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THE IMPACT OF KNOWLEDGE DISSEMINATION PRACTICES ON INNOVATIVENESS IN SME TECHNOLOGY AND ENGINEERING CONSULTANCIES

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ABSTRACT

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Keywords: Knowledge management, absorptive capacity, knowledge dissemination, technology and engineering consultancies, small and medium sized technology and engineering consultancies, innovativeness.

Management research has been focusing on creating knowledge management solutions funded by and destined for large technology and engineering consultancies. Subsequently, smaller consultancies, which fall under the SME category, have little research that supports the enhancement of different practices through which the flow of knowledge that gets into their organizations is managed.

This thesis comes as an extension of Ojanen, et al. (2011), which presents the importance of the impact of knowledge acquisition and utilization in technology and engineering consultancies (TECs) on innovativeness. As a result, this thesis starts by exploring and identifying the different knowledge dissemination practices used in SME TECs, from the existing literature. The impact of these practices on the ability of SME TECs to innovate is then deduced. The impact is measured through a framework that is built from the combination of two existing frameworks; the first measures innovativeness, while the second categorizes the main factors that are involved in

the process of knowledge dissemination. The aim of this thesis is to identify the different knowledge dissemination practices which improve the innovativeness capability in small and medium sized technology and engineering consultancies.

Interviews were conducted with employees in managerial positions working in SME TECs in Finland. A questionnaire was sent to these companies as well. The results confirmed the existence and the importance of the impact of several knowledge dissemination practices on innovativeness in SME TECs.

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Lappeenranta, May 15th, 2017.

Omar Jaoua

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LIST OF ABBREVIATIONS

B2B: Business-to-business

CEO: Chief Executive Officer

CIO: Chief Information Officer

KD: Knowledge dissemination

KIBS: Knowledge intensive business services

KM: Knowledge management

P-KIBS: Professional KIBS

SME: Small and medium sized enterprises

TEC: Technology and engineering consultancy

T-KIBS: Technical KIBS

1 INTRODUCTION

1.1 Background

Research has shown that small and medium sized enterprises (SMEs) are the engine of economic growth in the industrialized world. SMEs contribute to 66 per cent of the employment, along with 58 per cent of the added value in the European Union. SMEs contribute greatly to the economic growth of other regions of the world as well, such as Australia (over one third of the industry added value) and the Asia-Pacific Economic Area (Over half of the workforce works in SMEs) (Massaro, et al., 2016).

However, innovativeness can be difficult to achieve in SMEs. This is due to several factors, mainly related to the lack of financial resources, marketing skills and management expertise. In fact, given the size of these companies, limitations to how innovative and contemporary they can be, are directly linked to their limited resources and the wide range of managerial capabilities and practices they follow (Massaro, et al., 2016).

According to Ojanen, et al. (2011), knowledge acquisition and knowledge utilization can be important assets for improving the innovativeness capability in technology and engineering consultancies (TECs). However, there was no consistent conclusion for the role of knowledge dissemination in the subject. This was due to the fact that the sample used to collect data was heterogeneous in size, with many of the TECs used in the study being under the SME category. SME TECs rely heavily on informal channels of knowledge sharing, unlike larger TECs which rely on specialized platforms that codify explicit and tacit knowledge in order to make it available for the employees. Therefore, this thesis is dedicated to identifying the practices that SME TECs follow to disseminate knowledge, and then to linking them to their capability to innovate.

1.2 Research problem, objectives and delimitation

Large TECs have been investing heavily on knowledge management (KM) research for decades, which allowed them to develop sophisticated KM tools and platforms that help them limit the loss of knowledge within their organizations. These tools, however, can be too expensive for smaller companies to use. Subsequently, SME TECs today are heterogeneous when it comes to the way they manage their knowledge, as they develop their own KM practices. Little research has been dedicated to the development of successful knowledge management tools that are dedicated to and generated from the perspective of SME TECs. This is partly due to the fact that companies are usually not willing to share their financial status, which can make studying the business performance of these consultancies not as trivial (Boxall and Steeneveld, 1999). Moreover, informal channels of communication are not easily quantifiable inside SMEs, which makes studying knowledge dissemination in such companies a complicated task. Another delimitation involves the data collection process. Most of the companies which participated in the data collection process are innovation friendly and might be subjective towards innovative practices. Therefore, those companies might not be totally representative of the sampling frame as a whole.

The main objective of this thesis is to identify the knowledge dissemination practices that improve the level of innovativeness inside SME technology and engineering consultancies.

Therefore, this thesis aims at answering the following questions:

- What are the practices followed by small and medium sized technology and engineering consultancies to disseminate knowledge?
- How do knowledge dissemination practices influence the innovativeness of small and medium sized technology and engineering consultancies?

1.3 Research methodology

This thesis uses the triangulation technique for data collection.

- Secondary data is collected from the literature to explain the basis of the study. The literature part of the thesis identifies the different knowledge dissemination practices followed in SME TECs, and the possible impact they have on innovativeness. Different research articles and publications were used in order to build the framework of the study.

Sources for the secondary data include Google Scholar, FINNA, in addition to several other search engines and databases.

- Primary data is collected from Finnish SME TECs through the conduction of interviews and the use of a questionnaire. The answers selectively confirm and/ or reject the conclusions found in the literature. The interviews and the questionnaire were answered by employees at managerial positions in different SME TECs in Finland.

The results obtained from both the primary and the secondary data are then used to conclude the relationship between knowledge dissemination and innovativeness in SME TECs.

1.4 Organization of the study

The literature review has revealed that an efficient dissemination of knowledge can have a high impact on innovativeness. This thesis seeks to identify the knowledge dissemination practices used by small and medium sized TECs (SME TECs) and their impact on the innovativeness of said companies. In this thesis small and medium sized enterprises (SMEs) are identified according to the **European Commission**. This means that an enterprise that falls under the SME category, must have less than 250 employees and either a turnover that is equal or less than €50M or a balance sheet total not exceeding €43M (European Commission, 2016).
Different factors that influence innovativeness were identified throughout the literature. These factors were then linked to the knowledge dissemination practices found in the literature, in order to establish a connection between knowledge dissemination and innovativeness in SME TECs. The established connection is then used to generate the questions that were adopted for the interviews and in the questionnaire, as part of the data collection process.
The thesis is divided into 10 chapters. "Introduction" is the first chapter, and it presents the background of the study, the research questions, methodology, and the organization of the study. The second chapter, entitled "measurement of innovativeness", presents the framework which is followed to measure innovativeness. The third chapter presents the category of companies which are being studied, "Small and medium sized technology and engineering consultancies". The fourth chapter explains the three important concepts to the study, which are knowledge management, absorptive capacity and knowledge dissemination. The fifth chapter identifies the different KD practices followed in SME TECs, according to the categorization adapted in a second framework (one factor was added to the existing factors). The two

frameworks explained in chapters 2 and 5 are linked together, giving an explanatory sixth chapter which identifies the different KD practices which influence each of the innovativeness measurement factors. The seventh chapter presents the methodology which was followed in the study. The results were analyzed in chapter 8, and conclusions were presented in chapter 9. Chapter 10, identifies some of the possible limitations of this thesis, and projects how they would be avoided in future research.

2 MEASUREMENT OF INNOVATIVENESS

In order to create a correlation between knowledge dissemination and innovativeness, this thesis follows the framework developed by Adams, Bessant and Phelps (2006) to measure innovation. The purpose of using this concept is to connect it to the knowledge dissemination practices identified in chapter 5. The correlation serves to explain the influence of knowledge dissemination on innovativeness in small and medium sized technology and engineering consultancies.

This framework was chosen as it represents a set of factors which are according to the authors, "empirically demonstrated to be significant to the innovation process" (Adams, Bessant and Phelps, 2006). Since this thesis focuses on TECs which fall under the SME category, quantifiable innovativeness measurements are difficult to apply. SMEs do not usually share important parts of their performance data, and therefore a framework that focuses on behavior rather than numbers was deemed the most appropriate for this thesis.

2.1 Innovativeness

Innovativeness is a key component that contributes to the success of any company. It is the extent to which the company can innovate and engage in innovation, through the introduction of innovative processes and new ideas for services in the firm (Hult, Hurley and Knight, 2004). According to Subramanian and Nilakanta (1996), innovativeness is determined by the tendency a company has to adopt innovations that are new to its organization. The more innovations the company adopts, the more innovative it is considered. In this thesis, the innovation of SME TECs is measured according to the framework that was developed in Adams, Bessant and Phelps (2006), which is explained in the next part of this chapter.

2.2 Innovation measurement

Innovation is "the introduction of a new product, service, or process through a certain business model into the marketplace, either by utilization or by commercialization" (Gamal, Salah and Elrayyes, 2011).

Adams, Bessant and Phelps (2006) developed a framework to measure innovation in their paper entitled "Innovation management measurement: A review." The paper developed and evaluated the

impact of seven categories on the level of innovativeness in an organization. Each category was elaborately explained through identified factors that were deemed influential in the innovation measurement process.

According to this framework, measuring innovation requires taking into consideration seven factors: Inputs management, Knowledge management, Innovation strategy, Organizational culture and structure, Portfolio management, Project management, and Commercialization.

Since knowledge dissemination is part of knowledge management, and in order to avoid redundancy, the knowledge management category is divided into three categories. These categories are also taken from the same framework: Idea generation, knowledge repositories, and information flows.

The nine categories used in this thesis to measure the innovation of SME TECs are therefore the following;

- Input management
- Idea generation
- Knowledge repositories
- Information flows
- Innovation strategy
- Organizational culture and structure
- Portfolio management
- Project management
- Commercialization

2.2.1 Inputs management

Managing input involves managing human and physical resources. This category manages all of the company's inputs to measure their level of innovativeness. Innovation in human resources is measured according to three dimensions: Education, experience and a propensity for innovation. Physical resources involve all of the physical assets the company has (e.g. buildings, computers), along with slack resources, which are available for the development and adoption of innovations. (Adams, Bessant and Phelps, 2006) and (Subramanian and Nilakanta, 1996)

2.2.2 Idea generation

The generation of ideas is important as it represents the raw material for innovation. The capability of generating innovative ideas can be measured by evaluating the company's ability to encourage its employees to collaborate, both within the organization and with other external parties. The ability to incrementally innovate based on existing innovations is also an important asset for this factor.

2.2.3 Knowledge repositories

Knowledge repositories are computerized databases that include explicit and tacit knowledge in the form of documents and guidelines, divided by field of expertise. A knowledge repository in a company represents the knowledge accumulated, which can be a combination of new and existing ideas. The knowledge accumulated can be both internal and external. The inability of exploiting external knowledge for commercial ends can be considered as an obstacle towards innovation. Explicit knowledge can be measured through the number of patents a firm owns (Adams, Bessant and Phelps, 2006) and (Dingsor and Royrvik, 2003).

2.2.4 Information flows

Information flows into and within the firm, are of great importance to innovativeness. This factor adopts three measuring approaches: The relationship that the innovative team maintains with academic and research institutes, the internal processes of information exchange and the customers' information contacts (Adams, Bessant and Phelps, 2006).

2.2.5 Innovation strategy

Innovation strategy represents the strategy used when making resource allocation decisions. The objective of such strategies is to fulfill the company's business goals.

This category has two dimensions: Strategic orientation and strategic leadership.

i. Strategic orientation:

This dimension measures whether the company has an innovation strategy. The answer to this dimension can be achieved through the explicit expression ("Does the firm have an innovation strategy?"). The dimension also relies on commitment to differentiated funding and identifiable roles for new products and services.

This dimension also evaluates the innovation strategy in place to determine how effective it is. Measurements evaluate the strategic fit of a company through questions such as: "Are structures and systems aligned?" and "Do innovation goals match strategic objectives?" This allows to measure the efficiency of the adopted innovation strategy (Adams, Bessant and Phelps, 2006).

ii. Strategic leadership:

Senior managers play a strategic role in improving or deteriorating the level of innovativeness in their organizations. Senior executives with an innovation-friendly attitude have a clear vision of the future of their company and its operations, adopt an attitude that is tolerant to organizational change and creativity, develop and communicate a vision for innovation and provide their employees with a supportive and change-tolerant environment that allow them to innovate, and use conflict resolution techniques to solve debates. This dimension allows to examine the relationship between strategy and performance (Adams, Bessant and Phelps, 2006).

2.2.6 Organizational culture and structure:

This dimension examines the situational and psychological factors that support the generation of innovation within an organization. The literature has shown that innovative behavior is promoted by work environment factors. Several factors are involved in improving the level of innovativeness in a team. Employees should benefit from a certain degree of freedom that allows them to take risks, within a culture that tolerates failure. In this matter, McLaughlin, Bessant and Smart (2008) confirm that an open working environment can support innovativeness through giving the employees the freedom to take risks and to learn from mistakes, instead of being sanctioned. Moreover, collaboration between team members through

efficient interaction can be achieved through the creation of multidisciplinary teams that enjoy a certain degree of autonomy and responsibility.

Management has an important role in encouraging innovation as well. A dedicated, qualified and skilled project manager who is able to create a work environment that supports innovation and creativity (freedom to experiment) is an important factor in the generation of innovation. This includes providing employees with a certain security in the workplace, to reduce potential distractions and boost performance. (Lemon and Sahota, 2004) and (Adams, Bessant and Phelps, 2006)

2.2.7 Portfolio management

The process of selecting innovative ideas should follow a systematic process, through using formalized tools to optimize the intake of projects considered to take part of a portfolio.

Measurements of the innovativeness in portfolio management include checking the balance in quantity between long and short-term projects, between high and low-risk projects or large and small projects (Adams, Bessant and Phelps, 2006).

Lacking effective portfolio management can result in making wrong decisions during the project selection process and therefore blocks innovativeness. (Cooper et al., 2001)

2.2.8 Project management

This factor includes project efficiency (comparison between budget and cost, duration of the project and performance against schedule), the use of formal tools (formalizing the innovation process), internal communication, and the collaboration with suppliers and clients, and any other third party firms and individuals that would support the innovation process (Adams, Bessant and Phelps, 2006).

2.2.9 Commercialization

The commercialization of an innovation gets it to the market successfully. It includes market research, market testing, in addition to marketing and sales. This factor helps in fighting the

market resistance to the entry of new innovations. Moreover, commercialization enables an innovation to find its position in the market. (Adams, Bessant and Phelps, 2006) and (Chakravorti, 2004).

3 SMALL AND MEDIUM SIZED TECHNOLOGY AND ENGINEERING CONSULTANCIES:

This chapter explains what technology and engineering consultancies are, by explaining their roles and the added value they generate. The first part introduces knowledge intensive business services (KIBS), and explains their role in consulting. TECs are introduced in the second section of the chapter.

3.1 Knowledge intensive business services: Technical KIBS

The term "Knowledge-intensive business services" (KIBS) has been used for decades. It has been increasingly becoming an important topic in management research as the service industry started to flourish in several economies around the world (Muller and Doloreux, 2009). Miles (2005) defines knowledge intensive business services as "[KIBS] are mainly concerned with providing knowledge-intensive inputs to the business processes of other organizations. These other organizations can, and often do, include public sector clients." KIBS are mainly concerned with knowledge. Desmarchelier et al., (2013) describe KIBS as "activities in which knowledge is both the main input and the main output". KIBS consist of surveys, consulting services, research and engineering activities.

KIBS are B2B services that locate, combine and apply knowledge about technologies and applications to specific problems faced by customers. This knowledge can be from different fields of application and is usually tailored into a solution conceived to solve the customer's problem. KIBS have to be comprehensive, which means they do not only include product and process innovations, but delivery, strategic, managerial and marketing innovations as well. They are intangible services that are rich in strategic information and expertise, which aim at giving durable and effective solutions to the specific problems of the client. (Muller and Doloreux, 2009; Amara, D'Este, Landry and Doloreux, 2016).

Human capital and knowledge are two production factors that are important to a company's internal growth (Desmarchelier et al., 2013). KIBS increase human capital through the generation of knowledge that enables a general increase in labor productivity. They also improve the generation of knowledge, and therefore increase the productivity and the economic growth of companies that adopt them. KIBS played a strong role in replacing the importance of the physical capital by a more intangible capital, which combines a knowledge and human capital.

According to Lessard (2015), KIBS constitute a unique category of B2B services that produce high value in the service industry. It involves multiple stakeholders with different assessments of value, which enables a "multi-stakeholder and multilevel measurement of value". KIBS are potentially durable, which makes them highly valued in the consulting industry. Engineering and technology consultancies develop KIBS to their customers to solve their specific problems.

Multiple classifications of KIBS have been proposed by researchers for the past decades. The most recent classification done by Koch and Strotmann, (2006) divides KIBS into two categories: P-KIBS and T-KIBS. This classification is an improvement of the one done by Miles et al. (1995).

P-KIBS stand for Professional KIBS. These services consist of research and experimental development on social sciences and humanities, activities related to law, accounting, book-keeping and auditing, along with tax consulting, market research and advertising (Koch and Strotmann, 2006). T-KIBS however stands for Technical KIBS. Strambach (2008) points out that T-KIBS are the most dominant in Europe, in quantitative terms. This category includes software providers, technology and engineering consultants, and architects. According to Koch and Strotmann, (2006), T-KIBS consist of multiple activities, such as hardware consulting, software consulting and supply, data processing, database activities, maintenance and repair of machinery, R&D in natural sciences and engineering, technical testing and analysis, along with any architectural, engineering, technical or computer-related consulting services.

Technology and engineering consultancies provide T-KIBS to their customers. Therefore, this thesis focuses on technical KIBS rather than professional KIBS.

Technical KIBS consist of services that are within the engineering, technology and architecture fields. As mentioned above, these services can vary from software development to design, maintenance and repair of hardware. IT services are also included in the T-KIBS category in the classification done by (Koch and Strotmann, 2006), although some other classifications chose to create a third separate category for such services.

The knowledge requirements for technology users are constantly changing and therefore are difficult to comprehend and master. Therefore, many T-KIBS are designed to introduce new technology opportunities, which can be related to software services, or to technology-related trainings and transfer of technical knowledge (Fagerberg, Mowery and Nelson, 2004). Subsequently, KIBS in general and T-KIBS more specifically are put in the heart of the knowledge dissemination process in TECs.

The table below presents the different fields that are considered to be technical KIBS, according to Koch and Strotmann, (2006).

Technical KIBS	⇨ Hardware consultancy ⇨ Software consultancy and supply ⇨ Data processing ⇨ Data base activities ⇨ Maintenance and repair of office, accounting and computing machinery ⇨ Other computer related activities ⇨ Research and experimental development on natural sciences and engineering ⇨ Architectural and engineering activities and related technical consultancy ⇨ Technical testing and analysis

Table 1: Technical KIBS (Koch and Strotmann, 2006)

The fields shown above in the table are extremely innovative, which confirms the potential of innovativeness that comes with T-KIBS. In fact, according to (Fagerberg, Mowery and Nelson, 2004), T-KIBS are among the most important innovators in developed economies. This is due to high levels of R&D expenditures and patenting within these sectors.

TECs are consultancies that generate technical KIBS and solutions almost exclusively. The remaining of this chapter tries to give an overview of what these companies are and what they do.

3.2 Technology and Engineering Consultancies

Technology and Engineering Consultancies (TECs) are knowledge intensive organizations that play multiple roles in innovation systems. These companies have been playing a major role in the growth of countries with advanced economies, which is due to the important added value TECs generate (Ojanen, et al., 2011).

Technology and Engineering Consultancies (TECs) generate business to business solutions to their clients. Consultants look at how a client's company operate, then try to find a solution that can

improve it through creating systems that encourage innovativeness and generate competitive advantage. Companies that hire TECs, usually do so because they are facing difficulties, and are looking for solutions that can boost their performance and better their position in the market. The reasons companies choose to hire TECs instead of solving their problems themselves, is that they either lack time, the human resources or the appropriate expertise (Giges, 2012).

TECs work at the point where technology and business intersect. Subsequently, consultants acquire expertise in both technology and business. This allows them to be able to create large and ground-breaking solutions for their clients. Clients can be large or small corporations, as well as local or foreign governments.

These companies provide their customers with knowledge intensive services that support the design, development, maintenance and renewal of most of the physical infrastructures in modern economies. This can include transportation infrastructures, buildings and utilities. TECs continue to support their services over their entire lifecycles (Hopkins, et al., 2011).

TECs offer several technical services that range from the conceptual design, project development, environmental assessment, site selection, investment and acquisition appraisal and warranty management to decommissioning and rehabilitation (Hopkins, et al., 2011).

TECs capture value through acquiring and accumulating knowledge and experience. Partnerships with operators, strategy consultants and vendors constitute a great tool to do so. TECs are interested in both external and internal sources of knowledge, and therefore follow an open innovation approach. TECs often finance and work closely with universities and research institutes on topics that concur with the firm's interests. Previous experience is recorded in the form of guidelines and regulations that are accessible to the employees for them to use in the future, when facing the same problem in different circumstances. TECs develop their services themselves, through innovations that were generated from past experiences. Given that these consultancies follow an open innovation approach, tools that are used in the industry are usually developed by actors in the same industry (Other TECs) (Hopkins, et al., 2011).

Large TECs are multidisciplinary firms that work on both the national and the international scales. This is more accurate in countries with important economies. TECs provide facilities and systems that solve the problems of their customers. The projects can be large in size and therefore rewarding financially. In 2005, the top 10 clients for UK civil engineers got involved in contracts that are worth individually between £286M and £1.9B. These contracts were from both the public and the

private sectors. (Hopkins, et al., 2011). Smaller TECs, however, would more often than not focus on one or a few specific markets to avoid direct competitive confrontation against larger TECs with better resources and means.

Small and medium sized technology and engineering consultancies (SME TECs) are consultancies that provide services in the engineering and technology field. It is however important to point that the size of a consultancy can affect the nature and size of its clientele base. According to (Boxall and Steeneveld, 1999), large consultancies are more competitive on large contracts, while clients looking for small contracts usually go for SME consultancies. The reason behind this division of the market is that larger companies have a bigger knowledge base that allow them to be more efficient in large projects (Gray, 2006).

SME TECs do not have the necessary resources to work on a big range of disciplines. Therefore, these consultancies often focus on one or a few disciplines, leaving them unable to take on large project management contracts by themselves. Large consultancies, however, tend to hire smaller ones as subcontractors when an extremely specialized work is to be done, or when the large consultancy is over-committed (Boxall and Steeneveld, 1999).

Small engineering consultancies are still however considered to be multidisciplinary firms. This due to the fact that they provide knowledge intensive businesses that rely on intellectual property from different business and engineering fields. Subsequently, these firms are well-connected to academic and research institutes to have better access to academic innovation without having to invest heavily on their own research and development facilities (Petre, 2004).

Owners and CEOs of SME TECs are usually visionary enthusiasts. Therefore, engineering experts in these firms work long hours as they are considered to be the most important asset for any consultancy, especially the smaller ones (Petre, 2004).

Although usually secretive when it comes to their financial health, SME TECs are starting to share their annual financial reports on their websites, making it accessible to the public. This is part of an open innovation approach that SME TECs are taking interest in. Increasing the amount of knowledge inflow and the number of potential sources of information can be beneficial for said companies as it improves their performance and growth (Daud, 2012).

4 KNOWLEDGE MANAGEMENT: ABSORPTIVE CAPACITY AND KNOWLEDGE DISSEMINATION

Knowledge management (KM) has been a hot topic in the industrial engineering and management field for a long time. As experts started to realize the important impact of knowledge on the success or failure of firms, research started to intensify. Experts have been trying to both identify and create the tools that are deemed necessary to reach a high level of knowledge management efficiency. An efficient knowledge management strategy minimizes the amount of knowledge that is getting lost in firms, through the use of appropriate tools and techniques. The more knowledge is preserved, the more important the knowledge capital of the firm is. A firm's knowledge capital is considered to be a leverage that can generate competitive advantage (Ruggles III, 1997).

Large corporations started to recognize the importance of knowledge management in the early 1990s. Since then, numerous KM approaches and tools have been developed. The research, however, was commonly financed by large corporations. This resulted in the creation of KM solutions that are tailored according to the needs of large organizations. Highly efficient knowledge infrastructures have been developed, which subsequently made it difficult for smaller companies to join the trend because of financial restrictions.

This chapter presents three concepts: knowledge management, absorptive capacity and knowledge dissemination.

4.1 Knowledge Management

4.1.1 Knowledge management definition

Knowledge management has been a trendy research topic for the past three decades. According to International Data Corp. (IDC), a Framingham-based advisory firm in the IT and telecommunications industries, failure to share knowledge costs fortune 500 companies more than $31.5 Billion a year (Babcock, 2004).

Optimizing the management of knowledge has become a popular research subject both in management research and in practice. KM plays an important role in creating value through innovation, which in turn generates competitive advantage (Wang and Yang, 2016) (Marques and

Simon, 2006). Large companies started to realize the importance of KM and started financing research that has been allowing their companies to manage knowledge more effectively. Bryan (2004) explains the reason behind the heavy investments executives have put into knowledge management as “the promise of bringing all of a company's proprietary knowledge to bear on every problem or issue it faces”.

Multiple definitions have been developed by different experts in the field. Davenport’s definition of knowledge management is perhaps the oldest and the most used in management research. According to (Davenport, 1994), knowledge management is “the process of capturing, distributing, and effectively using knowledge”. Various other definitions can be found in the KM literature. Duhon, (1998) defines knowledge management as "A discipline that promotes an integrated approach to identifying, capturing, evaluating, retrieving, and sharing all of an enterprise's information assets. These assets may include databases, documents, policies, procedures, and previously un-captured expertise and experience in individual workers."

A more recent book sheds light on a more progressive definition: “In this century of creativity and ideas, the most valuable resources available to any organization are human skills, expertise, and relationships. Knowledge management is about capitalizing on these precious assets in a systematic fashion.” (Geisler and Wickramasinghe, 2015).

4.1.2 History of knowledge management

The usage and popularity of the term KM in books, business journals and conferences started in the 1980s. The concept first appeared in 1938 by Wells, who presented his vision of the “World Brain”. Wells explained that knowledge is being lost every day, and proposed a solution to help gather it and make it accessible for future usage. The “World Brain” resembles the current knowledge management concept that experts refer to today. The figure below shows how knowledge management shifted from being a proliferation of information technology in the mid1980s, to the multidisciplinary approach to dealing with knowledge which experts use today *(The MIT press)*.

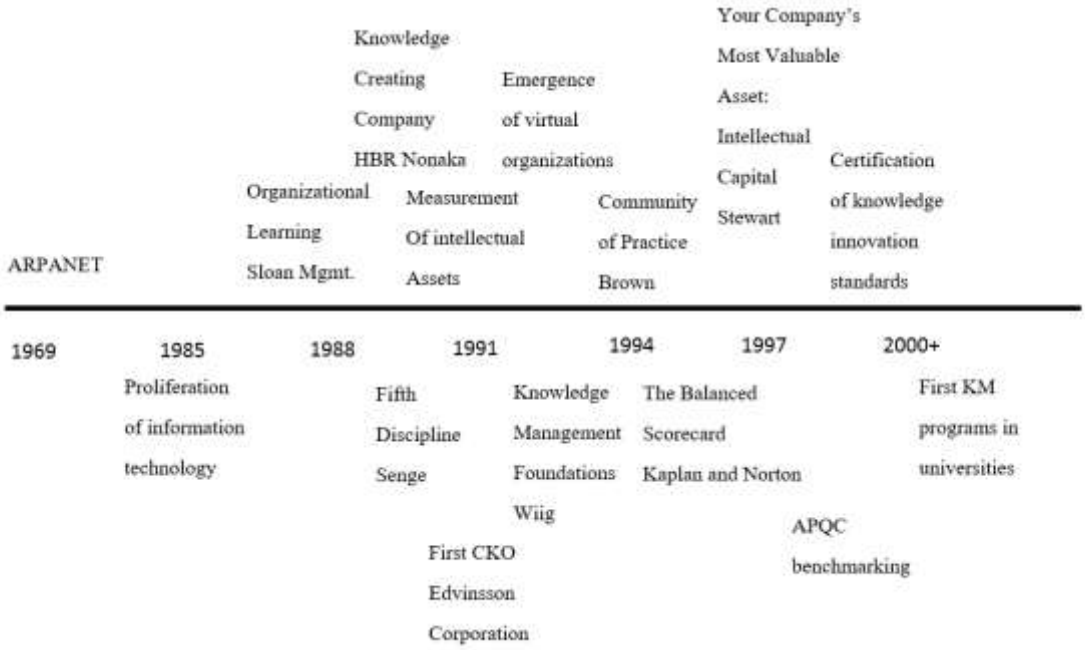

Figure 1: A summary timeline of KM (The MIT press)

Today, large companies (consultancies in particular) are developing and enhancing their own knowledge management tools and platforms. Accenture, a global management consulting, technology services and outsourcing company, has developed a KM platform that relies on social semantic technologies. This platform combines tacit and explicit knowledge, and encourages employees to share their knowledge through a social-network like architecture (Accenture 2016) (Accenture, 2012). Although extremely efficient, such platforms cannot be used by small and medium sized consultancies, because of several restrictions that are discussed later in this thesis.

4.1.3 Knowledge management disciplines

Knowledge management has a multidisciplinary nature. KM can be applied in several disciplines and areas of expertise. From technical writing to artificial intelligence, KM has been proven to be an efficient approach to limit the loss of knowledge and to contain as much information and expertise as possible. The figure below shows some of the most commonly found KM disciplines.

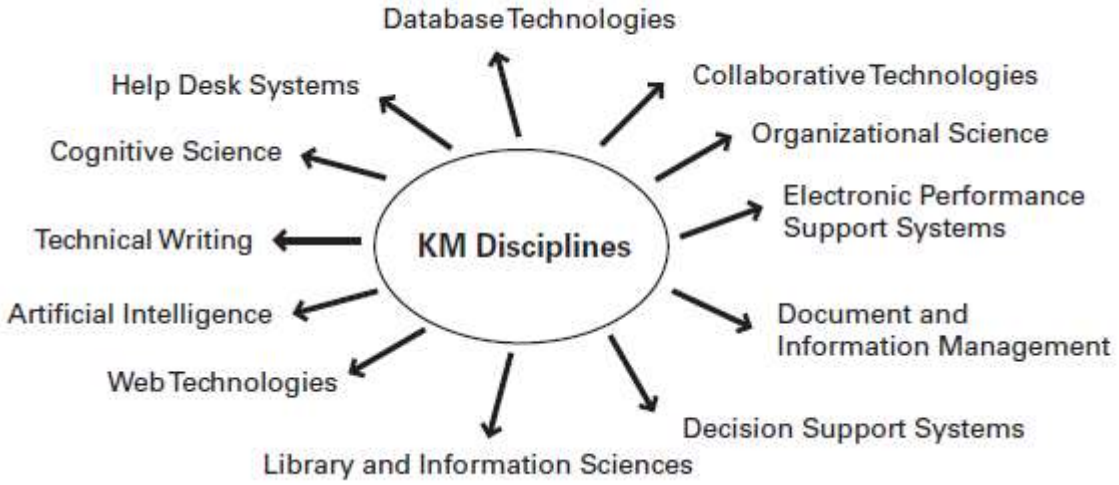

Figure 2: The multidisciplinary nature of KM (The MIT press)

The multidisciplinary nature of KM makes it easy for individuals and firms in various fields to understand and apply KM tools and systems. KM allows professionals from different specialties to be able to share knowledge and apply it in their respective and distinctive orientations. An example would be for a student to use one of the faculty's published articles, which is available on the university's database. If the student uses them to publish his or her own article, then the new publication would become available for the other students, and so on. The cycle therefore continues, ensuring that knowledge is being preserved for the university's staff and students to use.

4.1.4 Types of knowledge

There are two types of knowledge: Explicit knowledge and tacit knowledge.

Explicit knowledge consists of knowledge that can be translated and written in a formal language. This type of knowledge is usually found in academic documents. It usually follows a people to documents approach (Smith, 2001). Explicit knowledge can be recorded in the form of a report, an article, a book or any other form of printed or electronic media. Explicit knowledge is usually stored in a database, to be used in the future by other employees (Grolik et al., 2003) (e.g. scientific articles published by college professors are often stored in the university's library database, so faculty and students can re-use them for education or research purposes). Explicit knowledge can be

easy to acquire, disseminate and utilize, as formal documentation constitutes the most commonly used way of recording knowledge.

Tacit knowledge is acquired by practice and experience which develop into an operational "know-how", business judgement and expertise. It is not shared frequently and it is usually transferred in the form of knowledge intensive business services from consulting firms to their clients. Tacit knowledge is usually specific to the context and the circumstances that created it (Smith, 2001).

Tacit knowledge is difficult to formalize. The main reason is that this kind of knowledge is usually generated from past experiences that become embedded in an individual. Tacit knowledge includes insights, intuition, or any set of skills that can be uneasy to formalize or share with others. (Susanty, Handayani and Henrawan, 2012). Consulting firms usually encourage employees to share their tacit knowledge, in addition to storing it in the form of guidelines and regulations which other employees can relate to and follow in the future. (Grolik et al., 2003).

Tacit knowledge can be a great asset to any company that depends heavily on the expertise and know-how of its employees. Storing tacit knowledge allows the employees to collaborate with their colleagues and therefore makes redundant tasks easier and faster to tackle. Consultancies rely greatly on their human resources and therefore can benefit from managing tacit knowledge in addition to explicit knowledge.

4.2 Absorptive Capacity

Absorptive capacity is the ability of a company to absorb valuable knowledge to later disseminate it and utilize it. This concept provides a classification of the different stages of knowledge management. This thesis follows the absorptive capacity concept, which was also used in Ojanen, et al. (2011).

Multiple definitions have been proposed by management experts. The most popular definition is the one developed by Cohen and Levinthal, (1990), which defines absorptive capacity as: "an ability to recognize the value of new information, assimilate it, and apply it to commercial ends."

Other definitions were developed as well, such as the definitions presented by Daghfous (2004) in a more recent publication. The first definition is "[Absorptive Capacity is] a set of organizational routines and processes by which firms acquire, assimilate, transform, and exploit knowledge to produce a dynamic organizational capacity". A second shorter definition is also proposed in the same paper, defining absorptive capacity as "The firm's ability to identify, assimilate, and exploit

external knowledge". Absorptive capacity is important to the structure of this thesis, as it provides a classification of the different KM stages, which are knowledge acquisition, dissemination and utilization. This classification was also used in Ojanen, et al., (2011), and therefore provides a continuation to what was found in the paper. The different stages of knowledge management are briefly explained below:

i. Knowledge acquisition

The process of knowledge acquisition involves extracting, structuring and organizing knowledge. Knowledge is extracted from human experts (from within the organization or from outside of it). This enables the capture of problem-solving expertise which is then converted into a computer-readable form. This allows knowledge to be stored in a structured and organized fashion which can allow other users within the organization to have convenient access to it (Liou, 1990). Milton (2007) points out that knowledge acquisition requires a set of skills in order for it to be done well. This is partly due to the fact that the value of a certain information for a particular company on a particular setting is not constant, and therefore finding the most appropriate and most valuable knowledge (or source of knowledge) can be challenging. Milton (2007) describes knowledge acquisition as "one of those things that is easy to do badly and difficult to do well", which refers to the importance of having the appropriate skills to evaluate the value of knowledge before acquiring it.

ii. Knowledge dissemination:

Knowledge dissemination is the process of information exchange within an organization. The information exchange between employees can be formal (e.g. reports) or informal (e.g. Discussions between colleagues). The exchange can happen horizontally between employees at the same managerial level or vertically through information exchange between an employee and one of his or her bosses and vice versa. (Van Der Bij, Song and Weggeman, 2003)

Knowledge dissemination is an important stage in knowledge management as it ensures that knowledge goes through the proper channels in order for it to reach the employees who can benefit from it and hence improve their efficiency.

This thesis focuses on how knowledge is disseminated in SME TECs. Therefore, the following chapters are fully intended to explain the concept and link it to the companies in question and their level of innovativeness.

iii. Knowledge utilization

The process of knowledge utilization consists of the promotion of the outcomes obtained from both knowledge acquisition and dissemination. This process serves to exploit the knowledge that has been acquired and disseminated into commercial ends (Ojanen, et al., 2011).

4.3 Knowledge Dissemination

Knowledge dissemination (KD) is the second of the three processes involved in knowledge management, according to the absorptive capacity concept. Knowledge dissemination is the process of knowledge exchange inside a company.

The disseminated knowledge is any information that has been validated by experience and proven to be efficient enough to enhance the company's performance. This knowledge can be converted to a set of rules or guidelines for the employees to use in the future (Van Der Bij, Song and Weggeman, 2003).

As globalization is increasing rapidly, the efficient dissemination of new innovative ideas across the different structures within a given organization has become a necessity for any company looking to survive and achieve real growth (Song, et al., 2006).

Different experts and professionals are generating innovative ideas all over the world. Therefore, ideas and information are dispersed and distributed in a globally manner, resulting in potential innovative ideas not being able to see the light of day. Organizations and institutions around the world are increasingly hiring knowledge experts and trying to reach as much information as possible. Disseminating knowledge efficiently can potentially decrease the amount of knowledge that is constantly lost (Song, et al., 2006). Innovative ideas often come from the recombination of ideas and knowledge that was disseminated in the past. KD helps firms identify the market needs and the current developments in technology and what the competitors are working on (Van Der Bij, Song and Weggeman, 2003). Since most markets are often unpredictable, organizations can get in situations where improvisation is necessary. The use of proper knowledge dissemination tools can help managers have enough information to make the optimal decision within the given circumstances (Van Der Bij, Song and Weggeman, 2003).

Management research has identified several ways to enhance communication between employees, especially in the field of technology and innovation management (Van Der Bij, Song and Weggeman, 2003). However, sharing knowledge without the necessary tools is often complex, therefore companies started to develop computer mediated tools of communication and knowledge sharing to help their employees assist and support each other in an efficient and organized manner (Song, et al., 2006).

Knowledge dissemination does not always happen in a spontaneous way. Some employees, especially technology experts, can be somehow individualistic when it comes to sharing their work. Therefore, managers need to create the proper infrastructure for employees to exchange their knowledge, and encourage the use of such tools by the employees (Van Der Bij, Song and Weggeman, 2003).

Njenga, et al. (2013) divides the tools that can be used for knowledge sharing into two categories: Passive tools that are not actively promoted, and active tools that can encourage employees to communicate (e.g. Newsletters, email discussion groups, publications, workshops and conferences, referencing, policy briefing papers, social media, websites). Knowledge can be shared in reports, academic journals, publications, policy/issue briefs, multimedia (CDs and DVDs), and websites, among others. The chapter "Knowledge dissemination in small and medium sized technology and engineering consultancies" explains the factors involved in the process of knowledge dissemination, as well as the tools that were deemed appropriate for the same process according to the available literature.

5 KNOWLEDGE DISSEMINATION PRACTICES IN SME TECS:

According to absorptive capacity, knowledge dissemination is the second stage of knowledge management. It involves the codification and transfer of knowledge within the organization (Ojanen, et al., 2011). Knowledge dissemination is an important part of knowledge management, as it enables different employees in the same firm to share their skills and expertise with their colleagues. This creates a learning environment where the employees collaborate in order to preserve their tacit knowledge and therefore increase their productivity and efficiency. Moreover, the more knowledge is shared, the less knowledge is lost. The development and adoption of effective knowledge dissemination practices reduces the loss of knowledge within the organization and therefore can have a great impact on the business performance of any firm.

Technology and Engineering consultancies are companies that rely heavily on human resources. The experience that employees gather from different tasks and projects creates tacit knowledge which is considered to be a consultancy's most valuable asset. Therefore, developing tools that can improve the exchange of this kind of knowledge can achieve this purpose efficiently. An appropriate use of these tools can have a visible impact on the general growth of the firm.

This chapter defines and explains these factors, in addition to presenting the possible tools that can be used to enhance the company's innovativeness in each of them.

Susanty, Handayani and Henrawan, (2012) identified four main factors that are involved in the knowledge dissemination process: Human resources, organizational culture, organizational structure and information and communication technology (ICT). In this thesis, one more factor is taken into consideration: knowledge recycling. This is due to the fact that recycling knowledge can be an effective and cheap tool to generate and disseminate innovations in SME TECs and therefore potentially improves their level of innovativeness. Petre (2004) identifies several innovation disciplines, which revolve around recycling knowledge to incrementally innovate. Therefore, the factor was added in this thesis as it is not fully represented by the factors presented by Susanty, Handayani and Henrawan, (2012).

Therefore, the five factors taken into consideration in this chapter are:

- Human resources
- Organizational culture

- Organizational structure
- Knowledge recycling
- Information and Communication Technology

The effective KD practices identified for each factor are presented and explained in each of the following sections.

5.1 Human Resources

When compared to larger corporations, most SME TECs lack essential human and financial resources for rapid growth. They are however rich in tacit knowledge, which consists of the skills and know-how employees acquire through experience. Susanty, Handayani and Henrawan, (2012) believe that knowledge is an unlimited resource for technology-based SMEs, and that the only constraint in this matter would be for the company not to use it efficiently.

The most common way to exchange tacit knowledge is through direct communication. Therefore, employees should be able to demonstrate high social skills, as learning and sharing knowledge can be considered a full-time social activity that needs to be exercised frequently (Susanty, Handayani and Henrawan, 2012). Selecting experienced consultants who can collaborate with clients to develop new solutions (Hopkins, et al., 2011) can also help create a general understanding of the customer's needs and what the consultant can do to solve a certain problem. Distributing the problem-solving tasks between clients and specialized consultants can increase the knowledge flow between both parties, which results in a more effective exchange of knowledge and potentially a higher level of innovativeness.

Employers are encouraged to hire professionals with T-shaped skills. T-shaped professionals are individuals who have a broad set of skills from different specialties. This allows them to learn through connecting different perspectives from different fields. The completely opposite of a T shaped professional would be an I-shaped professional. I-shaped professionals focus on one particular area of expertise and try to learn about it as much as possible (Boynton, 2011).

⇨ T-shaped professionals are more prone to exchange knowledge than their I-shaped colleagues.

Employers are also encouraged to hire candidates with advanced soft skills. These skills include being able to take initiative, to work with others and to learn from past mistakes (Michael Page, 2016). They also include having advanced communication skills, a good professional reputation (through recommendations), and being able to work under-pressure (Michael Page, 2016).

- ⇨ Professionals with advanced soft skills are more prone to exchange knowledge than other candidates.

5.2 Organizational culture

Organizational culture refers to the values that are rooted in the organization. These values influence the attitude of employees towards knowledge sharing. The values and views of a company can be manifested in the design of the workplace, different policies and rules within the firm, organizational structure, advertising, and the design of a product or of the logo of the company itself, among others (Susanty, Handayani and Henrawan, 2012).

A culture that encourages innovative behavior increases the active exchange of ideas and knowledge. Knowledge can be disseminated both internally and externally. External dissemination happens through sharing knowledge with the external (e.g. people, governments, companies). This type of dissemination can enhance the company's credibility and accountability, which in turn helps in building a better reputation. Moreover, sharing knowledge with external parties, results in having them as potential sources of knowledge in the future (Rocha, et al., 2015).

Several studies have measured organizational culture using different dimensions. This thesis follows the dimensions found by Susanty, Handayani and Henrawan (2012), as this classification focuses more on the way knowledge is disseminated across SME TECs. Therefore, the three dimensions are the following:

i. <u>Trust:</u>

   Employees can be sometimes reluctant to sharing their ideas with their colleagues. This happens in extremely innovative fields, such as technology and engineering. Designing an innovative idea or even approach in the engineering field can be extremely rewarding both financially and professionally. Subsequently, employees in such fields often have

issues sharing their ideas with their colleagues for competitive reasons (Susanty, Handayani and Henrawan, 2012). Trust builds a safe sharing environment that can allow employees to help each other in achieving the company's business objectives, through trusting each other's promises and actions (Al-Alawi, AL-Marzooqi and Mohammed, 2007). This allows for a smoother knowledge sharing behavior between the employees.

ii. Learning culture:

Organizational learning is the continuous development of skills and expertise within a firm. It encourages employees to acquire new abilities through internal training and knowledge sharing. This helps increase the knowledge created by individuals within the company. The purpose of organizational learning is to generalize the knowledge created by the employees so that their colleagues have access to it. Companies that are unable to create an environment that promotes learning for their employees are likely to fail at some point in time in the future (Garcia-Morales, Jimenez-Barrionuevo and Gutierrez-Gutierrez, 2012) and (Marques and Simon, 2006).

iii. Collaboration:

Collaboration increases knowledge transfer and subsequently helps knowledge creation. This happens through spontaneous sharing of information between colleagues. Collaboration can play an important role in spreading the acquired knowledge across the firm's departments and divisions (Rocha, et al., 2015). An example of spontaneous collaboration would be for an employee to take part in meetings with communities of practice, within the same firm. Communities of practice consist of a number of coworkers with complementary knowledge who, voluntarily, form meetings with their colleagues to communicate their ideas and exchange knowledge. This kind of collaboration can be formed thanks to shared interests, work objectives or methodologies (Rocha, et al., 2015). This informal channel of communication can only be achieved if a group of individuals are willing to work together in teams that can be multidisciplinary, multicultural, that can have members with different opinions and/ or business orientation and objectives. Collaboration creates a two-way process of sharing knowledge between the transfer agent and the transfer recipient (Petre, 2004). Collaboration can be a great asset for SME TECs, as it represents a cheap and efficient tool to share tacit knowledge

and hence to decrease the amount of lost knowledge and consequently increase the employees' ability to accomplish their tasks in a time-efficient manner.

- ⇨ Trust, learning and collaboration have a positive effect on KD

5.3 Organizational structure

Organizational structure aims at building structures that encourage employees to connect and communicate with each other. The implementation of a proper infrastructure that enforces a certain degree of communication through formal and informal channels can increase the amount of knowledge that is being exchanged within the firm. Managers create formal communication channels, while informal channels are often built spontaneously by the employees (Susanty, Handayani and Henrawan, 2012). Employers can motivate their employees to build informal channels by inciting them to work in multidisciplinary teams. This allows them to generate knowledge as they become exposed to different opinions and perspectives. If managed effectively, multidisciplinary teams can be a knowledge dissemination tool that promotes knowledge creation (Karjalainen, Koria and Salimäki, 2009).

Employees become less enthusiastic about knowledge sharing when it becomes highly centralized or formalized. High centralization prevents the employees from being able to share their tacit knowledge with each other, as team work is not encouraged in this case. The owner or CEO of an SME with high centralization makes most of the strategic decisions without consulting the employees, depriving the company of potentially valuable knowledge and advice (Susanty, Handayani and Henrawan, 2012). Formalizing all channels of communication and requiring employees to use them can also decrease the amount of spontaneous and informal exchange of knowledge. Formalization can discourage employees from sharing their knowledge with their colleagues as it becomes more of a requirement than an interesting collaboration. A highly-centralized strategy can demotivate the employees which can lead to a loss of potentially valuable knowledge that is not being exploited.

- ⇨ Decentralizing the decision making process can be an effective way to disseminate knowledge.
- ⇨ Creating a balance between formal and informal knowledge dissemination channels encourages employees to share their knowledge more effectively.

- ⇨ Encouraging teams to work in multidisciplinary teams stimulates the creation and development of informal channels.

Several formal channels of communication have been developed to enhance the amount of knowledge that is being disseminated in a consultancy. The tools below are considered to be at the same time effective and cost-friendly;

i. Record keeping: Team meetings can be a fruitful opportunity to exchange innovative ideas and to organize future important tasks. Therefore, appointing one of the members to be a record-keeper, can be an efficient tool to make sure all ideas, decisions and all important information is kept safe for future use. Examples of record-keeping practices include typing down everything that is being said or taking photos of white boards. Any team member can be a record-keeper. Team members commonly take turns on who is keeping record of the meetings (Petre, 2004). Record keeping has been used for a long time in most fields of expertise and has been proven to be an effective tool to keep the ideas that are generated in meetings from getting forgotten and lost.

ii. Reflection on completed projects: Past completed projects can be a great source of knowledge. Therefore, "exceptional" consultancies should debrief on recently completed projects to reflect on the positive and negative outcomes of the experience. Moreover, reviewing old projects helps to check the relevance and/ or helpfulness of said projects in tackling newly acquired ones (Petre, 2004). This method ensures a continuation in the generation of ideas and the flow of knowledge inside the organization.

iii. Reviewing general themes: Small and medium sized consultancies are more focused and specialized than their larger competitors. Therefore, entering a new field of expertise can require the expansion of the human capital of the company as the employees might not be familiar with the new specialty in question. It is however not uncommon for employees in technology and engineering consultancies to be specialized in more than one area of expertise. Therefore, before recruiting new employees, SME TECs should hold meeting sessions where they discuss the unexploited experience and skills of their existing staff (Petre, 2004). This can be

profitable as hiring new experts requires extra costs in training in addition to remuneration.

iv. Brainstorming:

This technique has been used since the 1950s. It is a "group interaction technique that produces better ideas" (Petre, 2004). Employees would meet for a certain period of time, where they share their most wild ideas. The rules that every employee must follow during a brainstorming session are; Criticism is not allowed, quantity is good, and ideas should be incrementally combined, modified and improved. Work and non-work related topics are discussed, in order to widen the possibility of coming up with innovative ideas (Petre, 2004) and (Sutton and Hargadon, 1996). Brainstorming is used in most fields as it gives the employees the freedom to express themselves and hence strengthen their creativity.

5.4 Recycling of knowledge

Knowledge that has been acquired, whether or not it was used, should not be disposed of. Recycling knowledge by disseminating it again can be of great value. The following tools are accessible and convenient for consultants and engineers to use, and to therefore create incremental innovation in one or more specialty (ies).

i. Collection of loose possibilities: An important task for TECs is to predict problems before they happen and potentially interrupt the client's productivity. Therefore, consultants and engineers need to constantly test both internal and external innovations so they can collect potential problems. Such an innovative mindset allows engineers to generate ideas and therefore generate preventive solutions. Petre (2004) encourages these employees to keep track of the problems they encounter. Creating personal "ideas' diaries" for example can help engineers avoid losing knowledge that was perhaps not acquired at the right moment, so they can be used in the future.

ii. Systematic re-use or re-application of recent innovations: TECs are firms that work on more than one discipline. Consequently, it is possible to re-use the same innovations in more than just one context. Innovations that were created for the

purpose of one project, are transferred after the project has ended to other departments within the same firm. This is to evaluate the potential value it can create in other fields. Such multidisciplinary attitude can transfer technology into unrelated fields. Examples include medical engineering solutions, biotechnology products and services, and many others. This method allows TECs to bill "twice for the same bit of work" (Petre, 2004). The re-use and re-application of innovations constitutes a cheap and effective way to make sure that relevant knowledge is not being disposed of unnecessarily.

iii. Attention to conflicts: In multidisciplinary companies, employees come from different fields and find themselves in a position where they have to work with people who do not share their vision and their professional mindset. Having a variety of people with different backgrounds has proven to be an efficient way to enhance the level of innovativeness of the firm. However, conflicts are more likely to happen in this kind of situation.

An example would be for a conflict between the high-level goals set by the designer and the client's expectations for an acceptable solution. Solving this kind of conflicts can be an effective tool for engineers to innovate. Engineers in this case would need to create an innovative compromise that would solve the conflict (Petre, 2004). Conflicts can slow down the innovativeness process and hence create productivity issues.

iv. Exploration of possibilities: Exploring and harnessing the knowledge a consultancy has gathered can help consultants identify market trends, gaps and problems that need solving (Petre, 2004). This method is used in most fields as it gives a clear vision of the market's needs and therefore can create competitive advantage in addition to increasing the level of innovativeness in technology and engineering consultancies.

5.5 Information and Communication Technology

Large TECs rely heavily on ICT platforms and databases. These computerized tools can be extremely efficient, as the related research has been improving promptly. These sophisticated ICT solutions that enable consultants to have convenient access to a large amount of knowledge are however quite expensive for smaller consultancies.

Cheap ICT tools, however, have been developed for small firms. Therefore, implementing ICT tools in a consultancy can be rewarding financially, as consultant engineers use them to reduce cost (Falsh, 2014). Some of the possible practices that can be used to improve knowledge transfer are the following:

i. Making explicit knowledge more accessible, convenient and transferrable for employees. This is possible through either developing an internal database for explicit knowledge that is accessible for the employees (Electronic Resource Planning software), or outsourcing an external database through a contract (Susanty, Handayani and Henrawan, 2012) (Aspelund and Moen, 2004). Making a database of relevant knowledge available reduces the time the employees need to acquire the necessary information they need. Time efficiency is a key factor for the success of any firm, especially TECs which can benefit from having a faster response from their competitors.

ii. Developing a local intranet network that provides employees with transferred databases, automated knowledge maps, expertise database, advanced communication features, electronic yellow pages, etc (Susanty, Handayani and Henrawan, 2012). Intranet networks encourages employees to communicate and therefore share and/ or learn tacit and explicit knowledge.

iii. Providing employees with online communication tools such as email services (through acquiring an email domain for the firm) and videoconferencing services (e.g. Skype for business) (Aspelund and Moen, 2004). A company email address can create a sense of affiliation to the firm, which can in return increase productivity. The availability of proper videoconferencing equipment and software can eliminate unnecessary trips and therefore reduces transportation costs.

iv. Developing or outsourcing a commercial web portal, in order to facilitate the contact between employees and potential clients. The importance of a commercial web portal is in creating a bridge between the company and its clients, which makes it easier for the consultants to be more time efficient in their response to potential problems.

v. Partnering up with research institutions and other firms, to be able to have access to their explicit knowledge databases. Research institutions and large enterprises have

larger knowledge databases and therefore can be beneficial for SME TECs who do not have enough resources to develop their own (Aspelund and Moen, 2004).

6 THE IMPACT OF KNOWLEDGE DISSEMINATION PRACTICES ON THE INNOVATIVENESS OF SME TECS

In this chapter, the knowledge dissemination practices found in the previous chapter are connected to the innovativeness factors that were identified in the "Measurement of innovation" chapter. Each innovativeness factor will be presented with the knowledge dissemination practices that are deemed beneficial to its enhancement. Each of the knowledge dissemination practices is presented in the innovation measurement factor it influences.

The purpose of this part of the thesis is to identify which knowledge dissemination practices can enhance which innovation and innovativeness factors. This classification makes the connection between knowledge dissemination and innovativeness more visible. An explanatory figure is presented at the end of every section, in addition to a table at the very end of this chapter, which aims at summarizing the connections in question.

6.1 Practices that influence input management

Input management consists of all human and physical resources. Innovativeness is measured through the experience, skills and education of its human resources, along with its physical resources measured in currency. Human resources are represented by the human capital of the company, which can be enhanced through the recruitment of intelligent candidates with high social capabilities. T-shaped professionals have multiple skills, and therefore represent an important addition to their firms in terms of innovativeness.

The KD practices that influence innovativeness through input management are the following:

- ⇨ Recruiting T-shaped professionals with more than just one specialty
- ⇨ Recruiting people with soft skills that are able to constantly learn and share knowledge
- ⇨ Providing the employees with equipment that encourages knowledge sharing (computers, internet and intranet networks, etc).

The figure below explains how the different knowledge dissemination practices that influence input management are linked through the knowledge dissemination factors which were identified in previous chapters.

KD factors	⇨ KD tools
Human Resources	⇨ Recruiting T-shaped professionals with more than just one specialty ⇨ Recruiting people with soft skills that are able to constantly learn and share knowledge
Information and Communication Technology	⇨ Providing the employees with equipment that encourages knowledge sharing (computers, internet and intranet networks, etc).

Figure 3: Knowledge dissemination practices (tools) that influence input management

6.2 Practices that improve idea generation

The generation of innovative ideas can be improved by adopting an open innovation approach. Sharing knowledge with external stakeholders, clients and competitors can expose the employees to more ideas that can be potentially beneficial for the firm. Internal collaboration can be extremely beneficial for the generation of ideas as well. The generation of ideas can also be influenced by KD practices that promote the recycling of knowledge that was already used. These practices include the collection of loose possibilities (testing innovations to detect potential problems), the systematic re-use or reapplication of recent innovations (transferring an innovation after the end of its function in a project to other departments, so they can check if it could be used for other purposes), attention to conflicts (Detecting and solving internal problems between departments in the company), as well as forming multidisciplinary teams to stimulate the creation and generation of knowledge and innovation.

The KD practices that influence innovativeness through improving the idea generation capability are therefore the following:

- ⇨ Open innovation
- ⇨ Internal collaboration
- ⇨ collection of loose possibilities (testing innovations to detect potential problems)

- ⇨ The systematic re-use or reapplication of recent innovations (transferring an innovation after the end of its function in a project to other departments, so they can check if it could be used for other purposes)
- ⇨ Attention to conflicts (Detecting and solving internal problems between departments in the company)
- ⇨ Forming multidisciplinary teams

The figure below explains how the different knowledge dissemination practices that influence the generation of ideas are linked through the knowledge dissemination factors which were identified in previous chapters.

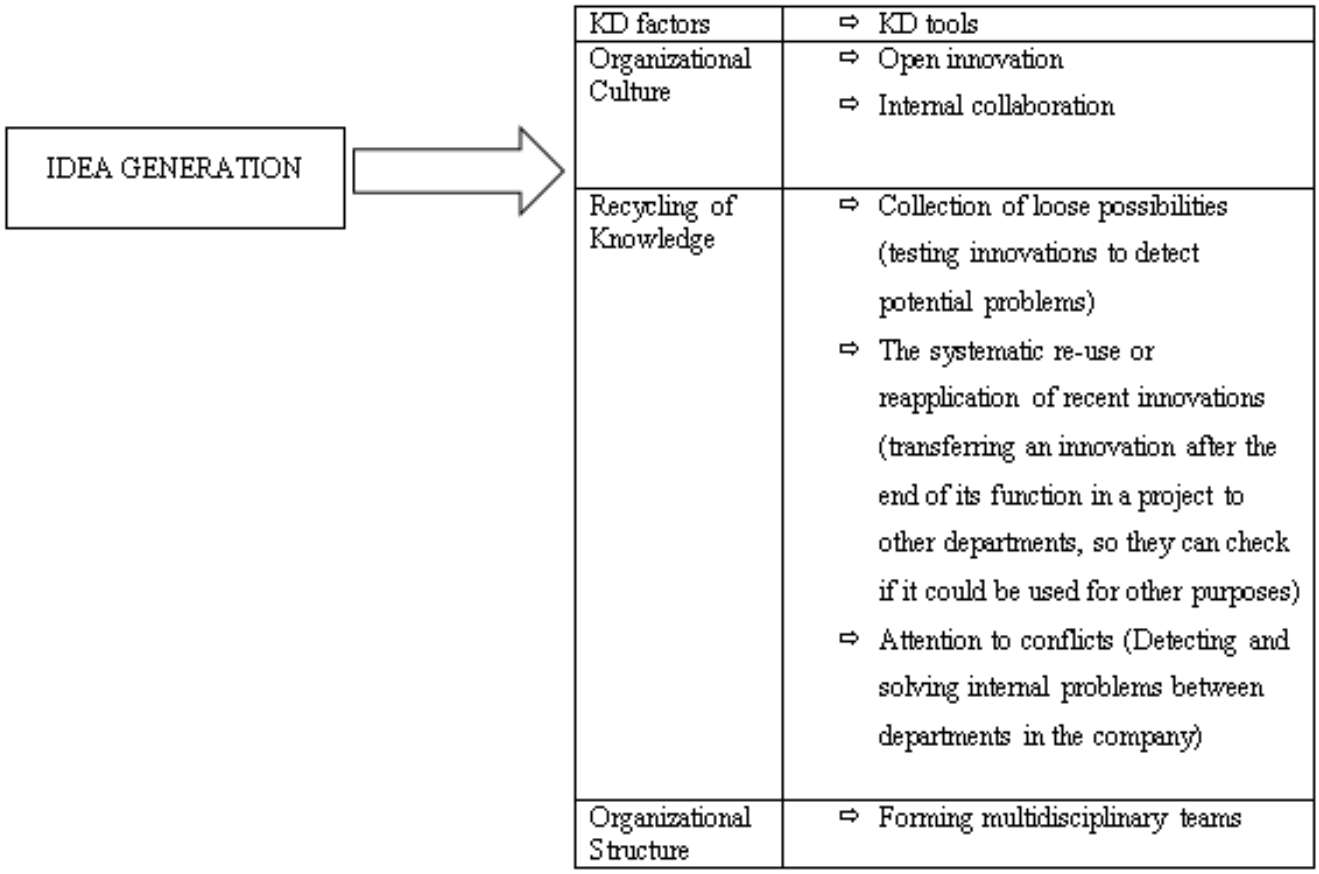

Figure 4: Knowledge dissemination practices that influence idea generation

6.3 Practices that influence the knowledge repository

The knowledge repository represents the knowledge accumulated by the company. The knowledge accumulated should be accessible for the employees. Therefore, making the explicit knowledge of the company accessible through databases the employees can use online is necessary. Tacit

knowledge can also be accumulated, through guidelines and sets of rules that the employees develop from their own professional experience in the firm and then store in the appropriate knowledge repository. Knowledge can also be accumulated through simple KD practices such as keeping record of all meetings, which ensures that all information exchanged during the meetings is recorded and secured for future use. Firms which do not own their own knowledge repository, can partner up with research institutions and other firms, to be able to have access to their explicit knowledge databases, and to collaborate with them in relevant research projects.

The KD practices that influence innovativeness through the use of knowledge repositories are therefore the following:

- ⇨ Making the explicit knowledge of the company accessible through databases the employees can use online is necessary
- ⇨ Accumulating tacit knowledge through guidelines and sets of rules that the employees develop from their own professional experience in the firm.
- ⇨ keeping record of all meetings
- ⇨ Investing in patents

The figure below explains how the different knowledge dissemination practices that improve the accumulation of knowledge in repositories, are linked through the knowledge dissemination factors which were identified in previous chapters.

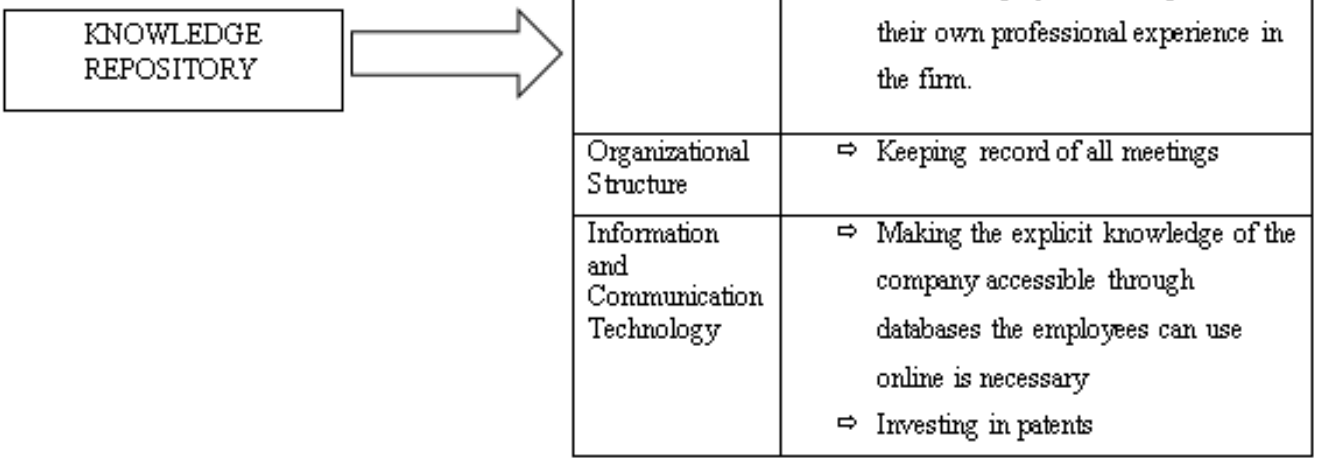

Figure 5: Knowledge dissemination practices that influence knowledge repository

6.4 Practices that improve the information flows

Information flows into and within the firm, are of great importance to innovation. This dimension adopts three measuring approaches: The relationship that the innovative team maintains with academic and research institutes, the internal processes of information exchange and the customers' information contacts. This dimension however can be enhanced by any of the practices that enhance knowledge dissemination, as it is part of the knowledge dissemination process.

The KD practices that influence innovativeness through improving information flows are therefore the following:

- ⇨ Sharing knowledge with external stakeholders, clients and competitors
- ⇨ Partnering up with research institutions and other organizations

The figure below explains how the different knowledge dissemination practices that influence the information flows are linked through the knowledge dissemination factors which were identified in previous chapters.

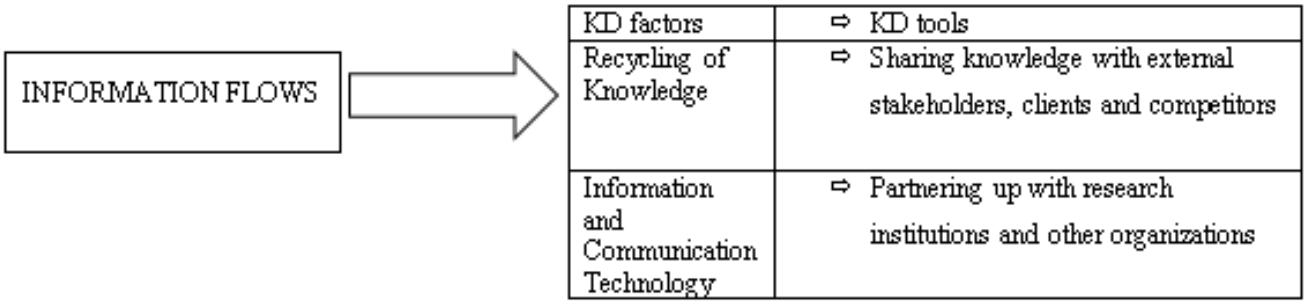

Figure 6: Knowledge dissemination practices that influence information flows

6.5 Practices that influence the innovation strategy

Innovation strategy represents the strategy used when making resource allocation decisions, to fulfill the company's business objectives. Innovativeness is measured through two dimensions: Strategic orientation and strategic leadership.

Strategic orientation is the dimension that measures whether the company has an innovation strategy. This can be measured through the explicit expression ("Does the firm have an innovation strategy?"). This dimension evaluates the innovation strategy in place to determine how effective it is. Measurements evaluate the strategic fit of a company through questions such as: "Are structures and systems aligned?" and "Do innovation goals match strategic objectives?" This allows to measure the efficiency of the adopted innovation strategy (Adams, Bessant and Phelps, 2006).

Strategic leadership is represented by senior executives with an innovation-friendly attitude, who have a clear vision of the future of their company and its operations, adopt an attitude that is tolerant to organizational change and creativity, develop and communicate a vision for innovation and provide their employees with a supportive and change-tolerant environment that allows them to innovate, and use conflict resolution techniques to solve debates. This dimension allows to examine the relationship between strategy and performance (Adams, Bessant and Phelps, 2006).

The KD practices that influence innovativeness through innovation strategy are therefore the following:

- ⇨ The innovation strategy can be enhanced by recruiting visionary and innovation-friendly managers who are able to provide their employees with a work environment that encourages innovativeness.

- ⇨ A decision making strategy with low centralization can encourage employees to get involved in the innovation process.

The figure below explains how the different knowledge dissemination practices that influence the innovation strategy are linked through the knowledge dissemination factors which were identified in previous chapters.

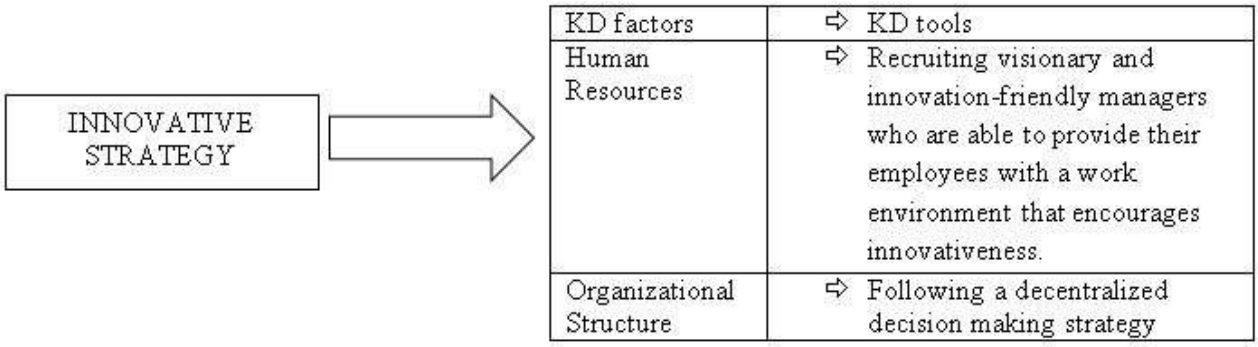

Figure 7: Knowledge dissemination practices that influence the innovative strategy

6.6 Practices that influence the organization and the culture

Innovative behavior can be stimulated through improvements in certain work environment factors. This includes forming multidisciplinary teams that enjoy autonomy and responsibility, project managers who dispose of the essential know-how, collaborative communication between disciplines, a work environment that supports innovation and creativity (freedom to experiment), as well as risk taking and tolerance to failure. Employees can be more productive and innovative if granted a certain degree of freedom and safety from their managers. Fear of losing a job can diminish the employee's ability to be creative, and therefore can block or decrease the innovativeness of the firm.

The appropriate KD practices to promote innovative behavior and therefore influence innovativeness through the organization and the culture of the firm are the following:

- ⇨ Creating an environment that promotes organizational learning through training and knowledge sharing.
- ⇨ Collaboration between employees, teams and departments to ensure knowledge is not lost. This can happen spontaneously through informal communication between colleagues from different disciplines but with common interests or objectives. An example would be to form communities of practice.
- ⇨ Decentralizing the decision making process by involving the employees though encouraging them to communicate their ideas with their managers and colleagues.
- ⇨ Creating a balance between formal and informal channels for knowledge dissemination encourages employees to share their knowledge more effectively.
- ⇨ Organizing brainstorming sessions to encourage collaborative communication between disciplines.
- ⇨ Developing an internal database for explicit knowledge that is accessible for the employees, or outsourcing an external database through a contract.
- ⇨ Developing a local intranet network that encourages employees to communicate and therefore share and/ or learn tacit and explicit knowledge.
- ⇨ Providing employees with online communication tools such as email services and videoconferencing services.
- ⇨ Developing or outsourcing a commercial web portal, in order to facilitate the contact between employees and clients.

The figure below explains how the influence of different KD practices on the organization and culture of the firm are linked and categorized according to the corresponding KD factors.

KD factors	⇨ KD tools
Human Resources	⇨ Collaboration between employees, teams and departments to ensure knowledge is not lost
Organizational Structure	⇨ Following a decentralized decision making strategy. ⇨ Creating a balance between formal and informal channels. ⇨ Organizing brainstorming sessions.
Organizational Culture	⇨ Creating an environment that promotes organizational learning through training and knowledge sharing. ⇨ Communities of practice.
Information and Communication Technology	⇨ Developing an internal database for explicit knowledge that is accessible for the employees, or outsourcing an external database through a contract. ⇨ Developing a local intranet network. ⇨ Providing employees with online communication tools such as email and videoconferencing services. ⇨ Developing or outsourcing a commercial web portal.

Figure 8: Knowledge dissemination practices that influence organization and culture

6.7 Practices that influence portfolio management

Measuring innovativeness in portfolio management can be achieved through the assessment of the size, duration, risk level and the number of projects a firm works on. This includes checking the balance in quantity between long and short-term projects, between high and low-risk projects or large and small projects. Assessing new potential projects requires reflecting on old experiences, and reviewing the unexploited skills that the employees might have. Therefore, The KD practices that influence innovativeness through portfolio management are the following:

- ⇨ Reflecting on completed projects as they can be a great source of knowledge. Innovative TECs debrief on recently completed projects in order to check if they can be relevant or helpful for tackling newly acquired projects.
- ⇨ Reviewing general themes by organizing meetings to check if the employees have skills that can be considered beneficial for future projects in new disciplines.

The figure below explains how the influence of different KD practices on portfolio management are linked through KD factors.

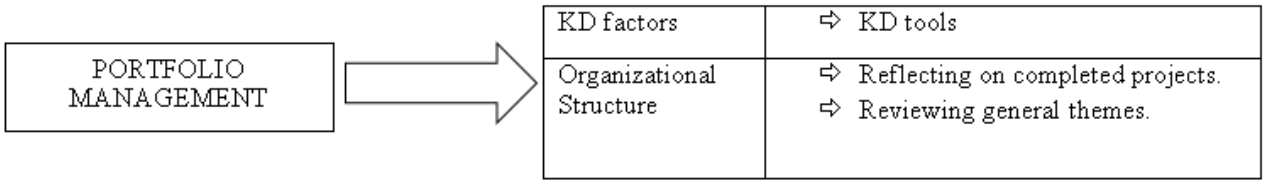

Figure 9: Knowledge dissemination practices that influence portfolio management

6.8 Practices that influence project management

The dimensions to measure innovativeness in project management are project efficiency, the use of tools, internal communication, and the collaboration with suppliers, clients and any other relevant third party firms. Therefore, the appropriate KD practices are:

- ⇨ Selecting experienced consultants who can collaborate with clients to develop new solutions can create a general understanding of the customer's needs and what the consultant can do to solve the problem.
- ⇨ Distributing the problem-solving tasks between clients and specialized consultants can increase the knowledge flow between both parties.

The figure below explains how the influence of different KD practices on project management are linked through KD factors.

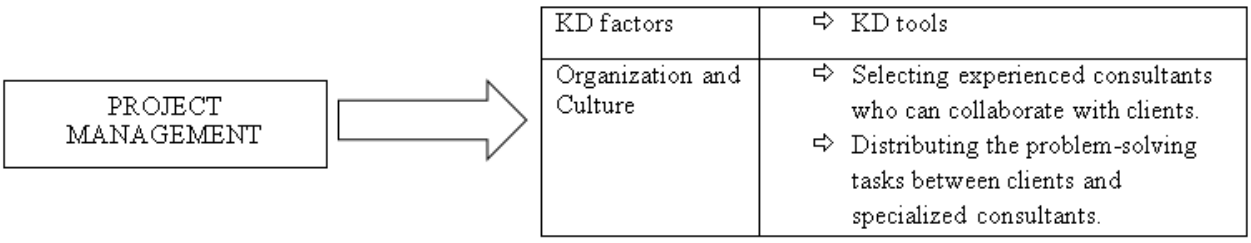

Figure 10: Knowledge dissemination practices that influence project management

6.9 Practices that influence commercialization

Commercialization includes market research, market testing, in addition to marketing and sales. This innovation measurement factor relies on the knowledge generated from market research, which is then disseminated in the firm to develop new services that satisfy the potential needs of the customer. The influential KD tool for this factor is:

- ⇨ Exploration of possibilities: Exploring and harnessing the knowledge the consultancy has gathered in order to identify market gaps and trends.

The figure below shows the KD tool that is considered to have an impact on commercialization.

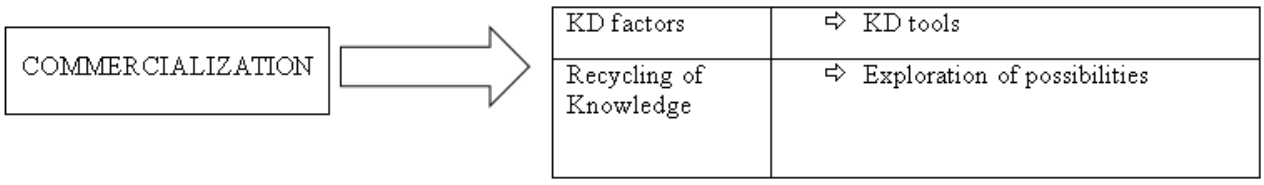

Figure 11: Knowledge dissemination practices that influence commercialization

6.10 Summary table of innovativeness factors versus knowledge dissemination practices:

The following table summarizes the KD practices that influence each of the innovation measurement factors, which were taken into consideration in this thesis. This classification skips the different categories that were assigned to the KD practices. The result is a table that presents each of the innovation measurement factors, with the knowledge dissemination practices that influence it.

Innovation measurement factors	**Knowledge dissemination practices**
Input management	⇨ Recruiting T-shaped professionals with more than just one specialty ⇨ Recruiting people with soft skills that are able to constantly learn and share knowledge

	⇨ Providing the employees with equipment that encourages knowledge sharing (computers, internet and intranet networks, etc).
Knowledge management	⇨ Adopting an open innovation approach. ⇨ Sharing knowledge with external stakeholders, clients and competitors ⇨ Internal collaboration ⇨ the collection of loose possibilities (testing innovations to detect potential problems) ⇨ The systematic re-use or reapplication of recent innovations (transferring an innovation after the end of its function in a project to other departments, so they can check if it could be used for other purposes) ⇨ Attention to conflicts (Detecting and solving internal problem between departments in the company) ⇨ Making the explicit knowledge of the company accessible through databases the employees can use. ⇨ Investing in patents ⇨ Multidisciplinary teams ⇨ Accumulating tacit knowledge through guidelines and sets of rules that the employees develop from their own professional experience in the firm. ⇨ Keeping record of all meetings ⇨ Partnering up with research institutions and other firms
Innovative strategy	⇨ Recruiting visionary and innovation-friendly managers who are able to provide their employees with a work environment that encourages innovativeness. ⇨ Following a decentralized decision making strategy

Organization and culture	⇨ Creating an environment that promotes organizational learning through training and knowledge sharing. ⇨ Collaboration between employees, teams and departments to ensure knowledge is not lost. ⇨ Communities of practice. ⇨ Following a decentralized decision making strategy. ⇨ Creating a balance between formal and informal channels. ⇨ Organizing brainstorming sessions. ⇨ Developing an internal database for explicit knowledge that is accessible for the employees, or outsourcing an external database through a contract. ⇨ Developing a local intranet network. ⇨ Providing employees with online communication tools such as email and videoconferencing services. ⇨ Developing or outsourcing a commercial web portal.
Portfolio management	⇨ Reflecting on completed projects. ⇨ Reviewing general themes.
Project management	⇨ Selecting experienced consultants who can collaborate with clients. ⇨ Distributing the problem-solving tasks between clients and specialized consultants.
Commercialization	⇨ Exploration of possibilities

Table 2: Innovativeness factors vs KD practices

7 METHODOLOGY

The thesis starts with a definition of the research gap and the problem in question. Following the statement of the research questions, a review of the literature is written. This is done in order to identify the different knowledge dissemination practices that can be used in SME TECs to enhance their innovativeness capability. The measurement of innovativeness was adopted from an existing framework, which was used to categorize the different knowledge dissemination practices by their impact on innovativeness.

The categorization of the KD practices according to their impact on innovativeness was used to create a questionnaire, and a set of questions to be asked in the form of semi-structured interviews. Qualitative data was deemed important to this study, as it is often difficult to quantify the level of innovativeness in SMEs, as well as the way knowledge is disseminated within this category of organizations. Informal KD practices are commonly used in SMEs. Subsequently, qualitative data was judged more representative and therefore conclusive.

7.1 Semi-structured interviews

Semi-structured interviews were deemed the most appropriate for the qualitative part of the data collection process. As SME TECs do not necessarily adopt the same business models, the semi-structured nature of the interviews allowed the conduction of a discussion rather than the reception of short answers. The questions that need to be answered were asked at one point or another. The interviews also allowed an introduction to the business model of the interviewed SME TECs. The services offered, the size and the resources of each of the companies also gave a different perspective on how the answers should be interpreted.

According to (Cachia and Millward, 2011), a semi-structured interview has some of the characteristics of both structured and unstructured interviews. Although the interviewer has a set of questions to be answered during the interview, these questions do not define the order with which the interviewee is to answer them. A discussion is held and the interviewee eventually answers all of the questions. However, the semi-structured characteristic of the interview allows the interviewer to get additional information about the company, in addition to getting the opinion of the interviewee on different matters related to the subject. The opinion of the interviewee often reflects

that of the company itself, and therefore makes the interpretation of the qualitative data more accurate and thus reliable.

The only interview that was held on the phone was with the co-founder of Company C (introduced later in this chapter). According to (Cachia and Millward, 2011) phone interviews can also be an efficient method to the collection of qualitative data. The same set of questions was followed, and the outcome of the interview was fruitful.

The set of questions that was answered during the interviews is the following:

7.1.1 The interview questions

The following questions were answered during the interviews. The questions were drafted according to the innovation measurement framework adopted by this thesis. The aim was to ask about the existence of the different KD practices which represent each of the innovativeness factors, identified in the previous chapters (secondary data).

1. What kind of skills do you look for when hiring a new employee? (T-skills, soft skills)
2. Does your company provide the necessary technology tools to share knowledge?
3. Does your company adopt an open innovation approach?
4. Is the explicit knowledge of your company accessible through databases the employees can use?
5. How does your company accumulate tacit knowledge? (guidelines and sets of rules)
6. Is knowledge shared with external stakeholders, clients and competitors?
7. Do employees at your firm collaborate with each other spontaneously? (Communities of practice)
8. Do engineers at your consultancy test past innovations to detect potential problems?
9. Does your supervisor promote the systematic re-use or reapplication of recent innovations?
10. How many patents does your consultancy own? How many a year on average? (The past 5 years)
11. Does your CEO promote the multidisciplinary nature when forming teams?
12. Do employees at your firm keep record of all meetings?
13. Does your company partner up with research and academic institutions? How often?

14. Is your manager visionary and innovation-friendly? Does he/she provide you and your colleagues with a work environment that encourages innovativeness?
15. Is the decision making strategy in your firm centralized?
16. Does your company promote organizational learning? How? (Training, knowledge sharing, etc).
17. Does your company follow a balanced structure of both formal and informal channels of communication?
18. Does your company organize brainstorming sessions?
19. Does your company have a local intranet network?
20. Are employees in your firm provided with online communication tools such as email and videoconferencing services?
21. Does your consultancy have a commercial web portal?
22. Does your company reflect on completed projects after they finish? (Evaluation of outcomes).
23. Does your company regularly review general themes? (evaluation of unexploited skills the employees might have)
24. Does your company rely on experience when recruiting managers?
25. Does your company distribute the problem-solving tasks between clients and employees?
26. Does your company accumulate knowledge on the market and then explore it to identify market gaps and trends?

7.1.2 The interviewed companies

In order to validate or reject the results obtained from the literature, interviews with local technology and engineering consultancies in Finland have been carried out. The objective of doing so is to get a grasp of what consultants in the industry think of knowledge dissemination, and whether they value or not the different practices that are deemed to be impactful on innovativeness according to management research.

Five companies were interviewed. Below, each one of them is briefly described. The settings of the interviews are also discussed.

Two companies chose for their contribution to remain anonymous. They are referred to as Company A, and Company B.

i. Company A

Company A is a Finnish SME which considers itself as an independent testing company with official authorization. Company A has approximately 200 employees in Finland.

Company A carries out inspections, tests and assessments in: Steel structures, ISO 9001, ISO 3834, EN 1090, pressure equipment, electrical equipment, fire alarm and extinguishing systems, and non-destructive (NDT) and destructive testing (DT) of materials.

The interview was held with Manager A, a Laboratory Foreman who works on non-destructive testing of material. Engineer A is a young inspector professional and engineer who also participated in the interview. The interview took place on March 6, 2017 in one of the company's regional offices Finland.

ii. Company B

Company B is an engineering consultancy that provides ship design, offshore engineering and construction services for marine offshore industries all over the world. The company delivers services across all of the vessel's lifecycle, from concept development and engineering to project management during shipbuilding and commissioning.

The interview was held with the Chief Information Officer, on March 13, 2017. It took place in the headquarters of Company B in Finland.

i. Company C

Company C is an independent consulting company that specializes in acoustics, noise abatement and audiovisual design services. It is considered to be a leading expert in the field in Finland and the Baltic countries. It employs over 30 experts.

The company was co-founded in 1994. Both co-founders still work in the company. The interview was held with one of the co-founders, who is currently in charge of the company's International Projects division.

The interview was held on the phone on February 20, 2017.

ii. Company D

Company D is a Finnish SME consultancy that specializes in geology and geotechnical engineering solutions. It employs 30 experts in its field of specialty.

The interview was held with the Development Manager, in the company's offices in Finland. The date of the interview is March 7, 2017.

iii. Company E

Company E is a consultation and design SME that develops investment sites for communities and industries. It specializes in tunnels, underground premises and protection technical buildings.

The interview was held with the Managing Director in the company's offices in Finland. The date of the interview is March 22, 2017.

7.2 The questionnaire

According to (Diefenbach, T., 2008), semi-structured interviews do not represent a sufficient data collection tool to draw reliable and valid conclusions. A need to collect additional information is clear, and therefore a triangulation of the data collection methodology can increase the consistency of the conclusions. The combination of a structured questionnaire in addition to the semi-structured interviews can provide a reliable source of data.

In that matter, a structured questionnaire was formulated to get more information from nine Finnish SME TECs. The questions revolved around the same information that was collected during the qualitative data collection process.

The questionnaire that was sent and answered by employees in managerial positions working in SME technology and engineering consultancies in Finland is included in APPENDIX 1.

7.3 The sample used for data collection

The list of technology and engineering consultancies operating across Finland is available on the website of the Finnish Association of Consulting Firms SKOL. The website provides the number of employees and the turnover of the companies in question.

The sampling frame, according to the information available on the website, for data collection consists of approximately 108 technology and engineering consultancies that fall under the SME category (According to the EU commission rules for SMEs). The questionnaire was answered by 9 companies, including 4 companies which chose to stay anonymous. Semi-structured interviews were held with 5 SME TECs. One of the interviewed companies participated in the questionnaire as well.

The total number of companies that participated in the data collection process is therefore 13, which represents approximately 12% of the sampling frame.

7.3.1 The sample used for the questionnaire

Nine companies accepted to answer the questionnaire. Four chose to remain anonymous, while five companies shared the name of their respective organizations.

Therefore, 8.33% of the sampling frame answered the questionnaire.

All of the companies that participated in the questionnaire answered “Yes” to the first question: “Does your company fit under the SME (Small and Medium sized Enterprise) category?” This was done to ensure that the companies that participated in the questionnaire do in fact fall under the SME category.

7.3.2 The sample used for the interviews

Five companies accepted to hold an interview. One interview was held on the phone, while four were held in the companies’ respective offices. The companies are referred to as Companies A, B, C, D, and E.

Therefore, 4.63% of the sampling frame accepted to hold an interview.

8 ANALYSIS OF THE RESULTS

In this chapter, the results obtained from the questionnaire and the interviews are analyzed to evaluate the conclusions that were established in the literature. The KD practices that were found to be pushers for innovativeness in SME TECs from the different articles that were studied are assessed from the perspective of the companies which took part in the data collection phase.

The results are categorized by the different factors that were adopted to evaluate innovativeness.

8.1 Input management

The literature identified three knowledge dissemination practices that improve the level of innovativeness in regards to input management.

- ⇨ Recruiting T-shaped professionals with more than just one specialty
- ⇨ Recruiting people with soft skills that are able to constantly learn and share knowledge
- ⇨ Providing the employees with equipment that encourages knowledge sharing (computers, internet and intranet networks, and etcetera).

To confirm or reject these results, two questions were included in both the interviews and the questionnaire. The first question asks about the skills the employer looks for when hiring a new employee. Here, a reference to T-shaped skills and to soft skills was brought to the attention of the interviewees, in order to get their opinion about the matter. In this matter, the interviewees had several opinions, which were similar in many ways.

8.1.1 T-shaped skills vs I-shaped skills

66.7% of the companies that participated in the questionnaire, chose T-shaped skilled candidates over their I-shaped peers.

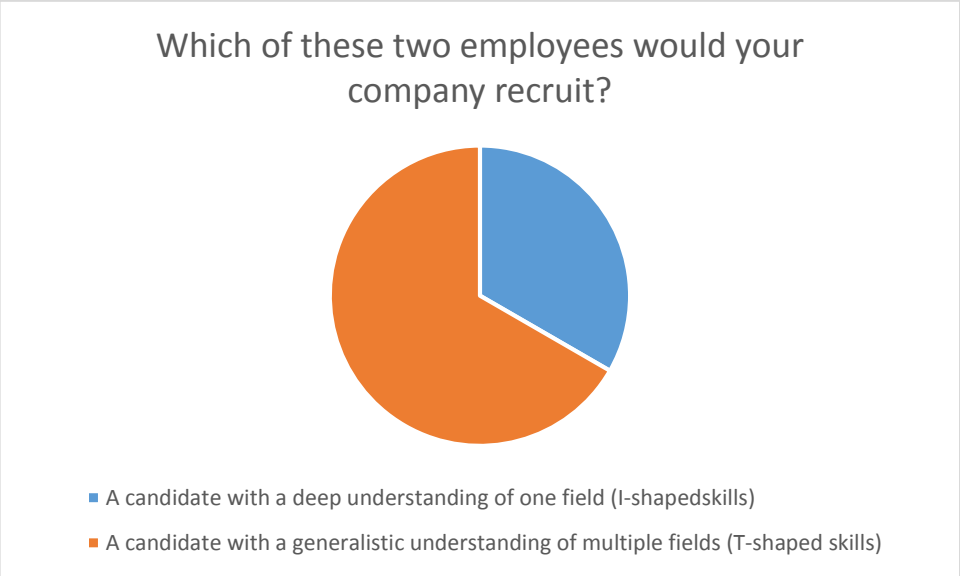

Figure 12: 66.7% of respondents to the questionnaire prefer candidates with T-shaped skills

The development manager in Company D followed the same trend. When asked about which kind of candidate the company would recruit, He immediately chose T-shaped candidates. However, the CIO of Company B, had a different perspective. He sees that both candidates are necessary for the success of a project that is being done by an engineering consultancy "[…] *When looking to hire someone for hydrodynamics for example, it's a very specific skill, then we probably go for that one [I-shaped skills], but if we are going to hire someone for the administration, then it's clearly that one [T-shaped skills]. So the answer is both, depending on the position. Because of our profile as a consulting company, we need to have those as well* […]".

It is important to note that Company D specializes in geology and geoengineering, while Company B specializes in the design of ships, covering all of the ship's lifecycle. The difference in the amount of technical work that is happening in both companies can explain the need for Company B to also hire I-shaped employees, unlike Company D which exclusively recruits candidates with a wider rather than deeper skills.

➔Therefore, although T-shaped skilled candidates are favored by most consultancies, the amount of technical work that happens in the consultancy might create the need to hire I-shaped candidates as well. The preference for T-shaped skilled candidates, however, is clear among the companies that took part in the study.

8.1.2 Soft skills and the ability to constantly learn

In this matter, most companies agreed on the importance of high social skills and the ability to learn. It is considered as a valuable necessity in these companies. The co-founder of Company C insisted that it is necessary for a candidate to be able to constantly learn, in addition to having advanced social skills "*[…]We get people who have a good idea on how to use new knowledge and how to find new knowledge. That's the first thing. The second thing is the right personality. It's very important that we get people who would swing with the group. Social ability is very important. Those are the two main things that we look for* […]". The CIO of Company B had a similar opinion "*we also require this type of interpersonal skills. So we look at both. It's kind of a background- how well they know the discipline, and then how well they get along with other people. So they need both*".

The respondents of the third question in the questionnaire (*Select the three most important skills your company considers when hiring a potential employee*), also valued the importance of social skills in a candidate. While 88.9% of all respondents considered having a good professional reputation as an important factor, 77.8% viewed social skills as an important asset to join the company. Social skills were therefore second in importance, according to the respondents to the questionnaire. The third most important skill was the ability to work in a multidisciplinary team, which also refers to the importance of communicating with other employees, regardless of the field of expertise. Companies, however, did not value excellent university grades, with only 22.2% of all respondents considering it as important.

Figure 13: The three most important skills when hiring an employee according to the respondents to the questionnaire

➔SME TECs value candidates with advanced social skills and the ability to grasp new knowledge. These two qualities allow the employees to share their knowledge with their colleagues, and to be able to constantly innovate when solving problems.

8.1.3 Providing the employees with equipment that encourages knowledge sharing

Basic knowledge sharing tools are available in most SME TECs. All respondents do have computers, and 88.9% of the companies that answered the questionnaire do have an intranet network and a company email. 77.8% have videoconferencing software and equipment.

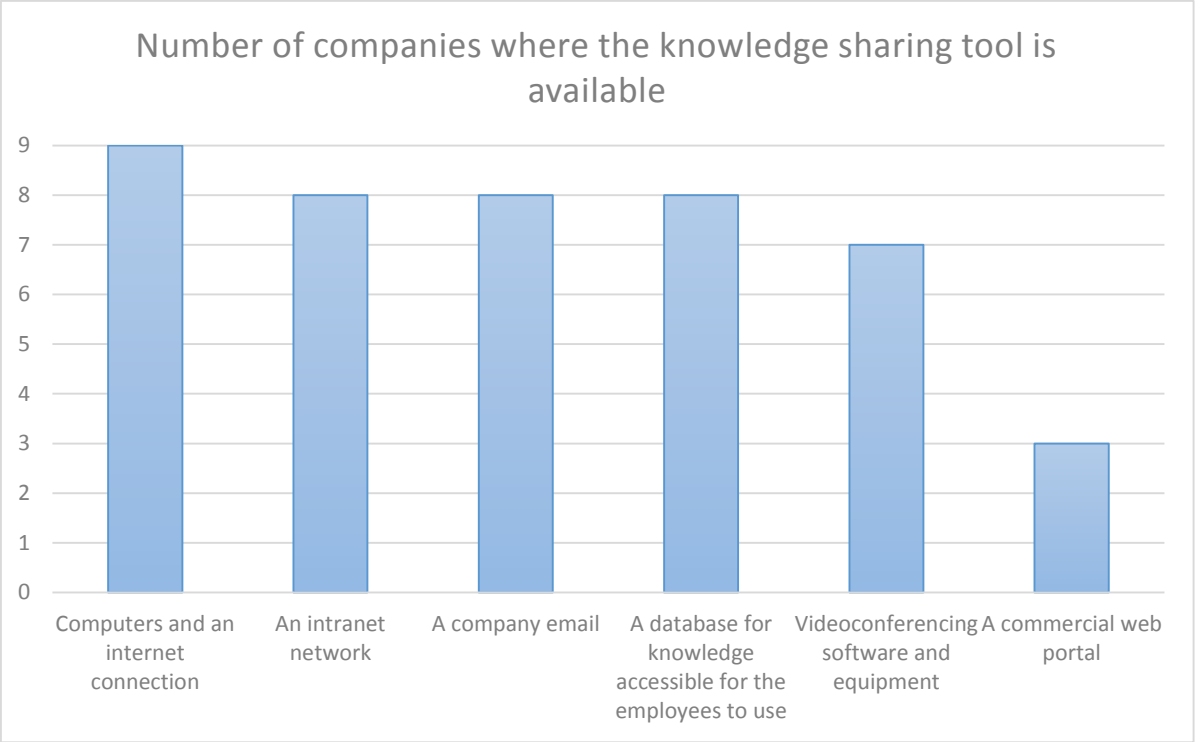

Figure 14: Availability of KD tools that encourage sharing among respondents to the questionnaire

The interviewed companies confirmed the existence of equipment that encourages communication and knowledge sharing in their respective organizations. The CIO of Company B confirms the existence of such tools at Company B "*Yeah well we have various tools for doing that. It's kind of tools for sharing knowledge inside the company and then tools to sharing knowledge within the project that we execute*". The CEO of Company E also confirmed the existence of these tools in his company.

➔The existence of the various communication tools that encourage knowledge sharing between employees has an important value in SME TECs. Most companies agree in fact, that these tools are important to the creation of an environment that encourages innovativeness.

8.2 Idea generation

The literature identifies two knowledge dissemination practices related to Idea generation that positively impact the level of innovativeness in SME TECs.

- ⇨ the collection of loose possibilities (testing innovations to detect potential problems)

- ⇨ The systematic re-use or reapplication of recent innovations (transferring an innovation after the end of its function in a project to other departments, so they can check if it could be used for other purposes)

To confirm or reject the importance of such practices, several questions were included in both the questionnaire and the interviews. The sections below analyze these factors individually, and then conclude the value of each of them in the studied firms. The figure below describes the number of the KD practices related to Idea generation checked by the respondents to the questionnaire.

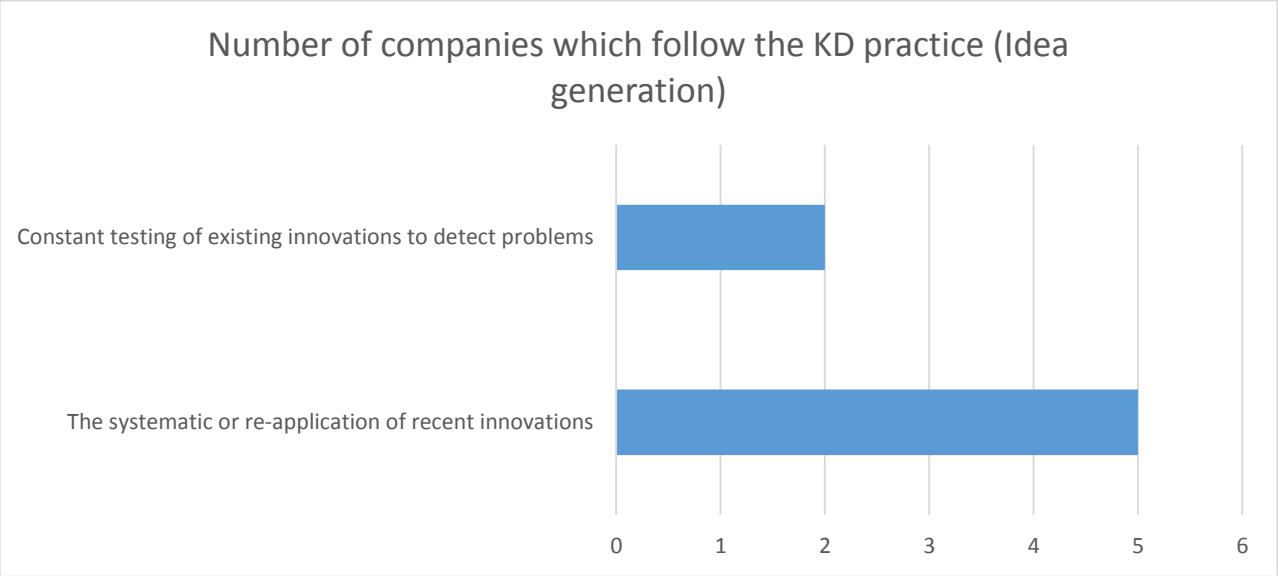

Figure 15: KD practices relative to idea generation among the respondents to the questionnaire

8.2.1 The collection of loose possibilities (testing innovations to detect potential problems)

22.2% of the respondents to the questionnaire considered this practice as available in their companies. Similarly, the interviewed companies considered this kind of practice as incompatible to some degree with their activities. As TECs focus on delivering services rather than developing products, the testing of past innovations only happens when certain guidelines must be revised or improved. The co-founder of Company C explains "[…] *we're just providing design solutions so not really in that sense no. Not in a formal way but every project is a little bit different. There is always gonna be a resolution of the guidelines. Every time you make a similar project, you will learn something new and then you'll improve the general guidelines accordingly. It's not formal. There are some things which are done formally which are related to the quality system*". The work

involved in SME TECs involves in many cases the repetition of certain tasks, which come in the form of service solutions. The development manager at Company D has a similar opinion regarding the matter "*I guess we modify the guidelines from what people say and then people try to follow that and then they comment. If it something doesn't work then we modify the guidelines, but there is no official method-test*".

The CEO of Company E was confident about the importance of this practice and sees it as part of the activities carried in his company. When asked about it, he answered "*Definitely, Yes. They do it. In this business they have done it, and they're doing it"*. This practice is also followed at Company B, according to the CIO.

Some of the companies have certain inspectors that would evaluate the tasks done in case of problems. Company A has such employees whose work involves fixing problems rather than preventing them "[…] *these level 3 guys for example check if it was x-rayed, or leaking or something like that, then the level 3 guys can inspect again, the same, take x-ray films and evaluate if it was made the right way or the wrong way. This happens not many times, maybe once every 10 years or something.*" The level 3 guys here are the inspectors, whose function is to repair the damage and prevent it from happening again.

➔The collection of loose possibilities is not a common practice in SME TECs. It is clear, however, that some companies do follow it partially, in order to improve their services. This practice, although not followed in most SME TECs, is valued in the ones with a higher business performance. Therefore, it is a pusher for innovativeness, and should be given the importance it requires.

8.2.2 The systematic re-use or reapplication of recent innovations

55.6% of the respondents checked "*The systematic re-use or re-application of recent innovations*" as a KD practice available in their companies. Company B follows this practice through the reapplication of certain partial design developments "*: I would say yes. We try to do that. In one project, we develop a specific type and then we try to re-use for the next one. At least, for some parts."* The CEO of Company E thinks that the re-use and re-application of recent innovations is in fact systematic in his company "*Yes. We have even supervisors in the company who systematically do this".*

The rest of the interviewed companies, however, did not relate to this practice.

➔The systematic re-use or reapplication of recent innovations can be systematic in some SME TECs. The human capital clearly has an important role in following such tasks. This however, does not mean that smaller companies do not re-use some of their innovative services, in an informal and perhaps unsystematic way.

8.3 Knowledge repository

The literature identifies two knowledge dissemination practices related to knowledge repository that positively impact the level of innovativeness in SME TECs.

- ⇨ Making the explicit knowledge of the company accessible through databases the employees can use.
- ⇨ Accumulating tacit knowledge through guidelines and sets of rules that the employees develop from their own professional experience in the firm.
- ⇨ Investing in patents
- ⇨ Multidisciplinary teams
- ⇨ Keeping record of all meetings

To confirm or reject the importance of such practices, several questions were included in both the questionnaire and the interviews. The sections below analyze these factors individually, and then conclude the value of each of them in the studied firms.

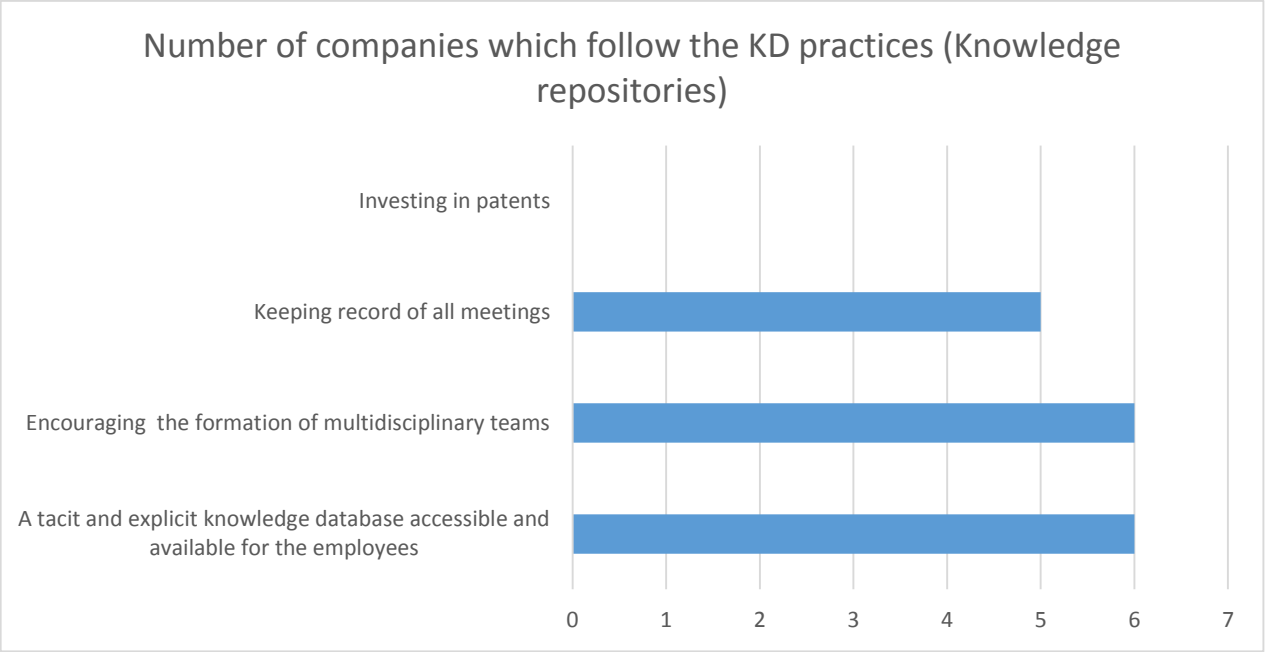

Figure 16: KD practices relative to knowledge repositories among the respondents to the questionnaire

8.3.1 The availability of a database for explicit and tacit knowledge

88.9% of the respondents to the questionnaire confirmed that they do in fact have a database that contains knowledge accessible for their employees. 66.7% checked "*making the explicit knowledge of the company accessible through databases available for the employees to use*", as an available tool in their organization. An even higher portion of the respondents (77.8%), answered favorably to "*accumulating tacit knowledge through guidelines and sets of rules that the employees develop from their own professional experience in the firm*". The companies that participated in the questionnaire clearly considered having a database as an important pusher for innovativeness.

All of the interviewed companies, do in fact have a database for tacit knowledge which consists of reports and guidelines for projects that can be used repeatedly by the employees. Employees at Company C have access to a database that includes different standardized reports for some of the tasks that they perform "*Yes we do that. We have standard reports for different kinds of solutions. How to design a standard report. How to acoustically design a school, a business center, and things like that. We have standard reports for preliminary acoustic design, acoustic work description and stuff like that. We have all sorts of standard documents like that. They're all in the same database.*" Company A also keeps a database for its employees, where they can find different project reports:

"*Company A has its own database for reports, but clients can't go there. We [The employees] can do it.*"

The CIO of Company B noted that his company also keeps guidelines for its employees to follow: "*So we have some guidelines that we follow in all projects. Kind of a type of instructions and operating procedures*". Company D uses a similar database that includes tacit knowledge available for their employees "*We have created some and some of them [guidelines] come from the government. How things should be done."*

The CEO of Company3, however, sees that accumulating tacit knowledge in the form of guidelines is not as easy of a task as it might seem. He argues that although they are clearly valuable, employees do not necessarily have the time to make them. This makes it harder to accumulate tacit knowledge, given the serious time constraint the employees are challenged with. Company E, however, does have guidelines that the CEO believes are good enough. The storage of these guidelines seems to be an organizational obstacle that the company looks forward to overcoming "*We have not managed to do. We have been talking about the subject but we have not managed to do it, it's too difficult so far. I feel we are talking about the idea. Should we do it? We said yes we should but then in the real world, it doesn't happen. Tacit information transfers from one place to another [through the teams]. […]. I have the feeling that we have good guidelines, but then following, whether the team members are using those or not, that is not very well. I feel that this is a challenge in all the organization because there is a tendency, in all the tasks, you have things to do and you have deadlines, and then you have a conflict with those. And the next morning you get a new task. We should have more time to do this kind of tacit information development and putting them in databases, but the real world hits back because there are [constantly] so many big tasks coming from the clients. This is the reality I think. This is a big challenge now."* The time constraint can be a clear obstacle towards the storage and development of tacit knowledge in SME TECs.

Explicit knowledge is also available in some of the interviewed companies. Company C, Company E, and Company B do have a database for explicit knowledge. Company A and Company D, however, do not store explicit knowledge.

The CIO of Company B explains that even though his company has a database for knowledge, access is controlled depending on the managerial level of the employees "*yes we have. We have that yes. We have both for project specific and for the company information. But that information is also closed -like depending on the position-, so this type of document management system that we have. So access to various parts of the information may vary depending on the position you have in the*

company also. So most parts are open to everyone. But anyway there is some kind of access control."

The co-founder of Company C sees that the existence of a database for knowledge does not necessarily mean it is efficiently used. He sees that maintaining a database for both explicit and tacit knowledge in an SME TEC can be difficult "*We have a server with a lot of material, a lot of articles, product information, but it's not 100% organized. It requires a lot of effort from everyone to find them*". The obstacles towards the development of a database are caused by the human and time constraints in SMEs.

➔Most companies that participated in the collection of either qualitative or quantitative data, believe that the availability of a database is a pusher for innovation. However, most of the interviewed companies (especially the smaller SMEs) see the development and the maintenance of such a database can be challenging because of the limited human capital and the time constraints that result from it.

8.3.2 Investing in patents

All of the companies that responded to the questionnaire reported having zero patents. Interviewed companies did not have any patents neither.

Company C does not work with patents "*we're not in the business of patents and stuff like that we're just providing design solutions so not really in that sense no.*" The CIO of Company B sees that the designs made at his company would be copied whether they do invest in patents or not "*We think is that they [our designs] would be copied anyway*".

➔SME TECs do not consider investing in patents as part of their work, or as a sound investment in that matter.

8.3.3 Keeping record of all meetings

55.6% of all respondents checked "Keeping record of all meetings" as a KD practice their companies follow. Some of the interviewed companies noted that although they do not take formal minutes, they do take notes for personal or collective use.

When asked about whether minutes are taken during meetings, the CIO of Company B confirmed that this practice is in fact followed in his firm "*Yes we do it [take minutes] typically"*. The CEO of Company E considers taking minutes as a necessity in his company "*Yes. We have to do it.*"

Employees at Company C take formal minutes when meeting for large projects. However, they find it sufficient to take notes or semi-formal minutes when meeting for smaller tasks. The co-founder says about the subject "*We take semi-formal minutes of the team meetings. Basically we go through the project and we have notes on that. For larger projects, when we have a team meeting for that, we'll also write formal minutes.*" Meetings are stored for future use, although access to it is controlled depending on the managerial level of the meeting. Minutes from the management board meetings are, for example, not accessible to all of the employees "*The employees do not have access to all minutes, for example [the minutes] from the management board meetings.*" Similarly to Company C, employees at Company D do take notes for some of the meetings, and find it enough for them to take notes for the rest. This typically depends on whether the clients ask for minutes to be taken. These minutes, however, are not shared or stored for future use "*[Some clients] they demand that we take some minutes for some meetings. But not all of them. We just take our own notes, and it's not shared or stored*".

Employees at Company A do not take minutes during their meetings. Instead, a report is drafted and sent to the main office. Manager A, explains how this is done: "*No. once a week in Lappeenranta we have a meeting for our people. We talk about what happens this week and try to handle that. Who's going where, etcetera. It's like a report. It's one letter, I write it down and yeah [send it].*"

➔Taking minutes is considered a necessity in some SME TECs. However, small SME TECs usually find that taking simple notes and/ or drafting reports that contain summaries of the important points covered during meetings to be sufficient.

8.3.4 Promoting the formation of multidisciplinary teams

66.7% of the companies that responded to the questionnaire checked "*The formation of multidisciplinary teams*" as a knowledge dissemination practice available in their company. All interviewed companies said the formation of multidisciplinary teams is promoted, at least to some extent.

According to the co-founder of Company C, all teams at his company have to be multidisciplinary, as each employee has unique skills in the firm "*The people in our office are anything from interior*

designers to doctors of acoustics. So any team put together for any project will be multidisciplinary. There is no way around it. Because we can't make a team of the same people, because we don't have two of the same people."

Company B forms multidisciplinary teams when working on large projects, as all competencies would be needed in this case "*yes we do. At least in the larger projects, you need all competencies, from many disciplines. So yes, we do.*"

The CEO of Company E considers that team leaders in his company are interchangeable. The team formation strategy is constantly discussed in the firm and the multidisciplinary nature is in fact promoted "*Forming teams is an ongoing discussion in our company. How we should form the next team. That is the nature of business in our case yes.*"

Company D, however, does not systematically promote the formation of multidisciplinary teams. It is however promoted, to some extent "*Well it's kind of hard in our field, because most people are specified in what they do but it's possible to promote it. Yes to some extent.*"

➔Promoting the multidisciplinary formation of teams is found to be necessary for most of the SME TECs that were studied. It is considered to be a pusher for innovation as well.

8.4 Information flows

The literature identifies two knowledge dissemination practices related to Information flows that positively impact the level of innovativeness in SME TECs.

- ⇨ Internal collaboration
- ⇨ Open innovation
- ⇨ Partnering up with research institutions and other firms

To confirm or reject the importance of such practices, several questions were included in both the questionnaire and the interviews. The sections below analyze these factors individually, and then conclude the value of each of them in the studied firms.

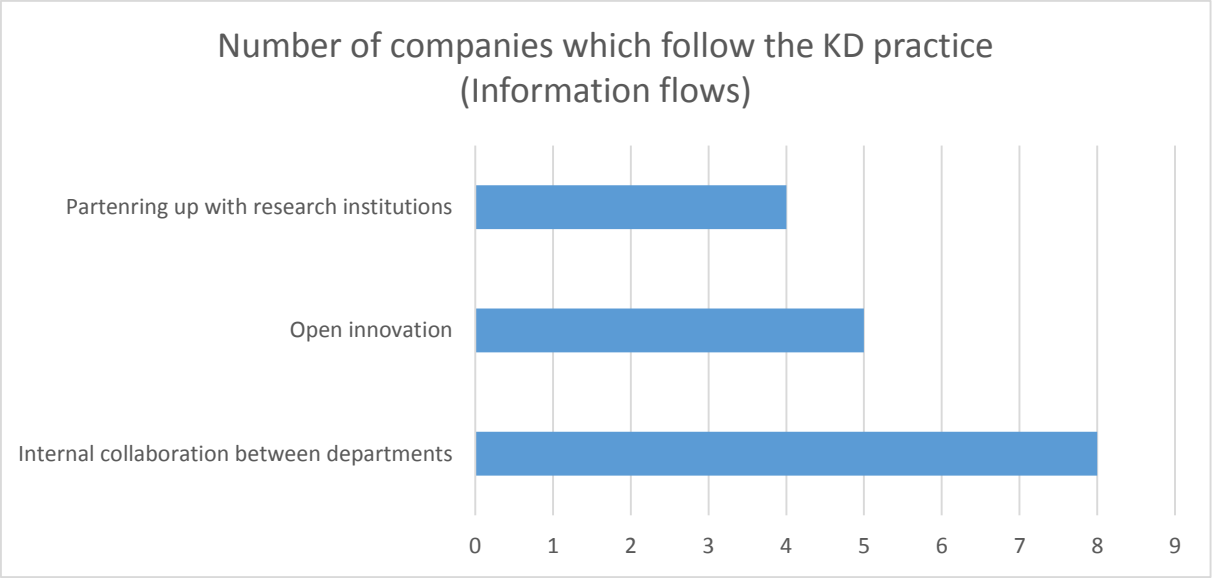

Figure 17: KD practices relative to information flows among the respondents to the questionnaire

8.4.1 Internal collaboration and Communities of practice

The development manager of Company D valued direct informal communication over communication induced from formal KD practices. Although formal communication channels are available at his company, he thinks that the most important way to share knowledge in SMEs is for employees to communicate with each other and build human relations "*most of it is informal, since we're close to each other. We talk to each other and we share knowledge that way.*" he continues, when asked about the existence of communities of practice in his firm "*They also talk to each other. We have a closed community. Some people have been working here for 25 years, that's actually when the company was founded."* As Company D is a family-run company, the old and close relations the employees have built constitute an advantage towards spontaneous internal collaboration.

The co-founder of company C considers spontaneous collaboration as a common practice in his firm "*Yeah they do that [form communities of practice] all the time. I mean there would be someone who starts to do some development project and stuff like that. It doesn't have to come from me – that's very good- they will do that regularly. It could be anything from new design practice to new measurement equipment to whatever*". Company A, originally a family-run business, values spontaneous collaboration as well "*Yeah. Sometimes we work in a team and if we get ideas to make this better, we speak and we think about that.*" The CEO of Company E shared the same opinion as well "*Yes I would say yes. Definitely. We support that*". The CIO of Company B, however, sees that

employees in his company should embrace this practice more often "*We should have better tools for doing this easier, but certainly, the idea is that you should be able to communicate spontaneously. I think it should be easier to do it".* It is important to note that Company B has the highest number of employees among the interviewed companies, with approximately 250 employees in Finland "*Still in Finland, we can be considered as an SME since we have roughly 250 people here."*. Several closed offices exist in the company, which can be considered as an obstacle towards building human relations and therefore spontaneous collaboration.

88.9% of the respondents to the questionnaire checked "I*nternal collaboration between departments*" and "*Collaboration between employees, teams and departments to ensure knowledge is not lost".* However, only 44.4% checked "*communities of practice (Spontaneous collaboration between employees with shared interests)*" as a KD practice followed by their employees.

➔Internal collaboration between employees and departments is a commonly followed practice in SME TECs. Spontaneous collaboration through the formation of communities of practice is also considered by managers in SME TECs as a pusher for innovation. However, spontaneous collaboration is more likely to happen in smaller SME TECs, where employees build stronger human relationships.

8.4.2 Partnering up with research institutions and other firms

44.4% of respondents to the questionnaire belong to companies which partner up with research institutions.

The co-founder of Company C explained that the field of expertise of his company is not taught in Finnish universities, which makes working with the local universities challenging. The company, however, hired professors from Aalto University as freelancers in the past "*Not so much from universities, but there are some other acoustic databases. […] There are none of the universities in Finland that are really seriously doing what we're doing -I mean the simple acoustic consultant. We had collaboration with the universities, with Aalto University for research. We used the professors there as freelancers."*

Company D had the same challenge as Company C. Because the field of expertise of the company was not taught in Finish universities, the management of the company worked with the local universities to create an educational program where students can study soil investigation. The program is now created, and Company D is receiving its first group of soil investigation fresh

graduates in the near future "*Not with universities but this soil investigation side, we have been from the beginning [trying] to form this education in Finland, but it's just lower level. Our CEO is part of the team that is making this education [soil investigation] happen".*

Company B is involved in several collaboration projects with some of the Finish universities such as Aalto University and Turku University of Technology "*yes we do. We had several collaboration projects for like energy efficiency, I think we did it with Aalto University. And then also something here with Turku University of Technology.*"

Company E is involved with universities as well. The CEO is also an academic who used to teach at Aalto University for 20 years. The company recruits regularly students to work on their master thesis at the company "*I have been teaching for 20 years at Aalto University. We have also other ways to cooperate with them, every now and then we ask younger fellows to come here to make their thesis, then we have all kinds of [collaboration], for example I organized some big work with a professor as a team leader to develop programs for this kind of ordinary works that we do.*"

Company A does not normally work with universities. However, Engineer A, who has been working at Company A for the past three years, did confirm during the interview that he worked with Company A on his master thesis "*In some way yeah. About 3 years ago, I did my thesis for Company A*", before joining the company as a full-time employee.

➔Most companies do value collaboration with universities and research institutions. It can however be challenging in some cases, as the research that these companies need might not necessarily be available.

8.4.3 Open innovation

55.6% of companies that participated in the questionnaire believe that an open innovation approach is adopted in their organizations. Interviewed companies, however, had some reservations when it came to open innovation. Most of them agreed that although knowledge is shared with clients, stakeholders and some companies with a similar business model, it can be risky to share knowledge with direct competitors. The co-founder of Company C explains how his company cannot share knowledge with similar Finnish companies, as they are often too close and therefore it would be risky to adopt an open innovation approach with them. He, however, underlined the importance of collaborating with similar companies in the Nordic region, which are working outside of Finland "*We find that most of the time the information is not classified in anyway, and there is no point why*

we shouldn't not using it among similar companies. But it helps with Nordic companies, more like Nordic competitors or colleagues, than actually our Finnish competitors. Our Finnish competitors are too close. We have good collaboration with most of our competitors in Finland, but when you're fishing for exactly the same job, it's a bit difficult to share too much information." Company B's CIO had a similar opinion about open innovation "*Some of the results that we have might be business critical, and we don't share, [...] so that's kind of our own – we have developed. But otherwise in many cases, we are open.so that's another answer. But some information we don't share. Because for example, maybe our clients don't want us to share it.*" The development manager of Company D had a similar approach to open innovation, by being open with some partners and closed with competitors "*Maybe we're in half way in that. We share some of our ideas about for example which programs to use with our partners, but not for the competition".* The CEO of Company E agrees with the importance of open innovation as well, "*that I think we have a very open approach with all the innovations that we do in the ICT world, and then also development."* Company A, however, has a different view towards open innovation. In fact, Company A chooses not to share the innovations that are created inside its organization "I *guess that if you get some ideas in Company A, they stay in Company A. I think it goes like this.*"

All respondents, however, agreed that knowledge should be shared with the clients and the different stakeholders, as it can be a necessity to save time and cost. Company B's CIO explains that if competitors are temporarily partners on a certain project, then knowledge must be shared with them as well "*if we are the main contractor, and then we have some ship owner, and then we have some yard somewhere in the world and then we have a cluster of these different parties, stakeholders, some of them may be competitors so yes we share the knowledge in this project but depending on the rules the ship owner sets. If they say that this is a project that we need to collaborate on with the stakeholders, then we do it.*" As clients might request that a consultancy works with a competitor for the sake of the project in question, open collaboration between both rivals becomes necessary to be able to innovate.

➔Most companies do share their innovations with their partners and clients. It is however uncommon for SME TECs to share their innovations with their competitors, as it might compromise their ability to get clients and consequently grow.

8.5 Innovative strategy

The literature identifies two knowledge dissemination practices related to the innovative strategy, which positively impact the level of innovativeness in SME TECs.

- ⇨ Recruiting visionary and innovation-friendly managers who are able to provide their employees with a work environment that encourages innovativeness.
- ⇨ Following a decentralized decision making strategy

To confirm or reject the importance of such practices, several questions were included in both the questionnaire and the interviews. The sections below analyze these factors individually, and then conclude the value of each of them in the studied firms.

8.5.1 Recruiting visionary and innovation-friendly managers who are able to provide their employees with a work environment that encourages innovativeness

88.9% of all respondents answered "yes" to the question "Do you consider your management strategy as innovation friendly?" in the questionnaire.

Figure 18: 88.9% of respondents to the questionnaire consider their management strategy to be innovation friendly

As innovativeness is considered to be an important asset in most technology and engineering consultancies, most managers realize the importance of allowing their employees work in an

environment that encourages creativity, and tolerates failure. The co-founder of Company C thinks that employees at his company are comfortable with developing new ideas. He notes that as long as the risks are calculated, the company supports the employees who take them "*I think they're [the employees] sometimes a little bit too little scared. They would do some pretty crazy stuff every now and then [chuckles]. I think they all appreciate that they should be careful of course, but they should also take risks, and, if they take well calculated risks, then the company will support them, whatever the outcome."*

Employees at Company B are also in a position to innovate and to suggest changes to the existing procedures "*Of course you can suggest or say you want to improve some kind of procedure and perhaps adopt them in other projects also. Yes I would say so".*

The CEO of Company E considers that managers at his company are visionary and innovation friendly as well "*There are many kinds of people that are very visionary people […] our geology manager has very visionary people and he's actually a researcher. Also, our architecture manager is also very visionary"*. The development manager of Company D also considers the CEO of his company as innovation friendly.

On the other hand, employees at Company A have to follow the procedures which they receive from the company's main office "*Normally we have to use the procedures. That's the way it goes."*

➔Managers at SME TECs should allow their employees to have a certain degree of innovation freedom, through the creation of an environment that encourages creativity and tolerates well calculated risks.

8.5.2 Following a decentralized decision making strategy

All managers which answered the questionnaire consider the decision making strategy in their respective firms as decentralized. Among the interviewed companies, Company A is the only company that has a centralized strategy, as most of the tasks done by the employees are received from the company's main office.

The decisions at Company D are usually the result of a collaboration between the project coordinators, the CEO, and the development manager *"I think it's more like a collaboration where we –me, a project coordinators and the CEO, we talk about some new equipment or programs or*

something that needs to be paid, but the CEO always makes the last decision. It's his responsibility if something fails." The final decision is, however, made by the CEO.

The co-founder of Company C considers the decision making strategy in his firm as decentralized. Although official decisions are made by the board of directors, decisions at the project level are usually made by the team which is in charge of it. This leaves employees with a certain level of autonomy, which in turn encourages innovativeness. "*It's not [centralized]. I mean we have an official organization with the board of directors, where the official decisions for the everyday operations of the company are done. But all decisions related to projects, are done within the project group. We have a pretty flat organization. It's one of the things which we're criticized for when we get extra orders. People are not quite aware of who's actually the boss, because it doesn't seem to be very important.*"

Company B has a similar view towards the decision-making strategy in the firm. Project-related decisions stay within the project team, while more important decisions are made by either the management team, or in some cases the board of directors "*When it comes to projects, project managers make the decisions for their project. So in that sense, I would say decentralized. Certain decisions of course by definition must be centralized. So they may be something like strategies, which is more like fewer people would be doing that, but it's not like one decides for all. Bigger decisions are taken in management team, and then of course the board of directors if it has to do with the ownership and so on.*"

The CEO of Company E considers the decentralization of the decision-making strategy in his firm as important to innovativeness. In order to enforce this strategy, the formation of teams in Company E is constantly discussed. Leadership positions are temporary for all employees. This means that a team leader in one project, will probably be a member in the next project, and vice versa. This eliminates the vertical hierarchy that most companies adopt, pushing the employees to focus on innovating within an organizational structure that is constantly changing depending on the tasks and the projects under development "*Certainly not [centralized]. For example TL is the team leader of project A, and then they work for one year or whatever. Then we have project B, a new project. In this next project, we organize it so that number 2 [member from project A] is the new team leader, and this TL is now member of the team. So that the culture of changing the team leader, […]. This means you can develop fantastic new projects, as this organization culture is not strict and not organized the same way all the time. it means that if you accept this idea -leadership can change all the time- this is mentally very good, and is a high level of professionalism , and that we have done here in our company".* The CEO noted that he, himself, is member in some of the teams in his

company, which are led by some of his employees as team leaders "*for example, I, me personally, even though I'm the managing director, in many teams, I'm here as a team member"*.

➔Most managers at SME TECs agree on the importance of adopting a decentralized decision-making strategy, especially at the team/ project level. Involving the employees in the decision making process can enhance their autonomy and therefore their ability to innovate.

8.6 Organization and culture

Three KD practices related to organization and culture were identified in the literature;

- ⇨ Creating an environment that promotes organizational learning through training and knowledge sharing.
- ⇨ Organizing brainstorming sessions.
- ⇨ Developing or outsourcing a commercial web portal.

To confirm or reject the importance of such practices, several questions were included in both the questionnaire and the interviews. The sections below analyze these factors individually, and then conclude the value of each of them in the studied firms. The chart below shows the responses of the companies in the questionnaire regarding the KD practices mentioned above.

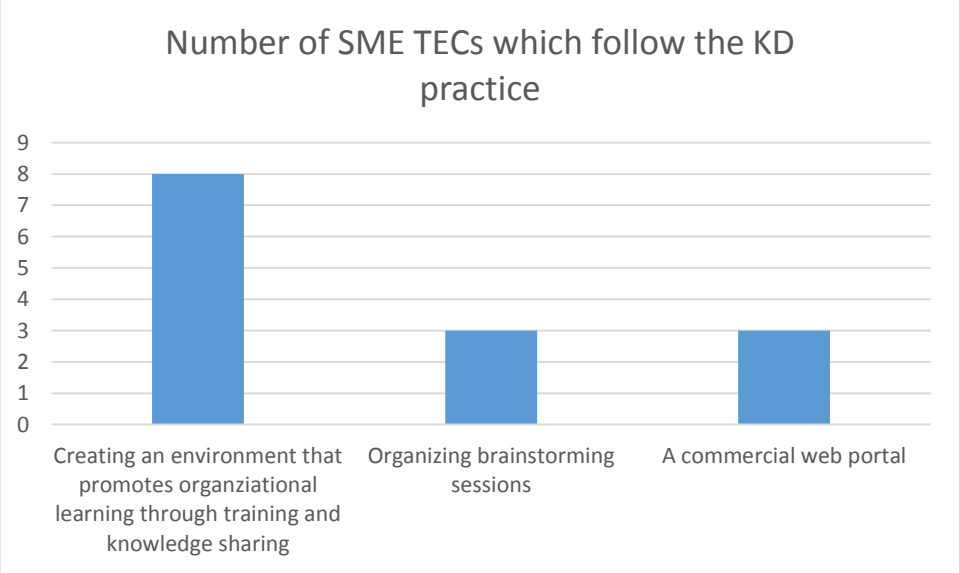

Figure 19: SME TECs which follow the KD practices relative to organization and culture in the questionnaire

The results are analyzed individually in the sections below.

8.6.1 Creating an environment that promotes organizational learning through training and knowledge sharing

88.9% of respondents considered "Creating an environment that promotes organizational learning through training and knowledge sharing" as an available KD practice available in their firms. Most SME TECs realize the importance of internal trainings and organizational learning, to improve the skills of their existing employees or to introduce their new recruits into the company's business. These practices can vary from periodical trainings, to special courses and conferences. Company C organizes internal conferences for its employees, where they get the chance to present their work to their colleagues, in an effort to share knowledge inside the company *"We have our own conferences. Like our own company conferences where different people would be presenting. We're going to different conferences, like acoustic design conferences, or theater design conferences, stuff like that. So yes we do promote that"*. The company also offers courses for its employees when necessary. This happens when new projects are introduced to the company, and the employees lack some of the required skills "*In some case, well we would have new projects, like for instance we've had some projects related to buildings. That means that we decided that some of the guys would participate in a building conference and take some courses"*. The co-founder of Company C insists however on the necessity of organizing periodical trainings every year for all of the employees as well "*Essentially, everybody has to do at least one or two training days per year. We have internal training. It's actually part of the qualities that people have to do trainings*".

Company B also offers its employees various trainings and courses. Although some of them are required for all or some of the employees, there are also those which are optional. The CIO of Company B explains "*And there is also this training calendar, we have this type of training according to specific items that you can participate, and there is someone who is actually organizing it so yes we do that. They're optional, you can participate if you want. Some of them are more or less mandatory. For example, these [other trainings] are more or less mandatory. They organized in various locations where we have our offices in Turku and Helsinki. If they have to work with the tools, then they will be there*". Company B also offers its employees a blog with a news feed that promotes the available new courses and trainings "*we actually have various news items has to do with official news and there are some blogs here".*

The development manager of Company D noted that his company does not organize any official training days. The company, however, does involve its employees into special trainings, which are destined to educate the employees about new equipment or software. He insisted, however, that none of them are official, and that some of them are organized by the supplier rather than the company itself "*Sometimes, if we acquire a new program, there is some education from the sellers or if we buy new equipment there is always some education for that or training for the users. Nothing official.*"

The CEO of Company E noted the existence of various types of trainings at his company. He sees organizational learning as a valuable stimulator for innovativeness "*We have training days, marketing trainings, team trainings, all kinds of training methods are used nowadays.*"

➔An environment that encourages organizational learning through different courses and trainings is an environment that pushes for innovation. The organization of and participation in conferences can also be a solution for smaller SMEs to help their employees acquire knowledge and share it amongst themselves.

8.6.2 Organizing brainstorming sessions

33.3% of all companies that participated in the questionnaire hold brainstorming sessions in their organizations, as a practice to disseminate knowledge and to push for creativity. Employees at Company C participate in brainstorming sessions when facing a difficult project, or when entering a new market or adopting a new service "*When we have a really difficult project, we would sit down again with the people who happen to be there, we would sit down and throw ideas around very openly. And sometimes if we decide to do something brand new, going into a new market or a new service, then we would have brainstorming meetings where we also try to work out what we would need and stuff like that.*" Company B organizes similar sessions, when needed "*yes for various topics. Not very often, but there is this kind of management review. It could be regarding sales or product development. We have that yes.*" Employees at Company D take part in brainstorming sessions when facing difficult projects "*If we have a project we have difficulties with, we meet and find out ways to do it.*" The CEO of Company E confirmed that employees at his company typically brainstorm as well.

➔Officially, brainstorming sessions are not very common in SME TECs. However, most of these companies do in fact brainstorm when facing a task that needs a collective effort for innovativeness and creativity.

8.6.3 Developing or outsourcing a commercial web portal

33.3% of all respondents to the questionnaire do have a commercial web portal. Two out of the five interviewed companies do have a commercial web portal as well. However, most of the companies that participated in the data collection process do not have a commercial web portal, but rather have an informational website which includes contact information and the different services that they offer to their potential clients. Company A and Company E are the two companies that do have a commercial web portal.

The CIO of Company B explains how the company's website is not commercial, but it is still informative enough for the clients to get the necessary information they need, in order to understand what the company has to offer. The CIO noted that the website serves as a recruiting tool as well "I*t's more like information distribution. We don't have any [commercial web portal] actually. It's just for spreading information and news and so. We take this recruiting stuff. But it's not like you can buy stuff. We don't have anything to sell that you can buy from here. We present our designs.*"

➔The availability of a commercial web portal is not as important for SME TECs as having an informative website available for the clients. Most companies which participated in the data collection process showed little interest towards the commercial aspect of the web portal. However, most of them do have a website that include the services offered at their respective firms, in addition to contact information and some general information about the tasks they perform.

8.7 Portfolio management

Two KD practices related to portfolio management were identified in the literature as stimulants for innovativeness.

- ⇨ Reflecting on completed projects.
- ⇨ Reviewing general themes.

The next two sections evaluate them individually, to confirm or reject their importance towards innovativeness in SME TECs.

8.7.1 Reflecting on completed projects

88.9% of the companies that participated in the questionnaire do in fact reflect on completed projects after they finish.

Figure 20: 88.9% of companies in the questionnaire do evaluate the outcomes of finished projects

The interviewed companies had similar views to how projects should be reflected upon, after their completion. Some companies, only reflect on the bigger projects, by meeting with the client at the end of the project to reflect on the outcomes of the collaboration, such as Company A "*Yeah some we normally make a meeting with the client. There is a lot to do and there are the reports, we talk [with the clients] about what's good from both sides. Not the small cases. Only the big cases.*" Employees at Company1 meet to evaluate their performance and to evaluate the economic outcome of the project "[…] *That means we make some marketing material about the project, which of course would involve all of us talking about what we would do better and so on. […] We only do a formal evaluation of the project, which is actually economic. So at the end of the project we'll make an evaluation of how the project did economically -If we made any money".* The co-founder of Company C notes that some of the projects are sometimes presented during company meetings or in conferences. In some cases, the outcomes would be used as references for future projects "*It depends. Some of the projects would be defined as references. Some projects we'll present either in conferences, or we'll present in our internal meetings*". Company B reflects on projects after they

finish through meetings that evaluate both the positive parts of the project, and the parts which should be performed differently in the future "*After a project is finished, we may have some conclusion, for example this and that should be done in a different way and in this project we succeeded with this part. Yeah we do that."*

Company D follows this practice as well. However, the reflection on completed projects does not happen at the end of every project. A collective evaluation of some of the bigger projects happens altogether in one session "*Not enough. We just had a meeting yesterday, me and the CEO and another guy that helps with the economic side, and we checked the biggest jobs from last year, and if there are positive or negative projects. It's hard, because there aren't a lot of us here, and we just don't have the time to go all the projects.*" The time constraint presents a challenge that prevents employees at Company D from reflecting on all of the projects that the company works on. The management team, however, does value this KD practice, and follows it whenever possible.

➔Reflecting on completed projects can be an efficient practice that pushes for innovativeness. Evaluating the outcomes of finished projects allows employees at SME TECs to assess their performance, and to prevent certain negative outcomes from happening in the future. However, the time constraint can make it challenging for some of the smaller SME TECs from being able to perform such a practice.

8.7.2 Regularly review general themes

44.4% of all respondents do in fact regularly review general themes, through the exploitation of the potentially unexploited skills the employees might have.

Figure 21: 44.4% review general themes regularly

According to the interviewed companies, this happens when a new project which requires some special skills, is about to take place. Employees at Company C evaluate unexploited skills, when needed and only informally. The employees in charge of the project would speak with their colleagues about it informally "*Not in a very formal way. There would be two or three guys involved in a project and they would be asking around. [..] It was not formally organized.*" Company A would in fact follow this practice. When facing a new project which requires a new set of skills, the employees who do have the skill would be trained for the job. Manager A, the NDT expert at Company A clarified that his company would consider training an existing employee rather than recruiting a new one "[…] *then we train the guy who's already being in Company A".*

The development manager at Company D explained that this practice is followed regularly in his company. He argues that recruiting a new employee can be an unnecessary expense, if the existing employees do already have the skills, or if they are willing to acquire it. According to him, outsourcing the skill is also an option. Employing a new candidate is however a viable option as well, if the skill is needed for the long term "*We ask the employees if anyone knows about that or if anyone is willing to learn. the new skill and that kind of thing, and that's the first, but sometimes you have to consider hiring a new guy or maybe buying the service from another company it kind of depends if it's something that's needed once or a couple of years or something. You have to think about the economic side. Do you really need a new guy and what does he do? It's very valuable to ask the guys, and then rotate them [according to their skills]*."

Both Company E and Company B confirmed that they regularly review general themes.

➔The review of general themes is an efficient practice that can prevent SME TECs from spending unnecessary expenses on hiring new employees, which are not needed in the company for the long term. As financial constraints present a common obstacle towards growth in SMEs, making sure that the human capital is properly exploited can push for a stronger innovativeness capability.

8.8 Project management

Two KD practices related to project management were identified in the literature as stimulants for innovativeness.

- ⇨ Relying on experience when recruiting managers
- ⇨ distributing of tasks between clients and employees

The individual evaluation of both practices is presented in the next two sections.

8.8.1 Relying on experience when recruiting managers

All of the respondents to the questionnaire, and the interviewed companies do rely on experience when recruiting managers. At Company C, all managers got their experience at the company. According to the co-founder, the company recruited a manager from outside the company once, and it did not go very well "*Yeah we do that I mean, to tell you the truth all managers in the company have come from within the company. So people are more interested in the management part than in the expert part. All of us have actually come from inside the company. We once tried with an external manager and that was not a very good idea.*" He sees that management positions should go to the experts who already are employees at the company.

➔Project managers should be experienced in their field, to be able to push for innovativeness within their teams.

8.8.2 The distribution of tasks between clients and employees

When managing a project, SME TECs tend to distribute the tasks between clients and employees. As clients might have some classified information that would help the consultancy do their job more efficiently, a collaboration between the two parties needs to take place to ensure efficiency. The co-founder of Company C explains how distributing the problem-solving tasks between employees is a necessary tool to create innovative solutions to the problem in question "*We work with the clients, then we would work with acoustic solutions and then they will ask us to do a specific job. Like product development for them, and then we work together. That means we would get classified information from them, which we'll use to help improve the design and the thing is that classified information within our company and not to other clients. What we present to the client includes everything. We don't give them black boxes without telling them what's inside. We present the whole solution to them."* He continues to explain the expectations that the clients have when hiring a TEC "*We have to sit down with the client and investigate the problem. So yes in that way we do. We are expected to give the answers to all the problems. We are hired to give the answers*". The development manager at Company D had a similar opinion towards the matter, explaining how the collaboration with the clients can take part during the whole project in some cases "*We have projects where we have problems and we solve them together with our clients. There is always special cases where we solve almost all the problems with our clients. We consult them and they consult us with every decision*". All of the interviewed companies confirmed that they do distribute the problem-solving tasks with their clients, when needed.

➔The distribution of problem-solving tasks between clients and employees is in fact an important KD practice that saves time and money, and therefore pushes for innovativeness.

8.9 Commercialization

When asked whether their companies do accumulate knowledge on the market and then explore it to identify market gaps and trends, 44.4% answered "Yes", 11.1% answered "to some extent", while another one answered "depends on the project". 33.4% did not answer the question.

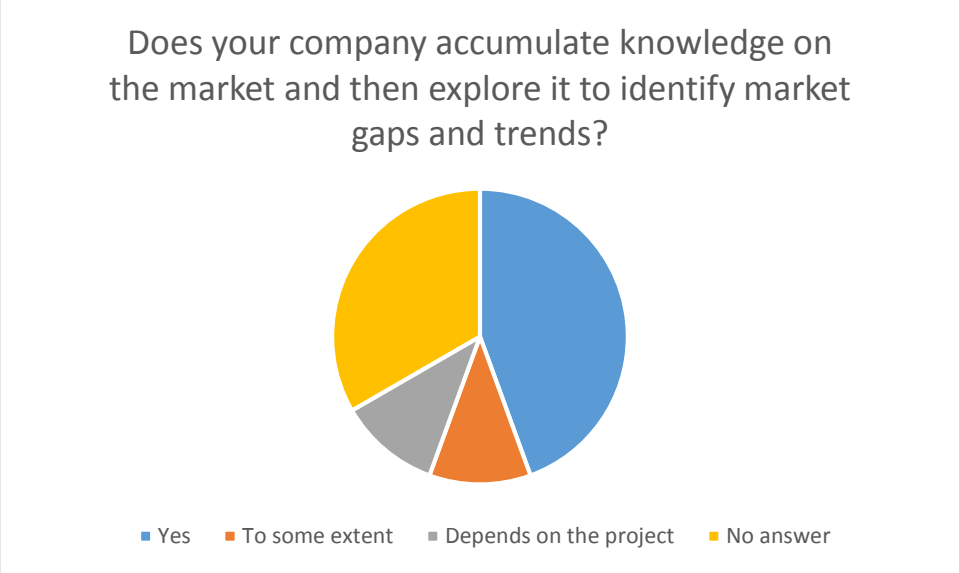

Figure 22: Market research in SME TECs according to the questionnaire

The interviewed companies had various answers to this question. The development manager at Company D admitted that his company does not do any market research, unless one of the company's good clients asks for a task that is not normally carried out at the company "*Sometimes when one of our good clients asks about something that we normally wouldn't do, we might think about that. But we don't do much market research neither*".

Both Company B and Company E consider market research as an important asset that requires the development and adoption of various tools. The CIO of Company B sees market research as an identifier that helps the company understand the needs of the clients and therefore the direction the company needs to take "*Yes we try with various tools to do that. There are actually many market analysis reports that you can get, and try to understand where we are moving [during a project]*." At Company E, employees are encouraged to develop various marketing tools and methods to accumulate knowledge on the market and to disseminate it properly so proper solutions get developed for the clients *"They try to do it at least. They are developing these methods all the time. For example, nowadays, we organize a marketing day 4 times a year, and then we talk about marketing with the people who are responsible for marketing, how should we continue with the information that we have. Where are the possible clients and which markets we should go to, then we identify them, and what kind of idea we should do for them [the clients]*."

Company A, however, does not carry activities related to market research. The procedures done at the company are dictated from the main office. Therefore, such activities are not required.

➔SME TECs with multiple fields of expertise need to accumulate knowledge on the market to then explore it to identify the direction the company should take when developing solutions for its clients. Smaller SME TECs, however, might not be interested in such activities, as their projects do not usually require investing in market research.

9 CONCLUSIONS

This chapter gives a brief presentation of the key findings of this thesis. The conclusions drawn from the literature, the questionnaire and the interviews are summarized and categorized according to the innovativeness measurement factors. The conclusions are in the form of a categorized list of KD practices that were considered by both the literature and the collected data as pushers for innovativeness.

9.1 KD practices that push for innovativeness relative to input management

This category focused on the profile of the perfect candidate for SME TECs. The results concluded that most SME TECs prefer candidates with T-shaped skills, advanced social skills, and who are able to grasp new knowledge and solve problems. Candidates with I-shaped skills are preferred for more technical positions. Having a good professional reputation through recommendations was, unsurprisingly, the most valued quality SME TECs search for in potential employees.

SME TECs push for internal communication through the availability of various knowledge sharing tools. These tools do stimulate knowledge sharing and therefore creates an innovation-friendly work environment.

9.2 KD practices that push for innovativeness relative to the generation of ideas

The collection of loose possibilities is not a common practice in SME TECs. It is clear, however, that this practice can be considered as a pusher for innovativeness, and should therefore be given the importance it requires. The systematic re-use or reapplication of recent innovations is another practice that pushes for innovativeness, although not practiced by many SME TECs. The human and time constraints present a challenge for such companies to formally follow the two mentioned practices. However, many SME TECs do follow them in an informal and perhaps unsystematic way.

9.3 KD practices that push for innovativeness relative to knowledge repositories

SME TECs follow several KD practices relative to knowledge management. Most of the companies which participated in the data collection process have a database for tacit knowledge which includes different guidelines and sets of rules for the employees to follow during the performance of certain tasks. Explicit knowledge is not available in all of the companies as maintaining such a database requires human and financial resources. However, it is valued and regarded as a pusher for innovativeness. Sharing innovations with partners and clients is also a common practice, followed by SME TECs to save time and cost when carrying a project.

Although taking minutes is considered a necessity in some SME TECs, many of them usually find that taking simple notes and/ or drafting reports that contain summaries of the important points covered during meetings to be sufficient.

SME TECs Promote the multidisciplinary formation of teams as it is necessary for companies which offer services that require a variety of skills. These companies, however, did not show any interest in patents.

9.4 KD practices that push for innovativeness relative to information flows

Most SME TECs value spontaneous internal collaboration. It is considered as one of the advantages that SMEs have, as opposed to larger enterprises. This is due to the small number of employees in such companies, which makes building human relations easier and therefore encourages the collective effort to innovate. Communities of practice are often formed in SME TECs.

Some SME s do collaborate with universities and research institutions, as long as their field of expertise is available in such institutions. It is however uncommon for SME TECs to share their innovations with their competitors, as it might compromise their ability to get clients and to consequently grow.

9.5 KD practices that support the innovativeness strategy

Having a certain degree of freedom to innovate is a great KD practice which many SME TECs provide their employees with. The ability to take risks can be a valuable pusher for innovativeness.

Including employees in the decision making process is also considered to be a practice that enhances the autonomy of the employees, which in turn allows them to be creative and innovative.

9.6 KD practices that push for innovativeness relative to organization and culture

An environment that encourages organizational learning through different courses and trainings is an environment that pushes for innovation. Many managers at SME TECs do support this practice, although its application is limited to the human and financial resources of the company.

Brainstorming is another practice which is not officially organized in SME TECs. However, it is commonly practiced by the employees who would form them spontaneously, in order to solve the different problems, they may face.

The availability of a commercial web portal is however not as important for SME TECs as having an informative website available for the clients. Most companies which participated in the data collection process showed little interest towards the commercial aspect of the web portal.

9.7 KD practices that push for innovativeness relative to portfolio management

Reflecting on completed projects can be an efficient practice that pushes for innovativeness. However, the time constraint can make it challenging for some SME TECs to perform such a practice.

The review of general themes is an efficient practice that can prevent SME TECs from spending unnecessary expenses on hiring new employees, which are not needed by the company in the long term. As financial constraints present a common obstacle towards growth in SMEs, making sure that the human capital is properly exploited can push for a stronger innovativeness capability.

9.8 KD practices that push for innovativeness relative to project management

Project managers should be experienced in their field, to be able to push for innovativeness within their teams. Distributing the problem-solving tasks between the clients and the employees is also an important KD practice that saves time and money, and therefore pushes for innovativeness.

9.9 KD practices that push for innovativeness relative to commercialization

Many SME TECs do not view market research as part of their work. It is however common for companies that are interested in expanding their line of work to perform such tasks in order to innovate when creating new services.

10 FUTURE RESEARCH AND LIMITATIONS

Several knowledge dissemination practices have been identified as pushers for innovativeness in SME TECs. Although several conclusions were drawn from the careful analysis of the literature and the collected data, it is however worth mentioning that a more extensive collection of data and the participation of a bigger portion of the sampling frame, requiring nevertheless funding of the project, would bring more consistent evidences and straightforward conclusions.

Collecting data could have been easier if the thesis was conducted in Finnish. Because the sampling frame consisted exclusively of Finnish SME TECs, several companies were not comfortable with taking part in the process. However, approximately 12% of the sampling frame did contribute with important data to this thesis through the questionnaire and the interviews. Therefore, the conclusions drawn from it can be considered reliable and valid. The results found in the literature were similar to the ones found from the empirical part, increasing the level of consistency of the conclusions.

A suggestion for future research would be to find a correlation between the turnover of the SME TECs and the number of KD practices that they follow. This would give a connection between an efficient dissemination of knowledge and a high business performance and / or growth of the companies in question.

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APPENDIX

The questionnaire

This appendix presents the questionnaire that was sent (in its original form).

I. The questionnaire:

Master thesis Questionnaire

This questionnaire collects data for my master thesis, which tries to link the different knowledge dissemination tools used in Finnish SME technology and engineering consultancies with innovativeness and radical innovation.

* Required

1. **What is the name of your company? (If you wish for your contribution to be anonymous, please leave this box blank).**

2. **Does your company fit under the SME (Small and Medium sized Enterprise) category?** *
   Mark only one oval.
   - ◯ Yes
   - ◯ No

3. **Which of these two employees would your company recruit?**
   Mark only one oval.
   - ◯ A candidate with a deep understanding of one field (I-shaped skills)
   - ◯ A candidate with a generalistic understanding of multiple fields (T-shaped skills)

4. **Select the three most important skills your company considers when hiring a potential employee:** *
   Check all that apply.
   - ☐ Intelligence (High IQ, Excellent university grades)
   - ☐ Social skills (High social and communication skills)
   - ☐ Good professional reputation (Good recommendations)
   - ☐ Ability to work in a multidisciplinary team
   - ☐ Ability to work in a multicultural team (International mindset)
   - ☐ Ability to work under pressure

5. **Which of these knowledge dissemination tools are available in your firm? (Check all that apply)** *

Check all that apply.

- [ ] Computers and an internet connection
- [ ] An intranet network
- [ ] A company email
- [ ] A database for knowledge accessible for the employees to use
- [ ] Videoconferencing software and equipment
- [ ] A commercial web portal

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6. **Check all of the knowledge dissemination practices that are available in your company in regards to knowledge management: (Check all that apply)** *

Check all that apply.

- [ ] Open innovation
- [ ] Sharing knowledge with external stakeholders (e.g. clients, competitors)
- [ ] Internal collaboration between departments
- [ ] Constant testing of existing innovations to detect potential problems
- [ ] The systematic re-use or re-application of recent innovations
- [ ] Paying attention and solving conflicts between employees and departments
- [ ] Making the explicit knowledge of the company accessible through databases available for the employees to use
- [ ] Investing in patents
- [ ] Encouraging the formation of multidisciplinary teams
- [ ] Accumulating tacit knowledge through guidelines and sets of rules that the employees develop from their own professional experience in the firm
- [ ] Keeping record of all meetings
- [ ] Partnering up with research institutions

7. **What kind of decision making strategy is followed in your firm?**

Mark only one oval.

- ◯ Centralized (The CEO /manager makes all the decisions without consulting the employees)
- ◯ De-centralized (The CEO/ manager makes the decisions after consulting the employees)

8. **Do you consider your management strategy as innovation friendly?**

Mark only one oval.

- ◯ yes
- ◯ no

9. **Check all of the knowledge dissemination practices that are available in your company in regards to organizational culture:** *

Check all that apply.

- [ ] Creating an environment that promotes organizational learning through training and knowledge sharing
- [ ] Collaboration between employees, teams and departments to ensure knowledge is not lost
- [ ] Communities of practice (Spontaneous collaboration between employees with shared interests)
- [ ] Creating a balance between formal and informal channels of communication
- [ ] Organizing brainstorming sessions
- [ ] Developing an internal database for explicit knowledge that is accessible for the employees, or outsourcing an external database through a contract so the employees have access to it

10. **How many patents does your consultancy own? How many a year on average? (The past 5 years)**

.....

s,google,com/forms/d/1qZ59V4aeP0D-ajDH-DspQ64-23E6E33IJyoLOZirXRM/edit

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11. **Does your company reflect on completed projects after they finish? (Evaluation of outcomes).**

Mark only one oval.

- ◯ Yes
- ◯ No

12. **Do managers in your company regularly review general themes? (evaluation of unexploited skills the employees might have)**

Mark only one oval.

- ◯ Yes
- ◯ No

13. **Does your company rely on experience when recruiting managers?**

Mark only one oval.

- ◯ Yes
- ◯ No

14. **Does your company accumulate knowledge on the market and then explore it to identify market gaps and trends?**

.....

15. **If you have any other remarks, please feel free to add them here. Thank you for your contribution!**

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