* and *meaning*, applied by individuals in interpreting the information they are given, which forms a missing component of tacit knowledge. Nevertheless, not all sense and meaning can be articulated. The way people interpret given or observed information is dependent and centered on their individual viewpoint and personal perceptions of an environment. However, ideas and knowledge carry a maximum impact on the successful organizational learning effort when they are shared broadly rather than held in a few hands (Garvin, 1998) thus cultivating the art of open, attentive listening. Polany (1966) calls the phenomenon of exploiting as yet non-articulated knowledge *tacit foreknowledge*. This is true with yet undiscovered solutions and ideas. He states:

> …That the Copernicans, against heavy pressure, passionately maintained during one hundred and forty years before Newton proved the point, that the heliocentric theory was not merely a convenient way of computing the paths of planets, but was in fact true!

However, tacit knowledge needs to be made explicit (Johannessen et al., 2001) and made measurable in order to support management's decisions about human capital and other economic resources such as money, time, and material assets (Boudreau, 2002).

In summary, the human knowledge potential in its tacit and explicit forms, finally realized by managers (Parden, 2001) in combination with the impetus of increasing regional and global competition (Bloodgood and Salisbury, 2001; Boudreau, 2002; Bresman et al., 1999; Mascitelli, 2000) and rapid technological changes (Johannessen et al., 2001; Lucarelli and Peters, 2001; Saviotti, 1997), has been widely identified as the sine qua non and the most critical resource guaranteeing future economic growth (Bresman et al., 1999). Despite growing evidence that most of the economically valuable knowledge is predominantly tacit (Jones and Jordan, 1998), it is a rare company that encourages active knowledge sharing among its employees (Brown, 1991; Fahey and Prusak, 1998). The same statement is valid for individuals as well (Thomas-Hunt et al., 2003). However, unlike production-based activities, where almost all specifications and breakdown of activities are predefined in detail, knowledge gathering and sharing are often unstructured and not laid out in all detail (Bhatt, 2002). Therefore, the outcome of such knowledge activities is uncertain, because both are an informal and social process (Johannessen et al., 2001; Kautz and Thaysen, 2001; Bhatt, 2002; Thomas-Hunt et al., 2003).

At the same time strategic change, knowledge, knowledge management strategies, and information technology are substantially interwoven (Bloodgood and Salisbury, 2001). Referring to information technology in terms of its use as a repository of codified or explicit knowledge (Hansen et al., 1999) and of its use as a facilitator for communication networks within and between organizations it focuses primarily on creating operational efficiency (Hammer and Champy, 1993). Mismanagement of information technology is therefore due to a lack of understanding of tacit knowledge and the relationship between tacit knowledge and information technologies (Bresman et al., 1999; Johannessen et al., 2001).

Tacit knowledge might be as real as explicit knowledge (Johannessen et al., 2001), but the process to acquire it for the benefit of a change process still lacks a universal approach to multi-disciplinary knowledge measures (Boudreau, 2003). For Polanyi (1958), however, tacit knowing is the dominant principle of all knowledge. Next, the focus will be on a possible way to convert tacit knowledge into a practicably usable, i.e., visible, managerial format with the help of information technology. Traditionally, this link between tacit knowledge and IT has not yet been explained and made concrete (Nonaka and Takeuchi, 1995; Stewart, 1997; Stehr, 1994).

Knowledge elicitation had its formal beginnings in the mid to late 1980s in the context of knowledge engineering for expert systems (Cooke, 1999). The cognitive complexity of jobs (Howell and Cooke, 1989), the interest in creating artificial intelligence in machines and the growing specialization of the workforce (Feigenbaum, 1989) are constant initiators for finding new ways of transferring knowledge between individuals in an organization.

3.   IT-applications and Tacit Knowledge Capture and Transfer

There is no simple one-size-fits-all solution when it comes to the question what kind of IT-application is to be favored in order to capture the tacit part of organizational knowledge (Bollinger and Smith, 2001; Carayannis, 1998; Thomas et al., 2001). Therefore, it is important to know how information technology (IT) can interact with this special type of knowledge and how IT can help to make it visible.

Carayannis (1999) notes the need to focus on the role of IT in reasoning, interpretation, and decision-making. Historically, information technology has had the net effect of making knowledge more explicit (Bloodgood and Salisbury, 2001). The reason is that IT facilitates rapid transmission of explicit knowledge (e.g., by the use of email and web pages), supports decision-making procedures, or helps to codify knowledge (e.g., through the use of an expert system). Explicit knowledge can be handled more easily with IT (Bloodgood and Salisbury, 2001; Mascitelli, 2000), however, Kogut and Zander (1992) conclude that one of an organization's abilities to transform any type of knowledge is a justification for its very existence:

> …What firms do better than markets is the sharing and the transfer of the knowledge of the individuals and groups within an organization…What is central to our argument is that knowledge is held by individuals, but is also expressed in regularities by which members cooperate in a social community.

However, even if a social community following established regularities is to be considered intact as outlined by Kogut and Zander (1992), it is not a guarantee for making the tacit part of the organizational knowledge visible, since the heterogeneity implicit in most organizational groups may clearly influence the differential contribution of knowledge by members (Larson et al., 1996; Phillips 2003; Thomas-Hunt et al., 2003; Wittenbaum 1998; Wittenbaum 2000). Individuals will not participate willingly in knowledge exchange until they share a sense of identity or belonging with their colleagues (Bresman et al., 1999). Stasser et al. (1992) even argue that:

> …Information sharing failures may, in part, be explained by group members' propensity to introduce and consider commonly held information at the expense of exchanging and considering information uniquely possessed by members.

Both Littlepage et al. (1997) and Thomas-Hunt et al. (2003) agree with this statement. They both further point out that the extent to which an organizational team acquires knowledge of its members' expertise affects the group performance and hence the success of an organization. Realizing that interpersonal contact and socialization (Nonaka, 1998a) are the key to exchanging valuable tacit and explicit knowledge within an organizational group Mascitelli (2000) finds:

> …The first technique for unleashing the creative potential of tacit knowledge is for managers to elicit the deep emotional commitment of employees to the innovation process. Once that commitment has been secured, it is incumbent on managers to facilitate the flow of tacit knowledge into commercially valuable forms…by emphasizing the interaction between design- team members…and encouraging intimate socialization among team members that can facilitate knowledge-sharing and improvisation.

However, individuals in such teams must often collaborate across functional, hierarchical, regional, and even international boundaries (Thomas-Hunt and Gruenfeld, 1998). As organizations have increasingly come to rely on team structures (Thomas-Hunt et al., 2003) management expected that knowledge exchanges would freely occur between individuals despite having different characteristics, different levels of experience and different values (Bresman et al., 1999; Mascitelli, 2000). But this is not always the case. Thomas-Hunt et al. (2003) conclude from their empirical study at the private Midwestern university mentioned earlier, that acknowledged experts participate more in-group discussions and emphasize both shared knowledge and others' unique knowledge significantly more than non-experts. These experts even assume responsibility for managing the information of the group, focusing on aggregating and emphasizing both shared and unique knowledge. This conforms to the findings of Katz and Benjamin (1960) who found that

> An acknowledged task related expert status often leads to greater levels of participation and contribution to the group.

However, the study by Thomas-Hunt et al. (2003) did not show how this knowledge can be made visible to group members. At this point, the aggregation of the reviewed literature concludes, that communication and perception skills of team members play a vital role in this effort as well as social ties and members' status within an organizational task group. Moreover, communication is the generative mechanism of change that gives people the reality in which they live (Giddens, 1984) and not simply a tool for representing and transmitting people's understanding or knowledge (Ford & Ford, 1995).

4.   Tacit Knowledge and the Limitations of Information Technology

Information technology can be considered as embodying two general capabilities: *codifying knowledge* and *creating networks* (Bloodgood and Salisbury, 2001; Hansen et al., 1999). Some knowledge can be made explicit by codifying it in a decision support system or an expert system. A subject matter expert for example can be interviewed about his/her domain of expertise and the answers can be made visible to anybody

seeking information about the same domain of interest. Consequently, the second general capability of an IT system is helping to keep track of people and their particular domain of expertise (Bloodgood and Salisbury, 2001). At the same time, IT can enable easy communication between these experts and reduce resources such as transfer time and costs (Bresman et al., 1999; Johannessen et al., 2001).

Although this approach to knowledge management seems to be useful, it still enables some knowledge to remain tacit, since IT only allows access to explicit knowledge within an organization. In the same context, Lee (1994) points out that electronic mail filters out important cues such as body language and tone of voice. He further argues that unlike face-to-face meetings, e-mails are not conductive to immediate feedback. Nonaka and Takeuchi (1995) also underline that the interaction between individuals at meetings is psychologically close and the information media is rich, but cannot be captured by IT-applications.

In summary, benefits of heterogeneous organizational task groups with regard to capturing tacit knowledge are evident (Busch et al., 2003; Johannessen et al., 2000). Although alternative means of testing tacit knowledge (Reber, 1993) have been established, Sternberg's approach is widely accepted because of the workplace-oriented focus of the research (Busch et al., 2003). Sternberg (1999) used a technique to gain tacit knowledge by interviewing both types of group members: novices and experts. However, this approach is workplace-oriented and hence not automatically transferable to other organizational work-structures. A general approach to how novices and experts within an organization manage to exchange tacit knowledge in particular has to be found. Nonaka (1998) was the first researcher trying to model the relation between both explicit and tacit knowledge floating among individuals within an organization. Knowledge is not tangible, but it is measurable (Bollinger and Smith, 2001).

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IV.   NONAKA'S SPIRAL KNOWLEDGE MODEL

Since knowledge accessibility is divided into the two categories of tacit and explicit, knowledge does not grow in a linear way, through the accumulation of facts and the application of deductive methods (Nonaka, 1998a), but rather resembles an upward spiral. This is true for both types, tacit and explicit, of knowledge. Each time an individual re-evaluates a position or place it has had before, it does so from a new perspective. Johannessen et al. (2001) argue that if tacit knowledge is emphasized, it will promote continuous improvements of learning by doing, using, experimenting, and interacting. Thus, knowledge creation is a dynamic process of interactions between tacit and explicit knowledge (Nonaka, 1998b). This "spiral of knowledge creation" offers insight into the essentially human aspect of knowledge gaining and leading to highly successful innovation.

Models are employed to reduce the complexity of reality to a manageable scope and scale. Models are always an abstraction of a real environment, capturing the essential elements of a problem in order to make a solution more feasible. In addition, models help to give insight into an area of interest in a more practical approach. Nonaka (1998a) describes the knowledge-spiral as a continuous conversion between explicit and tacit knowledge within an organization. He therefore distinguishes between four knowledge flows as Figure 2 shows.
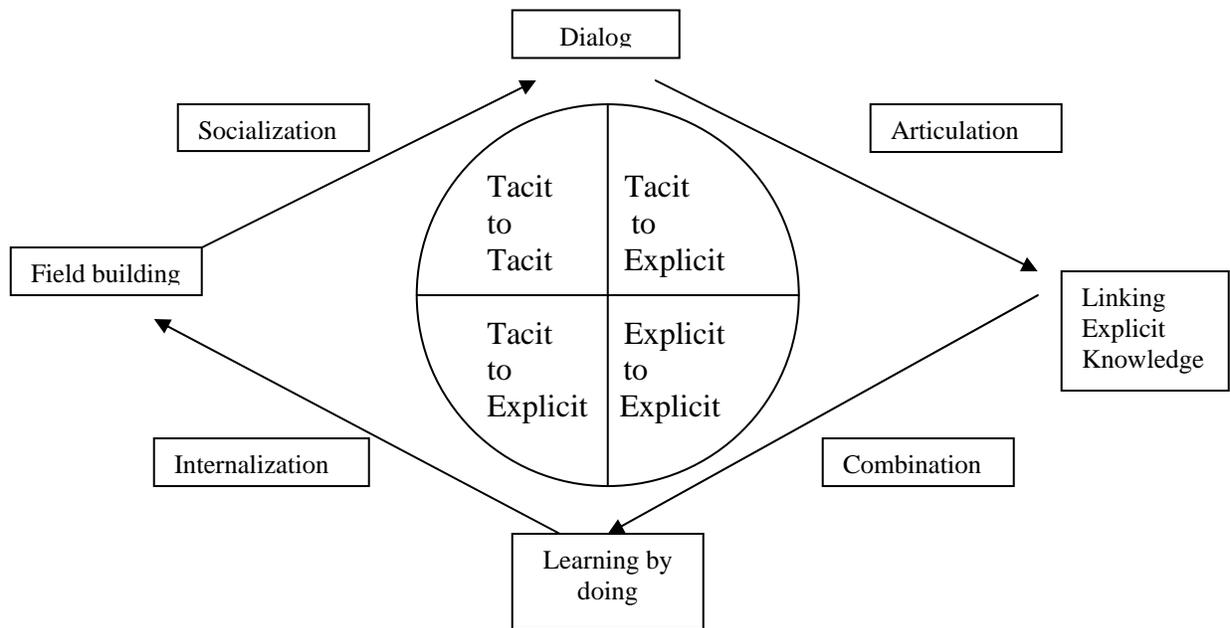
Figure 2: A visual interpretation of Nonaka's Knowledge Spiral (Nonaka 1998a)

Nonaka's Knowledge Spiral shows four knowledge flow or conversion stages of knowledge. First *socialization*: This stage describes the person-to-person interaction enabling an individual to get a grasp on the knowledge by either on the job training, through an apprenticeship team, or mentorship. At this stage the individual learns tacit skills through observation, imitation, practice and dialogue; in essence he/she is getting socialized into a craft. The motivation to transfer here is provided by sympathy between participants (Ingram and Simons, 2002) as well as the differential contribution of knowledge by group members (Thomas-Hunt et al., 2003).

The second stage is *articulation*. Here, dialogue comes into play as an important vehicle transferring tacit knowledge to explicit knowledge. Stories, metaphors, and analogies help to make tacit knowledge more "understandable" for the recipient.

The third stage is called *combination*. An individual can combine discrete pieces of explicit knowledge into new ones completely enhanced by an advanced IT-application.

Finally, *internalization* is the stage at which each individual converts explicit knowledge into tacit knowledge. This momentum is similar to the "I've got it" or "Eureka" effect. At this stage, employees begin internalizing shared knowledge, i.e., they use it to broaden, extend, and reframe their own tacit knowledge base. In a knowledge

creating and processing organization, all four stages exist in dynamic interaction, a kind of spiral of knowledge (Nonaka, 1998a).

1.   The Tacit Knowledge Questionnaire for Novices and Experts

The ideal environment for sharing tacit knowledge according to Mascitelli (2000) is a ripe area for both conceptual and empirical research. He further notes that when the Apple II computer was developed, a powerful common goal, the sense of being underdogs, and the fact of limited resources were the ingredients for development-team-members to eliminate virtually all barriers to knowledge sharing. However, most established organizations do not generally suffer from limited resources (Mascitelli, 2000). The challenge for managers is to achieve a similar level of knowledge shared by their team members. The focus here is to find how tacit knowledge can be captured and made explicit for every organizational team member. Knowledge elicitation often begins with observations of task performance within the domain of interest (Cooke, 1999).

Hence, a questionnaire developed for novices and experts about their observations of their working environment should include open as well as closed questions. Not only specific workplace scenarios, but also personal perceptions with regard to an ongoing organizational change as well as the efforts made by management to achieve this change should be interviewed. The questions do not claim to be comprehensive, since no specific questions about a particular workplace scenario are considered in the questionnaire as can be seen in Appendix A.

The last questions refer to the organizational change effort in particular. Typically there are strong resistances to change and people doubt that there are effective means to accomplish organizational change of any scale and scope (McNamara, 1999).

Knowledge that is cumulative builds on a basic set of words and symbols, and still involves a barrier to communication between novices and experts: Listening to a lecturer or reading a text cannot always suffice (Zucker et al., 2002). Knowledge is a correlational and a retrieval/interpretive structure, and it has a local character (Saviotti, 1997; Saviotti and Mani, 1995). The degree of such a local character can be measured by the span of a given piece of knowledge, i.e., by the number of variables and by the

amplitude of the range over which correlation is provided (Saviotti, 1997): Particular pieces of information can be understood only in the context of a given type of knowledge. E.g., new knowledge creates new information; however, this new information can only be understood and used by those who possess the new knowledge in a specific context.

But tacit knowledge requires that one of those already holding that knowledge works with the novices to teach them in a hands-on-process. This highly personal, subjective form of knowledge is usually informal and can be inferred from statements of others (Sternberg, 1997). Stories, for example, about why things happened and how information was or could be applied contain tacit knowledge (Smith, 2001). When both addressees, novices and experts, share a common stock of vocabulary due to their work environment they will frequently use similar terms when answering the above questions. At British Petroleum (BP) on-site workers are connected electronically with drilling and hardware experts, when faced with malfunctions of their drilling equipment. A high-resolution video camera provides a view of the malfunctioning parts of the equipment to the experts, who then in turn can provide online solutions to the problem (Bhatt, 2002).

The process of communication between both parties involves a standardization of concepts and definitions since a conversation can provide a valid approach for action by clarified assumptions, intentions, and expectations (Ford and Ford, 1995; Isaacs, 1993; Schein, 1993; Senge, 1990). In addition, the same process provides a selection of organizational routines subject to change (Nelson and Winter, 1982) and potential solutions proposed by different responders, which are overlapping.

The proposed questionnaire is to be seen as a reflection about communication having taken place within an organizational group. A high correlation of similar word-usage by both novices and experts will give insight into who is a potential tacit knowledge provider and who is a good recipient of that tacit knowledge. This *first assumption* should turn out to be valid when specific questions about specific workplace scenarios are put to the participants. In a similar study Busch et al. (2003) point out:

> …The purpose is to see what responses are more common among the group without showing unnecessary detail, which makes the lattice less comprehensible. … We can see what responses are shared with

whom, which, with a more extensive set of results could lead us to conclude that participants who share a number of similarities with experts could be tacit knowledge receptors and therefore possibly transferees.

Experts are considered to be storehouses and more effective users of tacit knowledge (Busch et al., 2003; Sternberg, 1999). Consequently, novices presenting answers to questions five through eleven similar to the experts' responses could be considered as 'higher level' tacit knowledge carriers (Busch et al., 2003). A *second assumption* therefore is, that everybody makes use of tacit knowledge at varying degrees. Listeners and observers can evaluate story content and actions and apply tacit knowledge to their own jobs (Smith, 2001). Smith (2001) further argues that nearly two-thirds of work-related information that is transformed into tacit knowledge comes from face-to-face contacts. Such contacts can be casual conversations, formal meetings and conferences, stories told by experts and novices alike, or apprenticeships. Important to all types of interaction is that they happen in an open, supportive, and free environment in short, an environment favorable for knowledge sharing (Bresman et al., 1999; Ford and Ford, 1995; Mascitelli, 2000; Smith, 2001; Thomas et al., 2001). Tacit knowledge, understood as 'context', is often easier to remember and talk about than explicit knowledge or content (Wah, 1999b). Potential tacit knowledge carriers can then be employed for mentoring roles in an organization, contributing to a chosen change strategy by creating understanding for the change to be developed more easily among employees.

A structured and detailed questionnaire can help to provide more constraints on the novice's and expert's responses and consequently more coverage of the domain of interest (Cooke, 1999). In order to reach a wide auditorium of novices and experts in an organization and make answering the questionnaire easy for the participants, it should be web-based enabled, including security features like the use of an anonymous user-name in combination with an individually generated password. This way, the participants have the freedom to answer the questionnaire when and where it suits them without using working time and being protected against identity theft or eavesdropping. In addition, the greater the sample size is the more confidence in the statistical results can be claimed.

41

Organizational knowledge can exist in individuals and groups of individuals, or it can be an organization-wide phenomenon (Bloodgood & Salisbury, 2001; Nelson & Winter, 1982; Nonaka & Takeuchi, 1995). More specific, organizational knowledge and individual knowledge are distinct yet interdependent (Bhatt, 2002). Organizations should identify where the knowledge resides when designing strategies for organizational change. Although an organization can use individual expertise in order to find an organization-wide problem such as change, it cannot claim its right on individual's knowledge (Bhatt, 2002). Individual knowledge or expertise is not always sufficient; e.g. designing and writing complex software programs require the use of many experts working with different modules and applications. In this case, organizational culture and patterns of interaction between the experts become essential (Ford and Ford, 1995; Parden, 2001; Thomas-Hunt et al., 2003).

However, an organization can become vulnerable to the mobility and idiosyncrasy of its experts (Bhatt, 2002; Mascitelli, 2000). Hence, the identification of an appropriate change strategy is vital for the success of capturing the tacit knowledge at an individual level and turning it into a visible driver of a change effort at the organizational level. Why the measurement of tacit knowledge is important can be gathered from the following lines:

> As learning projects attempts to measure the intangible capital, which we should actually call in German fortune, do make sense. This way we can determine at least different points of views. ... Whether the standard of measurement is correct is insignificant for such learning projects, as long as one uses the same standard for inter- and intra-company comparison. ... We need standards, for legitimacy and deployment of a common picture and because of time constraints and the sensitivity of decision makers. Finally, the employment of substantial resources can be better arranged internally. (Schneider, 1999; translated by the author of this thesis)

Boudreau (2002) argues similarly that measuring knowledge systematically can support decisions about human capital, and can signal how knowledge can be valued.

42

Finally, competitive advantage rests not on simply possessing resources, but in the way they are exploited by organizations in particular (Bloodgood et al., 2001; Carayannis, 1999; Saviotti, 1997).

2. An Analysis Strategy for the Proposed Questionnaire

Knowledge is increasingly important to the competitive advantage of organizations (Boudreau, 2002a) and organizations are beginning to realize that their knowledge assets are becoming increasingly important to them and are something that is worth making greater use of (Bollinger and Smith, 2001; Busch et al., 2003). Competitive advantage rests not simply on possessing the resource knowledge, but on how it is exploited by organizations. Hence, information *about* knowledge, i.e. knowledge measurement, becomes more critical and important allowing better decisions about both organizational change and human capital. However, simply creating knowledge measurements does not achieve these goals (Boudreau and Ramstad, 1999).

The goal of any applied analysis strategy in order to measure organizational knowledge would be to find out whether there exists a statistical correlation between the answers to questions nine through twenty-five (cf. Appendix A) given by experts and novices. Apart from a formalization of tacit knowledge, the analysis of the questionnaire is to determine who is likely to have greater concentrations of tacit knowledge, who is able to transfer, and who is able to absorb this type of knowledge. This focus is necessary because the questions deal with a specific change-intent of an organization and the communication channels used to make this particular change happen. Therefore, both experts and novices can base their individual answers on a common understanding with regard to the same organizational situation, i.e., a preset change process.

Confronting the same people with an additional questionnaire about specific work place scenarios could then either confirm or disprove the results on a statistical basis: Each individual has to write 'plans for action' of how he/she would handle each of a series of complex problems (Williams et al. in Sternberg et al., 1995). Descriptive statistics would then permit conclusions to be drawn as to the articulable tacit knowledge (aTK) inherent in individuals. This approach is called the 'social network analysis' approach and helps testing the flow of tacit knowledge between individuals (Sternberg,

1999; Busch et al., 2003). The 'social network analysis' approach maps out the diffusion of articulable tacit knowledge between participating respondents who provide answers to a series of questions such as in the questionnaire or organizationally specific workplace scenarios. These workplace scenarios could be developed in advance from interviews of both experts and novices. The questions are to be open or closed questions, and answer options are given or left open for participants.

Because of the fact that a too small sample size of respondents could bias the result it is to be pointed out that this kind of questionnaire is more suitable for large organizations with many potential participants. In this way, one could claim greater confidence in the results of the questionnaire analysis.

V. IT AND KNOWLEDGE MANAGEMENT STRATEGIES AND ACTIVITIES

There is no consensual definition of Knowledge Management (KM); however, Liss (1999) describes KM as

> A formal, directed process of determining what information a company has that could benefit others in the company and then devising ways to make it easily available.

Others (Bresman et al., 1999; Bloodgood and Salisbury, 2001; Johannessen et al., 2001) define variously KM as the process of knowledge transfer between business units, a trust- and relationship-building process including the creation, transfer and protection of knowledge within an organization, and a process facilitating knowledge-related activities, such as creation, capture, transformation, and use of knowledge (Bhatt, 2000; Bhatt, 2002). In contrast, Bhatt (2002) and Davenport et al. (1996) even argue that the definition of knowledge management has been broadened so much that every successful organizational activity has been categorized under the purview of knowledge management. Nevertheless, even these two authors try to provide a framework between individual and organizational knowledge enabling managers to understand how different kinds of knowledge are conceptualized and can be managed.

A key to organizational change and adaptation is how an organization manages its knowledge (Bloodgood and Salisbury, 2001). Therefore, it should identify where the knowledge resides when designing strategies in order to ensure that relevant knowledge is transferred between individuals (Smith, 2001; Thomas et al., 2001). In order to implement change, management can use three knowledge management strategies: (a) *knowledge creation* (b) *knowledge transfer* and (c) *knowledge protection*.

1. Knowledge Creation

Strategies focusing on *knowledge creation* deal with creative problem solving in technical support, recombining old knowledge to produce new knowledge, the generation of innovations, or the emergence of idiosyncratic knowledge in organizations (Yakhlef, 2001; Argote et al., 2003). Knowledge creation often involves high levels of explicit and

tacit knowledge (Nonaka and Takeuchi, 1995), focuses on organizational learning, research and development, employees' motivation to innovate and learn continuously in order to refresh their individual knowledge base by interacting with others (Bollinger and Smith, 2001; Bhatt, 2002;). Nonaka (1994) postulates that the organization itself provides the context in which individuals create knowledge. He further argues that knowledge creation is supported in an environment where individuals show an intention to create knowledge and have the autonomy to do so. Moreover, he (Nonaka, 1994) sees learning-by-doing as a means to internalize both explicit and tacit knowledge. In order to support knowledge creation, self-organizing and cross-functional teams are as necessary as mutual trust and a free and open environment (Johannessen et al., 2001; Kautz and Thaysen, 2001; Smith, 2002).

Although useful for new product development, this kind of strategy may imply that attention is turned away from knowledge transfer and protection. This would allow knowledge to flow uncontrollably, causing vulnerability and putting an organization's competitive advantage at stake since knowledge has appeared as a strategically important resource (Grant, 1996; Johannessen et al., 2001). An example of an activity that is part of a knowledge creation strategy is the inclusion of both the supplier and the customer in a series of meetings to help define a future version of an existing product or service (Bloodgood and Salisbury, 2001). New knowledge can be created through the exchange of unique perspectives of employees, suppliers, and customers during these meetings by their integration and the sharing of ideas and experiences (Nonaka and Takeuchi, 1995). Sveiby (1998) therefore stresses the importance of knowledge management (KM) and argues that KM is also about the management of people involved in a change effort. In essence, KM is the identification and communication of explicit and tacit knowledge residing within processes, people, products, and services (Bollinger and Smith, 2001). This is in line with Thomas et al. (2001) who argue that knowledge management is an integrative process of capturing, organizing, and retrieving information, transformation, and the use of knowledge. This process includes a range of activities such as learning, collaboration, and experimentation and implementation. Carayannis (1998) argues:

Catalyze the creation of trans-disciplinary and transfunctional knowledge clusters across teams and organizations. Provide a more responsive information technology infrastructure supporting knowledge workers, being able to design products and services, which are in line with current and emergent markets needs. Enable better utilization of resources by reducing/ eliminating redundancies and identifying weaknesses and anticipating opportunities for change.

Finally, knowledge as a strategic asset facilitates creation of new knowledge, but needs protection against outsiders and competitors of an organization as well (Bollinger and Smith, 2001). Successful knowledge creation may not provide a lasting competitive advantage, if insufficient effort is spent to make knowledge transferable within an organization and protect knowledge from transmittal to the outside at the same time (Bloodgood and Salisbury, 2001). Organizational change relying on knowledge creation could therefore be at risk to succeed.

2.   Knowledge Protection

Knowledge is a resource that is valuable to an organization's ability to innovate and compete (Mascitelli, 2000; Bloodgood and Salisbury, 2001; Bollinger and Smith, 2001; Bhatt, 2002; Argote et al., 2003). Knowledge resources will be wasted unless management accepts and supports efforts to gather, sort, transform, and share knowledge, but also takes precautions to protect the knowledge of its organization as well (Bhatt, 2001).

Employee expertise and organizational culture are two strategic resources that need to be protected (de Hoog and van der Spek, 1997) since knowledge management is a function of the organizational culture and employees' collective knowledge (Bollinger and Smith, 2001). Explicit knowledge, compared with tacit knowledge, is not difficult to protect against unwanted access, since it can be stored either on paper or electronically and protected by access policies. However, explicit knowledge exists always in a form that is inherently easy to imitate (Mascitelli, 2000). A typical knowledge protection activity would be to limit the number of employees having access to certain information, making sure no single employee has access to the majority of information surrounding a new product, service, or operational marketing strategy (Bloodgood and Salisbury, 2001).

47

In contrast, tacit knowledge is difficult to protect against competitors, although it is also difficult for competitors to replicate it (Nelson and Winter, 1982; Teece, 1987; Wernerfelt, 1989; Mascitelli 2000). Tacit knowledge cannot be imitated or codified as easily as explicit knowledge, since it belongs to the personal domain (Nonaka, 1998). A way for management to stimulate and utilize this knowledge is by creating an environment of collaboration and informal coordination as a result of social interactions (Mascitelli, 2000; Johannessen et al., 2001; Bhatt, 2002). Mascitelli (1999, 2000) argues:

> Social groupings such as project teams can merge the tacit knowledge of individuals into a powerful source of breakthrough innovation. The ability of firms to form and nurture such knowledge-sharing groups may be more important to long-term competitive advantage than the transitory benefits of even the most commercially successful innovations.

Tacit knowledge relies on the awareness of details, which cannot be specified or tested in a known scientific way (Johannessen et al., 2001). However, nearly 90 percent of the knowledge in any organization is embedded and synthesized in people's heads (Wah, 1996b; Bonner, 2000; Lee, 2000). Tacit knowledge therefore is lost through outsourcing, downsizing, mergers, and terminations (Bhatt, 2001) and then cannot be protected against copying and imitation by competitors. This sustains the need for an organization to gather, visualize and transfer this type of knowledge as much and as early as possible. But using IT to codify and then transfer tacit knowledge within an organization can be costly and difficult (Bloodgood and Salisbury, 2001). In addition, the conversion of tacit knowledge into explicit knowledge makes it more vulnerable to be imitated by external entities (Nonaka and Takeuchi, 1995).

3.   Knowledge Transfer

The concept of transfer is difficult to capture (Bresman et al., 1999). There is no consensual distinction between knowledge creation and knowledge transfer (Sahal, 1981; Granstrand, 1982). However, *knowledge transfer* can lead to an advantage through speedier and easier deployment of both existing knowledge and newly created knowledge. The factors that facilitate knowledge transfer are communication, visits and meetings, and the articulability of knowledge (Bresman et al., 1999). Knowledge transfer

in this context means that there is a transmitting unit and a receiving unit accumulating or assimilating new knowledge. Communication during meetings and visits alleviates anxiety caused by misinformation, facilitates interaction between individuals, and ensures that the change process during implementation is explicit and transparent (Buono and Bowditch, 1989). Moreover, in the process of a conversation, participants can observe other opportunities or threats that need to be discussed, allowing them to initiate new change conversations (Ford and Ford, 1995).

Typically, explicit knowledge is more transferable than tacit knowledge within and outside an organization (Bloodgood and Salisbury, 2001) and therefore easy to access and imitate by competitors (Johannessen et al., 2001). This type of knowledge can be made available to other parties with little regard for personal interaction. Explicit knowledge, codified, and stored in a hierarchy of databases can be accessed with information retrieval systems, reused to solve similar types of problems or connect people with the same domain of interest (Bresman et al., 1999; Bloodgood and Salisbury, 2001; Smith, 2001). However, the sharing of processes for explicit knowledge often requires major monetary investments in an IT-infrastructure needed to sustain and maintain the sharing environment process (Hansen et al., 1999; Smith, 2001).

In contrast, the tacit form of knowledge is best transferred through intensive communication during many visits and meetings (Bresman et al., 1999; Kautz and Thaysen, 2001). The conversion of a transmitter's tacit knowledge to explicit knowledge and back into tacit knowledge by a recipient takes place in an interactive social process through continuous communication. Smith (2001) argues that

> Nearly two-thirds of work-related information that is gradually transformed into tacit knowledge comes from face-to-face contacts, like casual conversations, stories, mentoring, internships and apprenticeships.

As a first example of an activity that is part of a knowledge transfer strategy, McKinsey &Company and Bain & Company use people-to-people methods to internalize tacit knowledge. Both companies developed and implemented networks allowing

employees to share tacit knowledge face to face, over the telephone, by e-mail and through video conferences (Hansen et al., 1999).

A second example is the internal publication of the behavioral characteristics of a newly designed product via the use of a corporate intranet (Bloodgood and Salisbury, 2001; Prokesch, 1997). This type of knowledge is mostly explicit, thus being easily communicable. Communication between individuals is important to knowledge transfer and integration (Bresman et al., 1999), technical meetings, extended visits and joint training programs (e.g., the Standing Naval Force Atlantic is an internationally comprised task force within NATO where ships of different NATO members frequently join each other for combat training for up to six months with frequent exchanges of personnel throughout at all levels of ranks). The more such interactions are encouraged the more effective the integration process, and the higher the level of knowledge transfer. The frequency of visits and meetings is positively related to knowledge transfer in both directions between participants (Bresman et al., 1999).

If knowledge is tacit, and thus not readily communicated in a written or symbolic form, its transfer between individuals and across functional and organizational borders is far from trivial. The transfer of tacit knowledge relies on a strong social bond between individuals or organizational parties (Bresman et al., 1999; Nonaka, 1998 a). However, for Polanyi (1958) tacit knowing is the dominant principle of all knowledge. Consequently Mascitelli (2000) and Nonaka (1998a) argue:

> The first technique for unleashing the creative potential of tacit knowledge is for managers to elicit the deep emotional commitment of employees to the innovation process. Once that commitment has been secured, it is incumbent on managers to facilitate the flow of tacit knowledge into commercially valuable forms by emphasizing the interaction between design-team members and encouraging intimate socialization among team members.

Bresman et al. (1999) see what they call a *single social community* as a facilitator for the transfer of tacit knowledge between individuals. Nevertheless, tacit knowledge needs to be made explicit and visible, but the role of IT in making this happen is limited (Johannessen et al., 2001). In the reorganization of a Norwegian shipyard, including two

50

fundamental changes in production, teams were formed across functional borders. In focusing on making tacit knowledge explicit in teams, a high level of team learning was experienced. Organizing in such teams was seen as a win-win situation for everybody in the team, creating the foundation for trust and a helping attitude within the team (Johannessen et al., 2001). For successfully transferring tacit knowledge between individuals, the assimilation of cross-functional expertise and collective learning became important (Prahalad and Hamel, 1990; Johannessen et al., 2001; Bhatt, 2002).

A similar concept management can apply is that of *communities of practice*. Communities of practice are informal groups of people who share their ideas and expertise (Bollinger and Smith, 2001). These groups are easily vulnerable to disintegration, but human resource management can help them by recognizing their existence and facilitating communications between individuals drawn to each other by social and professional interests (Bhatt, 2000; Smith, 2001). Management's role in creating a collaborative environment becomes increasingly important, since complex organizational changes require a deeper analysis of a problem space (Bhatt, 2002; Bloodgood and Salisbury, 2001). Examples of such knowledge sharing communities are found within Hewlett-Packard and 3M. These two companies created collaborative environments in their organizations facilitating easy networking and knowledge sharing among their employees (Bhatt, 2002). This is in line with Nonaka and Takeuchi (1994) who argue in favor of the facilitation of interactions between individuals and making them sensitive toward environmental stimuli allowing them to amplify their personal knowledge and contributing to an organizational knowledge base. Even if knowledge deviation occurs it is considered to be useful. The process can bring forward new perspectives on the individual's knowledge through validity checks (Bhatt, 2002).

Mascitelli (2000) argues that the most important step for management to harness the tacit knowledge of individuals is to foster an emotional commitment and deep personal involvement of the people within an organization. By story-telling and collaboration through chatting, participants can

…tap into each other's knowledge, thus transcending the organization's documented knowledge (Bollinger and Smith, 2001; Brown and Duguid, 2000).

Individual commitment to a change process, the confidence to engage oneself bodily, personally, and emotionally in the process (Mascitelli, 2000) are likely to lead to the creation of a supportive environment or 'social community' (Bresman et al., 1999) allowing an easier implementation of organization-wide solutions (Mascitelli, 2000; Bhatt, 2002). The elicitation of knowledge by means of IT-applications can be regarded as more appropriate for the explicit part (Bloodgood and Salisbury, 2001). However, IT can be used as a means to catalogue individuals in an organization holding critical tacit knowledge, and enabling communication between those who need the knowledge and those who have it (Thomas et al., 2001) and hence help identifying potential tacit knowledge transmitters and recipients (Argote et al., 2003).

VI.   IMPLEMENTATION BARRIERS TO KNOWLEDGE MANAGEMENT AND CONSEQUENCES FOR ORGANIZATIONAL CHANGE STRATEGIES

Swan et al. (1999) note that the knowledge management (KM) literature is preoccupied with information technology (IT) and technical solutions, while it reflects only a limited view of the complete organizational knowledge base. This is the *first barrier* to successful knowledge management. IT as the primary solution for knowledge management is the wrong focus. The practice of knowledge management, however, is commonly degraded to the implementation of new IT-based systems, neglecting organizational aspects such as human and social issues (Carayannis, 1999; McNamara, 1999; Kautz and Thaysen, 2001). At the Danish software enterprise NP, which experienced an organizational change process, Kautz and Thaysen (2001) found out that IT played an important, yet subordinate role. They concluded that

> The awareness that the social nature of knowledge gets lost in information processing (Pentland, 1995) has led to the insight that IT should only be used to gather, store and distribute information, leaving all other aspects of learning and knowledge to human actors. … The case has demonstrated how a fairly simple IT-based tool can support learning processes in an organization that understands knowledge and learning as something which goes beyond the mere transmission of codifiable facts.

One implication for managers is to understand that if the most valuable knowledge assets of their organization are locked in the heads of their employees, they should spare no effort to protect this wealth from expropriation by competitors and unauthorized personnel (Jones and Jordan, 1998). Consequently, the change strategy of *reconfiguring existing resources* requires a high focus on the protection of knowledge (Bloodgood and Salisbury, 2001). The reason is that this strategy focuses on the facilitation process of closer coordination between functional areas in an organization. This process depends on tacit knowledge and its inimitability (Hall, 1992). Management is to determine when socialization activities between functional areas are needed and keep knowledge tacit where and when appropriate.

The change strategy *reconfiguring with new resources* focuses mainly on knowledge creation (Mascitelli, 2000; Bloodgood and Salisbury, 2001; Johannessen et al., 2001) and a moderate effort on knowledge protection and transfer (Bloodgood and Salisbury, 2001). In order to enable organizations to initiate knowledge creation and innovations within a turbulent and complex environment, they need fast access to information (Ives and Jarvenpaa, 1991; Garvin, 1998; Johannessen et al., 2001; Bloodgood and Salisbury, 2001) and hence, knowledge needs to be made explicit to some extent (Bloodgood and Salisbury, 2001). This is in line with the fact that in the case of knowledge creation a too great effort spent on knowledge protection could hinder the dispersion of any knowledge type across inner and outer organizational boundaries where seen as appropriate.

The explicification[2] of tacit knowledge as a strategic asset should be limited to a predetermined extent. Management can guide and control through organizational policies the social interaction between individuals derived from an analysis of the questionnaire in Appendix A. A *second barrier* therefore is the question to what extent tacit knowledge should be made explicit, and between whom this type of knowledge should be transferred with a minimum of protection. The answers to these two questions must be found at the senior level in each organization.

A *third barrier* for choosing and implementing a KM strategy comes with *acquiring new resources*. This strategy solely requires a focus on explicit knowledge because it emphasizes the use of any IT-tool presented in Appendix B. This strategy stresses the rapid transfer of knowledge between participants (Bloodgood and Salisbury, 2001) and therefore does not concentrate on socialization activities. Using IT increases the speed and volume of information available to users which, in turn, can enhance innovational organizational change efforts (Ives and Jarvenpaa, 1991; Johannessen et al., 2001; Kautz and Thaysen, 2001). Because of the lack of tacit knowledge in this strategy, knowledge protection is reduced to the question of technical feasibility and organizational needs identified by management. However, management should keep in mind that this strategy might lead to a de-emphasizing of tacit knowledge (Johannessen et

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[2] This is a neologism created by the author of this thesis. Its meaning is to make something explicit.

al., 2001). In addition, IT does not provide an adequate mechanism to sustain and maintain competitive advantages on its own. IT involves organizational change and resistance to change is commonly observed (Yap, 1989). In his study, Yap (1989) points out that conflict arose between engineers and senior partners in a company. Secretaries were also reluctant to change to any new word-processing system their management favored. Markus and Robey (1988) argue that

> Information technology generally or some particular constellation of technological features are responsible for 'impacts' such as change in organizational structure, skill enhancement or deskilling workers, or change in employment opportunities.

Consequently, decision makers should provide an answer to both the rate of organizational change and of change in information technology within the organization, before implementing any knowledge management strategy and any new IT system in particular. Hence, organizations must develop the ability to channel resources into new skills and capabilities (Lucarelli and Peters, 2001). In this context, Dosi (1988) states

> Organizational routines and higher level procedures to alter them in response to environmental change and/or to failures in performance embody a continuous tension between efforts to improve capabilities of doing existing things, monitor existing contracts, allocate given resources, on one hand, and the development of capabilities for doing new things or old things in new ways.

The strategy of *business as usual* requires little in the way of knowledge creation, transfer, or its protection (Bloodgood and Salisbury, 2001) and, by itself, forms a barrier to successful innovative knowledge management. Applying this strategy, management wants an organization to continue to work with the existing organizational knowledge, while knowledge-transfer and -protection remain unchanged. Such an organization has no, or has not identified, a need for change. However, continued reliance on existing resources without any reconfiguration provides little value to the organization (Bloodgood and Salisbury, 2001; Lucarelli and Peters, 2001). Lucarelli and Peters (2001) further argue that investing in non-valuable resources and capabilities at the expense of other resources and capabilities weakens the competitive advantage of an organization.

For Lucarelli and Peters (2001) the acquisition of valuable but homogeneous resources, i.e., available and exploitable to any organization, results in competitive parity. This means that organizations gain competitive advantage only from a resource that is difficult to trade, transfer, imitate, or replicate (Amit and Shoemaker, 1993; Bollinger and Smith, 2001; Bhatt, 2002) and distinguishes their performance outcome from others'. Penrose (1959) stresses that an organization may achieve economic rents, not only because it has better resources, but also because it uses these resources in an efficient way.

> The services yielded by resources are a function of the way in which they are used – exactly the same resource when used for different purposes or in different ways and in combination with different types or amount of other resources provides a different service or set of services.

In summary, this strategy neither focuses on any knowledge management activity nor on socialization and externalization (Bloodgood and Salisbury, 2001). Therefore, it is not suitable for any organization having realized that knowledge management has become an important strategic asset (Bloodgood and Salisbury, 2001; Bollinger and Smith, 2001).

A *fourth barrier* to effective KM implementation lies within the nature of any managerial type – KM implies controlling people (Bollinger and Smith, 2001). If that is people's main perception, KM will be destined to fail (Manville and Foote, 1996). In addition, employees will not use new technology and may even subvert it, if there is a lack of trust and respect, and if they sense a lack of interest in common goals (Carayannis, 1998). Therefore, management has to stress the dialogue with its employees. Understanding the change and necessary education and training of the workforce will capture the benefit of change and is essential for its success (Grupp, 2002).

Figure 3 shows a selection of barriers for the successful implementation of a knowledge management strategy from three different perspectives, i.e., from the perspective of an individual within an organization, from a team/group perspective and from an organizational perspective separated and represented by different rings. The rings represent the different focus of viewpoints of the three different participating organizational entities, since each of them has a limited view and perception within an

organization when it comes to knowledge sharing and organizational change. The three different types of perspectives; however, are closely interwoven with each other and therefore cannot afford to neglect one another's viewpoint, but have to interact with each other constantly in order to keep the change effort going and finally to make it successful.

Organizational Ring Perspective

Difficult to codify tacit knowledge,
　People are resistant to new management strategies and change,
　　KM implies controlling people,
　　　Information can be taken out of context,
　　　　What type of knowledge is to be made transparent and to whom?
　　　　KM is time consuming, labor intensive, not easy to achieve,
　　　　　Management has to be motivated and committed to KM,

Team Ring Perspective

Social Isolation of team members,
　Individual knowledge is a constituent of personal reputation,
　　Sharing knowledge means losing ownership of that knowledge,
　　Efforts are subverted when no mutual respect and trust exist,
　　Fear of criticism by peers and even management,
　　　Lacking respect for other disciplines or functional areas,
　　　What are the social connections within the team/group?

Individual Ring Perspective

Sharing knowledge means losing ownership
of that knowledge,
　Knowledge is a source of power,
　I am a novice; I am an expert,
　　Fear of diminished personal value,
　　When giving up knowledge?
　　What are my social ties?

Figure 3: The Three-Ring-Perspectives

VII. CONCLUSIONS AND RECOMMENDATIONS

A.   CONCLUSIONS

The picture of Knowledge Management (KM), i.e., getting the right information to the right people at the right time with any IT-application, is too simple and wrong. KM must be incorporated into standard operating procedures of organizations. KM is profoundly social in nature and must take both the human and social factors within an organization into account. Organizational knowledge is a strategic asset and the extent of its use and exploitation will determine who will play a major role in the future among peers in the market. The outcome for management must therefore be to allow an organizational environment that fosters and shares explicit and tacit knowledge simultaneously, and in doing so, improves the organizational efficiency and its core competency, i.e., KM. In order to reach this goal, individuals within an organization need to be asked direct questions about their personal perspective towards the information flow within their working environment and their personal impression of the pursuit of ongoing organizational change.

The analysis of various KM strategies with regard to organizational change shows that every organization needs to analyze its total organizational knowledge base and select a change strategy that allows it to incorporate this knowledge simultaneously. The reason is that organizational knowledge is a strategic asset and hence vital to the future competitive advantage and operational effectiveness of an organization. Moreover, both explicit and tacit knowledge need to be captured and made visible and hence available to all employees in order to sustain a performance-driven organization.

Individuals absorb more knowledge than they know, called tacit knowledge. It is important to be aware that tacit knowledge is part of the personal domain. In order to capture and visualize this type of knowledge, management must make use of the proposed questionnaire in Appendix A in order to identify tacit knowledge carriers and transmitters. This will help maximizing the use of each individual's knowledge base;

hence improve the overall organizational knowledge visibility enabling management to make better decisions with regard to manpower requirements and engagements of different employees.

However, management must appreciate the fact that there are barriers to the implementation of KM and organizational change strategies. It is not only difficult to capture but also to manage tacit knowledge; however, the awareness of the aforementioned barriers is essential for creating an environment of collaboration and informal coordination in order to facilitate the flow of information and knowledge between employees. Creating new organizational knowledge will help form the basis of organizational improvements, breakthrough innovations, and hence competitive advantage. In addition, matching IT efforts with strategic change efforts helps to avoid added costs, lack of adequate knowledge capture and transfer.

Mutatis mutandis, superimposing IT-applications will not make any organizational change effort successful and does not provide the essential grounds for effective knowledge management per se. However, IT-applications can help capture, organize, visualize, and transfer knowledge. They should be used to store, maintain, and protect knowledge where desired or appropriate due to an organization's interest.

In summary, there are seven key aspects management of any organization should realize and take action accordingly:

1. Commitment to change, even though it is a time-consuming effort.

2. Choose a change strategy and explain to employees why change is necessary.

3. Use the total knowledge base of the organization and allow time to gather this knowledge.

4. Capture both explicit and tacit knowledge and make it visible to everybody within the organization.

5. Rethink knowledge as only being valuable and strategically useful to an organization when it is extracted and made explicit: individuals absorb more knowledge than management can imagine.

6. Use the questionnaire in Appendix A to extract the tacit part of the employees' knowledge and evaluate it.

7. Anticipate the barriers to implementing any organizational change strategy.

B.   RECOMMENDATIONS
1.   Possible Future Research Efforts

For the confirmation of the theoretical findings and conclusions of this thesis, future research work in the field of knowledge management and organizational change strategies is recommended to perform an empirical test with the proposed questionnaire within organizations. These tests could not only help to gain insight into the validity of the aforementioned conclusions, but also into a possible correlation between tacit knowledge carriers and absorbers. However, successes of such empirical tests depend on both the willingness of management to allow these test performances and of the employees to participate in them.

2.   The Evaluation of the Questionnaire and New KM Strategies

To be successful, organizations must not only process information but also create new information and knowledge with respect to organizational change efforts. However, there is a need to study how the proposed questionnaire can help capturing tacit knowledge and how this tacit knowledge residing within an organization could be managed successfully. This orientation could further help capture the dynamics and possibly new ways of knowledge management strategies enriching the overall understanding of how organizations can utilize and transfer knowledge to others as well.

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APPENDIX A: QUESTIONNAIRE

As you know, your organization/department/unit is undergoing currently a change. Any organizational entity and its members can only perform as good as the flow of information is. You are asked to fill in the following questionnaire in order to provide important insight into how the information-flow in your department/organization looks like.

The questionnaire is anonymous and therefore do not state your own or other peoples names. Instead, try to use job titles. Please mark your answers with an 'X' where appropriate in the provided hexagon(s). If you do not want to answer a question please mark it with an 'O'. You are, however, encouraged to answer every question as best as you can and as detailed as possible. When asked to state your opinion, please use the provided space for your answer.

<u>Questionnaire</u>

1. Please state your age: ☐ years

2. Please mark your educational background?

   High-School ⬡   College ⬡   University ⬡

   other ⬡   not applicable ⬡

   If you have been to University, please state the type of degree achieved:

   Bachelor ⬡   in ☐

   Master Degree ⬡ in: ☐

   PhD ⬡   in: ☐

3. What kind of organization have you worked for in the past?

   Non-Profit Organization ⬡ For how long? ☐ months/years

   Governmental Organization ⬡ For how long? ☐ months/years

   Commercial Organization ⬡ For how long? ☐ months/years

   Other Organization ⬡ For how long? ☐ months/years

4. What was your field of expertise there?

┌───┐
│   │
│   │
│   │
└───┘

5. What is your field of expertise today?

┌───┐
│   │
│   │
│   │
└───┘

6. For what kind of organization do you work today?

Non-Profit Organization ⬡ For how long? ☐ months/years

Governmental Organization ⬡ For how long? ☐ months/years

Commercial Organization ⬡ For how long? ☐ months/years

Other ⬡ For how long? ☐ months/years

7. How many levels of authorities does this organization have? ☐

8. With how many of these levels do you have to work with your own level included? ☐

9. How often do you meet with colleagues in order to discuss any problems?

☐ per day   ☐ per week   ☐ per month

10. Are these meetings or visits taking place on a regular basis?

Yes ⬡   No ⬡

11. What other types of contacts and channels of communications are used?

Phone ⬡   Fax ⬡   Email ⬡

Flyers ⬡   Face-to-face ⬡   Other ⬡

12. Which one do you personally prefer and why?

13. What other communication tool would you like to have access to?

   Internet ⬡   Intranet ⬡   Mobile ⬡   Other(s) ⬡

   What other tool(s) and why?

14. If you have marked Face-to-face meeting in question 11, with whom do you have these meetings?

   Supervisor ⬡   Peer ⬡   Expert ⬡

15. Do you trust that person and why?   Yes ⬡   No ⬡

   Because:

16. Assume you have to find a solution to a problem given to you. How do you approach the problem? Do you ask others? If so, whom do you ask and why?

17. What is your personal impression of the reason/intention for change by management?

Cutting cost ⬡   Cutting personnel ⬡

Automating processes ⬡   Change for the sake of change ⬡

Others ⬡

What other impressions do you have?

[ ]

18. How does management communicate the need for change?

Personally ⬡   Flyers ⬡   Email ⬡   Phone ⬡

Meeting ⬡   Other ⬡

What other media does management use?

[ ]

19. Do you personally think this organizational change is needed?

Yes ⬡   No ⬡

Because:

[ ]

20. Who do you think agrees with you on question 19 and why?

Supervisor (s) ⬡   Peer(s) ⬡   Expert(s) ⬡

Because:

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```

21. What do you think are strengths and weaknesses of others with whom you work?

Their ability to listen   Yes ⬡   No ⬡

Because

```

```

Their ability to explain   Yes ⬡   No ⬡

Because:

```

```

Their ability to reason   Yes ⬡   No ⬡

Because:

```

```

22. What do you know about **your** strengths and weaknesses, values and ambitions?
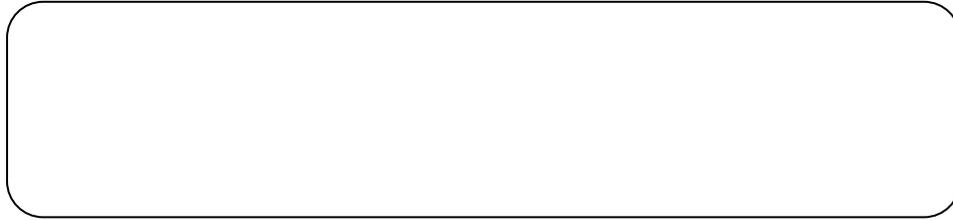
23. What would you change of the current way of operations if you had the authority to do so and why?
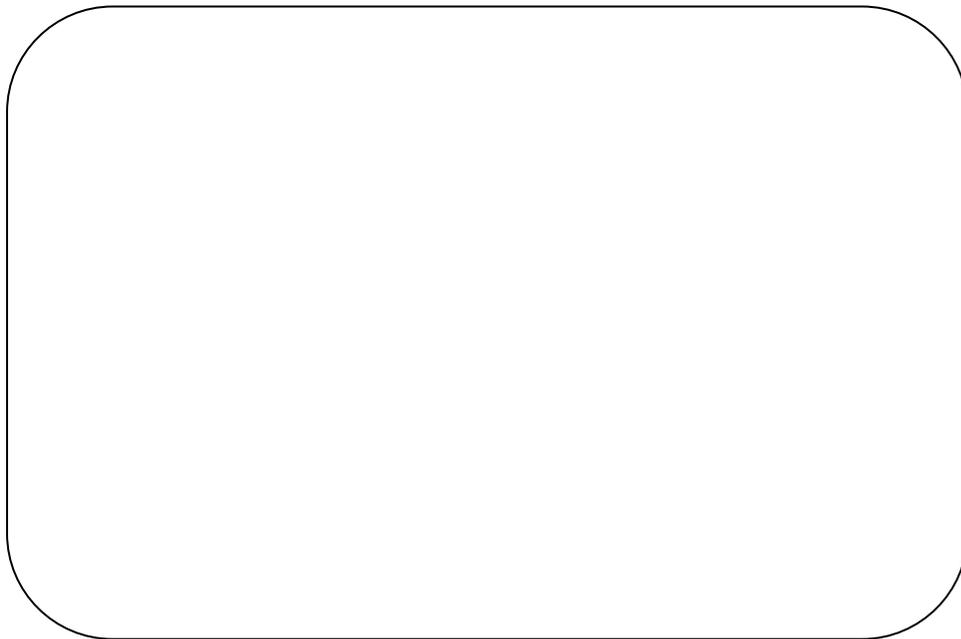
24. How would you involve people to make the change successful?

Personally ⬡   Flyers ⬡   Email ⬡   Phone/ Fax ⬡

Meeting ⬡   Other ⬡

What other way(s) would you use to involve people in the change and why?

Other way(s):

Because:
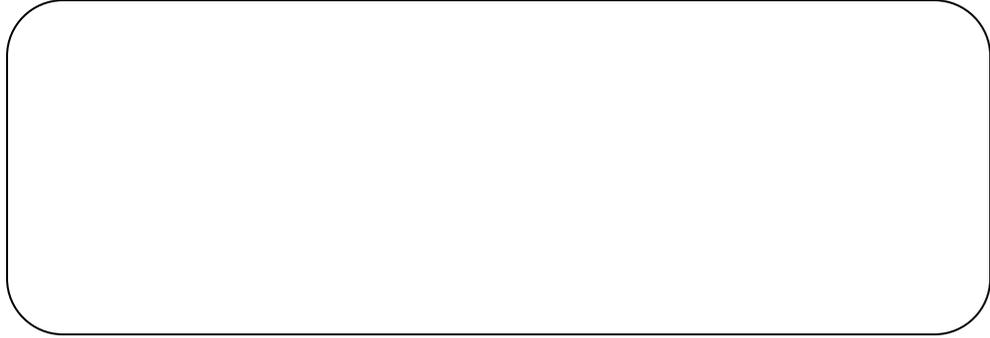
25. Who would you involve to prepare and make the change happen and why?

Who:

Because:

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APPENDIX B: TABLE OF COMPUTER INFORMATION TECHNOLOGY TOOLS FOR KNOWLEDGE MANAGEMENT

Tool Category	Tool
Hardware technologies	- Investment in information technology (IT) - Networks - Intranet
Software and database tools	- Knowledge-based systems (KBS) - Collaborative hypermedia for documentation of discussions - Learned lessons databases - Data warehouses - Databases for classification, codification, and categorization of information - Storage of e-mail thread to create a repository of best practices - Corporate memory databases also known as knowledge archives - Employee home pages on an intranet
Collaboration tools	- Electronic meeting systems - Group Ware - Video-Conferencing - Electronic bulletin boards
Intelligent tools	- Decision support tools using neural networks - Virtual reality - Genetic algorithms - Intelligent agents - Internet search engines - Knowledge mapping
Non-technology mechanisms	- Formal mechanisms for sharing information - Research and Development management - Cross-functional project teams - Formal mentoring program
Mechanisms involving both technology and non-technology	- Project management systems - Customer management systems - Vendor management systems

Source: Bollinger and Smith, 2001

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