Master Thesis Organization Studies 2012 -2013

The Process of Tacit Knowledge Transfer

An Empirical Study on Managing the Transfer of Tacit Knowledge in Innovation Projects

Tilburg University

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"The only ng that becomes more when it is shared is knowledge"
Maria van der Hoeven, Dutch Ministry of Economic Affairs.

Executive Summary

This research provides insights and recommendations to understand the yet questionable contribution of formalization of Knowledge Management Systems (KMS) to the effectiveness of tacit knowledge transfer. The process of tacit knowledge transfer seems problematic, especially in high dynamic and complex environments. This study reveals that the transfer of tacit knowledge is more effective when the KMS are formalized up to a certain extent and the Knowledge Management (KM)-cycle is applied actively. The first part of this study investigates to what extent the formalization of KMS influences the ability and willingness of individuals to transfer tacit knowledge within innovation projects of different orientations. Ability and willingness are the two antecedents required for effective tacit knowledge transfer. The second part concentrates on how tacit knowledge is transferred effectively between individuals within innovation projects.

Findings of this study indicate that the higher the degree of job specificity, the higher the ability of an individual to obtain tacit knowledge and willingness to use tacit knowledge because formalization of KMS creates commonality in processes and communication structures, which eases communication and creates mutual understanding. The other dimension of formalization of KMS, job codification, has a negative effect on the willingness to use tacit knowledge. The effect of job codification on ability even as the other effects on ability differs along with the orientation of the project. In an exploration oriented project, job codification has a negative effect and job specificity has a less positive effect on ability than it had in the basic model. While in an exploitation oriented, job codification now has a positive effect and job specificity has a more positive effect on ability than it had in the basic model. Moreover, individuals engaged in exploration oriented projects have more ability to obtain tacit knowledge. While individuals engaged in exploitation oriented project have more willingness to use tacit knowledge. Hence, it can be concluded that there is an optimal degree of formalization of KMS. Deviations from this level will lead to a lower effectiveness of tacit knowledge transfer, either due to a too low degree of job specificity or to a too high degree of job codification.

In order to ensure the effectiveness of the process of tacit knowledge transfer, it is important to actively manage the process by using the ongoing KM-cycle. The qualitative findings indicated that especially the activities ‘capturing’ and ‘storing’ are important in order to ensure the quality

of the knowledge base. The behavior to reuse knowledge out of this knowledge base is of great importance since this will ensure that the cycle is ongoing. Moreover, three components are important in transferring knowledge: people, process, and technology. This study mainly focused on 'process' and 'technology'. However, current literature shows that 'people' require substantial effort because managing knowledge is managing people. Therefore, balance the interaction between these three components and knowledge will become a key strategic resource which drives innovation, improvement of operations, and ultimately, success. Thereby, continue to be advantageously in a hypercompetitive environment.

Recommendations are made on four levels: *(1)* Formalization of KMS *(2)* Organizational level, *(3)* Cultural level, and *(4)* Managerial practices.

1a. Formalize the basis of KMS; balance the degree of job specificity and job codification.
1b. Formalize KMS of exploration projects differently than KMS of exploitation projects.
1c. Maintain a mix between IT-based and human-based KMS.

2a) Throughout the whole organization it is required to put effort in the KM-cycle.
2b) Offer frictionless KMS. Systems need to be convenient in use, interactive, confidential and an accepted way of working as perceived by their users.
2c) Nonhierarchical organization design based on project working to encourage interaction.

3a) Develop KMS and KM practices which fit the organization's knowledge-oriented culture.
3b) Carefully look at the fit between the composition and the orientation of projects.
3c) Human attention of all stakeholders is required.

4a) Promote a culture of sharing and managing knowledge.
4b) Stimulate strong leadership. Leaders are the example for the rest of the organization.
4c) Attend trainings and workshops and allow others to do so.
4d) Encourage collaboration, also cross-functional en senior-junior combinations.
4e) Create communities and foster intensive social networks.
4f) Revisit the interaction pattern between people, process, and technology.
4g) Provide no extrinsic rewards as primary motivator for KM practices.

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Acknowledgements

At first sight, I thought that conducting an academic research and writing a thesis would not be the most enjoyable activity of my two-year-study time at Tilburg University. Finding an interesting topic and conducting a relevant academic research seemed at some point impracticable. However, when looking back, I am glad to conclude that I have succeeded in doing so, despite the difficulties that came along.

I believe that the motivation and drive to work hard did not only come from me personally but also due to the amazing support I have had during along the way. Therefore I would like to express my deep gratitude to some individuals. Firstly, I would like to thank all the business people for their faith in my research and their provision of access into the organizations. In particular, I would like to thank Pim Meijer and Simon Minderhoud for their extra support and contributions to this project.

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Thanks to you all!

Nino van de Wal,
Tilburg, August 2013

Abstract

Tacit knowledge transfer is a complex process that is important to address for the academic and the business environment. This study examines how tacit knowledge can be effectively transferred between project members of innovation projects during different innovation orientations. First, a research model is presented in order to examine to what extent the degree of formalization of knowledge management systems influences a individual's ability and willingness to transfer tacit knowledge within innovation projects, and to what extent this relationship differs given the orientation of an innovation project. Data is collected by conducting 23 interviews and by distributing a questionnaire in 23 projects which resulted in a response of 218 project members. This quantitative data is complemented with qualitative data which provide deeper insights to the quantitative findings as well as how tacit knowledge is transferred between individuals within innovation projects, and how the process of tacit knowledge transfer process managed. The results provide insight in the process of transferring tacit knowledge. The quantitative data reveal significant positive effects of job specificity and job codification on the both the antecedents of effective tacit knowledge transfer: individuals' ability to obtain and willingness to use tacit knowledge. However, job codification negatively influences the willingness to use tacit knowledge. Besides, there are found significant influences of the orientation of innovation projects. Despite a few limitations this study provides valuable contributions to the literature of Knowledge Management, Knowledge-Based View, and Sociotechnical Systems design. At the end of this report, managerial recommendations and research recommendations are provided.

Keywords: Tacit Knowledge Transfer, Knowledge Management Systems, Formalization, Knowledge Management Cycle, Innovation, Exploration, Exploitation.

Table of Figures and Tables

1. Introduction

Innovation and collaboration are receiving a great deal of attention in the current dynamic business environment. Given the increasing complexity of the innovation context in this environment, units (e.g. individuals, groups or departments) are forced to interact and bundle strategic resources (Grant, 1996). Based on the knowledge-based view of the firm (Grant, 1996), knowledge is such a strategic resource that enables sustainable competitive advantage in hypercompetitive environments. In order to bundle knowledge it has to be transferred from one unit to another. This is essential to the success of organizations, collaborations, and innovation development (von Krogh, 1998; Chou, 2005). Especially when the environment is dynamic and complex, it often becomes essential for organizations that they continually create, validate, and apply new knowledge into their products, processes, and services for value-addition (Bhatt, 2001). Today's scholars and business people even argue that knowledge creation, integration, transfer, and application would benefit organizations more than knowledge itself (Chou, 2005).

The transfer of knowledge is the essential start activity of every innovation process or other new development (von Krogh, 1998). While organizations usually want minimize or at least to control knowledge transfer to other organizations, they typically desire to foster internal knowledge transfers (Argote, 1999). However, even when knowledge transfer is desired, it can be difficult to achieve because of the intangible nature of knowledge and because it requires interactions among people, process, and technology (Szulanski, 2000; Bhatt, 2001). In a reaction to this difficulty Knowledge Management (KM) practices evolve (Nonaka & Takeuchi, 1995). These practices concentrate on managing what is known and managing the interaction between people, process, and technology (Alavi & Leidner, 2001). Conscious KM aligns an organization's expertise, ideas, and best practices around the critical success factors of the organizations and employs an appropriate mix of people, process, and technology (Weggeman, 1997; Bhatt, 2001). By applying this approach the difficulty of transferring knowledge can be seen as an anomaly rather than as a characteristic feature of the transfer (Szulanski, 2000).

The development of complex products requires high specialized research and development staff members. This dispersed state of knowledge creates a need for knowledge transfer. This is why the transfer of knowledge is already investigated and documented by several scholars (e.g. Allen,

1977; Szulanski, 1996; Argote & Ingram, 2000). Although the transfer of best practices and entities capabilities remains underinvestigated (Szulanski, 1996; Fahey & Prusak, 1998). These best practices and capabilities are partly captured in the tacit dimension of knowledge and are an important driver of innovative performance (Nonaka, 1994). Tacit knowledge is 'know how' which is more likely to be rare and difficult to replicate or transfer (Cavusgil et al., 2003). Just as the stickiness of tacit knowledge makes it difficult for other organizations to imitate competencies, it could be difficult to imitate them internally (Szulanski, 1996). However, the effectiveness to transfer competencies, best practices and capabilities internally is critical to a firms' sustainable competitive advantage (Grant, 1996). Moreover, Cavusgil et al. (2003) found that tacit knowledge boosts innovation the most which makes the effectiveness of transferring this type of knowledge in even more important in an innovative context. Such a context is characterized as complex and highly knowledge and capability intensive (Rui et al., 2008). Therefore, more research is needed to understand the conditions under which knowledge transfer is effective in an innovative environment (Argote, 1999).

The advancements in information technology enabled the possibility to develop information systems in order to facilitate the transfer and integration of knowledge (Alavi & Leidner, 1999). These systems can facilitate the transfer of knowledge across virtually every organizational unit (Griffith et al., 2003). Such systems are referred to as Knowledge Management Systems (KMS). Yet there is little evidence what the contribution of KMS is to the success of knowledge transfer (Grant, 1996; Goh, 2002), especially when knowledge is tacit and the environment is high-dynamic (Griffith et al., 2003). These KMS provide access to the knowledge base but they also help units to operate in accordance with the procedures and comply with the rules (Argote, 1999). KMS help in applying a formal way of working which is an effective way for retaining and transferring best practices and routines (Szulanski, 1996; Jensen & Szulanski, 2007). Hence, it is expected that the degree of formalization of KMS influences the effectiveness of tacit knowledge. However, in contrast to these formal structures and systems, the organizational context of innovation is more suitable with organic structures and non-formal systems given the constantly occurrence of fresh problems and unforeseen requirements for action (Aiken & Hage, 1971; Burns & Stalker, 1994). Therefore a paradox arises between the need for formalization in order to effectively transfer tacit knowledge, and the need for autonomy in order to successfully develop innovations.

The application and structure of systems change along with the orientation and context of innovation projects. In the beginning of the innovation process the structure of a project and its context is organic (Burns & Stalker, 1994). In these early stages the focus is more on exploring new possibilities and creating totally new ideas and knowledge (March, 1991). However, when a project is exploitation oriented a more mechanic structure is desired because these phases focus on the implementation of knowledge and execution of concepts (March, 1991). These changes in the context lead to changes in the degree of formalization of KMS during different phases of the innovation process.

This study will develop an understanding of how to effectively transfer tacit knowledge between project members of innovation projects during different innovation orientations. To develop understanding about this complex, intangible, and difficult to measure concept (Fahey & Prusak, 1998; Argote, 1999), metric relationships are tested as well as in-depth insights are gathered. The quantitative part investigates to what extent two antecedents of effective tacit knowledge transfer are influenced by the degree of formalization of KMS. Effective knowledge transfer among individuals depends on organizational behavior (Yang & Farn, 2007). The behavioral science literature suggests that effective knowledge transfer is realized when individuals' are able to obtain and willing to use tacit knowledge (Hislop, 2005). Thus, both the ability and willingness are two critical antecedents for effective knowledge transfer (Bock et al., 2005; Liao et al., 2007). Moreover, Grant (1996) argues that the ability and willingness to transfer best practices and capabilities internally is critical to a firms' sustainable competitive advantage. The qualitative part lays extending understanding of the quantitative findings by providing in-depth insights. The qualitative research also investigates how tacit knowledge is transferred effectively among individuals and how this transfer process is managed during innovation projects.

1.1. Research Question

Following the objective, reasoning and concepts of the introduction the main research question is prepared as follows:

How to effectively transfer tacit knowledge between project members of innovation projects during different innovation orientations?

To have a better understanding of the research question, and to provide a more adequate answer to this question, sub-questions are formulated. Each section of this research focuses on its own sub-questions:

Theoretical framework

- *What is Knowledge and, especially, Tacit Knowledge?*
- *What is a Transfer of Tacit Knowledge?*
- *What is the Management of Tacit Knowledge Transfer?*
- *What is the Orientation of an Innovation?*
- *Which relations between the research concepts are suggested by the literature?*

To this end the useful key concepts in knowledge management and accompanying literature are described in the report. Hereafter the role of KM practices and KMS in innovation projects is investigated. The first part of this study concentrates on testing the suggested relationship between the formalization of KMS and the ability and willingness of individuals to transfer tacit knowledge within innovation projects of different orientations. While the second part of the study concentrates on the current state of tacit knowledge transfers and KM practices in an innovative environment.

Quantitative research

- *To what extent does the perceived degree of formalization of knowledge management systems influence an individual's ability and willingness to transfer tacit knowledge within innovation projects and to what extent this relationship differs for different orientations of the project were this individual is engaged in?*

Qualitative research

- *How is tacit knowledge transferred between individuals within innovation projects?*
- *How is transfer of tacit knowledge managed during innovation project?*

This document entails the methods, information, and findings of the research. After the quantitative and qualitative research methods and results are presented, a conclusion is drawn. Subsequently, these findings are discussed in the discussion section and managerial recommendations are developed. At the end of this report the limitations and future research possibilities are presented.

1.2. Relevance

In recent years the interest of scientists and practitioners in intra-organization knowledge management and transfer increased (e.g. Szulanski, 2000; Tsai, 2002; Cavusgil et al., 2003). While much theory exists on knowledge management, little empirical work has been undertaken. Furthermore, in contrast to other management practices like Total Quality Management, it seems like knowledge management is here to stay (Koenig, 2012). The graphs in figure 1 chart the number of articles in the business literature with the phrase 'Total Quality Management' or 'Knowledge Management' in the title. These phrases represent the intentions of the authors to express new findings in their respective fields. More phrases mean a higher level of attention and higher rate of development.

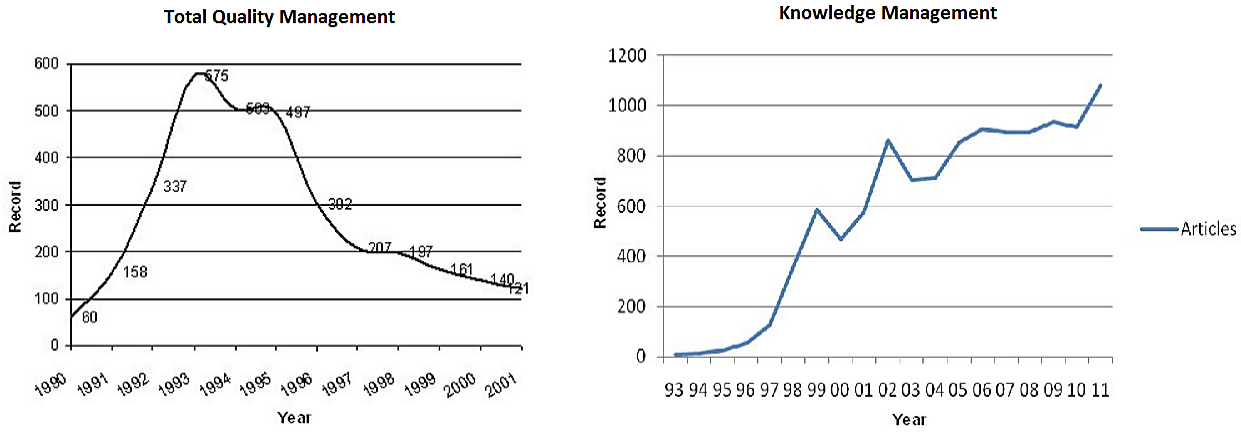

Figure 1. Number of article per management practice

In line with this development, researchers recognize the importance of the tacit dimension of knowledge in organizational routines, procedures and systems and in knowledge management (e.g. Nonaka & Takeuchi, 1995; Foss, 2003; Miller et al., 2006). Among the organizational

elements, the value of knowledge management systems and processes is widely recognized (Lee & Lee, 2000; Alavi & Leidner, 2001; Chou, 2004). Suggestions have been made that the processes and activities involved need to be organized but these suggestions lack empirical evidence and academic insights (Fahey & Prusak, 1998; Alavi & Leidner, 1999; Davenport & Prusak, 2000). Nonetheless, transferring tacit knowledge remains problematic. Hence, there is a huge demand for research and insights. This research partially fulfills this demand and is a significant contribution to a body of literature that has suffered from a lack of empirical measurement. In short, this research will complement the literature in identifying conditions that contribute to tacit knowledge transfer process from a knowledge-based view perspective.

Not only practices of knowledge management focus on managing the interaction between people, process, and technology but also the sociotechnical systems perspective does (Cherns, 1976). A valuable contribution to this interaction is provided since it is necessary to have a proper understanding about how and where to add value in the knowledge-intensive process and the role of technical and social aspects herein (Alavi & Leidner, 2001; Tsai, 2002; Zheng et al., 2010). Both KM and the sociotechnical system perspective are striving to employ an appropriate mix of people, process, and technology in order to enhance processes and outcome.

The societal and practical relevance of this study relates to the development of managerial recommendations regarding how to transfer tacit knowledge effectively among individuals within innovation projects. These recommendations concentrate on the conditions for effective tacit knowledge transfer and how to manage this process, as well as how to design KMS. Concrete insights are given about how to influence individuals' ability and willingness to transfer tacit knowledge in different phases of innovation development. Practitioners could adjust the structure of the systems used with the findings of this research. Making individuals able and willing to transfer tacit knowledge is important for making them transfer knowledge to others in the innovation project but also in wider contexts such as to others in the organization, to other organizations, the industry and to the new generation of employees. Based on the practical paper by Fahey and Prusak (1998), it is of great importance to pay attention to the role and importance of tacit knowledge within organizations.

2. Theoretical Background

This section starts with the theoretical basis of this study. Hereafter, the theory underlying the variables and associated concepts are explained. First is explained what knowledge is and why tacit knowledge is that important in the context of this research. The next section elaborates on both Knowledge Management (KM) and knowledge transfer, which results in the two dependent variables used in the quantitative research. KM aims on the critical interaction between people, process, and technology. Therefore this paragraph entails the sociotechnical system design. Paragraph 2.4 is about Knowledge Management Systems (KMS) which influence the dependent variables. The relation between these variables is interacted by the orientation of the innovation project. Innovation, the process, and the orientation of an innovation project are defined and elaborated in paragraph 2.5. The last paragraph aims at the conceptual model of the research. In total four effects are hypothesized between one independent variable and two dependent variables, influenced by an interaction variable.

2.1. A Theoretical Perspective

Organization theory helps to analyze complicated situations in organizations and to discover effective and creative means for dealing with them. It provides understanding for many aspects of life both inside and outside organizations. Therefore organization theory is useful for managers and other business people. For example, strategic management has drawn its theories from both economics and organization theory. Its primary objective is explaining the determinants of strategic choice and therefore explains a firms' performance. The theoretical fundament of this thesis is formed by the *knowledge-based view of the firm*. This theoretical perspective is developed by Grant (1996). It builds upon the resource-based view of the firm developed by Penrose (1959) and expansion by Wernerfelt (1984, 1995,). "According to the resource-based view of the firm, organizational routines, embodied in the individual's as well as in the firm's tacit knowledge, are the most sustainable source of hard-to-imitate competitive advantages (Osterloh & Frey, 2000, p. 546). Therefore knowledge generation and transfer is an essential source of firms' sustainable competitive advantage, which makes knowledge also the most strategically important resource (Kogut & Zander, 1992; Osterloh & Frey, 2000). The knowledge-based view assumes that knowledge is embedded in multiple entities such as

organization culture, routines, policies, systems, and documents, as well as in individuals (Grant, 1996). Individuals and their competences are seen as key elements of the organization. All tangible and intangible relations are the results of human action. Knowledge is considered as the most strategically significant resource of the firm. Knowledge-based resources have to be valuable, rare, in-imitable, and non-substitutable (similar to the 'VRIN-principle' of the resource-based view). Dependent on how resources are combined and applied capabilities are developed (Makadok, 2001). This results in competitive advantage and superior corporate performance (Barney, 1991). Though Crook and colleagues (2008) found strong evidence that support the resource-based view, both the knowledge-based view as well as the resource-based view have been the subject of considerable debate. However, Grant (1996) has stated from the beginning that "the emerging 'knowledge-based view' is not, as yet, a theory of the firm" (p. 110). Still the knowledge-based view has strengthened its position in the literature and in practice over the past years.

2.2. What is Knowledge?

In order to investigate knowledge transfer properly, it is first necessary to make clear what exactly is meant by knowledge. Many scholars have conceptualized knowledge. Grant (1996), the founder of the knowledge-based view, views knowledge as residing within the individual and simply defines knowledge as "that which is known" (p. 110). This definition is completely exclusive, since information and data also can be known and are both accepted as parts of the definitions of knowledge. Figure 2 illustrates the general portrayal of knowledge by using the knowledge pyramid. The knowledge hierarcy moves bottom-up from data to information (facts and figures), to knowledge (meanings and understanding) and, ultimately, wisdom (intelligence, knowledge with insights) (Alavi & Leidner, 2001).

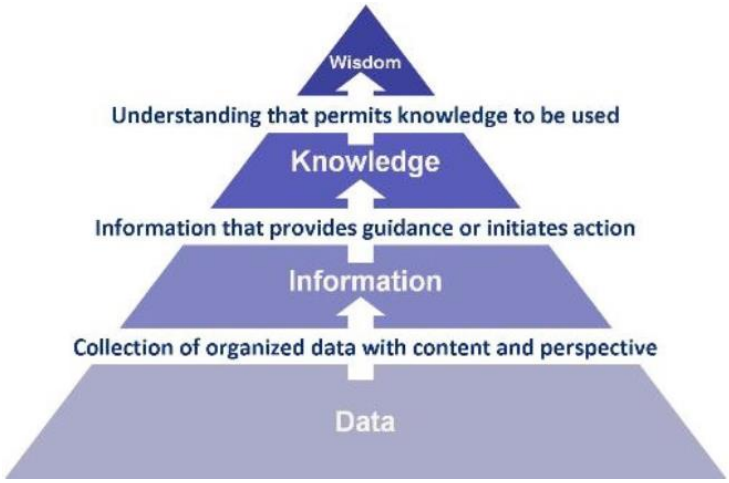

Figure 2. The knowledge pyramid

The difference between information and knowledge is best explained by Nonaka (1994). He argues that *information* is a flow of messages which is independent from its context. While *knowledge* is created and organized by this flow of information, is context specific and, more importantly, related to human action. This relation with human action emphasizes the essential aspect that knowledge is "anchored on the commitment and beliefs of its holder" (Nonaka, 1994, p. 15). Therefore knowledge is harder to transfer than information. This latter characteristic is called 'transferability' (Grant, 1996), which aims at knowledge transfer within and between organizations and humans. According to Grant (1996) this is one of the most pertinent characteristic of knowledge. Moreover, transferability is even more important considering the context of this research. Therefore the comprehensive definition of Davenport and Prusak (2000, p. 4) is used. It takes into account all the concepts mentioned earlier.

> **Knowledge** is a fluid mix of framed experience, values, contextual information, expert insight and grounded intuition that provides an environment and framework for evaluation and incorporating new experiences and information. It originates and is applied in the minds of knower's. In organizations it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices and norms.

2.2.1. Types of Knowledge

The most commonly used distinction of types of knowledge is between tacit and explicit knowledge. Since the work of Polanyi (1966) many scholars have applied this distinction and investigated both types of knowledge (Kogut & Zander, 1992; Grant, 1996; Nonaka, I. & Von Krogh, G., 2009). *Explicit knowledge* can be expressed in words and numbers, and can relatively easily be shared by codifying it trough many forms of data such as manuals, documents, scieftifc formulae, specifications, and the like (Nonaka & Konno, 1998). It goes through some transformations before being put to work or being restored. In other words, it is codified knowledge which refers to "knowledge that is transmittable in formal, systematic language" (Nonaka, 1994, p. 16).

The second type of knowledge is *tacit knowledge*, which Nonaka defines as "highly personal and hard to formalize, making it difficult to communicate or share with others" (Nonaka & Konno, 1998, p. 42). As something not easily visible and expressible, much less transferable, tacit knowledge is deeply rooted in an individual's actions, skills and experience as well as in procedures and routines. This is called the *technical dimension* of tacit knowledge. The other dimension is the *cognitive dimension* which consists of beliefs, ideals, values, mental models or emotions a person embraces (Nonaka & Konno, 1998). Both these tacit dimensions are subject to this research and are defined in accordance with Nonaka (1994, p. 16).

Tacit knowledge has a personal quality, which makes it hard to formalize and communicate. Tacit knowledge is deeply rooted in action, commitment, and involvement in a specific context.

2.2.2. Why Tacit Knowledge?

In short, explicit knowledge is 'knowledge about' and tacit knowledge is 'know-how'. Tacit knowledge reflects an individual's know-how and experience of work, which is an important type of valuable intangible resource that is difficult to imitate and acquire (Nonaka, 1994). As presented in figure 3, explicit knowledge is only a small tip of the iceberg. While tacit knowledge is the largest part of the iceberg. This part is under the surface which means that a huge knowledge capacity of the organiation still is left to be converted. The metaphor of the

iceberg emphasizes the fact that most knowledge available in organizations is only 5% of the knowledge capacity of all the members of that organization. The reason why only a small part of knowledge is available is related to the transferability characteristic of knowledge. Tacit knowledge is hard to transfer because it is embedded within individuals (Grant, 1996). Therefore it is more difficult to convert tacit knowledge into explicit knowledge. The conversion proces of knowledge contains several stages which are described in the SECI model (Socialization, Externalization, Internalization, and Combination) of Nonaka and Takeuchi (1995) (also known as the 'knowledge spiral'). This research focuses on effective tacit knowledge transfer because the majority of knowledge in an organization is tacit. Besides, the way of transfering this type of knowledge is of great importance since it results in mutual learning, valuable resources, enhanced organizational effectiveness and new innovation creation (Tsai, 2002; Zheng et al., 2010). Therefore the transfer of tacit knowledge and management of the process within innovation projects are of great importance. Especially in high technological environments, where entities are knowledge intensive and tasks are highly cognitive and specialized, management of knowledge is key (Rui et al., 2008).

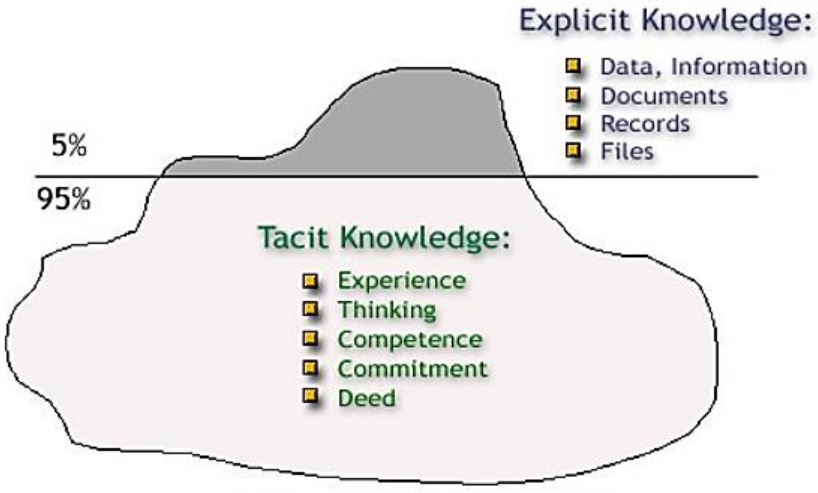

Figure 3. The iceberg metaphor, based on explicit and tacit knowledge

2.3. Knowledge Management

In the early 1990s a new research field was formed: Knowledge Management. KM is essentially about getting the *right knowledge* to the *right person* at the *right time*. The most prominent academics in this field are Ikujiro Nonaka, Thomas H. Davenport and Hirotaka Takeuchi. As from the moment these academics suggested that tacit knowledge is the key source of innovation, the interest in the management of knowledge to benefit the organization grew (von Krogh, 1998; Cavusgil et al., 2003). It appeared that many organizations have problems in maintaining, locating, and applying knowledge (Goh, 2002). KM approaches these problems with a systematic process involving various activities (Alavi & Leidner, 2001). The *five basic processes* of KM are knowledge creation, validation, presentation, distribution, and application (Bhatt, 2001). During these processes the right strategies, structures, and systems have to be used to sustain and enhance the management of knowledge (Zhen et al., 2010). This research focuses on the knowledge distribution process which is a mechanism to leverage knowledge that lies dispersed within organizations. It is a strategy proposed to tap into disturbed knowledge. It is essential to distribute knowledge throughout the organization, before it can be exploited at the organizational level (Bhatt, 2001).

In terms of management practices KM is a systematic way to manage an organization's knowledge assets for the purpose of creating value and meeting tactical and strategic requirements. KM mostly focuses on ensuring organizational learning and the creation and generation of knowledge (Nonaka, 1994). In this research the definition of Alavi and Leidner (2001) for KM is used:

> **Knowledge management** refers to identifying and leveraging the collective knowledge in an organization to help the organization compete (Alavi & Leidner, 2001, p. 113).

2.3.1. Three Core Elements of Knowledge Management

KM practitioners and experts believe that KM is best carried out through the optimization of technological and social systems (Bhatt, 2001). Therefore it is important to focus on three key elements: organizational *people, process and technology* (Bhatt, 2001). These three elements are related to each other as graphically displayed in figure 4. The implementation of KM has an

impact on each of these elements and it underlying components. Moreover, the interactions between these three key elements can have direct bearing on knowledge distribution. "For example, organizational structure [and systems], based on traditional command and control, minimizes the interactions between technologies, techniques, and people, and thus reduces the opportunities in knowledge distribution" (Bhatt, 2001, p. 73). Most KM projects mainly focus on the technology while executing KM activities such as implementing an IT system (Davenport et al., 1997). However, "KM researchers such as Davenport (2000) and Dilip Bhatt (2000) say technology is just 10% of the KM concept efforts required, processes, 20%, and the rest, people and culture issues account for 70% of a KM efforts required for an organization" (Ed'son de Pary, 2009, p. 29).

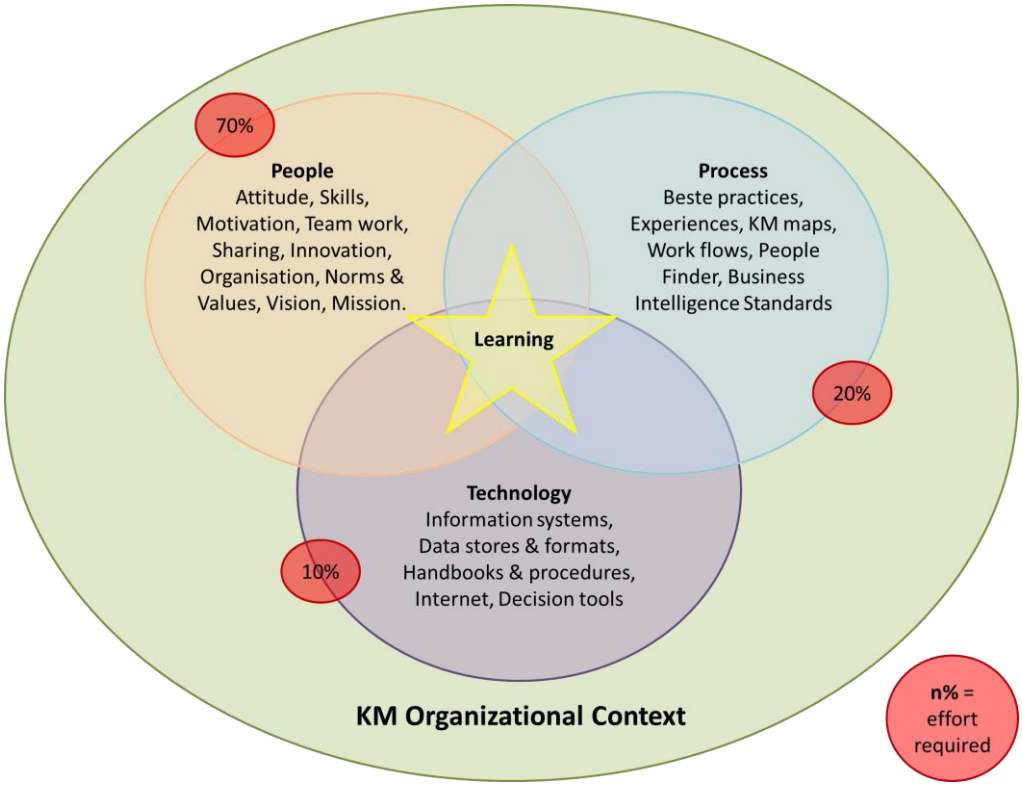

Figure 4. Key components KM

Bhatt (2001, p. 69) states that "the roots of this view can be found in the sociotechnical perspective of the organization (Emery, 1959, 1967; Trist, 1981; Trist and Bamforth, 1951)". This approach initially aimed at redesigning work and increasing the quality of work life by using democratic principles for work design (Herbs, 1974; Cummings, 1978). This work design

emphasizes the interaction between both *social* (i.e. human and behavior) and *technical* (i.e. processes and systems) aspects in workplaces. Here, technical does not necessarily imply material technology but it focuses on technical aspects of organizational structures, systems, and processes (Trist, 1981). Examples of technical aspects are work systems, procedures and related knowledge. The sociotechnical system design has nine principles which concentrate on compatibility and integration of both excellence technical performance and quality in people's work lives (Emery & Trist, 1972; Cherns, 1976). Malhorta et al. (2001) proved that the design is highly beneficial. A minor remark that they make is that it may be the case that the sociotechnical system design especially works in *cognitive intense tasks*. However, this remark suits the context of this study because it is aimed at innovation projects in the high-tech sector. Particularly these innovation projects involve complex cognitive intense tasks.

2.4. Knowledge Transfer

Knowledge management is generally perceived to fall under innovation management. According to Von Krogh (1998), organizations develop innovations when organizational members: "share tacit knowledge; convert this into explicit knowledge in the form of a concept for a product or service; use company visions, strategies, market studies, or social opinions to justify this concept; and finally build a new prototype product" (p. 135). Thus, innovation development begins with effective sharing and transfers of tacit knowledge. Therefore many researchers have recognized the importance of the tacit dimension of knowledge in organizational routines and knowledge transfer (Nonaka & Takeuchi, 1995; Nightingale, 2003; Miller et al., 2006). An important process of KM is to ensure that knowledge is transferred to the locations where it is needed and can be used. Knowledge transfer occurs on various levels: from individuals to explicit sources, between individuals, from individuals to groups, between groups, across groups, and from groups to the organization. Hence, all parties involved can be a holder or recipient of knowledge, and sometimes even both.

> **Knowledge transfer** is defined as the transmission and receipt of knowledge – a process that is most easily accomplished across actors who share a common practice. (Berends et al., 2011, p. 72)

According to Szulanski (1996, 2000) the knowledge transfer process consists of four stages. First, the *initiation stage*, includes the decision to transfer knowledge to the place where it is needed. Second, the *implementation stage*, entails the knowledge flow between source and recipient. Once transferred to the next stage, *ramp-up stage*, it is about using the transferred knowledge. The last stage, the *integration stage*, is about the results that the recipient achieves with the transferred knowledge. This research is focused on individuals within groups and in particular the implementation stage. During this stage the capability of an individual to effectively transfer tacit knowledge is elementary (Szulanski, 1996). Hence, this stage determines the effectiveness of the transfer process.

2.4.2. The Capability of an Individual to Transfer Tacit Knowledge

Individual knowledge is necessary for developing the organizational knowledge base. The interaction of an individual with other people, the process, and the technology is essential for the dissemination of knowledge (Bhatt, 2001). Hence, the capability of an individual to transfer knowledge influences the effectiveness of knowledge transfer. The ability as well as the willingness of an individual determines the effectiveness transfer process. This is in line with the absorptive capacity principle of Cohen and Levinthal (1990) and the behavioral science literature (e.g. Szulanski, 2000; Argote & Ingram, 2000; Yang & Farn, 2007). Also Tsai (2002) argues that the concept of absorptive capacity is a reliable measurement for the effectiveness of a knowledge transfer process. Moreover, the lack of absorptive capacity is viewed as a deficiency in the knowledge transfer process (Szulanski, 1996). Therefore the definition of absorptive capacity is used to define effective tacit knowledge transfer:

Effective tacit knowledge transfer is the employees' ability to obtain tacit knowledge and the willingness to use this tacit knowledge in the project's innovation capability (prepared from Liao et al., 2007, p. 341).

The two concepts in this definition are the antecedents of effective tacit knowledge transfer. These two antecedents are the dependent variables of the conceptual model (figure 7, p. 27). Minbaeva et al. (2003) found that, "while the main effects of both employees' ability and employees' motivation [on level of knowledge transfer] are positive but non-significant, the

interaction effect between these two variables is highly significant. This indicates that neither employees' ability nor motivation by themselves is sufficient to facilitate knowledge transfer. The significant interaction of motivation and ability shows that in order to facilitate knowledge transfer both aspects of absorptive capacity - ability and motivation of employees' - are needed" (p. 596). Based on this it is assumed that both the antecedents need to be influenced positive in order to have effective tacit knowledge transfer. Individuals in the organization need to have knowledge-based capabilities and willingness to obtain and share tacit knowledge in order to effectively transfer tacit knowledge (Liao et al., 2007).

2.4.1. Systems to Manage Knowledge Transfer

The management of knoweldge transfer focuses on the management of creating, retaining, and transferring knowledge (Argote, 1999). This management is realized by the right design of structures and systems (Alavi & Leidner, 2001). In developing the design the three key elements interact with eachother. It is crucial that an appropriate mix between these three elements is ensured, even as the fact that organization's expertise, ideas, and best practices need to be aligned around the critical success factors of the organizations (Weggeman, 1997). In the context of this design, three principles of the sociotechnical system perspective are applicable (Trist, 1981). One is concerned with the location of the boundaries. In a systemic view the locations where the system exchanges resources with the environment are the boundaries. In more practical terms, the locations are where work activities or resources pass from one group to another and a new set of activities or resoursces is required (Cherns, 1976). This is where knowledge transfer takes place. Futher, the research of Malhorta et al. (2001) shows that the implementation of knowledge management technologies are important because they facilitate collaboration. Also the principle regarding information is of importance in this research. This principle states that information must go to the place where it is needed for action (Cherns, 1976). This is related to knowledge transfer and knowledge management systems (KMS). KM helps people, processes, and technology to effectively flow information to the right person, place and time. The processes of KM can be managed by using KMS. Alavi & Leidner (2001, p. 114) refer to this kind of systems as:

Knowledge management systems are a class of information systems applied to managing organizational knowledge.

Examples of KMS are rules, procedures, handbook, instruction cards, as well as, IT systems, intranet, databases and ERP systems. Many scholars and practitioners argue that information technologies play key roles in knowledge management (e.g. Davenport & Prusak, 2000; Lee & Lee, 2000; Goh, 2002). Informational systems can be used to enhance knowledge management and accelerating knowledge sharing (Alavi & Leidner, 2001). An example of KMS in the context of the sociotechnical system design is the implementation of a coordination protocol which coordinates the information but also creates a shared understanding (Malhotra et al., 2001). Concerning the design of these systems, Cherns (1976) developed four principles: *(1)* Minimal critical specification, which state that no more should be specified than absolutely essential, but the essential must be specified. *(2)* The socio-technical criterion, if variance (defined as deviations from expected norms and standards) cannot be eliminated, they must be controlled as close to their point of origin as possible. *(3)* Design and human values, systems need to permit a reasonable level of autonomy and tasks need to provide opportunity to learn. *(4)* Incompletion, the design is an iterative process which means that you leave room for adaptation and learning. These four principles go from a certain level of required specifications up to a certain level where room for adaptation and autonomy is required. Therefore, in this research the link is made with the extent of formalization of these KMS.

2.5. The Focus of Innovation

Innovation is a very common term. A new type of paper clip, as well as, 3D printing can be considered as an innovation. In order to discuss innovation it is necessary to define innovation in a meaningful manner. The key element of innovation is novelty, it is a novel function or a novel way of performing an existing function (Van de Ven et al., 1999).

Innovation is 'the development and implementation of new ideas and knowledge into social and economically successful product, process or service innovation' (Meeus, Oerlemans, & Kenis, 2008, p. 4).

This research builds on this definition because it is often applied and generally accepted (Gilsing et al., 2008; Gilsing et al., 2011). This definition is twofold, organizations innovate by undertaking activities aimed at *(1)* the discovery and *(2)* successful commercialization of new products, processes, services, technologies or operating methods. Successful innovations nearly almost always concern a combination of several of these items (Tilburg University, 2012). This is also argued by the biblical Preacher (Ecclesiastes 1:9) and the economist Schumpeter, "paraphrasing there is nothing new under sun, only new combinations" (Nooteboom & Stam, 2008, p. 19). In short, two central elements in innovation are thus *novelty* and *combination*.

Figure 5. The focus of innovation

Innovation also focuses on the area where the fields of strategy, organization and learning are combined (as presented in figure 5). Since modern organizations view knowledge as the core asset for innovation, organizational learning is a key element of innovation and is closely connected to the field of strategy and the field of organization. *Learning* involves the development, acquisition and application of new rules, routines or knowledge. The literature about knowledge, KM and KMS is part of this field. Further, *strategy* is important because it sets out the general guidelines for the organization and the innovation. Strategy is about the strategic decisions that an organization makes regarding the nature, choice and timing of the innovation activities. The third field is *organization*, which concerns the management of innovation which involves structuring the innovation process, ensure the outcome and successfully implement and commercialize the innovation. *Innovation management* includes tools that allow entities to

cooperate with a common understanding of goals and processes. An example of those tools is project management. Project management is important in the setting of this research because it concentrates on innovation projects. *Project management* can be defined as "the planning, organizing, directing and controlling of company resource for a relatively short-term objective that has been established to complete specific goals and objectives" (Kerzner, 2009, p. 4). Innovation and project management are intertwined. Project management is a key aspect of innovation management, as well as knowledge management.

2.5.1. The Innovation Process

In order to manage an innovation process it is necessary to know how such a process is structured. This structure is presented by the innovation funnel. It illustrates how the process starts, of which phases the process consist and what the goal/outcome of each phase is. The process starts with the ideation and research. In the beginning the focus is on discovering new knowledge and ideas which result in an invention. These early phases can be related to the first part of the definition of innovation: *(1) the discovery*. After the discovering part the process continuous with phases of application and diffusion which result in an innovation. These phases are related to the second part of the definition of innovation: *(2) implementation and commercialization*. Furthermore, it is possible to develop more innovations based on one invention. Also innovations can be improved of adapted which result in improvement and differentiation. From the above can be concluded that there is a distinction between invention/discovery and innovation/implementation. This is in line with Schumpeter's (1947) view on innovation. He argues that 'it seems appropriate to keep invention distinct from innovation' (p. 152). Moreover, the distinction made between discovery and implementation is much like the distinction made by March (1991). He developed theory about the distinction between *exploration* and *exploitation*. Both the distinction of Schumpeter (1947) as well as that developed by March (1991) are often applied and generally accepted among researchers and practitioners (e.g. Van de Ven et al., 1999; Gilsing et al., 2008). In addition, exploration and exploitation are related to inter- and intra-organizational learning (March, 1991; Holmqvist, 2004), interpersonal learning and tacit knowledge (Miller et al., 2006), organizational adaptation and knowledge absorption (Van den Bosch et al., 1999), firm performance and technological

innovation (He & Wong, 2004). In the business environment the innovation department is often called 'Research & Development'. Also these two concepts are consistent with the focus of the two half's of the funnel. The information and relations made explained here are presented in a clear overview in figure 6.

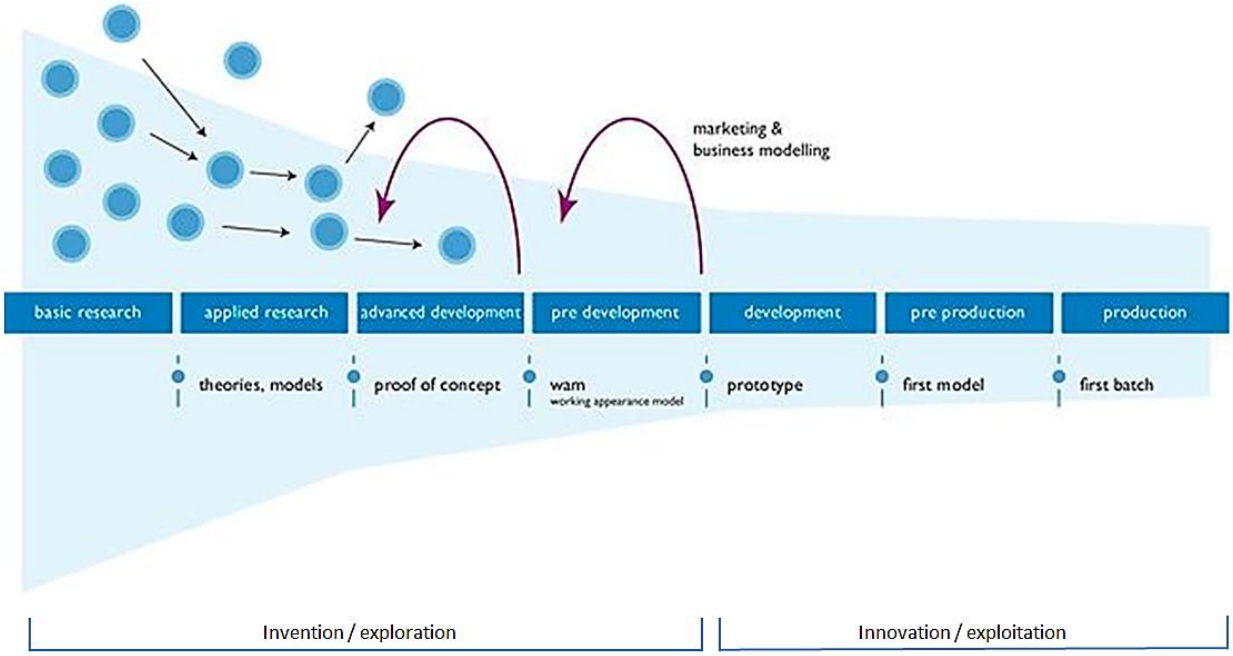

Figure 6. The innovation funnel

2.5.2. The Orientation of Innovation Project.

Concluding from the previous section it can be argued that the phases of an innovation process can be more exploration oriented or more exploitation oriented. In the beginning of the innovation process the orientation is more on exploration (Gilsing et al., 2008; Gilsing et al. 2011). While at the end of the development process the orientation is more on exploitation (Gilsing et al., 2008; Gilsing et al. 2011). Along with this change in orientation also the innovation context changes. Hence, that an individual engaged in a project perceives a more exploration than exploitation oriented innovation context or vice versa (March, 1991; He & Wong, 2004). These two orientations are related to organizational learning, capabilities and absorptive capacity (Van den Bosch et al., 1999; Holmqvist, 2004; Miller et al., 2006), which in turn are related to the concepts of the research model. Moreover, when the orientation changes this leads to changes in the context of the innovation project which in turn lead to changes in the

structures and systems. Therefore the degree of formalization of KMS changes during the innovation process.

> **Innovation orientation** is defined as a strategic direction and learning philosophy that guide the projects' strategies and actions, including those embedded in systems, behaviors, competencies, and processes of the innovation project, to promote innovative thinking and facilitated successful development, evolution and execution of innovations (prepared from Siguaw et al. 2006, p. 560).

2.6. Relationships between Research Concepts

To this end the useful key concepts related to knowledge transfer are described. The relationships to each other are also briefly explained. By following this reasoning and looking to the main objective of this study, the subsequent conceptual model is developed. In this section the relationships are explained in more detail which results in four hypotheses. It is important to notice that the two antecedents of effective knowledge transfer serve as the dependent variables of the model. Based on organization behavior literature and prior research it is assumed that these two antecedents lead to effective knowledge transfer (Cohen & Levinthal, 1990; Szulanski, 2000; Argote & Ingram, 2000; Tsai, 2002; Minbaeva et al., 2003; Yang & Farn, 2007).

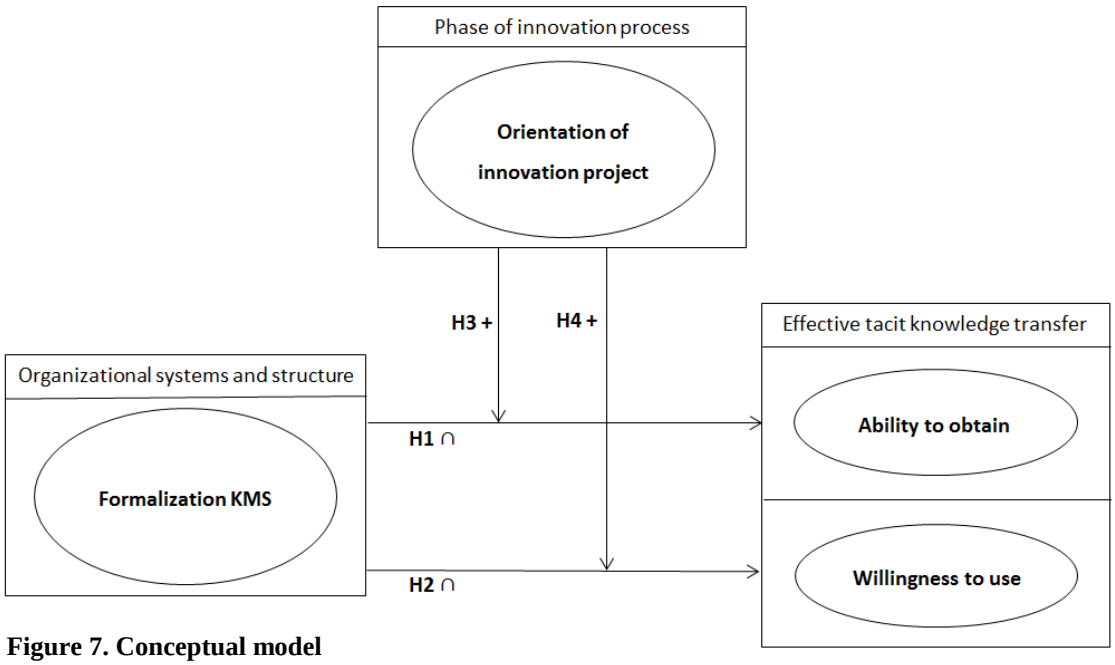

Figure 7. Conceptual model

2.6.1. The Influence of Formalization

This research investigates the relation between the formalization of KMS on the two antecedents of effective knowledge transfer. Based on current literature it is assumed that both ability and willingness need to be positively influenced in order to increase the effectiveness of knowledge transfer (e.g. Minbaeva et al., 2003). In this study formalization of KMS has three indicators: *job codification*, *job specificity* and *rule observation*. The definitions are presented in the operationalization table (appendix VII). All these measures are considered as indicating the degree of formalization by several scholars for a long time (Hage & Aiken, 1967; Pennings, 1973). Job codification is a measure of the latitude of behavior that is tolerated from standards (Hage & Aiken, 1967). While rule observation and job specificity represents the degree of work standardization.

Based on this reasoning two variables measuring formalization of KMS are expected. One variable, consisting of job specificity and rules observation, which measures work-related aspects like to what extent systems and procedures check on the observance of the rules. While the other variable only consists of job codification measures the behavioral-related aspects like to what extent an individual has the autonomy to do almost as they please with regard to knowledge transfer. However, all three indicators are combined into one variable that measures the formalization of KMS. The reason for this is it is explicitly acknowledged that KMS focus on the interaction between people, process, and technology (Bhatt, 2001). The sociotechnical system perspective also focuses on this interaction but divides it in two aspects: *social* (i.e. human and behavior) and *technical* (i.e. processes and systems) aspects in work design (Cherns, 1976; Trist, 1981). Based on this division of social and technical it is argued that job codification measures the social aspects because it measures the behavioral-related aspects. While job specificity and rule observation measures the technical aspects because it measures the work-related aspects. In order to measure the interaction between social and technical, and therefore the interaction between people, process, technology, it is decided that these three indicators together form one variable that measures the formalization of KMS. In this way formalization of KMS measures the extent of *codification of behavioral* by the KMS as perceived by the individual. This concept is essential to many definitions of formalization and is a well-known, and widely used, measuring instrument for formalization in an innovation context (Bodewes, 2002). As a result, the variable ‘formalization of KMS’ measures to what extent the knowledge transfer processes,

systems and rules are formalized (codification) on the one hand. While at the same time this variable measures to what extent the behavior of individuals complies with these processes, systems and rules (behavior). Thereby the interaction between codification and behavior, and therefore between people, process, and technology, is taken into account. Hence, it seems obvious to measure the extent of codification of behavior by using this variable because this variable fits the context of the research. The concepts used are a valid measuring instrument to measured formalization in innovation (Bodewes, 2002). Moreover, throughout the years it has been found that various combinations of indicators of formalization are possible in order to measure the concept formalization or formal structural mechanisms (Hage & Aiken, 1967; Aiken & Hage, 1968; Pennings, 1973; Mom, van de Bosch, & Volberda, 2009).

Formalization provides standards for behavior and outcomes. These standards are systems, procedures and other controls that coordinated behavior of individuals and groups (Bodewes, 2002). By applying these controls on organizational behavior knowledge is controlled because knowledge is socially embedded (Lam, 2000). This notion of social embeddedness underlines the tacit nature of knowledge (Lam, 2000). As with individual skills and capabilities, so experiences, routines, values and mental models are also largely tacit. This happens not only because individual cannot usually describe in precise term what they do, but also because competencies and values originate from complex social interactions and remain largely opaque to individuals (Marengo, 1996). However, formalization partially embodies the tacit dimension of knowledge by the use of routines and it enables dissemination of knowledge and experience among the organization (Conradi & Dyba, 2001). In this way operations regarding tacit knowledge transfer are controlled and coordinated. Due to formalization organizations achieve coordination through the definition of a common set of rules, codes and languages which are well understood and shared by all the members of the organization involved in a given interaction. The early work of Gupt and Govindarajan (1991) already focused on the role of control structures on knowledge flows. In accordance, Cummings and Teng (2003) argue that these flows are fostered or hampered by the design of organizational structures and systems. Structural mechanisms are critical for the coordination of work and the description of behavior (Gupta & Govindarajan, 1991). These mechanisms need to ensure the understanding of the source en recipient, the extent to which the individuals have similar knowledge bases, and the extent of interaction between source and recipients influences knowledge transfer (Cummings & Teng, 2003). Hence, tacit

knowledge is rooted in organizations' coordination mechanisms and organizational systems such as procedures, rules, and routines. Therefore the ability to obtain and willingness to use tacit knowledge can be controlled by these systems and its structure.

2.6.2. Formalization on Ability

Tacit knowledge can be embedded in people, tools, processes and best practices (Weggeman, 1997; Argote & Ingram, 2000). Formalization can structure the behavior of people and structure tools and processes. Thus, formalization is a tool which influences the ability of an individual to obtain tacit knowledge. Kogut and Zander (1992) argue that "a set of higher-order organizing principles act as mechanisms by which to codify technologies into a language accessible to a wider circle of individuals" (p. 389). Shared codes and language comprise a common set of terms and understanding that allow individuals to interact effectively with one another (Collins & Smith, 2006). These organizing principles and shared language will lead to more similarities and common grounds among individuals. This common grounds and language leads to mutual understanding between source and recipient (Vlaar et al., 2006). Mutual understanding between source and recipient is a critical aspect to investigate from a knowledge-based view perspective (Grant, 1996). It enables an individual to cooperate because individuals are more likely to understand the other and therefore more able to cooperate, when they share a common purpose and language (Collins & Smith, 2006). In the same way, interaction between individuals is enabled by common grounds and understanding which, in turn, enhances the ability of these individuals to obtain tacit knowledge. This common ground, language, purpose, and shared codes are all part of a common way of working. A common way of working is achieved by employing routines and imposing the same rules and procedures to individuals (Conradi & Dyba, 2001). Besides, by applying formalized templates (defined as working examples of organization routines) an entire routine or best practice can be imitated (Jensen & Szulanski, 2007). So formalization can also codify best-practice routines, which makes it easier to transfer knowledge, particularly tacit knowledge (Jensen & Szulanski, 2007). This codification of knowledge results in formats, handbooks, work designs, and structures in information systems. Several studies have stated that formalization increases efficiency and coordination and decreases administrative costs of knowledge flows (e.g. Arrow, 1974; Kogut & Zander, 1992). These are all consequences of

the implementation of one way of working. These mechanisms also imply that there is a higher for the ability of an individual to obtain tacit knowledge. When source and recipient have a common way of working and they apply the same rules, procedures and systems regarding the transfer of tacit knowledge. There will be mutual understanding and their knowledge bases will be more similar. This makes the recipient more able to obtain tacit knowledge from the source or system. Based on this reasoning a positive relationship between formalization of KMS and ability to obtain tacit knowledge is expected.

There are also downsides to formalization. Too much formalization can lead to too much rules and procedures. In this case the organization becomes too bureaucratic, which is found to be negatively related to innovative behavior (Thompson, 1965). High formalized structures and systems can constrain individuals in their actions and capabilities (Bock et al., 2005). This limits the extent of interaction between source and recipient which negatively influences knowledge transfer (Cummings & Teng, 2003). Since tacit knowledge is rooted in action, procedures, and heads of individuals (Nonaka & Von Krogh, 2007), it is often shared through personal interaction and learning-by-doing (Grant, 1996; Polanyi, 1967). This human dimension requires some degree of autonomy. Therefore the ability to obtain tacit knowledge can decrease as a result of too much formalization because bureaucracy will restrict individuals in their behavior (Kogut & Zander, 1992). Tsai (2002) found that a hierarchical structure negatively impacts intra-organizational knowledge sharing which suggests that individuals need to have a certain extent of decision-making power and autonomy. Moreover, Allen (1977) found that a bureaucratic organization can inhibit the effectiveness of communication flows within organizations. Therefore the flow of tacit knowledge can be interrupted which leads to individuals that fail to receive or send knowledge. As a result the ability of an individual to obtain tacit knowledge decreases.

The before mentioned negative and positive effects together result an inverted u-shape as hypothesized. A moderate degree of formalization of KMS is the optimal degree of formalization of KMS in order to make individuals more able to obtain tacit knowledge.

H1: *There is a curvilinear relation between formalization of KMS and the ability to obtain tacit knowledge in innovation projects (inverted u-shape).*

2.6.3. Formalization on Willingness

The other antecedent of effective tacit knowledge transfer is willingness to use tacit knowledge. Since tacit knowledge is a resource locked in the human mind, the transfer of it among organizational members is socially driven (Yang & Farn, 2007). Interaction and communication between people are proposed to be the most effective ways to transfer tacit knowledge (Kogut & Zander, 1992; Szulanski, 1996). This interaction is based on the behavior of individuals which in turn is driven by motivational factors. Moreover, the decision to participate to the transfer process and the success of this process are also driven by intrinsic and extrinsic motivation of the source and recipient. Both types of motivation are critical as they are complementary to each other. "Intrinsic motivation enables the generation and transfer of tacit knowledge under conditions in which extrinsic motivation fails" which also works the other way around (Osterloh & Frey, 2000, p. 540). Besides, both source and recipient need to be willing to make the effort to actively engage in the transfer process (Hislop, 2005).

Intrinsic motivation is based on individuals' knowledge sharing behaviors and intentions (Bock et al., 2005; Burgess, 2005). By formalization of the KMS a common way of transferring tacit knowledge is ensured. This leads to understanding and similarity which makes it easier to use tacit knowledge. Several studies already have stated that formalization eases communication and knowledge flows (Arrow, 1974, Collins & Smith, 2006, Olson, 2005 as stated in Sampson, 2007). When individuals can transfer knowledge easier and execute work more efficiently, the individual will become more willing to transfer knowledge. On the other hand, formalization can provide external motivational incentives. By using organizationally-imposed rules, systems and procedures the behavior of employees can be steered and controlled (Bock et al., 2005). These systems use the power of control in order to provide extrinsic motivation, as suggested in Transaction Cost theory (Williamson, 1981). The management can also provide incentives via systems to stimulate knowledge transfer behavior (Osterloh & Frey, 2000). When the management determines pay rise, promotions and job offers according to the knowledge possessed or shared by an individual, individuals will become more willing to do so. Individuals are also more willing to develop firm-specific skills such as shared language when they receive reciprocal investment from the firm (Collins & Smith, 2006). Individuals will have no incentive to give up their individual competitive knowledge advantage as long as they are not compensated or compensated according to the project's profitability (Osterloh & Frey, 2000). So formalization

of KMS can provide motivational incentives to transfer tacit knowledge. It can also help develop a shared language and mutual understanding which makes transferring knowledge easier, and therefore individuals will become more willing to use tacit knowledge. Based on this reasoning a positive relationship between formalization of KMS and willingness to use tacit knowledge can be expected.

However, too much formalization will negatively influence the willingness of an individual. Bureaucracy can limit individual's willingness to transfer technological information and knowledge (Allen, 1977). Too much rules and procedures will restrict individuals in their behavior. They will have no autonomy or power which negatively influences the motivation of professionals and knowledge workers (Montagna, 1968; Bodewes, 2002). This motivation together with the personality of individuals results the organizational climate. The same applies for the flow of tacit knowledge. Bock et al. (2005) found that the organizational climate is an important driver for individuals' intention and attitude to share knowledge. Moreover, March and Simon (1958, as described in Kelley et al., 1996) found that formalization can also lead to a change in the goal that an employee wants to achieve. In this case the goal of the employees is to follow the procedures and not doing their work. This applies only when KMS are too formal. When the level of formalization is too high, the goal of the employees will become to follow the rules and procedures instead of using or transferring knowledge. This results in more willingness to follow rules and procedures instead of more willingness to use tacit knowledge. Moreover, individuals will become less willing to use tacit knowledge as the obtainment of knowledge becomes more difficult due to the too high degree of formalization of KMS. Thus, highly formalized systems will negatively influence the willingness to transfer tacit knowledge.

According to the last paragraphs, positive and negative relationships between formalization of KMS and willingness to use tacit knowledge are expected. Following the reasoning of both relationships, an optimal degree of formalization is suggested. A certain degree of formalization leads to easier execution knowledge transfer activities and it can stimulate and force individuals to behave and act in accordance to systems. However, too much formalization can restrict in their behavior and willingness. Therefore an inverted u-shape is hypothesized.

H2: *There is a curvilinear relation between formalization of KMS and the willingness to use tacit knowledge in innovation projects (inverted u-shape).*

2.6.4. The Influence of Orientation of Innovation Project

According to the last paragraph a certain extent of formalization positively influence the two antecedents of effective tacit knowledge transfer. In contrast, it is commonly perceived that innovation projects need organic, low-formalized organizing design structures (Aiken & Hage, 1971). This organic form also require organic KMS which leaves the users with autonomy and provides them with information, advice and other support rather than instructions and decisions (Burns & Stalker, 1994). Therefore a paradox arises between the need for formalization in order to effectively transfer tacit knowledge, and the need for autonomy in order to successfully develop innovations.

Several studies show that exploration and exploitation require different structures, people and processes (e.g. March, 1991; Holmqvist, 2004; He & Wong, 2004). "Exploration is associated with organic structures, loosely coupled systems, path breaking, improvisation, autonomy and chaos, and emerging markets and technologies. At the same time exploitation is associated with mechanistic structures, tightly coupled systems, path dependence, routinization, control and bureaucracy, and stable markets and technologies" (He & Wong, 2004, p.481). In other words, exploration can be related to a context with a lower degree of formalization and exploitation can be related to a context with a higher degree of formalization. A difference in context of an innovation project will demand for change in its content such as human and knowledge resources. The organizational design has to adapt with the contextual factors in order to ensure a balance between the characteristics of the transfer processes and with the characteristics of the environment in which the organization operates (Marengo, 1996). Therefore, the structures, systems, and processes need to be aligned with the context and content of the innovation project. This will demand a different degree of formalization on KMS along the innovation process because the orientation of the project will change.

The effect of formalization of KMS on ability to obtain tacit knowledge will be stronger for individuals that are engaged in more exploitation oriented projects. In phases where the emphasis is on exploration, the innovation process activities are more creative and outcomes less predictable. However, in phases where the emphasis is on exploitation, the outcomes are more predictable and the activities are more structured and focused to realize this intended outcome. Hence, the work activities and procedures can better be prescribed and codified in exploitative

projects. The activities and processes allow more standardization and need to be more standardized to accomplish the intended outcome (Burns & Stalker, 1994). This allows work design, structures, and systems to be higher formalized. Following this reasoning, the KMS will also be higher formalized. Since tacit knowledge is context specific (Nonaka, 1994), the reuse of tacit knowledge is easier when the context is more or less the same as the context where this tacit knowledge is gathered or implicated before. When an individual has to do more or less the same work, reuse of tacit knowledge is easier and this individual is more able to obtain other tacit knowledge. Thus, the more an innovation project is exploitation oriented, the more formalization is possible, allowed and effective, the stronger the effect of formalization of KMS on ability to obtain tacit knowledge

H3: *The relation between formalization of KMS and the ability to obtain tacit knowledge is positively interacted when an innovation project is exploitation oriented.*

In line with the above, the difference in easiness of reuse and better applicability of tacit knowledge when it is used in the same context relates to the willingness of an individual to use tacit knowledge. When an innovation project where an individual is engaged in is more exploitation oriented, the effect of formalization of KMS on willingness to use tacit knowledge will be stronger. This individual experiences that the tacit knowledge fits the context better which makes the transfer process easier (Jensen & Szulanski, 2007). This knowledge is also easier applied because the activities and processes are quite similar in the exploitation phases, which leads to more willingness to use tacit knowledge. Due to formalization shared codes and language are created which causes mutual understanding. Mutual understanding enables the interaction between individuals that, in turn, makes individuals more motivated to interact and therefore willing to use tacit knowledge of others (Bodewes, 2002). Moreover, at different orientations of innovation projects different types of people or skills are required (Burns & Stalker, 1994; Holmqvist, 2004). These types of people do have a different personality and demand for environment (He & Wong, 2004). Individuals in an explorative project are more exploratory in nature. They like to experiment, do new things and have a more creative mind (He & Wong, 2004). Their way of working is less organized and with more autonomy (Aiken & Hage, 1971). This difference in type of people has two consequences. First, it is likely that

explorative people dislike standardization and formalization more than exploitative people. In explorative projects less formalization is possible, allowed, and effective. Secondly, explorative individuals like to have more autonomy and work more independently because they rely more on their own capabilities. Explorative individuals will be less willing to use tacit knowledge of other sources and out of systems. They want to solve problems and create knowledge themselves. On the other hand, exploitative people do like to have tightly coupled systems, control structures, and routinization (He & Wong, 2004). Therefore these people will be more willing to use tacit knowledge out of formalized systems. Both these consequences, as well as the better possibility to apply tacit knowledge when a project is more exploitation oriented, influence the relation between formalization of KMS and willingness to use tacit knowledge. The more an innovation project is exploitation oriented, the more formalized the systems and its structure can be, the stronger the effect of formalization of KMS on ability to obtain tacit knowledge

H4: *The relation between formalization of KMS and the willingness to use tacit knowledge is positively interacted when an innovation project is exploitation oriented.*

3. Methodological Framework

In this chapter a quantitative and qualitative empirical analysis of tacit knowledge transfer in innovation projects is presented. First, the research design and methods of data collection are discussed. Next, in section 3.2, the empirical analysis of the variables is discussed. Section 3.3 presents the data analysis of both the quantitative and qualitative data. At the end of this chapter, the research quality indicators are discussed in section 3.4.

3.1. Research Design

The research used a quantitative and qualitative approach to gather metric as well as in-depth data about the research concepts and its relationships. By combining these techniques for the collection of data a more valid and comprehensive image has been obtained. The quantitative part investigated to what extent the ability to obtain and willingness to use tacit knowledge were influenced by the degree of formalization of KMS. The qualitative part revealed in-depth insights of the findings of the quantitative research. The qualitative research also investigated how tacit knowledge is transferred effectively among project members and how this transfer process is managed during innovation projects. The use of the two research techniques helped to check the integrity of inferences drawn from data in social research (Bryman, 2001). A total dataset with broad data as well as deep insights has been obtained by investigating the relation between the research concepts via a survey (the quantitative sub-question) but also via interviews (the last qualitative sub-question. Further discussion of the quantitative findings in a third round of interviews has been used to extend the understanding of quantitative findings, and for validating qualitative research evidence (Ritchie & Lewis, 2003). This design provided the opportunity to examine both types of research questions and therefore to answer the main research question eventually. In light of the concepts of this research and the context of KM, this approach seems most suitable because complex, intangible, and difficult concepts were measured (Fahey & Prusak, 1998; Argote, 1999). The research used a cross-sectional approach, since data has been collected at one moment in time. The underlying cause for this is a pragmatic consideration; only a limited time was available for conducting this research. The unit of analysis and unit of observation are the project members of the innovation projects in the high-tech industry.

3.2. Empirical Context

The quantitative empirical evidence has been collected within the high-tech industry. The reason for choosing this industry is that the organizations in the industry develop and use the most advanced technologies of the world. Therefore all the organizations share the importance of investing in R&D and innovation (Collins & Smith, 2006; Rui et al., 2008). This study collects its data in region Eindhoven. This is Europe's leading R&D region (High Tech Campus Eindhoven, 2013). Brainport Eindhoven is also located in this area which is famous for its high concentration of high-tech and knowledge-intensive industry (Brainport, 2013). Hence, this region's characteristics and its workers match the concepts of the research (Collins & Smith, 2006). Most qualitative evidence has been collected in the high-tech industry as well. Only a few interviews were held with managers of consultancy firms. These managers were highly knowledgeable and experienced in subjects related to knowledge management, innovation management, and project management.

3.3. Sampling

This present study has investigated several individuals from 18 different organizations. Fourteen of the eighteen organizations were located in the high-tech industry of region Eindhoven. Of these fourteen organizations, nine organizations belong to the quantitative data sample. In the quantitative part of this study stratified purposive sampling has been used as a between sample strategy. This ensured that projects with different orientations were included. In total 23 innovation projects were included which consisted of 334 project members. The quantitative study had no within sample strategy. All the employees engaged in the innovation projects were included in the research. These 23 projects were all active in the high technological industry in the sector electrical engineering in region Eindhoven. All projects extended over the period 2008 towards approximately 2016. This timespan covered projects of different orientations. There were eleven projects more exploration oriented which were mostly planned to finish within 2013, two exploration projects were planned to finish in the period from 2013 towards approximately 2016 and from one exploration project the deadline was unknown. Besides, there were twelve projects more exploitation oriented which were also all planned to finish within 2013, except one which deadline was 2015.

The other five organizations which were located in the high-tech industry of region Eindhoven but did not deliver innovation projects, only delivered individuals which were interviewed. They were obtained in the qualitative data sample together with the individuals of the four organizations not located in the high-tech sector of region Eindhoven. Since these interview aim at gathering in-depth data of the research concepts and their relations, the individuals were selected based on the three main areas of this research: knowledge management, innovation management and project management, and three important timeframe areas: past, present, future (Fahey & Prusak, 1998). The individuals obtained in the data sample to discuss the findings of the quantitative research were selected based on the selection criteria 'firm size' in order to discuss the findings with individuals of all three different firm sizes obtained in the quantitative data sample. These three different firm sizes are: Small = < 50 FTE's, Medium = < 250 FTE's, Large = > 250 FTE's. Figure 8 visualizes the structure of the sample. More details about the data sample can be found in appendix V.

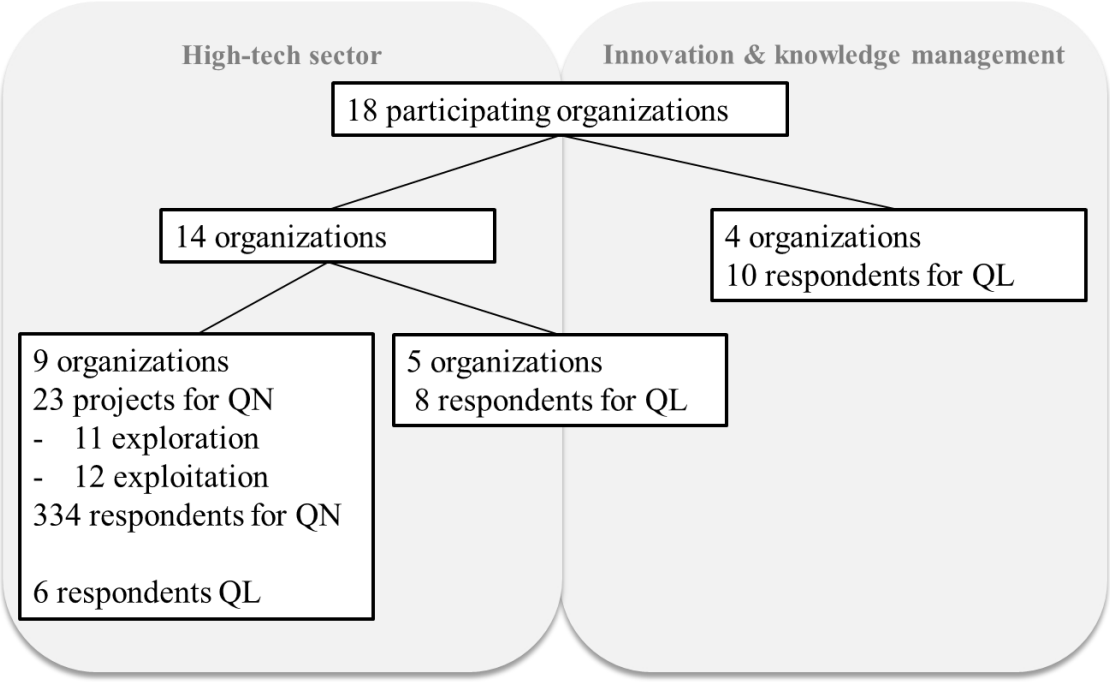

Figure 8. Structure of the sample

3.4. Data Collection

Just like the use of different research techniques, there were also various data collection methods. A questionnaire has been used to collect quantitative data. The qualitative data has been collected through semi-structured and structured interviews. These different approaches helped the researcher to acquire a comprehensive understanding (Ritchie & Lewis, 2003). Data collection had taken place in several stages. A visualization of these stages is displayed in figure 9. The data collection period extended over the period February to May 2013.

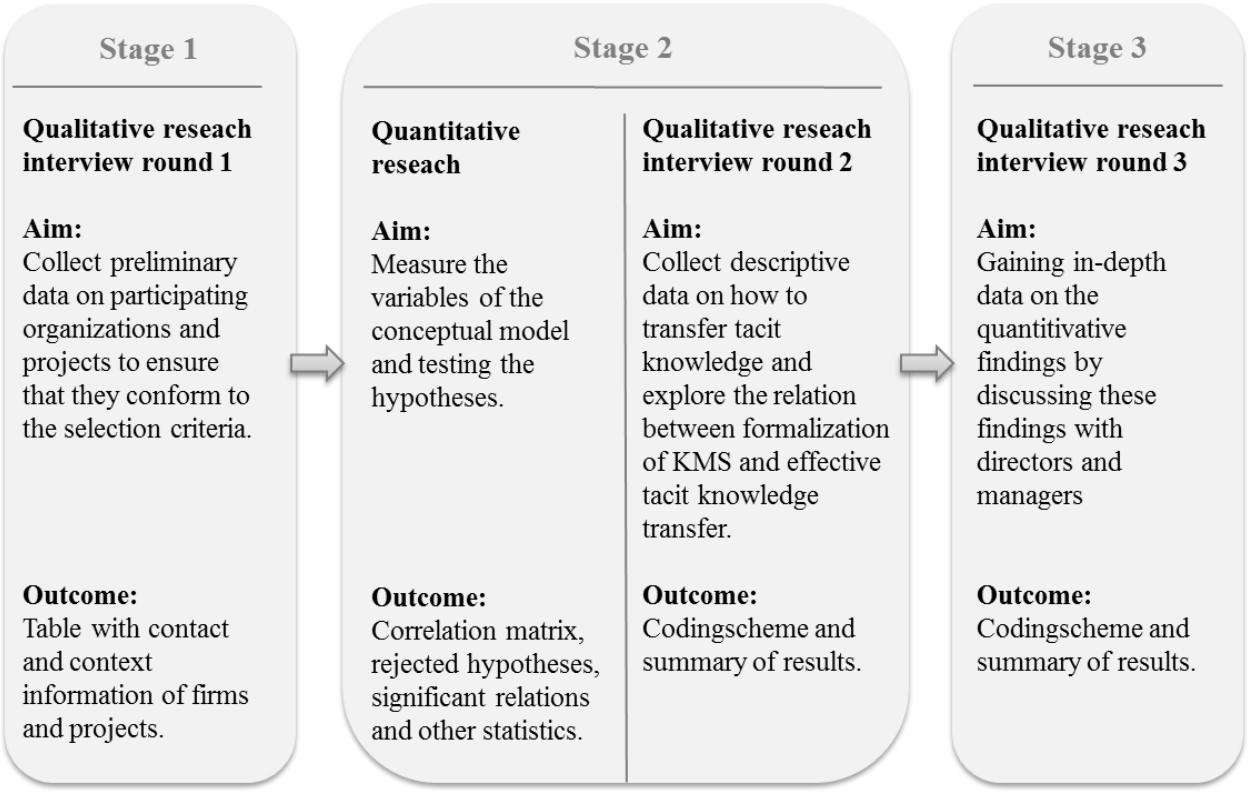

Figure 9. Stages of data collection

Stage one consisted of preliminary interviews with directors and managers of the participating firms to ensure that the delivered projects conformed to the selection criteria (see appendix III for selection criteria). When projects fitted the criteria, a few characteristics of the innovation projects where asked (see appendix III for which characteristics). The conversations to obtain this data were held by the use of different media (i.e. telephone, e-mail, personal meeting and/or

Skype). Therefore no transcripts were made. The data was processed in the table shown in appendix III. At the end, the collected data was checked for input errors or misinterpretations by the project managers and adjusted by the researcher if necessary.

The second data collection stage consisted of questionnaires and interviews. Both methods were executed at the same time. During this stage the most data has been collected. Hence, this stage extended over the period from March to April 2013. The quantitative data has been collected by distributing a questionnaire. However, before distributing the questionnaire a pilot was conducted in order to control ambiguities, errors and suitability. Hereafter the questionnaire was digitalized using ThesisTools and distributed by mail (see appendix I for the questionnaire). To increase participation among the respondents, the questionnaire was distributed by the project managers of the innovation projects. A number of 334 members of different innovation projects were approached to fill out the questionnaire. From all approached project members 218 responded to the questionnaire. This comes down to a response rate of 65.3%, which is a reasonably high level that provided a dataset of high quality. A non-response analysis has been conducted. However, the information of population data that was needed for conducting such an analysis was not available in proper condition. Not all nine participating organizations could provide sufficient data of the population for performing a statistical analysis. The organizations simply did not have the information because the projects included individuals of external organizations and individuals employed on a temporary or payroll basis. Nevertheless, some information of the population was obtained as shown in table 1. In some cases the managers estimated some of these values. Finally, the values of the population data were compared with the characteristics of the high-tech industry (Brainport, 2013; High Tech Campus Eindhoven, 2013; Brainport Development NV, 2013). Both images were fairly similar. By comparing the values of the organization as well as total mean values with the values of the observed data, no major differences were found. Therefore, no indication for any non-response bias was found.

Table 1. Results non-response analysis

	Gender (% male)	Age (years)	Educational level (most common level)	N
Population data				
FEI	93.4 %	44	WO	103
NTS	93.0 %	42	WO*	113
Assembléon	100%	47	HBO/WO	7
CCM	100%	45*	WO	17
Frencken	100%	39	HBO	30
MIpartners	100%	36	WO	6
Phenom World	100%	40*	HBO/WO*	14
Mutracx	100%	44	HBO/WO	14
Solaytec	100%	38*	HBO/WO*	30
Total mean:	98.5%	41.7	WO	334
Observed data				
FEI	94.9%	43.0	77.0% WO	47 (45.6%)
NTS	90.8%	41.1	61.5% WO	87 (77.0%)
Assembléon	100%	47.0	50% WO	6 (85.7%)
CCM	100%	44.4	50% WO	16 (94.1%)
Frencken	100%	38.0	13.6%WO / 68.2% HBO	25 (83.3%)
MIpartners	100%	36.3	50% WO	5 (83.3%)
Phenom World	100%	38.6	70.0% WO	10 (71.4%)
Mutracx	100%	41.9	66.7% WO	11 (78.6%)
Solaytec	100%	43.0	66.7% WO	11 (36.7%)
Total mean:	98.4%	38.5	56.2%	218 (65.3%)

* Estimated by managers due to insufficient administrative information
Observed data contains missing values which can lead to underestimation.

In the second stage, the qualitative data has been collected through interviews. This round of interviews focused on collecting descriptive qualitative data on tacit knowledge transfer, knowledge management systems, and the management of tacit knowledge transfer in the context of innovation (see appendix IV for topic list). The questions in the topic list are derived from the theoretical operationalization of the research concepts (appendix VII). However, because data collection and data analysis were partially overlapping, the researcher was able to probe for particular themes that emerged during other interviews. There was also collected qualitative data on the relation between the research concepts. This data did not provide any affirmative findings or inferences but only deep insights and complementary contributions to the quantitative data. A total number of sixteen semi-interviews that lasted between 35 and 70 minutes were conducted,

recorded, and transcribed. Based on general accepted qualitative research provisions and the paper of Guest et al. (2006) this is a valid and representative amount. During all interviews there has been made use of a notebook in the middle of the table to make it possible for the respondent to support his or her story visually. These visualizations were obtained in the transcripts.

The last stage of data collection focused on discussing the findings with directors and (project) managers. The aim of this round of interviews was gaining in-depth data about the quantitative findings. Since the findings were known at this stage of the research, and it is desired to only gather in-depth information about these specific subjects, structured interviews were conducted of 21 to 44 minutes. The seven respondents were selected based on the selection criteria 'firm size' in order to discuss the findings with individuals of all three different firm sizes obtained in the quantitative data sample. The topic list can be found in appendix VI. This topic list also contains a page with images to support the results and questions. Here again, there is made use of a notebook in the middle of the table to make it possible for the respondent to support his or her story visually. These visualizations were also obtained in the transcripts. the individuals interviewed and overview of the outcome of the whole data collection can be found in appendix V, IX, XII, and XIII.

3.5. Measurements

In the study, formalization of KMS, orientation of innovation project and ability and willingness to transfer tacit knowledge were measured to test the research model. Also four control variables are included. In this section all the variables will be explained and operationalized in order to make the variables measureable. In appendix VII an overview is presented by the use of an operationalization table.

3.5.1. Dependent Variables

This study had two dependent variables, namely the ability of an employee to transfer tacit knowledge and the willingness of an employee to transfer tacit knowledge. These are two commonly used concepts to measure the effectiveness of knowledge transfer (Tsai, 2002; Liao et al.,2007). This way of measuring is based on the absorptive capacity principle of Cohen and

Levinthal (1990). Minbaeva et al. (2003) found that the interaction effect between these two conditions on transfer of knowledge was highly significant. This construct was operationalized by the researcher itself to more effectively measure tacit knowledge transfer in the context of this research. However, the questions were based on the instrument of Liao et al. (2007). The construct 'willingness' had five questions (items 1-5) and the construct 'ability' had seven questions (items 6-12). Items were assessed by using a 7-point Likert scale with possible answers ranging from 1= strongly disagree to 7= strongly agree.

3.5.2. Independent Variables

Two independent variables were obtained in the research model. The first independent variable was 'formalization of KMS' which *directly* influences the dependent variable. This variable consisted of three constructs. All constructs were operationalized by the researcher itself to more effectively measure formalization in the context of this research. However, the questions were based on the instrument of Hage and Aiken, (1967). The first construct is 'job codification' which consisted of five questions (items 1-5). The second construct 'job specificity' consisted of six questions (items 6-11). Third, the construct 'rule observation' only consisted of two items (items 12 and 13). These constructs are widely tested and applied by many researches, and found to be a reliable measure. The items were assessed by using a 7-point Likert scale (1= strongly disagree; 7= strongly agree).

The second independent variable was 'orientation of innovation project' which was an interaction variable. It was expected that the orientation of an innovation project affects the causal relationship between the other two variables. This interaction variable specifies *when* the variable 'formalization of KMS' would had a certain effect and *whether* this relationship differs with regard to the orientation of a project. This construct was operationalized by the researcher himself because this concept has not been used in the literature as it has been used in this research, and to more effectively measure orientation of innovation in the context of this research. Although this instrument was developed by the researcher himself, it was evaluated by the use of the instrument of He and Wong (2004). All eight items were assessed by using a 7-point Likert scale (1= strongly disagree; 7= strongly agree). Item 1 to 4 measured the extent of exploration and item 5 to 8 measured the extent of exploitation of the innovation project where

the individual was engaged in. While only a hypothesis was developed for exploitation, also the extent of exploration was measured to obtain a more comprehensive dataset. This dataset did provide more insights and more ways to accept or reject the hypotheses.

3.5.3. Control Variables

All constructs were measured on the individual level and were subjective (perceived by the employees themself). This was necessary since knowledge is socially embedded in individuals, projects and organizations (Polanyi, 1967; Kogut & Zander, 1992). There was controlled for influencing factors on all these three levels. The first level was 'the individual'. On this level was controlled for personal characteristics:

- Gender [0 = men, 1 = women],
- Age [continuous in years]; and
- Educational level [1 = vmbo, 2 = havo, 3 = vwo, 4 = mbo, 5 = hbo/bachelor, 6 = master].

All these variables were characteristics which can influence perceived formalization as well as ability or willingness to transfer tacit knowledge. For example, an employee who is higher educated can have more ability to transfer knowledge and also work experience and capabilities (partially tacit knowledge) come with age. This makes age an important factor to control for and a better factor to control for than tenure because it is about overall work experience, capabilities, norms and values, not only about experience within the current organization. Secondly, there was controlled for the influence of variables at 'project level' and 'organizational level'. Three control variables were included in the research model:

- Project size [continuous in number of individuals that participated in the project],
- Duration of the project [continuous in months]; and
- Firm size [continuous in number of FTE's].

The reasoning for including the size control variables was that it is suggested that a relationship may exist between size and organizational structure aspects such as span of control and decision making (Williamson, 1973). This may suggest that especially large organization and projects will have formalized mechanisms and structures thus maybe more formalized KMS. Large

organizations and projects also have complex and bigger innovations which lead to the need and deployment of more resources. This can increase the ability of employees. A formalized structure can also influence the willingness of an employee. Larger organizations and projects with complex innovations have larger innovation projects which are more likely to have a longer duration. The bigger and longer the organization and/or project, the more formalized structures and systems will be, and the more and the better the deployed resources and individuals can be. Besides, the constructs used to measure both dependent variables originate from the absorptive capacity principle as used in other studies were also was controlled for or suggested to control for individual and organizational characteristics (e.g. Szulanski, 1996; Chou, 2005).

3.6. Data Analysis

3.6.1. Quantitative Data Analysis

The quantitative data was analyzed by using SPSS 20. First data was cleaned and organized. No strange values where found as the questionnaire was set out digitally and therefore did not allow for answers outside of the possibilities. Although the constructs used to measure the variables were based on tested measurements, factor and reliability analyses were conducted. This has two reasons. First, the questions were cross-translated, implemented in another context, and modified several times. Second, in the literature it is argued that several different constructs can be used to measure formalization (Hagen & Aiken, 1967). In this research three constructs were used which were assumed to fit the context of this research the best and measure the degree of formalization of the KMS the best. Because of this selection it was checked how the items load on which component and how reliable the measurement was. After the factor and reliability analyses two different types of quantitative data analyses were conducted in order to test the hypothesis. These are a multiple regression analysis and multi-level analysis because of the structure of the data set.

3.6.2. Factor Analysis and Reliability Analysis

Principal components factor analysis with factor extraction and OBLIMIN rotation was conducted to examine unidimensionality and construct validity (Pallant, 2005). Before performing the factor analysis, it was tested if the dataset copes with five restrictions for performing factor analysis: *(1)* Each item had seven response categories per item; *(2)* The number of respondents was 218; *(3)* The number of 218 respondents was higher than five times 23 items; *(4)* All Bartlett's Test of Sphericity were significant (p = .000), and; *(5)* All KMO values were higher than .742. Based on the fact that all five criteria's were met, factor analysis was conducted and was used as a method of data reduction.

Ability to use tacit knowledge

The factor analysis clearly showed that 'ability' exists out of one component. The Eigenvalue of this component was 2.927. The factor loading of all items was above 0.4. This factor structure was the simplest structure and contained no single item factors.

Table 2. Results of factor analysis 'Ability to use tacit knowledge'

Pattern matrix without fixed components	
	Component 1
A5. Ability to use and organize the acquired tacit knowledge	,803
A1. Equipped with excellent professional tacit knowledge	,764
A2. Acquire quickly and thoroughly new tacit knowledge	,759
A4. Higher educational qualifications than other members	,757
A3. Better working skills than other members	,742

Willingness to obtain tacit knowledge

The factor analysis clearly showed that 'willingness' exists out of one component The Eigenvalue of this component was 2.956. The factor loading of all items was above 0.4. This factor structure was the simplest structure and contained no single item factors.

Table 3. Results of factor analysis 'willingness to use tacit knowledge'

Pattern matrix without fixed components	
	Component 1
W4. Rewards offered by the management can effectively encourage me	,822
W5. Reward system of our company are better than that of competitors	,774
W7. Obtain fair rewards for their progress in learning	,641
W1. Strive to acquire working skills and job licenses	,638
W3. Management determines pay rise, etc. according to the working skills	,579
W6. Acquisition behavior has positive impact on the working efficiency	,524
W2. Others assign further opportunities according to obtain tacit knowledge	,505

Formalization of KMS

The factor analysis clearly showed that 'formalization of KMS' exists out of two components. This showed that the three indicators of formalization cannot be put together in order to create one measurement that measured the interaction between people, process, and technology. The division of two components was also different than the expected three components based on literature. The division of three components should have theoretically resulted in one component with loadings on two items of rule observation. However, one of those items loaded on component 'job description' and the other item loaded on component 'job specificity'. Therefore it was concluded that a separate component for construct 'rule observation' does not exist and was decided to make use of two components. The items of 'job specificity' and 'rule observation' fit together. This resulted in component 1 called 'job specificity' which measured to what extent the procedures were specified by the systems and the activities were standardized. This component had an Eigenvalue of 7.299 and the factor loading of all items was above 0.4. The items of 'job codification' formed a separate component. This second component was called 'job codification' which measured the latitude of behavior that was tolerated by systems and to what extent codification was enforced by the rules. This component had an Eigenvalue of 1.405 and the factor loading of all items was above 0.4. All the items that measured job codification were reversed coded.

Table 4. Results of factor analysis 'formalization of KMS'

Pattern matrix based on two components		
	Component 1	Component 2
RO2. Constantly watched by systems in obeying rules	,969	
JS4. Going through KMS is constantly stressed	,910	
JS3. Everyone has a specific job to do	,868	
JS5. Follow procedures of KMS at all times	,814	
JS6. KMS keep a record of performance	,803	
JS2. KMS provide procedures to dealing situations	,786	
RO1. Constantly checked on rule violations	,723	
JS1. Look in the KMS for answers on problems	,623	
JC4. Allowed to do almost as they please [R]		,870
JC1. Own boss in transferring tacit knowledge [R]		,806
JC3. How is left up to the person [R]		,782
JC5. Make my own rules [R]		,759
JC2. Make own decisions without checking in KMS [R]		,634

[R]: item was reverse coded.

In conclusion, using two components resulted in the best factor structure and all other criteria were not violated. Moreover, the resulting components were theoretically valid. Bodewes (2002, p. 220) states in his paper that if the formalization construct can be divided into two dimensions, "they [Aiken and Hage (1968)] acknowledge job codification and rule observation as the two dimensions that embody the formalization construct". The reason for the division in these two dimensions is the presumption that a high degree of formalization implies not only a preponderance of rules defining jobs and specifying what is to be done, but also the enforcement of those rules (Aiken & Hage, 1968). By using the components job specificity and job codification to measure formalization of KMS separately, the interaction between people, process, and technology is not measured within one variables or effect. For this reason, it is important that the effects of each independent variable on the dependent variables should be interpreted relatively to each other in order to assess the critical interaction between people, process, and technology.

Orientation of innovation project

By conducting an analysis with no fixed components the factor analysis results in three components. One item appears to form a separate factor. This is item1 which is about the statement: "The innovation project introduces new generation of products, processes and/or services". It appeared that all the respondents argue that they concentrate on introducing new generation of products, processes and/or services because nearly all respondents have answered on this item positively. This indicated the possibility of questionably quality which was tested in the reliability analysis. This reliability analysis resulted however showed no indication of low quality. Therefore this item stays included in the scale and was chosen to run a factor analysis based on two fixed components. Moreover, by taking into account the decision rule according to the exclusion of single item factors, it was obligated to choose for a two component structure. Component one was called 'exploitation' and had an Eigenvalue of 3.248. Component two was called 'exploration' and had an Eigenvalue of 1.854. The factor loading of all items was above 0.4.

Table 5. Results of factor analysis 'orientation of innovation project'

Pattern Matrix based on two components		
	Component 1	Component 2
O8. Improve yield or reduce material consumption.	,939	
O7. Reduces production cost.	,916	
O6. Improves production flexibility.	,889	
O5. Improves existing product quality.	,578	
O4. Enters new technology fields.		,802
O3. Opens up new markets.		,797
O2. Extends product range.		,735
O1. Introduces new generation of products		,609

In conclusion, the factor analysis showed that all variables form the expected component structure except variable 'formalization of KMS'. Factor analysis divided the measurement 'formalization of KMS' into two components. Finally, the reliability of each new scale with the new item distribution was checked. No items were deleted. All values of the Cronbach's Alpha were above the critical level of 0.7. It can therefore be concluded that all measurements were reliable. The results of this analysis are displayed in table 6.

Table 6. Results of reliability analysis

Scale	Cronbach's Alpha based on standardized items	Items	N
Ability to obtain	.821	5	193
Willingness to use	.769	7	188
Job specificity	.934	8	190
Job codification	.852	5	190
Exploration	.727	4	206
Exploitation	.863	4	204

3.6.3. Multiple Regression Analysis and Multi Level Analysis

Both multiple regression analysis and multilevel analysis were conducted in order to test the hypothesis. All hypotheses were tested at a minimum of the $p < .05$ level of significance. Standardized coefficients were used to compare the relationships between the variables. The curvilinear effects were analyzed by multiplying the associated variables with themselves. The interaction effects were analyzed by multiplying the X variables (ability or willingness) with the Z variables (exploration or exploitation). This technique increases the chance of multicollinearity being present. However, by mean centering the variables involved the chance for multicollinearity was reduced. The rule-of-thumb cutoff of 10 for the variance inflation factor (VIF) was used to examine the presence of multicollinearity (Pallant, 2005). As a result, issues of multicollinearity seem not to be a problem.

Multilevel analysis was performed to test the hypothesis because of four reasons. Firstly, the population had a hierarchical structure (Hox, 1995). This means that data points were obtained at different levels (different organizations, projects and individuals) whereby these levels and its characteristics were not independent. Second, running separate analyses for each project was possible but this comes at the expense of the statistical efficiency because then small datasets would be analyzed (Verboon, 2012). The third reason was that this dataset exists of relatively too many projects and individuals which make it impractical to run separate analyses. The last reason was because this research focuses on the total common effect, multilevel analysis is required (Verboon, 2012). First, the intra-class correlation was measured to investigate if the assumption of independence of the observation was violated. The intra-class correlation (ρ) was

obtained by applying an equation based on the intercept of the model with no explanatory variables, also called intercept-only model or 'nulmodel' (Hox, 1995). The equation gives the researcher the value of the deviance which is a measure of the degree of mis-fit of the model. When the intercept of the nulmodel is significant ($p < .05$) this means that the total variance of the scores is caused by the variance between the classes. The results of both data analysis techniques are discussed in the results section.

3.6.4. Qualitative Data Analysis

Before analyzing the interviews all recordings were transcribed by the use of transcription program f4. While transcribing the interviews some parts, like small talk, examples and technical or irrelevant fragments, were not transcribed. These parts were signposted in the transcriptions and can be retrieved by using the timestamps. The raw data of interview round two was analyzed based on the framework approach described by Ritchie and Lewis (2003). This approach ensured transparency about the researchers' interpretations of the experience of participants and is appropriate for the analysis of cross-sectional descriptive data. The framework approach consists of three stages: *data management*, *descriptive accounts*, and *explanatory accounts*. In the data management stage the raw data was reviewed and labeled using in-vivo coding and open coding based on the operationalization table. The 'review-option' in Microsoft Word was used for labeling. A coding matrix was developed in Microsoft Excel in order to reduce and order the data (see appendix IX for coding matrix). At the end of this stage, codes were grouped together into broader initial categories. In the second stage these initial categories were reviewed and the diversity of coded data was reduced by refining final categories. These final categories were also grouped together which resulted in themes. These categories and themes formed a 'coding index' that was used by exploring relations between the codes, categories and themes (see appendix IX for coding index). The qualitative analysis was finished with the explanatory accounts stage which involved exploring the relationship between the core concepts, the operationalization table and the theoretical framework. These qualitative findings are not used to confirm or reject the hypotheses but provide deeper insights by exploring relations and mechanisms. Furthermore, the associations made in the previous stage were verified and the outcome was reflected with the original data. After the analysis all results and insights were summarized in an extensive

summary. Important quotes were selected and used in this summary. This extensive summary served as the basis for the qualitative results in the result section (see appendix X).

The data of interview round three was analyzed regarding the same starting phase as described above. However, the second and third phases were not conducted because the aim of this interview was on gaining in-depth insights into the quantitative findings and hypothesis. After labeling the data, a coding matrix was developed based on the hypothesis, quantitative findings and topic list (see appendix XI for coding matrix interview round three). This matrix presents a clear and comprehensive overview of the data.

3.7. Research Quality Indicators

In order to fit this study's needs best, both qualitative and quantitative research methods were employed. This triangulation of methods enhances the quality of the data and therefore a more comprehensive and valid view was obtained (Bryman, 2013). Four indicators for quality assessment will be used: construct validity, internal validity, external validity, and reliability (Ritchie & Lewis, 2003).

Three aspects indicate that the *construct validity* of this research is high. First, the questionnaires as well as the topic lists were developed based on the operationalization table. This ensured that the concepts were measured as intended and theoretically valid. Moreover, the qualitative data was coded with support of the operationalization table which ensures all theoretical aspects are considered. Second, the questions are based on generally accepted and standardized measurements which are tested by several scholars. This indicates that the quality of the scale in itself is valid. To ensure a good fit with the empirical context a pilot was conducted among business people. Besides, a pilot was conducted among colleagues, family, and friends to check the quality of the cross translation and the design of the questionnaire. Third, although validated scales were used, factor analysis was performed in order to check the scales and, if necessary, modifications were made in order to enhance the construct validity. A minor critical remark concerning the construct validity of the measurements used is the fact that measuring knowledge related concepts and practices is difficult (Fahey & Prusak, 1998). By asking for respondents' own perception this study used subjective measurements. This is a valid way to measure the

construct seen the intangible and social dimension of knowledge, although honest self-reflection remains critical and has to be assumed. Nevertheless, the possibility for biased answers should be taken into account such as the expression of desires about KMS in the organization.

However, the quantitative way of measuring allows it to investigate a larger population and obtain more data points in this population which enhances the *internal validity*. Further considerations regarding increasing the internal validity led to the exclusion of within sample strategies. Thus, selection bias is not an issue. The questionnaire was distributed to all project members by the project managers of the innovation projects. As a result, a high response was obtained which led to a high internal validity. In addition, non-response analyses has pointed out that the sample is very much like the population and therefore non-response bias is neither an issue. Moreover, seen the structure of the data, multilevel analysis is performed. This multilevel analysis has controlled for the assumption of independence of the observations in order to prevent for spuriously but invalid 'significant' results. The results of the multilevel analysis were similar to the results of the multiple regression analysis, and the intra-class correlation was relatively low which provided a strong argument to conclude that the effects found by the multiple regression analysis were valid. In addition, a number of control variables were included in the research model. Therefore the validity of causal inferences was warranted. Furthermore, during the qualitative data collection suggestions for extraneous and confounding variables were discussed. These suggestions were investigated further during the interviews and by the use of literature. The insights that this investigation provided were discussed in the discussion section. By considering and discussing all these insights and possible relation between variables, this study provides strong evidence for causality (Ritchie & Lewis, 2003). Lastly, the appliance of triangulation of sources the internal validity of the findings was further ensured (Bryman, 2013).

On the other hand, the between sample strategy used to select the population affects the *external validity* negatively. This stratified purposive sample strategy results in a population of a specific industry, sector and region, as well as higher educated males which conduct cognitive intensive tasks. However, by selecting the population it was taken into account to obtain as much variance as possible within this population. The selection of respondents for the interviews was based on expertise, industry and sector. For interview round three, respondents are selected based on 'firm size' in order to discuss the findings with directors or managers of small, medium and large

organizations. For this selection criteria was chosen because this variable was found to have a significant influence based on the quantitative data.

Thus, in conclusion the overall validity of this study; a high response was obtained from a quite specific population. The characteristics of this population fit the research subjects and its context well because the knowledge transfer process is even more important and complex in a knowledge intensive and dynamic environment such as the high tech industry. Aiming at this population was therefore a conscious choice. Hence, the causal inferences are highly applicable to the target population of the study but less applicable to other populations and environments.

Lastly, the *reliability* of the research will be discussed. Concerning the scope of the research and the accessibility of the population, this research was conducted by only one researcher and at only one period of time. Therefore the inter-rater reliability and test-retest reliability is low. However, the thorough description of the research process and the use of standardized procedures provide the reader with transparency while minimizing the chance for systematic and unsystematic errors. This should increase readers' understanding of the research process that was followed by the researcher and this enhances the replication possibilities of this study. Reliability was concerned during both QN and QL data collection techniques. Both techniques started with a guiding letter which explained the subject, background and importance of the research and ensured the respondents anonymity. Concerning the questionnaire, attention was paid to the layout and the order in which questions were asked in the questionnaire. This ensured that the confidence level of the questions increased over the course of the questionnaire and provided a more professional look which increased the degree in which respondents filled in the questionnaire in a convenient, serious and punctual matter. The in-depth interviews were structured which ensured that the interviewees all were asked similar questions. Therefore, it was valid to compare the answers from different respondents, which provided the researcher with an overall view before drawing conclusions and discussing findings. At the end the reader was led through the findings in a structured way and with help of figures and tables for better insights and transparency. In that way the reader is ensured that conclusions are supported by adequate findings. All in all, the design of the study is repeatable and thereby reliable.

4. Results

4.1. Quantitative Results

In this section the results of the survey will be discussed. First, some descriptive statistics will provide more basic insight in the data. Hereafter, multiple regression analysis and multilevel analysis is used to test the hypotheses. Overall, testing results lent no support for the hypotheses. However, other interesting significant relationships are found which will help to provide an answer on the quantitative sub question.

4.1.1. Descriptive Statistics

Table 7 shows descriptive statistics and correlations for all variables. For all the control variables applies that the whole range of answer categories is used in the questionnaire, except for control variable age. The range here is 23 to 58. This indicates that no respondent was younger than 23 and over 58 years of age and therefore the outcomes of the study cannot be generalized to the audience outside this range. With respect to the means and ranges presented in the correlation table, it is interesting to denote that the findings are consistent with the fact that the high-tech industry is a knowledge-intensive industry with many high educated and male employees (Collins & Smith, 2006). The mean score on educational level is 5.43. This high mean score indicates that most of the respondents graduated at master level (= 6), some at higher professional education (= 5) and only a marginal amount lower than this (given the full answer range is used). The mean score on gender is 1.03 which indicates that only a few women are obtained in the sample.

The three significant correlations between the independent variables and the dependent variables show that significant relationships are found. The strong correlation between job specificity and job codification is highly significant (r = 0.651, $p < .01$), which shows that the two variables measuring formalization of KMS are both important indicators of formalization. This is in accordance with prior literature. The same goes for the strong significant correlation between exploration and exploitation (r = -0.525, $p < .01$). Moreover, there are some interesting significant correlation found concerning exploration and exploitation. Exploration is correlated to ability to obtain tacit knowledge (r = 0.153, $p < .01$), while exploitation is correlated to

willingness to use tacit knowledge (r = 0.245, p < .01). The other significant correlations between exploitation and both the duration and size of a project, indicate that projects that are exploitative oriented have a longer duration (r = 0.156, p < .05) and have more project members (r = 0.283, p < .01).

With respect to the control variables it is interesting to denote that from the control variables on the individual level only educational level is significant correlated with ability (r = 0.267, p < .01) and with orientation (r = -0.150, p < .50). The other three control variables have thirteen significant correlations. Project size is strongly significant correlated with firm size (r = 0.554, p < .01). These control variables both are also correlated to the same other variables ability (r = 0.265, p < .01; r = 0.206, p < .01), job specificity (r = 0.292, p < .01; r = 0.341, p < .01), job codification (r = 0.221, p < .01; r = 0.281, p < .01), and duration of innovation project (r = 0.350, p < .01; r = 0.233, p < .01). This confirms the mechanism that the bigger the project and/or organization, the longer the duration of a project, the more formalized systems applied, the more and the better the deployed resources, and the more project members are able to obtain tacit knowledge.

Table 7. Descriptive statistics and correlation matrix

	Variable	N.	Mean	S.D.	Min.	Max.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1	Ability	193	4.80	1.11	1.60	7.00											
2	Willingness	188	3.87	0.94	1.14	6.43	.187*										
3	Job Specificity	190	3.53	1.46	1.00	7.00	.471**	.174*									
4	Job Codification	190	3.19	1.15	1.00	6.40	.269**	-.036	.651**								
5	Exploration	206	4.69	1.38	1.00	7.00	.153*	.046	-.012	.067							
6	Exploitation	204	4.25	1.75	1.00	7.00	-.097	.245**	.021	-.121	-.252**						
7	Gender	189	0.03	0.16	0.00	1.00	.080	-.044	.043	-.005	.056	-.115					
8	Age	185	42.15	7.93	23.00	58.00	.010	-.103	.090	.052	-.053	.086	-.142				
9	Educational level	191	5.43	0.90	1.00	6.00	.267**	.119	.006	-.015	-.105	-.082	.068	-.136			
10	Duration project	218	31.80	17.58	3.00	72.00	-.029	.009	.106	.114	.106	.156*	-.091	.146*	.027		
11	Project size	218	20.75	13.28	2.00	50.00	.265**	.079	.292**	.221**	-.047	.283**	.002	.071	.089	.350**	
12	Firm size	218	2.05	0.62	1.00	3.00	.206**	-.126	.341**	.281**	-.027	.065	.041	.149*	.047	.233**	.544**

* = p < .05; ** = p < .01; Two-tailed tests.
1 t/m 6: 1 = total disagree, 7 is total agree; Gender: 1 = male, 2 = female; Age in years; Educational level: 1 = vmbo, 6 = master; Duration project: duration in months; Project size: number of project members ; Firm size: 1= small (> 25 FTE), 2= medium (26 – 250 FTE), 3= large (> 250 FTE).

4.1.2. Multiple Regression Analysis

Two multiple regression analyses were run to test the hypotheses of both dependent variables. Both models of the analyses were constructed in the following way. The first model contained solely control variables. In the second model the independent variables were added together with the variables that are part of the interaction effects. In the third step the independent variables were multiplied by itself which resulted in nonlinear effects. Lastly, the interaction variables were included in the model to test interaction in step four. The change in the multiple squared correlation coefficient (R^2) is traced from step to step.

The results of the multiple regression predicting 'ability' show four significant models (based on R^2 change, F-value, and p = .000 in table 8). However, only model 2 is interpreted because the F-value and R^2 change of model 2 are higher than those values are for model 3 and 4. Furthermore, the increase of explained variance between model 2 and 3 is marginal and model 3 shows no other significant effects than model 2. On the other hand, model 4 shows an interesting role of the variable 'exploration' in the research model. In this model the interaction effect of exploration on the quadratic relation between job codification and ability appears to be significant, while neither the main quadratic effect nor the direct effect of job codification is found to be significant. This indicates that the main quadratic effect is close zero. Therefore this quadratic effect is not significant but when it goes away from zero as the interacting variable (exploration) goes up or down, it will become significant. Interestingly, model 2 shows also that exploration has also a positive direct effect on ability (β = .201 p = .002). This indicates that this variable has an important influence in the research model which will be further investigated in the discussion section. Regression model 2 has an explained variance of 33.8% (adjusted R^2). Based on this model can be concluded that hypotheses one and two are rejected. No u-shaped effects but only linear effects are found between the independent variables and ability to obtain. Only the dimension job specificity has a linear positive effect (β = .368, p = .000. Of the control variables educational level (β = .267, p = .000), project size (β = .219, p = .007), and project duration (β = -.161, p = .017) are found have a significant influence.

The results of the multiple regression predicting 'willingness' show also four significant models (based on R^2 change, F-value, and p = .000 in table 9). However, the same reasons for choosing model 2 as by the regression predicting ability apply for this regression model. Model 2 has the

highest R^2 change and F-value, and the increase of explained variance is marginal for model 3 and 4 is marginal. Therefore, model 2 is interpreted which has an explain variance of 15.9%. Based on this model there are also no hypotheses confirmed. However, some parts of the mechanisms discussed in the theoretical framework appear to be true. Job specificity has a positive linear effect (β = .368, p = .000). While job codification has a negative effect (β = -.194, p = .040). The results further show an interesting role of exploitation in the research model. This variable has a direct negative influence on willingness (β = -.261, p = .001). Of the control variables only the control variable 'firm size' is found to have a significant negative effect (β = .241, p = .011). Thus, the more FTE's a firm has, the less willingness to use knowledge a project member has.

Table 8. Summary of multiple regression analysis for variables predicting ability to obtain tacit knowledge

	Model 1			Model 2			Model 3			Model 4		
Variable	*B*	*S.E.*	*β*	*B*	*S.E.*	*β*	*B*	*S.E.*	*β*	*B*	*S.E.*	*β*
Constant	-2.707**	.871		-2.129**	.770		-2.033**	.771		-2.014**	.776	
Step 1. Control variables												
Gender	.352	.489	.051	.062	.429	.009	.050	.429	.007	.066	.431	.010
Age	.006	.010	.041	.005	.009	.038	.004	.009	.032	.005	.009	.034
Educational level	.303***	.087	.247***	.328***	.077	.267***	.287***	.083	.234***	.289***	.083	.235***
Project duration	- .009	.005	-.142	-.010*	.004	-.161*	-.010*	.004	-.151*	-.009*	.004	-.149*
Project size	.020**	.007	.242**	.018**	.007	.219**	.016*	.007	.191*	.016*	.007	.193*
Firm size	.157	.150	.088	-.042	.135	-.024	-.002	.138	-.001	-.026	.140	-.014
Step 2. Main effects												
Job specificity				.374***	.063	.493***	.340***	.069	.448***	.347***	.069	.458***
Job codification				-.093	.079	-.097	-.082	.086	-.086	-.089	.088	-.093
Exploration				.161**	.052	.201**	.174***	.052	.217***	.196*	.077	.245*
Exploitation				-.053	.043	-.084	-.060	.044	-.095	-.016	.069	-.025
Step 3. Nonlinear effects												
Job specificity squared							.054	.037	.113	.057	.038	.120
Job codification squared							-.001	.050	-.002	-.038	.058	-.057
Step 4. Moderator effects												
JS²*Exploration										.014	.023	.082
JS²*Exploitation										.026	.027	.135
JC²*Exploration										-.060*	.029	-.264*
JC²*Exploitation										-.068	.040	-.230
R^2 Statistics												
R^2	.157			.375			.384			.401		
Adjusted R^2	.128			.338			.340			.342		
ΔR^2	.157			.218			.009			.017		
F	5.370***			10.156***			8.671***			6.814***		
N	193											

B: Unstandardized coefficients; *β*: Standardized coefficients; * = p < .05; ** = p < .01; *** = p < .001

Table 9. Summary of multiple regression analysis for variables predicting willingness to use tacit knowledge

	Model 1			Model 2			Model 3			Model 4		
Variable	*B*	*S.E.*	*β*	*B*	*S.E.*	*β*	*B*	*S.E.*	*β*	*B*	*S.E.*	*β*
Constant	.503	.787		.664	.745		.663	.752		.592	.759	
Step 1. Control variables												
Gender	-.296	.442	-.051	-.316	.416	-054	-.313	.418	-.054	-.306	.421	-.052
Age	-.009	.009	-.076	-.011	.009	-.094	-.011	.009	-.094	-.011	.009	-.094
Educational level	.109	.079	.105	.152*	.075	.146*	.148	.080	.142	.151	.081	.145
Project duration	.000	.004	-.004	-.002	.004	-.032	-.002	.004	-.032	-.002	.004	-.036
Project size	.014*	.007	.200*	.006	.006	.083	.006	.007	.080	.006	.007	.091
Firm size	.342*	.136	-.226*	-.361**	.131	-.238**	-.357**	.135	-.235**	-.339*	.137	-.224*
Step 2. Main effects												
Job specificity				.237***	.061	.368***	.240***	.067	.373***	.244***	.067	.380***
Job codification				-.158*	.077	-.194*	-.167*	.084	-.205*	-.150	.086	-.184
Exploration				.097	.050	.144	.097	.051	.143	.069	.075	.101
Exploitation				-.140***	.042	.261***	.142***	.043	.265***	.137*	.067	-.254*
Step 3. Nonlinear effects												
Job specificity squared							-.002	.036	-.006	.002	.037	.006
Job codification squared							.013	.049	.023	.026	.057	.045
Step 4. Moderator effects												
JS²*Exploration										.016	.023	.109
JS²*Exploitation										.046	.027	.283
JC²*Exploration										-.011	.029	-.054
JC²*Exploitation										-.050	.039	-.200
R^2 Statistics												
R^2	.067			.207			.208			.225		
Adjusted R^2	.034			.159			.149			.147		
ΔR^2	.067			.141			.000			.017		
F	2.012***			4.318***			3.562***			2.883***		
N	193											

B: Unstandardized coefficients; β: Standardized coefficients; * = p < .05; ** = p < .01; *** = p < .001

4.1.3. Multilevel Analysis

Based on multiple regression analysis significant effects are found. However, the structure of the population and dataset require a multilevel analysis as concluded in the section 3.3.1. The first part of this section presents the result of the multilevel analysis predicting 'ability' and the second part focuses on the other dependent variable 'willingness'. Both the parts start with measuring the intra-class correlation (ρ) and testing if the intercept of the nulmodel is significant ($p < .05$). Hereafter, all the hypotheses were tested based on the same way of adding the variables in the same steps as done by the multiple regression analysis, and/or based on the hierarchical level the variable obtains in the population, from lowest to highest level (Hox, 1995).

The mean (estimate) of ability is 4.68, intercept is significant (p = .000) and has an interval of [4.40; 4.96]. The equation for the intra-class correlation results in 21.03% (based on the intercept

and residual of the random parameters in table 10). This means that there is significant difference between the projects and that 21.03% of the total variance is explained by the variance between projects. Further analysis was performed by using mean centered variables because of two reasons. First, centering around the group mean makes very explicit that the individual scores should be interpreted relative to group mean (Hox, 1995). Second, it has statistical advantages because the group-centered individual deviation scores have a zero correlation with the disaggregated group means (Hox, 1995). While performing the analysis the -2 LL marginally decreases with every step because variables and effects were added. This is a common occurrence due to the statistical equation for calculating -2 LL. However, by investigating this change in -2LL relative to the change in the BIC and AIC value, a turn point is found. As a result it can be concluded that model 2 fits the data the best based on the goodness-of-fit values. This model shows five significant effects that are related to the same variables as in the multiple regression analysis. These significant effects have the same direction and more or less the same strength.

The multilevel analysis for variables predicting willingness to use tacit knowledge shows an error that states that the covariance parameter is redundant. Therefore the test statistic and confidence interval cannot be computed in the 'estimates of covariance parameters' table. In table 11 this is indicated by the random parameters by using a [b]-symbol. Due to this error the validity of the results cannot be ascertained. However, the results show a significant mean (estimate) of willingness of 3.86 (intercept, $p = .000$) and has an interval of [3.67; 4.05]. The intra-class correlation for willingness is 7.54%. This means that there is significant difference between the projects and that 7.54% of the total variance is explained by the variance between projects. Further analysis was performed by using mean centered variables. The results show that model 2 fits the data the best based on the same reasoning as for the multilevel analysis predicting ability (due to values of goodness-of-fit). Nearly the same findings are found as the multiple regression analysis predicting willingness.

Table 10. Summary of multilevel analysis for variables predicting ability to obtain tacit knowledge

	Null model		Model 1		Model 2		Model 3		Model 4	
Fixed Coefficients	*Est.*	*S.E.*	*Est.*	*S.E.*	*Est.*	*S.E.*	*Est.*	*S.E.*	*Est.*	*S.E.*
Intercept	4.682***	0.134	-2.442**	.898	-1.851*	.777	-1.750*	.779	-1.749*	.777
Step 1. Control variables										
Gender			.262	.459	.022	.396	.017	.395	.038	.391
Age			.007	.010	.005	.009	.004	.009	.004	.009
Educational level			.298**	.098	.332***	.085	.284**	.091	.284**	.091
Project duration			-.008	.006	-.011*	.005	-.011*	.005	-.011*	.005
Project size			.024	.009	.022*	.008	.020*	.008	.020	.008
Firm size			.022	.183	-.173	.161	-.118	.165	-.125	.170
Step 2. Main effects										
Job specificity					.367***	.062	.338***	.067	.332***	.066
Job codification					-.117	.075	-.119	.081	-.105	.081
Exploration					.183***	.051	.198***	.052	.235**	.075
Exploitation					-070	.045	-.069	.046	-.063	.066
Step 3. Nonlinear effects										
Job specificity squared							.043	.035	.051	.036
Job codification squared							.014	.048	-.003	.057
Step 4. Moderator effects										
JS^2*Exploration									.033	.027
JS^2*Exploitation									.026	.023
JC^2*Exploration									-.066	.040
JC^2*Exploitation									-.046	.030
Random Parameters										
Residual	.979***	.106	.955***	.114	.701***	.082	.694***	.082	.669***	.078
Intercept	.261***	.121	.064	.080	.048	.056	.047	.054	.065	.058
Goodness-of-fit										
Deviance (-2 LL)	569.7		497.5		443.5		441.7		438.2	
AIC	573.7		515.5		469.5		471.7		476.2	
BIC	580.2		544.0		510.7		519.1		536.3	

Est.: Estimates; S.E.: Standard Error; * = p < .05; ** = p < .01; *** = p < .001

Table 11. Summary of multilevel analysis for variables predicting willingness to use tacit knowledge

	Null model		Model 1		Model 2		Model 3		Model 4	
Fixed Coefficients	*Est.*	*S.E.*	*Est.*	*S.E.*	*Est.*	*S.E.*	*Est.*	*S.E.*	*Est.*	*S.E.*
Intercept	3.858***	.090	.330	.792	.807	.746	.818	.750	.756	.751
Step 1. Control variables										
Gender			-.297	.412	-.357	.387	-.366	.387	-.357	.386
Age			-.009	.009	-.013	.008	-.013	.009	-.013	.008
Educational level			.102	.088	.112	.083	.113	.090	.114	.091
Project duration			-.000	.004	-.001	.004	-.001	.004	-.001	.004
Project size			.010	.007	.006	.006	.005	.007	.006	.007
Firm size			-.214	.139	-.274*	.133	-.272	.140	-.255	.140
Step 2. Main effects										
Job specificity					.254***	.060	.243***	.066	.241***	.066
Job codification					-.179*	.075	-.163*	.081	-.142	.082
Exploration					.079	.048	.080	.050	.069	.073
Exploitation					.102*	.042	.096	.043	.101	.066
Step 3. Nonlinear effects										
Job specificity squared							.013	.036	.017	.037
Job codification squared							-.025	.047	-.017	.058
Step 4. Moderator effects										
JS²*Exploration									.035	.027
JS²*Exploitation									.011	.023
JC²*Exploration									-.048	.039
JC²*Exploitation									-.015	.031
Random Parameters										
Residual	.827***	.092	.790***	.086	.686***	.074	.685***	.074	.675***	.073
Intercept	.067	.067	.000[b]	.000	.000[b]	.000	.000[b]	.000	.000[b]	.000
Goodness-of-fit										
Deviance (-2 LL)	510.8		442.5		418.5		418.1		415.6	
AIC	514.8		460.5		444.5		448.1		453.6	
BIC	521.3		488.7		485.2		495.2		513.1	

[b]: this covariance parameter is redundant. The test statistic and confidence interval cannot be computed.
Est.: Estimates; S.E.: Standard Error; * = p < .05; ** = p < .01; *** = p < .001

Based on the multilevel analysis no hypothesis can be confirmed because no non-linear nor interaction effects are found. The model predicting ability shows that educational level has a positive effect (Estimate: .332, p = .000), duration of project has a negative effect (Estimate: -.011, p = .037), and project size (Estimate: .022, p = .012). Instead of a u-shape effect the variable 'job specificity' has a linear positive effect (Estimate: .367, p = .000). This model also underlines a significant role of exploration in the research model. Exploration directly influences the ability to use tacit knowledge positively (Estimate: .183, p = .000). However, no interaction effect is shown in model 4 as was the case in the multiple regression analysis. The model predicting willingness shows that firm size has a negative effect (Estimate: -.274, p = .042). As

with the multiple regression analysis the multilevel analysis shows that some mechanisms discussed in the theoretical section are found. Job specificity has a direct positive effect (Estimate: .254, p = .000), while job codification has a direct negative effect (Estimate: -.179, p = .019). The multilevel analysis model also underlines the interesting role of exploitation in the research model because a direct positive effect is found (Estimate: .102, p = .017).

Furthermore, there is investigated if the variance depends on the organization which a project of individual is engaged in (subject in mixed model analysis is changed in 'organization' instead of 'project'). This turned out to be not the case because not enough second level units (only nine organizations) were obtained in the dataset. Therefore no significant results were found. In conclusion, both multilevel analyses show nearly the same results as both the multiple regression analyses. This indicates that there is little variance explained by the project to which an individual is engaged. This is also indicated by the relatively low intra-class correlation resulting out of the values of both null models. Especially the intra-class correlation of willingness is low (7.54%). Therefore it is decided to only interpret the results of both the multiple regression analyses for drawing inferences.

4.1.4. Summary of Quantitative Results

In the previous paragraphs the quantitative results are presented extensively. It appeared that none of the hypotheses can be confirmed. This does not mean that no significant relationships were found. In total five significant relationships were found between dependent and independent variables, and five significant influences of control variables. Factor analysis resulted in the splitting of the variable 'formalization of KMS' which led to changes in the conceptual model. Besides, each orientation of an innovation project is found to have a relationship with another dependent variable. Exploration is related to ability and exploitation is related to willingness. All the significant relationships between the independent and dependent variables are displayed in figure 10.

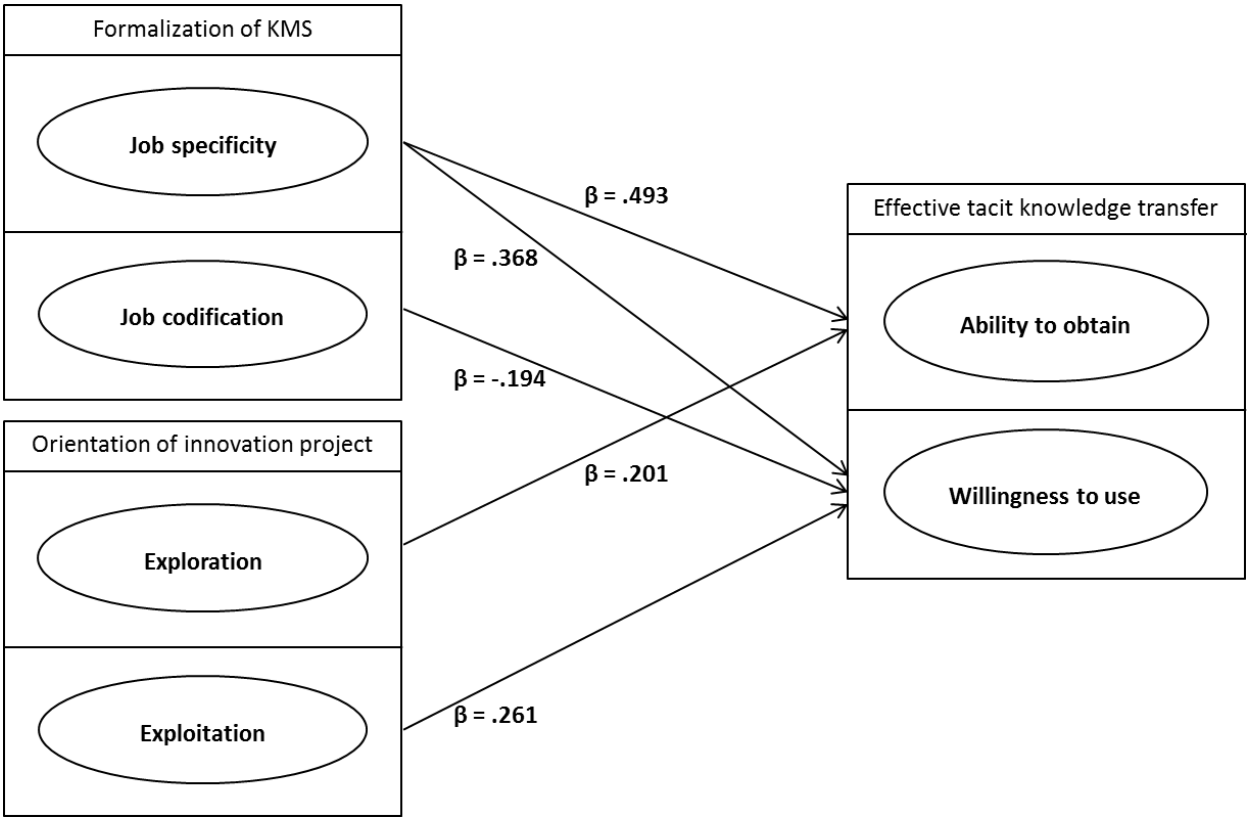

Figure 10. Summary of found effects

4.2. Qualitative Results Interview Round 3

Before an answer on the quantitative sub question can be provided, the quantitative findings are combined with qualitative insights of seven business people. This section is structured according to the hypotheses in order to ensure that any found effect that is related to the hypotheses is discussed. In this way the quantitative findings are complemented with qualitative insights. This structure also provides the possibility to compare the findings with the mechanisms suggested by the literature.

H1: *There is a curvilinear relation between formalization of KMS and the ability to obtain tacit knowledge transfer in innovation projects (inverted u-shape).*

No significant quadratic effect is found. Based on the quantitative data only a positive linear effect of job specificity on ability is found. As explained by the interviews, more formalization

will lead to a more common way of working due to the use of standardized processes and communication structures. This creates mutual understanding that eases the transfer of tacit knowledge. The respondents state that this common way of working is achieved when individuals comply with the rules and procedures. First, however, this rules and procedures should been standardized. The extent of standardizaion is measured by the variable job specificity. Therefore the qualitative data supports this found quantitative effect. Furthermore, most interviewees argue that through formalization the knowledge base is structured. Therefore, knowledge is better accessible and interpretable, thus better obtainable for an individual. Structuring the knowledge base is achieved by the codification of rules and conditions. All respondents only talk about the effect that codification of procedures and systems has on ability but not about the effect of the coordination of behavior on ability. Interestingly, respondents do argue that the coordination of behavior will have a negative effect on other concepts, such as creativity.

> *"You will perhaps have positive effects of formalization but you are going to have negative effects on your creative output."* (CEO, May 16th)

Because of these negative influences, most respondents argue that that KMS should be formalized up to a certain extent because too much formalization will have a negative effect on other aspects. Hence, there are more variables to keep in mind while designing KMS or the processes within innovation projects. So far it can be concluded that job specificity positively influences ability.

H2: *There is a curvilinear relation between formalization of KMS and the willingness to use tacit knowledge transfer in innovation projects.*

For this hypothesis a positive linear effect of job specificity and negative linear effect of job codification are found. This indicates that individuals are more willing to use tacit knowledge when there is higher degree of job specificity. This is substantiated by the argument that it becomes easier to search and find knowledge when a more common way of capturing and transferring knowledge is used. When it becomes easier and quicker to find or apply knowledge, it will also become more attractive to use this knowledge. Besides, one respondent states that a

formalized structure gives a sense of security to do things right because you adhere to the procedures and trust in the KMS which leads to more willingness.

> *"What you see is that they have a need for security and structure. They want to have an example of how they do it. Like give me a plan which ensures that it is correct what I am going to do. They can derive security from this."* (Engineering Manager, May 15th)

Respondents argue that not all current KMS focus on conditions in order to increase willingness. These statements correspond with the negative effect of job codification. The negative relationship between job codification and willingness indicates that the willingness of an individual is lower when less latitude of behavior is tolerated from KMS. Therefore, it can be argued that it is not only about codifying procedures. People also need to behave in accordance to these procedures. An example is given by a respondent. This respondents talks about the KM practices within a large consultancy firm. In this organization there is an extremely focus on capturing and storing knowledge in order to make reuse possible. Each consultant has the opportunity to use 15% of the project budget for capturing and storing knowledge. The consultants have templates and systems to capture and store knowledge. The entire procedures and rules are codified. However, there is no incentive or behavioral intention to reuse this knowledge. As a result, the procedures are not performed, the transfer process is interrupted, and no individual is willing to use the knowledge that is available. Moreover, interviewees stated that it is well known that formalization negatively influences human or personal aspects such as motivation and creativity. Everyone has its own way of learning and doing things. People can get a passive attitude when they are restricted in their behavior. This could even provoke aversion. A quote of a respondent which underpins this:

> *"Each person has his own way of practicing his profession. You will restrict him when you impose him with rules which tell him how to practice his craftsmanship."* (Managing director, April 5th)

When the behavior of individuals is driven by rules too much and no deviation from these rules is accepted, these individuals will become less willing to behave in accordance to the rules and procedures such as using knowledge of others or out of systems. On the other hand, formalization can force and stimulate an employee to use tacit knowledge. In such a case the standardization of the transfer process is so high that an individual need to work in accordance to the codified procedures and rules. Even though 'must' (forcing, extrinsic motivation) is not the

same as ‘should’ (motivation, intrinsic motivation), it can cause an increase of willingness to use knowledge. The statements in the questionnaire measure both extrinsic and intrinsic motivation. However, extrinsic incentives are not the desired incentives, as argued by two respondents, because in this case an individual will look for loopholes or other possibilities. In conclusion, job specificity can increase the willingness of an individual to use knowledge. However, there are side effects on the other side of the coin related to job codification. Job codification controls the behavior of individuals which negatively influences the willingness of an individual to use knowledge. Therefore it is of major importance to find a balance between these two variables.

H3: *The relation between formalization of KMS and the ability to obtain tacit knowledge transfer is positively interacted when an innovation project is exploitation oriented.*

From the quantitative analysis it already appeared that the variable ‘exploration’ has a positive direct effect on ability. Thus, no interaction effect is found. The relationship between the two dimensions of formalization of KMS and ability does not differ when the project were an individual is engaged in is exploitation oriented. Nevertheless, all respondents agree on the fact that each orientation has its own type of people. This results in another type of culture and context for each orientation. Individuals in explorative projects are more eager about their contribution and discoveries. They like to link their name to a discovery for example by citing. In exploration phases, people tend to work more independently and more under their own name. These individuals are more specialists than all-rounders, which creates a cognitive distance between the types of people. This distance causes less mutual understanding.

> *“That does not surprise me because that is more related to personality rather than actually the type of such projects.”* (CEO, May 16th)

Some respondents argue that individuals engaged in exploration oriented projects are more creative, open minded, and higher educated. This can lead to more ability to obtain tacit knowledge which is in line with the found significant relationship between exploration and ability. However, further investigation of the role of exploration is needed and therefore will be discussed in the discussion section.

H4: T*he relation between formalization of KMS and the willingness to use tacit knowledge transfer is positively interacted when an innovation project is exploitation oriented.*

The variable 'exploitation' is found to have a positive direct effect on willingness. Thereby, the interviews confirmed that this variable shows an important distinction between the two orientations. People in exploitation oriented projects require another type of processes and systems. In the exploitation phases, people tend to work in a bigger team and collaborate more with others (this is confirmed by the significant positive correlation ($r = 0.283$, $p < .01$) between project size and orientation). In exploitation phases individuals execute the idea of someone else or produce the product conceived by others. These latter circumstances allow it better to transfer knowledge or to reuse knowledge, practices and processes because there is more structure. Moreover, more or less the same (production-like) activities are executed. An individual can rely better on previous knowledge and practices in this environment. The activities that are executed in the exploitation phases can be better described in checklists or procedures than this is possible for creative processes.

> *"That is one side, a piece is locked in mankind. Another aspect, I think, is that it is in this phase also easier to formalize. The work here is just a little more concrete, more tangible. So you can more easily formalize and therefore a user will faster take advantage of it."* (COO, May 14th)

Role of cultural aspects and control variables

All seven respondents argue that there cultural aspects that have an important role in the research model. This is also found during the interviews of round two. Culture and personality, as well as, trust in the source which delivers of contain the knowledge are important. A source is eventually always an individual. You can obtain knowledge directly from an individual or via a system. A part of the culture is that it is a way of working to capture and store knowledge but also share them with others. If only a few employees contribute to the knowledge base or use the procedures and systems, this would not work out well and eventually everybody will stop this way of working. People need to see the value of this common way of working and there has to be an open an innovative culture, certainly not a culture where someone's 'head is cutoff' or where making a mistake is 'deadly'.

> *"It makes no sense to write down tacit knowledge if there is no need for. […] It is about seeking a balance between culture, organizations, content, quality, human behavior, and all those things. It is actually a complex puzzle and that is why people find KM difficult"* (CEO, May 16th)

The last point that six of the seven respondents talked about, even though it was not a question in the interview, is size of a project or an organization. All these respondents argue that the bigger the project or the organization, the more formalization is required. Besides, two respondents argue that exploitation oriented project have more project members than exploration oriented projects. Lastly, two respondents argue that it is about the maturity of an organization or individuals which is related to firm size. They argue that bigger organizations have more space, resources, and a better environment to develop its maturity. These latter arguments about 'size' are supported by significant correlations in the correlation table.

Sub-question: *To what extent does the perceived degree of formalization of knowledge management systems influence a project member's ability and willingness to transfer tacit knowledge within innovation projects and to what extent does this relationship differ for different orientations of the project were a member is engaged in?*

With three significant relationships can be concluded that the degree of formalization of KMS influences a project member's ability and willingness to transfer tacit knowledge *to a large extent*. However, this answer is twofold. One indicator of formalization of KMS, job specificity, positively influences both the ability and willingness to transfer tacit knowledge. While the other indicator of formalization of KMS, job codification, negatively influences only the willingness to transfer tacit knowledge. Due to standardized systems, procedures and other controls the ability to obtain tacit knowledge increases. These structural mechanisms will lead to a common set of rules, languages, and way of working. This ensures mutual understanding which is a critical aspect in the knowledge transfer process. Formal structures make knowledge easier to find and apply which will make individuals more willing to use knowledge. Besides, formal structures can force and/or stimulate individuals to be more willing to use tacit knowledge when management determines pay rise, promotions and job offers according to the knowledge possessed or shared by an individual. In contrast to these extrinsic motivation incentives there

are intrinsic motivation incentives. The last effect found is that job codification negatively influences the willingness to use tacit knowledge. This willingness is negatively influenced when individuals perceive that their behavior is codified and controlled too much. When job codification is high individuals have no autonomy and feel restricted in their doings. It is not tolerated to deviate from the standards. These behavioral restrictions, lack of empowerment, and the control of the employment of rules negatively influences the motivation of professionals and knowledge workers. It is important to find a balance between the positive relationships of job specificity and negative relationship of job codification. This balance, the optimal degree of formalization, is where the two lines of the effect intersect.

Quantitative research has revealed that this relationship does not differ for different orientations of the project were a member is engaged in. Instead of an interaction effect the analysis revealed that exploration is direct related to ability to obtain positively, and exploitation is direct related to exploitation positively. The qualitative data provided valuable insights in the explanation of these effects. Individuals in exploitative projects are another type of people than individuals in exploitation projects. People engaged in exploitative oriented project are more willing to use tacit knowledge because the operations and associated knowledge are more concrete and recurring. This makes it more possible and easier to use tacit knowledge.

4.3. Qualitative Results Interview Round 2

In the subsequent section the qualitative sub questions of the study are answered. An extensive summary of the results of the 16 interviews can be found in appendix X. This section only discusses the results that are relevant for answering the qualitative sub questions. Several statements of the respondents are used in this appendix as an illustration or clarification.

Sub-question: *How is tacit knowledge transferred between individuals within innovation projects?*

Essential for tacit knowledge transfer is interaction and therefore mankind is the basis for knowledge transfer. A human-based knowledge management system that is mainly used to transfer tacit knowledge is selecting the right people for a project or a senior-junior combination. Important in such systems is the right combination of technical knowledge and experience of the people, and the character fit of these people. In addition, knowledge team leaders are often appointed. These are individuals who are responsible for making available and generate knowledge needed in a project and gained during a project. In the past, these individuals were the only medium ways that were used to transfer knowledge. These days' employees follow trainings, there is external recruitment (including trainees), and the working environment is arranged in such a way that employees have more freedom and are more flexible. This promotes interaction and thereby the transfer of tacit knowledge.

> *"Systems are supportive. They help to achieve improvements which can be achieved by these tools but it is always just an instrument."* (Managing consultant and owner, April 4th)

Besides the human-based KMS there are IT-based KMS. These systems also support people in transferring tacit knowledge. It is hard to transfer tacit knowledge only via these types of KMS. However, IT-based KMS certainly are supportive and especially help capturing and mapping knowledge. These tools enhance the ability of an employee to obtain tacit knowledge. Examples of such systems are people-finder systems, knowledge-storing systems, search-systems and or a system to interact and share documents.

Sub-question: *How is transfer of tacit knowledge managed during innovation projects?*

In order to share knowledge among the organization and projects, the processes and activities involved need to be organized. All these processes and activities are part in an ongoing cycle, the KM cycle. The phases and related activities of this cycle are displayed in figure 11. The KM cycle starts with the knowledge base. This is an 'archive' with knowledge, information and other business intelligence. Hereafter the upstart of the project takes place which is about accelerating by the synergy and sharing of knowledge. At the end of a process it is important to have a debriefing which concentrates on the lessons learned and new insights. This debriefing session results in core knowledge and documents which have to be captured and labeled in KMS. All new knowledge and documents are stored in the knowledge base and ready to use in another project. These last two phases, capturing and storing, are critical for the quality of KMS. However, behavior or an incentive to (re)use knowledge out of the knowledge base is of great importance since this will close the cycle and will assure the quality and active management of knowledge. These days, only the input and output of the innovation process and all its phases are formalized in most organizations. The KMS in the project / core process is formalized in a small degree. If formalized, only the basis of KMS is structured like prescribed formats and models.

> *"Knowledge management never ends because it is a circle."* (Business consultant enterprise mobility, March 8th)
> *"So this part, call it evaluation or closing the learning loop, this is the weak point. It is a critical point and at the same time a weakness."* (Senior innovation consultant, March 29th)

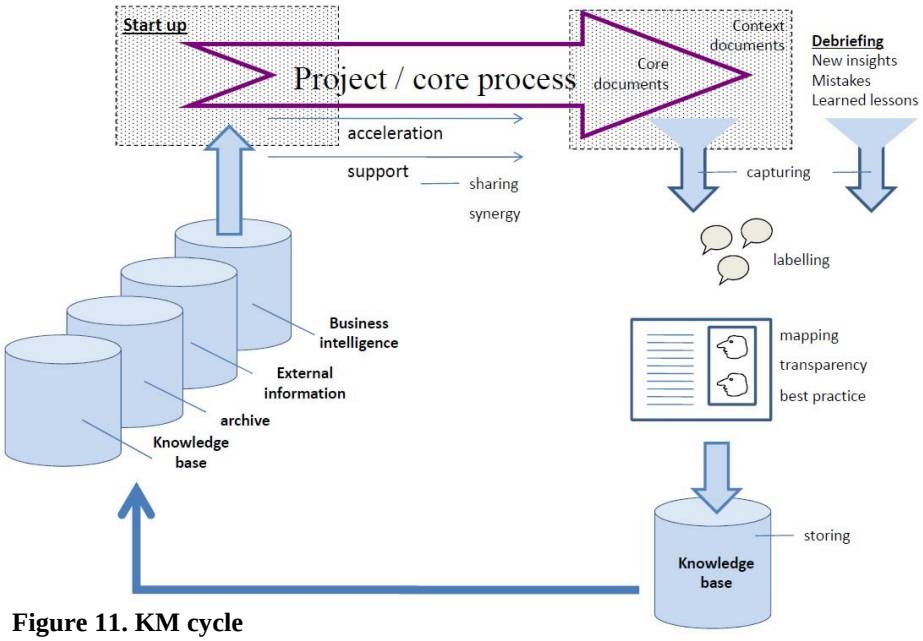

Figure 11. KM cycle

5. Conclusion and Discussion

In the previous sections, the quantitative sub question investigated the relationship between two dimensions of formalization of KMS and the two antecedents of effective tacit knowledge transfer. These quantitative results were complemented with qualitative results. Therefore deeper insights were obtained regarding the quantitative effects found and regarding how tacit knowledge is transferred within innovation projects. To this end all sub questions are answered which makes it possible to answer the main research question of this study: *How to effectively transfer tacit knowledge between project members of innovation projects of different innovation orientations?*

The answer to this question is presented in the subsequent section. Hereafter this answer and other insights revealed by the findings of this study are discussed. At the end recommendations for in practice are suggested and the research process is reflected which result in further research possibilities.

5.1. Conclusion

Tacit knowledge is effectively transferred between individuals of innovation projects when the KMS used are formalized up to a certain extent and when an appropriate mix is made between human-based KMS and IT-based KMS. The KMS do not differ for different types of orientation of innovation projects. Explorative as well as exploitative projects use KMS that are formalized to the same extent. The quantitative findings prove that both the antecedents of effective knowledge transfer, ability and willingness, are found to be significantly correlated to each other and significantly influenced by the two dimension of formalization of KMS. The correlation between ability and willingness is consistent with the findings of Minbaeva et al. (2003) which "indicates that neither employees' ability nor motivation by themselves is sufficient to facilitate knowledge transfer" (p. 596, and as discussed on p. 21). The correlation between ability and willingness proves that both antecedents are required to facilitate effective knowledge transfer. Job specificity has a positive effect on both antecedents of effective tacit knowledge transfer. So when knowledge transfer processes are standardized, and rules and procedures define the transfer of tacit knowledge, individuals will become more able and willing which, in turn, makes the transfer of tacit knowledge more effective. However, job codification has a negative effect on the

willingness of individuals to use tacit knowledge. This negative effect indicates that the less latitude of behavior is tolerated from standards, the less willing individuals are to use knowledge. Willingness to use is only one antecedent and has therefore not enough influence to make knowledge transfer totally ineffective. However, the negative effect of job codification on willingness to use certainly has a negative influence on the effectiveness of knowledge transfer. Therefore it is important to take all effects into account. Hence, it can be concluded that there is an optimal degree of formalization of KMS. Deviations from this level will lead to a lower effectiveness of tacit knowledge transfer, either due to a too low degree of job specificity or to a too high degree of job codification. By interpreting all effects relatively to each other, the critical interaction between social (behavior is related to job codification) and technical (process and systems are related to job specificity) is partially investigated.

It is important to denote that KMS are supportive in transferring tacit knowledge. KMS are tools which enhance the capabilities of individuals but mankind is always the basis for knowledge and the transferation of it. Not only IT-based KMS are required for effective tacit knowledge transfer but also human-based KMS are required such as meetings, workshops and senior-junior combinations in order to assure interaction and learning-by-doing. This conclusion is in line with the sociotechnical system design which is mainly about the interaction between people and technical aspects of the organization (Trist, 1981; Cummings, 1978). Another principle of the sociotechnical system design suggests that a certain level of specifications is required but room for adaptation and autonomy is also required (Cherns, 1976). This is consistent with the findings of this research.

The results of the study substantiate the suggestion that the tacit dimension of knowledge is embodied in rules, routines and other structural mechanisms. If individuals apply standardized procedures which help them to coordinate the operations regarding tacit knowledge transfer, this will lead to a more effective means of knowledge transfer. Based on these findings it can be argued that by applying formalized KMS, problems regarding the tacit knowledge transfer process can be solved. By the use of KMS, tacit knowledge can be found, captured, and applied easier. Besides, the people containing this knowledge are localized and interacted with easier. All these activities are described in the KM cycle. Along the process of each innovation project it is important to apply the phases and activities described by the ongoing KM cycle. The KM cycle

offers a structured process with activities and sources in order to effectively transfer knowledge within innovation projects. Some practitioners already suggested that the processes and activities involved need to be organized but these suggestions lack empirical evidence (e.g. Fahey & Prusak, 1998; Alavi & Leidner, 1999; Davenport & Prusak, 2000). However, this study proves that an organized and structural approach of these processes and activities is recommended. The KM cycle starts with a knowledge base such as an archive with knowledge, information and other business intelligence. This base is the basis for the KMS and since findings showed that these KMS have to be formalized up to the optimal degree, this knowledge base has to be formalized up to this optimal degree as well. This extent of formalization implies that there need to be description and formats available for all transition and decision processes, and other knowledge transfer activities. There should be standardization in the capturing and labeling processes and activities. In this way the filling and using of this base is structured in a common manner which ensures commonality in executive processes and communication structures which, in turn, creates mutual understanding.

All in all, effective tacit knowledge transfer is an important knowledge management activity and a driver to innovation, improvement of operations, and ultimately, success (von Krogh, 1998; Goh, 2002). Organization will have to formalize the KMS up to the optimal degree and adopt the processes of the ongoing KM cycle in order to transfer tacit knowledge in the most effective manner. Thereby, continue to be advantageously in a hypercompetitive environment.

5.2. Discussion

The conclusion above revealed that by the optimal use of formalized KMS, tacit knowledge transfer becomes more effective. Besides, all the phases and activities of the KM cycle should be applied to transfer tacit knowledge within innovation projects. In the first part of this section the findings will be discussed and related to theory. The second part will discuss unexpected relations between variables and of unexpected influences of other variables.

In the conclusion the relation between the significant effects and the critical interaction between three organizational elements, people, process, and technology, is partially discussed. As a result, an intersection between the significant effects became clear. When the two effects predicting

willingness to use tacit knowledge are plotted and visualized in one figure, an intersection appears. Figure 12 show that formalization of KMS by job specificity has a positive effect up to a certain degree (about moderate level). This is where the negative effect of job codification intersects the positive effect of job specificity. From the intersection point onwards, the effect of formalization of KMS by job codification takes over and the positive effect switches to a negative. Therefore, an inverted u-shape appears (dashed line in figure 12). From this it can be concluded that there is an optimal degree of formalization. This optimal degree of formalization of KMS leads to easier execution of knowledge transfer activities and it can stimulate and force individuals to behave and act in accordance to systems. However, too much formalization can restrict in their behavior and willingness.

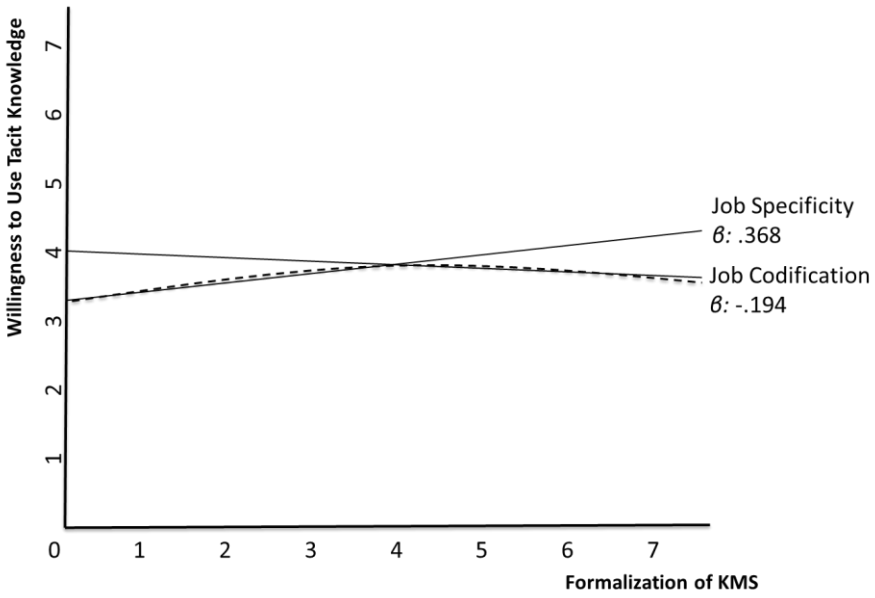

Figure 12. Plotted effects of model predicting willingness

A plot of the effect of job specificity on ability shows a positive line which is steeper than the effect between job specificity and willingness (figure 13). This indicates that the effect of job specificity on ability to obtain tacit knowledge is stronger than its effect on willingness to use tacit knowledge. Moreover, no significant relation is found between job codification and ability. This lack of relation is explained by the fact that job codification is related to the social and behavioral aspects (Hage & Aiken, 1967). Willingness is such a social aspect, whereas ability is

not. Ability of an individual is a technical and work related aspect. This technical aspect of formalization is measured by job specificity and rule observation (Hage & Aiken, 1967). Thus, no relationship between job codification and ability is found because the concepts measure a different aspect. Again, the distinction between the social and technical dimension of formalization becomes clear, despite the role of the critical interaction between people, process, and technology (Bhatt, 2001).

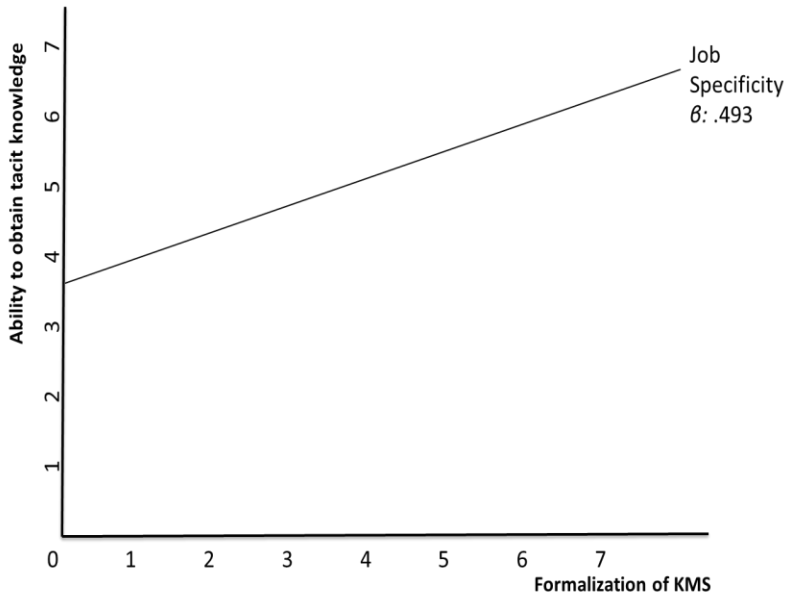

Figure 13. Plotted effects of model predicting ability

In short, because ability and willingness are related to each other in theory and by a significant correlation, all three effects found should be interpreted relatively to each other. This results in an intersection between all the effects which indicates that the KMS can be formalized by using job specificity up to a small degree. When the degree of job specificity is too high, the effect of job codification on willingness is negative. Therefore one of the two antecedents is influenced negatively which harms the effectiveness of tacit knowledge transfer.

Another remarkable result is the role of the variable exploration and exploitation in the research models. Exploration has a positive direct effect on ability to obtain tacit knowledge ($\beta = .201$, $p = .002$). This means that the more the exploration oriented a project is, the more ability to obtain tacit knowledge an individual has. On the other hand, in the research model predicting

willingness a positive relationship of exploitation is found (β = .261, p = .001). This means that the more exploitation oriented a project is, the more willing an individual is to use tacit knowledge. The finding of these last two effects is related to the difference in culture and personality of the individuals in the orientations, and to the different environment of these orientations and its projects. Both of these arguments are already supported by qualitative data. However, regarding the literature a distinction between explorative and exploitative behavior and structure is also suggested (e.g. March, 1991, Siguaw et al., 2006). The driving mechanism behind these behaviors is dissatisfaction which is contingent to experiences, change, and authority (Holmqvist, 2004). This interplay is related to intra-organizational learning processes and absorptive capacity (Lane & Lubatkin, 1998). Moreover, Baum, Li, and Usher (2000, p. 768) suggest that "exploitation refers to learning gained via local search, experiential refinement, and selection and reuse of existing routines. Exploration refers to learning gained through processes of concerted variation, planned experimentation, and play". Both concepts include transfer of knowledge. The only difference lies in the fact that it is done using an old trajectory or in a new and/or different manner (Gupta et al., 2006). This is in line with Vermeulen and Barkema (2001, p. 459) who define exploration as the "search for new knowledge" and exploitation as the "ongoing use of firm's knowledge base". In exploration phases individuals develop new ideas, models, theory, or solutions. It is about the discovery of knowledge and/or combination of knowledge with other resources. To discover and develop new knowledge an individual need to understand the possibilities of the knowledge but also need to understand the knowledge of other sources. Therefore, in the search for and development of new knowledge individuals in exploration oriented projects are more focused on obtaining new knowledge. This focus will lead to a development in and enhancement of the capabilities to obtain tacit knowledge which, in turn, will lead to a higher ability to obtain tacit knowledge. On the other hand, exploitation focuses more on the development of prototypes and products. This is about using and implementing knowledge. The ideas, models, and knowledge developed in explorative innovation projects are implemented in order to elaborate an idea or concept. Therefore, exploitative individuals are focused on the use of tacit knowledge. That is why exploitative individuals are more willing to use tacit knowledge. This study substantiates the conclusions made in literature and complements the literature with the finding that exploitation better allows formalization of KMS. Exploitation oriented projects have a better environment for reuse and use of existing resources

such as knowledge. In testing a prototype or starting with the production the same procedures, processes, and best practices can easier be applied in comparison to conducting research to a whole new technology or other phenomena.

Model 4 predicting ability to obtain tacit knowledge shows a significant interaction effect of exploration on the quadratic relationship between job codification and ability, while neither the quadratic effect nor the direct effect of job codification is found to be significant. This effect means that the linear and quadratic effects are close to zero. However, it deviates further from zero as the other variable (exploration) goes up or down. For example, if exploration is zero, there appears to be no significant direct and quadratic effects of job codification. If a project is more exploration oriented there appears to be significant effects of job codification. This effect is not interpreted because model 2 predicting ability predicts better according to the F-value and R^2 change. However, this finding indicates for further significant influences and possible effects of exploration. Therefore new multiple regression analyses are performed in order to investigate the role of exploration and exploitation in the model predicting ability. Every interaction effect between one of the two dependent variables (job codification and job specificity) and one of the two interacting variables (exploration and exploitation) is tested in a separate model. As a result, all interaction effects are found to be significant. The direct effects of job specificity on ability and exploration on ability are the same as before (significant positive direct effects). The effects of the control variables are also the same as before. The findings concerning the interaction effects are presented in table 12. Each effect has been obtained by running separate analyses with all the same control variables in model 1 and direct effects of all dependent variables in model 2. Each time the interaction effect was included in model 3.

Table 12. Summary of the interaction effects running separate multiple regression analyses predicting ability

Effect	*B*	*S.E.*	*β*	*Sig.*
Job specificity*Exploration	-.109	.029	-.239	.000
Job specificity*Exploitation	.071	.025	.185	.006
Job codification*Exploration	-.121	.040	-.209	.003
Job codification*Exploitation	.073	.034	.157	.031

B: Unstandardized coefficients; β: Standardized coefficients; Sig: p-value

These findings indicate that the slopes of the regression lines between job specificity and ability or job codification and ability are different for the different types of orientation of an innovation project. The β indicates how different those slopes are. The interpretation of these effects is as follows: the direct effect of job specificity on ability is positive. Job specificity*exploration indicates that the effect of job specificity on ability is less positive when a project is more exploration oriented (β = -.109, p = .000). The effect job specificity*exploitation indicates the opposite. The effect of job specificity on ability is more positive when a project is more exploitation oriented (β = .071, p = .006). Thus, a higher degree of job specificity results in a similar way of working. This ensures mutual understanding which in turn makes an individual more able to obtain tacit knowledge. When a project in which an individual is engaged is more exploitation oriented, the positive effect between job specificity and ability becomes stronger. On the other hand, when a project in which an individual is engaged is more exploration oriented, the positive effect between job specificity and ability becomes weaker.

These findings are consistent with the current literature that argues that exploration is related to a lower degree of formalization while exploitation is related to a context with a higher degree of formalization (e.g. March, 1991; Holmqvist, 2004; He & Wong, 2004). In phases where the emphasis is on exploitation, the outcomes are more predictable. Hence, the work activities and procedures are better prescribed and codified. Therefore, the content and context of exploitation projects allow more standardization and need to be more standardized to accomplish the intended outcome (Burns & Stalker, 1994). Job codification measures these technical aspects because it measures the work-related aspects (Hage & Aiken, 1967). Thus, the more an innovation project is exploitation oriented, the more job specificity is allowed, required and effective, and therefore the stronger the effect of formalization of KMS on ability to obtain tacit knowledge.

In contrast to this, in phases where the emphasis is on exploration, the innovation process activities are more creative and outcomes less predictable. Therefore the activities and procedures to accomplish the outcome can be less prescribed and codified. The content and context of exploration innovation projects allow and require KMS that restrict individuals and the activities to a lesser extent. Individuals in exploration projects need to have more room to participate to new activities and enter new environments in order to search for new knowledge (Vermeulen & Barkema, 2001). Thus, the more an innovation project is exploration oriented, the

less job specificity is allowed, required and effective, and therefore the weaker the effect of formalization of KMS on ability to obtain tacit knowledge.

No significant relationship between job codification and exploration or exploitation was found. However, when the interaction term exploration and exploitation is included in the relationship between job codification and ability, this relationship becomes significant. So by including exploration or exploitation to the effect, the effect does deviate from zero. The interaction effect of job codification*exploration is negative (β = -.209, p = .003). Initially the effect of job codification on ability was zero. Therefore, the effect of job codification on ability is negative when an individual is engaged in an exploration oriented project. On the other hand, the effect of job codification*exploitation indicates that effect of job codification on ability is positive when an individual is engaged in an exploration oriented project (β = .157, p = .031). The reasoning behind this is that individuals in an explorative project need to have the room to experiment and do new things (He & Wong, 2004). Individuals in exploration projects need to have more autonomy and less formalization (Aiken & Hage, 1971). This personality of the individuals in exploration innovation projects leads to the need that the behavior of explorative people may not be restricted by rules, procedures and other standardization activities. Job codification measures these social aspects because it measures behavioral-related aspects (Hage & Aiken, 1967). Thus, the more an innovation project is exploration oriented, the less job codification is allowed, required and effective, and therefore the initially zero effect of formalization of KMS on willingness to use tacit knowledge becomes negative.

The reasoning for the negative interaction effect of exploitation is the other way around. Individuals in exploitation projects focus more on the reuse of knowledge (Vermeulen & Barkema, 2001). The activities and processes allow more standardization and the individual in exploitation projects are used to and like a higher formalized environment (Burns & Stalker, 1994). This allows KMS to be higher formalized. Moreover, since tacit knowledge is context specific (Nonaka, 1994), the reuse of tacit knowledge is easier when the context is more or less the same as the context where this tacit knowledge is gathered or implicated before. When an individual has to do more or less the same work, knowledge will better fit other contexts, therefore reuse of tacit knowledge is easier which makes the individual more willing to use tacit knowledge. Thus, the more an innovation project is exploitation oriented, the more job

codification is allowed, required and effective, and therefore the initially zero effect of formalization of KMS on willingness to use tacit knowledge becomes positive. After finding these interesting findings more new analyses were performed to investigate the role of exploration and exploitation in the model predicting willingness. However, no new significant effects were found.

The correlation between project size and the orientation of a project (r = 0.283, $p < .01$) is supportive to the conclusion regarding the difference in content, context and personality of individuals in exploration and exploitation. This correlation argues that an exploitative project exists of more project members. In exploitation oriented projects individuals have a more cooperative mindset and are more willing to use tacit knowledge of others. In exploration oriented projects only a few researchers, who work more individually, are engaged. As argued by practitioners, they collaborate less and are also less willing to use knowledge of others. This finding is complementary to the literature about the 'not-invented-here syndrome' (Lichtenthaler & Ernst, 2006). Researchers already found that self-enhancement (Bartel, 2001), several project characteristics (Katz & Allen, 1982), communication structures and incentive systems (Mehrwald, 1999 as stated in Wastyn & Hussinger, 2011) influence the adaptation and use of knowledge. These findings are substantiated by insights obtained from the Social Identity Theory (Tajfel, 2010) and Organizational Identity Theory (Ashforth & Mael, 1989). Based on the last paragraphs, recommendations about applying different systems, structures and management approaches regarding exploration and exploitation can be made.

In the model predicting ability as well as the model predicting willingness it is noticeable that control variable ´educational level´ has a significant influence. By further investigating this control variable it is found that all respondents find themselves relatively well able to obtain tacit knowledge. The lowest score on ability is 1.60, the highest score 7, and the mean is 4.80. This mean score indicates an average score on ability that is above the center of the 7-point Likert. An explanation for this can be the high educational level of the respondents (The mean score on educational level is 5.43, further explanation in section 4.1.1). This explanation is supported by the significant correlation between ability and educational level (r = 0.267, $p < .01$) which is not unexpected given a question that measures ability as 'I have a higher educational level than other project members'. Furthermore, it is investigated which proportion of the variance is explained

by educational level in the model predicting ability. Performing the same multiple regression analysis as before but yet without educational level included as control variable, results in an adjusted R^2 of 27.2%. Initially the adjusted R^2 was 33.8% which is a difference of 6.6 percentage points. In conclusion, 6.6% of the variance explained by the regression model predicting ability can be attributed to control variable 'educational level'. This is almost a fifth of the total variance explained. Therefore it can be concluded that educational level has an important role in the regression model and is an important predictor of ability to obtain tacit knowledge. In current literature it is already found that knowledge transfer tends to improve with educational level (Sveiby & Simons, 2002). People with higher education find access to knowledge easier and they can more easily interpret knowledge transferred. This shows the importance of education-related activities such as school, training, workshops, and communities. Besides, the capability of an individual to transfer knowledge is measured based on the absorptive capacity principle of Cohen and Levinthal (1990). Absorptive capacity has two elements: prior knowledge and intensity of effort (Cohen & Levinthal, 1990). Prior knowledge refers to existing knowledge available for an individual (Minbaeva et al., 2003). This can be knowledge obtained via schooling and training but also knowledge obtained via work-related activities and experiences. The latter is encompassed by the tacit dimension of knowledge (Nonaka, 1994). Thus, employees' ability and their educational background may represent the 'prior related knowledge' which an individual needs to assimilate and use (Cohen & Levinthal, 1990; Minbaeva et al., 2003). Therefore, this prior related knowledge is essential for the ability of an employee, and therefore for the effectiveness of tacit knowledge transfer.

The notion of the importance of prior related knowledge is also part of the definition of a knowledge worker: "Knowledge workers have high degrees of expertise, education, or experience, and the primary purpose of their jobs involves the creation, distribution, or application of knowledge." (Davenport, 2005, p. 10). Other characteristics of knowledge workers are their non-routine problem solving, creative thinking, and drive to search for or do new things (Drucker, 1999; Reinhardt et al., 2011). These characteristics are in line with the characteristics of innovative employees such as the innovation project members that have been interviewed. Besides, the investigated industry and its organizations are knowledge-intensive (Brainport, 2013). Following this reasoning makes it plausible to suggest that the respondents are knowledge workers. This, in turn, makes it valid to conclude that education is an important aspect for

knowledge workers since education is an effective tool to increase the (prior) knowledge, expertise, and experience level of individuals. Moreover, education increases the ability of individuals to obtain knowledge which is an essential aspect for the creation, distribution, or application of knowledge (Szulanski, 1996).

However, the concepts obtained in this research model and discussed above do not explain everything. They mainly focus on organizational systems and structures which lead to an explained variance of 33.8% for the research model predicting ability and an explained variance of 15.9% for the research model predicting willingness. This supports the argument that there are more factors that influence the effectiveness of tacit knowledge transfer. The qualitative data suggests factors like culture, personality and trust. Moreover, there will be other variables that are influenced negatively by formalization such as craftsmanship, motivation, and creativity, as suggested by the qualitative data. According to the literature, the concepts motivation (Michaels et al., 1988), creativity of an employee (Ekvall, 1996), the ability or willingness to execute operations and apply skills (Ohly et al., 2006), or the characteristics of the person or work (Ohly et al., 2006) should be meausured to find negeative effects. If there is too much formalization, bureaucracy emerges which will restrict the employee and can be hostile to more uncertain projects, creativity and innovation (Sampson, 2007). Meanwhile, this creativity is critical in innovation projects. Besides, too much formalization can also lead to a change in the goal that an employee wants to achieve (March & Simon, 1958 as described in Kelley et al., 1996), even though it is explicitly mentioned that systems are supportive in executing operations and not leading to a goal in itself. Thus, by the formalization of KMS, the ability and willingness to transfer knowledge will increase and therefore a more effective transfer of tacit knowledge is made possible. However, it can have negative consequences such as employees that end up drowning in bureaucracy

The social factors discussed in the paragraph above are also suggested in the literature as the concept ‘people’ in the KM organizational context (Ed'son de Pary, 2009). The concepts investigated in this study account for 30% of effort required to invest in KM (20% technology and 10% process, see figure p. 21). On the other hand, people and cultural issues account for 70% of the effort required for an organization to invest in KM. This can be expected, given the nature of knowledge, especially for tacit knowledge. Knowledge is context specific and related

to human action (Nonaka, 1994). Especially tacit knowledge is deeply rooted in actions, skills, experiences, norms, and values (Nonaka & Konno, 1998). Therefore knowledge transfer largely depends on individuals' intention and attitude (Bock et al., 2005). "Although knowledge transfer in organizations involves transfer at the individual level, the problem of knowledge transfer in organizations transcends the individual level to include transfer at higher levels of analysis, such as the group, product line, department, or division" (Argote & Ingram, 2000, p. 151). Hence, individual aspects as motivation, attitude, trust, and personality characteristic, but also organizational aspects such as organizational climate, organizational culture, and social capital are important (Starbuck, 1992; Bock et al., 2005; Smith et al., 2005). The conclusion and discussion of this research reveal that the interaction between this key component and the other two key components of KM is critical. *Technology* is the best for capturing knowledge (Griffith et al., 2003). *Processes* are most effective for transferring knowledge. Still, technology and process require for *people* to use them and, besides, individuals are the most effective source for acquiring and storing tacit knowledge (Argote, 1999). These components, as the essential interaction between them, correspond with key components of the sociotechnical system design.

Nevertheless, as mentioned in the beginning of this thesis, it is hard to transfer tacit knowledge and as founding father Michael Polanyi (1966, p. 4) states: "We can know more than we can tell". Therefore, eventually, there will always be some dimension of knowledge that is not transferrable because of its complexity, stickiness, and context-specificity (Szulanski, 1996). However, the more complex and ambiguous the knowledge, the more tacit and explicit knowledge must exist together for knowledge to be usable (Schultze, 2000), and by using KMS which are appropriate to its users, content and environment, the major dimension of knowledge can be transferred.

5.3. Managerial Recommendations

Effectively transferring tacit knowledge or managing this transfer is a complex process that requires a manager to consider issues on several levels. The literature suggests that knowledge management benefits will only be realized by organizations that have the systems and processes (KMS) as well as the organizational, cultural and managerial elements aligned for knowledge management (Alavi & Leidner, 1999). The same holds for effective tacit knowledge transfer and

the management of it as suggested by this study. First, recommendations concerning the formalization of KMS are discussed. Hereafter, implications of this study on the organizational and cultural level are discussed. Lastly, some managerial practices are presented which ensure that tacit knowledge is transferred effective.

Recommendations concerning *the formalization of KMS* can be made based on the degree of job specificity and the degree of job codification. Job specificity positively influences the ability and willingness of an employee. So when knowledge transfer processes are more standardized, and rules and procedures better define the transfer of tacit knowledge, individuals will become more able and willing which, in turn, makes the transfer of tacit knowledge more effective. On the other hand, job codification negatively influences the willingness of employees. So when the behavior of individuals is controlled too much, this negatively influences the willingness of an individual to use knowledge. Thus, there appears to be an optimal level of formalization of KMS which results in the recommendation that the basis of KMS needs to be formalized. Only formalize the basis like formats, communication structures, and activities that provide incentives to follow KM processes. Seen the negative influence of job codification, the emphasis should be on aspects related to job specificity and not on aspects related to job codification. Furthermore, it is important to formalize KMS of exploration projects differently than KMS of exploitation projects because of a different content, contexts, culture and personality. Individuals in exploration projects are more able to obtain tacit knowledge and individuals in exploitation projects are more willing to use tacit knowledge. This difference concerning the orientation of a project also influences the effect between job specificity and ability, and job codification and ability. The relationship between job specificity and ability as well as job codification and ability is negatively influenced when a project in which an individual is engaged in is exploration oriented. Therefore, it is important to keep in mind that an explorative innovation environment reacts less positive on formalization via job specificity and negative on formalization via job codification. Besides, a mix between IT-based and human-based KMS needs to be maintained. Human-based KMS better create interaction, learning, and trust among employees (Yang & Farn, 2007), while IT-based KMS require for people to use them and individuals are the most effective source for acquiring and storing tacit knowledge (Argote, 1999). IT-based KMS mainly aim at capturing knowledge and at facilitating knowledge transfer in order to make it easily accessible. The success of these KMS partially depends upon the extent of (re)use. The most

important driver to use these KMS is the quality of the systems. Further drivers and requirements of IT-based KMS as well as examples are presented in appendix X.

At the *organizational level* attention has to be paid to the KM cycle. Throughout the whole organization it is required to put effort in this cycle. If this requirement is met, the KM cycle will not be interrupted and therefore becomes an iterative process. Often processes like knowledge capturing and storing already receive a decent amount of attention (Davenport & Völpel, 2001). However, the process of transferring knowledge receives less attention and the process of (re)using knowledge even worse. These last two processes need to receive more attention and need to be addressed in any formal or structured way. As a result, the quality of the KM cycle and all related processes and systems increases. The practices of the KM cycle concentrate on managing what is known and managing the interaction between people, process, and technology (Alavi & Leidner, 2001). It is important that an appropriate mix of people, process, and technology should be employed and an organization's expertise, ideas, and best practices should be aligned around the critical success factors of the organizations (Weggeman, 1997; Bhatt, 2001). The second implication on organizational level is about the organizational design. The organizational design needs to encourage the use of human-based KMS which increase horizontal communication and interaction. The organizational design should not be hierarchical since this can hinder knowledge flows (Tsai, 2002). Rather, the design is 'flat' and based on working in projects (Goh, 2002).

Second, the implication at *cultural level* is about taking a careful look at the composition of project teams, the culture of the organization, the content and context of projects, and the personality of employees. A difference in culture and personality of people in exploration and exploitation projects has been extensively discussed in the discussion section and paragraph about recommendations concerning formalization of KMS. Remember, the success of KM is only limited by the amount of human attention and the KM(S)-culture fit. Knowledge management projects force an organization to redefine its traditional work procedures, systems, structures, and technologies. Therefore, an organization needs to gradually assimilate the principles of KM over the organization's entrenched behavior. Technology and processes can provide assistance in KM but it pales in comparison to develop knowledge–oriented cultures. The organizations that are successful with knowledge management initiatives build their

knowledge management approach to fit their culture (Hislop, 2005). Moreover, "managing knowledge is managing people. Managing people is managing knowledge" (Davenport & Völpel, 2001, p. 218). Therefore, every person should be encouraged to view their jobs in terms of effective KM and eventually accept this way of working. People require the most effort of the three key components of KM. According to Bhatt (2001), changing people's behavior is one of the critical implementation problems in KM.

Regarding *managerial practices* that should be applied, the most important recommendation is that the management should promote the culture of transferring and managing knowledge. Strong leadership is a key element to successful KM and the change towards it. Leaders and managers are the example for others and need to pronounce and express their faith and trust in KM practices. Moreover, seen the crucial role of education level of an employee, it is essential to let employees and managers attend trainings and workshops. Encourage collaboration and team work, also cross-functional, and foster intensive social network among employees for example by creating communities. In order to promote the willingness to share knowledge, one could offer frictionless KMS and involve the end user in designing them. The second important practice a manager should perform is revisiting the interaction pattern between people, process, and technology. Putting too much emphasis on one element is not sufficient. The three elements should be in balance. Besides, it is important to notice that no extrinsic rewards should be the primary motivator within knowledge transfer practices (Osterloh & Frey, 2000; Bock et al., 2005). It has to be adopted in the culture and become an accepted way of working. Promote the issues from above and reduce the difficulties for employees by addressing knowledge work processes in business process reengineering or quality programs. It is not only about focusing on new operational processes but also about evaluating the current and, if necessary, eliminating non-value-adding processes.

Start with applying these recommendations, firstly by yourself and your department and later on in virtually every business unit and function. Then, the management of knowledge will continue to improve its importance to the business success.

5.4. Limitations and Future Research

Even though the findings of this study provide new and valuable insights, some limitations need to be discussed. First, the measurements of the dependent and independent variables are subjective. They measure the opinions and thoughts of individuals regarding his or her capabilities and environment. Regrettably, it seems that scholars as well as researchers seek to measure knowledge and KM practices directly (Fahey & Prusak, 1998), or to develop metrics to assess benefits of KMS (Alavi & Leidner, 1999). Some objective measures recently developed emphasize on scope and quality of data bases or number of requests or "hits" pertaining to KMS. Yet, a moment's reflection will convince even the most diehard metric devotee that such indicators are not the ultimate solution, honest self-reflection remains critical by such intangible concepts as knowledge. Another solution could be carrying out experiments and doing observations. Provide innovation projects (or other type of teams) with an assignment and each project member with his or her own function and activities. After a while the project members will change in roles and by doing so they should transfer the developed knowledge and insights to his or her substitute. Some teams will have low formalized KMS to transfer this knowledge, some teams will have a certain extent of formal KMS, and some teams will have high formalized KMS. Afterwards the effectiveness of the knowledge transfer can be measured by using indicators and other score measures. However, seen the scope of and resources available for this research, this approach was not feasible. The same goes for observing the extent of formalization of KMS and observing how the KMS are used by project members. This would positively affect the quality of the dataset. However, this approach was not desired by the organization given the confidentiality and dynamics of the environment. These kinds of settings can be carried out in future research.

Second, this study explicitly aims at the transfer of tacit knowledge in innovation projects. The research model is tested and validated using data collected from Dutch high-technology industry. Although a good quality data sample is obtained, future research could apply the selection criteria 'firm size > 100 FTE's' to focus on larger firms that are most likely to have formally established systems and where knowledge must be managed because of its amount, complexity, and its disperse state. In the current data sample also small organizations are obtained which do not meet this criterion. Therefore small as well as medium and large organizations are included which causes 'noise' in the dataset because part of this range is irrelevant for measuring the

concepts and effects. Moreover, in order to increase the generalizability of the findings and managerial implication, future research may include knowledge of other countries, markets and industries, like stable and low-technology industries, as well as other knowledge processes such as knowledge creation and localization.

Lastly, the theoretical framework did not include all possible antecedents. This study focused on only some core concepts related to KM practices. For instance, the personality and innovation capability of a knowledge-worker of is not studied, and neither the convenience to use KMS nor the quality of KMS is studied. Seen the insights of this study these concepts should be interesting variables which could be added to the research model. Future research may include these antecedents, as well as a more thorough analysis of the counter-intuitive results like the side effects of formalization (Bock, et al., 2005). Besides, no organizational structure, culture and strategy elements are studied such as co-operative behavior, innovation or risk-avoiding culture, the decision-making structure and expenses in KM and KMS. Although these are named in past research (Alavi & Leidner, 1999; Goh, 2002; Tsai, 2002; Lai & Lee, 2007; Liao et al., 2007; Zheng et al., 2010). Another interesting research area to which the contribution of KM practices should be examined is in intraorganizational networks and relations. By using network analysis, Tsai (2002) allready examined the influence of an organizational unit's network position and Becerra (2008) investigated the influence of cultural aspects in alliances. So the journey in the research area of knowledge management has proven to be interesting and looks promosing given all the possibilities and challenges.

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