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The interplay between organizational capabilities and individual skills

STUDIES OF TECHNICAL AND ENGINEERING CONSULTING FIRMS

Svjetlana Pantic-Dragisic

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Svjetlana Pantic-Dragisic
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Abstract

The number of professional service firms has increased rapidly in the recent decades. This thesis focuses on a type of professional service firm that has, thus far, been under-researched, namely the technical and engineering consulting (TEC) firm. TEC firms are important actors with regard to innovation, knowledge development, and the transfer of knowledge among problem-solving contexts. This thesis addresses the organization and development of engineering knowledge and the roles of the TEC firm and the technical consultants in the transfer of knowledge among assignments, projects, client organizations, and industries.

This thesis consists of a compilation of four papers and an extended summary. It builds on four qualitative studies and takes a multilevel perspective by utilizing an embedded case-study design to examine both the organizational level and the individual level as well as the interaction between the two levels. The thesis draws upon interviews with managers, consultants, client representatives, and industry experts and analysts. Moreover, it presents findings from an in-depth study of a competence development program for technical consultants.

This thesis contributes to the professional service firm literature by uncovering the knowledge-based advantages accrued by TEC firms through the organization and development of engineering knowledge. This thesis identifies two capabilities, *swift transition* and *knowledge cycling*, and argues that the link between these capabilities creates the foundation for the successful organization of engineering knowledge. The thesis demonstrates that the capabilities developed by TEC firms are formed through the interaction between the organizational level and the individual level. In addition, this thesis illustrates that capabilities differ among TEC firms. These differences stem from the organizational processes of the firm and the individual skills of the technical consultants. Based on these differences, the thesis identifies two ideal types of firms: *resource-capitalizer* and *project-capitalizer*. Furthermore, it develops the notion of knowledge cycling which demonstrates how the mobility inherent in the technical consultants' work facilitates the transfer and development of knowledge within and among problem-solving contexts. This process highlights the roles of the individual consultant, the TEC firm, and the client organization in the transfer of knowledge within and among assignments, projects, client organizations, and industries. Finally, this thesis provides insight into how formal training can develop the consultants' ability to transfer knowledge among problem-solving contexts by enhancing their liminality competence.

Keywords: technical and engineering consulting firm, professional service firm, technical consultants, mobile engineers, engineering knowledge, knowledge transfer, organizational capabilities, individual skills, liminality, liminality competence

Sammanfattning

Antalet professionella tjänsteföretag har ökat snabbt de senaste decennierna. Denna avhandling fokuserar på en specifik typ av professionella tjänsteföretag som har fått begränsad vetenskaplig uppmärksamhet, nämligen teknikonsultföretag. Teknikonsultföretagen har fått en alltmer framträdande roll i många sektorer och branscher då de, genom det sätt på vilket de bidrar till att organisera och utveckla ingenjörskunskap, är viktiga för innovation, kunskapsutveckling och kunskapsöverföring mellan organisationer. I denna avhandling studeras organiseringen och utvecklingen av ingenjörskunskap med särskilt fokus på teknikonsultföretagens och teknikonsulternas respektive roller för kunskapsöverföring mellan uppdrag, projekt, kundorganisationer och industrier.

Denna avhandling består av fyra artiklar och en kapp. Avhandlingen grundar sig i fyra kvalitativa studier och tar ett flernivåperspektiv genom att studera både den organisatoriska nivån och den individuella nivån och deras interaktion. Den bygger på intervjuer med chefer, konsulter, kundrepresentanter, samt branschexperter. Dessutom presenteras resultat från en djupgående studie av ett kompetensutvecklingsprogram för teknikonsulter.

Avhandlingen bidrar till forskningen om professionella tjänsteföretag genom att visa på de kunskapsbaserade fördelar som teknikonsultföretag tillförskansar sig genom det sätt på vilket de organiserar och utvecklar ingenjörskunskap. Denna avhandling identifierar två organisatoriska förmågor, *swift transition* och *knowledge cycling*, och argumenterar för att länken mellan dessa förmågor skapar grunden för organiseringen av ingenjörskunskap. Avhandlingen visar att de organisatoriska förmågor som teknikonsultföretag utvecklar bildas genom samspelet mellan den organisatoriska nivån och den individuella nivån. Dessutom synliggör avhandlingen att organisatoriska förmågor skiljer sig åt bland teknikonsultföretag beroende på företagets processer för att organisera och utveckla ingenjörskunskapen och teknikonsulternas individuella färdigheter. Baserat på dessa skillnader identifierar avhandlingen två ideala typer av företag: (i) de som tar utgångspunkt i de enskilda konsulternas kunskaper och (ii) de som tar utgångspunkt i möjligheten att skapa kunskapssynergier genom integration av olika konsulters kunskaper. Vidare utvecklar avhandlingen *knowledge cycling* begreppet som belyser hur rörligheten, vilket är en central del i teknikonsulternas arbete, påverkar kunskapsöverföringen och kunskapsutvecklingen inom och bland problemlösningssammanhang. Denna process betonar rollerna hos den enskilda konsulten, teknikonsultföretaget och kundorganisationen vid kunskapsöverföring inom och bland uppdrag, projekt, kundorganisationer och industrier. Slutligen ger föreliggande avhandling inblick i hur kompetensutveckling kan bidra till konsulternas förmåga att överföra kunskap mellan olika problemlösningssammanhang, genom att möjliggöra utvecklingen av s.k. liminalitetskompetens.

Nyckelord: teknikonsultföretag, professionellt tjänsteföretag, teknikonsulter, mobila ingenjörer, ingenjörskunskap, kunskapsöverföring, organisatoriska förmågor, individuella färdigheter, liminalitet, liminalitetskompetens

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Linköping, April 2019

Svjetlana Pantic-Dragisic

Appended papers

Paper I:

Pantic-Dragisic, S. & Söderlund, J.: Knowledge-based advantages of the TEC firm: Swift transition and knowledge cycling. Earlier version presented at the *Academy of Management Annual Meeting, Philadelphia, 2014*. Under review for publication.

Paper II:

Pantic-Dragisic, S. & Söderlund, J.: Heterogeneity of capabilities among professional service firms: A study of technical and engineering consulting firms. Earlier version presented at the *Professional Service Firms Annual Conference, Stockholm, 2017*. Working paper.

Paper III:

Pantic-Dragisic, S. & Söderlund, J. (2018). On the move to stay current: Knowledge cycling and scheduled labor mobility. *Management Learning* 49(4): 429-452.

Paper IV:

Pantic-Dragisic, S. & Borg, E. (2018). Creating the mobile engineer: A study of a training program for engineering consultants. *European Journal of Training and Development* 42(7/8): 381-399.

Table of contents

Chapter 1 Introduction	1
1.1 The TEC firm's role in the organization and development of engineering knowledge.....	2
1.2 The nature of technical consultants' work	5
1.2.1 Technical consultants as mobile engineers	7
1.2.2 Technical consultants and liminality	9
1.3 Aim and research questions	10
1.4 Thesis outline	11
Chapter 2 Theoretical background	13
2.1 Knowledge-based view of the firm	13
2.2 Professional service firms	14
2.2.1 Characteristics of professional service firms	14
2.2.2 Heterogeneity across professional service firms	16
2.2.3 Neo-professional service firms	18
2.3 Knowledge management in professional service firms	21
2.3.1 Knowledge transfer	23
2.4 Labor mobility as a facilitator for knowledge transfer	26
2.5 Summary	28
Chapter 3 Methodology	31
3.1 The research approach	31
3.1.1 A qualitative approach	32
3.2 The research process	35
3.3 Case selection	40
3.3.1 Single-case study	40
3.3.2 Multiple-case study	40
3.4 The case firms	41
3.4.1 Alpha	41
3.4.2 Beta	42
3.4.3 Gamma	42
3.4.4 Delta	43
3.4.5 Epsilon	44
3.4.6 Zeta	44
3.5 Phase I: Single-case study	45
3.5.1 Exploring the organization of engineering knowledge	45
3.5.2 Exploring knowledge transfer in technical consulting	51
3.5.3 Exploring an introductory development program	55
3.6 Phase II: Multiple-case study	61
3.6.1 Exploring heterogeneity among TEC firms	61
3.7 My contribution to the papers	66
3.7.1 Paper I	66
3.7.2 Paper II	66
3.7.3 Paper III	67
3.7.4 Paper IV	67
3.8 Establishing trustworthiness in qualitative research	68

Chapter 4 Summary of papers	71
4.1 Paper I.....	71
4.2 Paper II	72
4.3 Paper III	72
4.4 Paper IV	73
4.5 Summarizing the four papers	74
Chapter 5 Discussion.....	75
5.1 TEC firms as neo-professional service firms	75
5.2 TEC firm capabilities	77
5.2.1 The capability of swift transition	78
5.2.2 The capability of knowledge cycling	79
5.2.3 The interplay between swift transition and knowledge cycling	80
5.3 The heterogeneity among TEC firm capabilities	82
5.4 Facilitating knowledge transfer and knowledge development through mobility	85
5.5 Developing liminality competence through formal training	88
Chapter 6 Conclusions	91
6.1 Conclusions and contributions	91
6.1.1 Conclusions	91
6.1.2 Theoretical contributions	93
6.1.3 Practical implications	94
6.2 Future research	95
References	97

Figures

Figure 1. Summary of the theoretical background.....30

Figure 2. The research process.36

Figure 3. Data analysis: Exploring the organization of engineering knowledge.50

Figure 4. The knowledge cycling loop in technical consulting.....54

Figure 5. The structure of the Introductory Development Program.....55

Figure 6. The interplay between swift transition and knowledge cycling.....81

Tables

Table 1. Overview of the data collection process: Phase I.38

Table 2. Overview of the data collection process: Phase II.....39

Table 3. Data analysis of the IDP.....60

Table 4. Data analysis: Exploring heterogeneity among TEC firms.64

Table 5. Overview of the four papers comprising the thesis.74

Table 6. Comparing capabilities: Swift transition and knowledge cycling.....81

Table 7. Capabilities in the two ideal types of TEC firms.....84

Table 8. Characteristics of knowledge cycling.....87

Extended summary¹

¹ This extended summary builds on the first draft of this thesis presented in my licentiate thesis Pantic-Dragisic, S. (2015) Swift transition and knowledge cycling: A study of knowledge transfer in technical consulting. Linköping: Linköping University Electronic Press.

Chapter 1

Introduction

During the last decades, the economy has become increasingly knowledge-intensive, which has impacted the nature of organizations and the nature of work itself (Grant and Parker, 2009; Walsh et al., 2006). The changes that began to occur during the latter portion of the 20th century have “created value chains that are heavily dependent on the creativity of individuals and their knowledge-based human capital” (Walsh et al., 2006: 661). The knowledge revolution coupled with the parallel shift toward the globalization of markets has led to the rise of work arrangements that differ from traditional lifetime employment in which firms increasingly rely on external workers employed through nonstandard work arrangements (Ashford et al., 2007; Barley and Kunda, 2001; Hoffman et al., 2013; Kalleberg, 2000; Miller and Miller, 2012; Schilling and Steensma, 2001). These developments have, in turn, impacted the growth of the professional service industry (Løwendahl, 2005; Teece, 2003).

The number of firms providing professional services has increased rapidly in the last decades (Empson et al., 2015). Examples of firms providing such services are law firms, accounting firms, advertising agencies, architectural firms, management consulting firms, and technical and engineering consulting firms (Cooper et al., 1996; Criscuolo et al., 2007; Empson, 2001a; Greenwood et al., 1990; Løwendahl, 2005; Malhotra, 2003; Morris and Empson, 1998; Pinnington and Morris, 2002; von Nordenflycht, 2011; Werr and Stjernberg, 2003). This “sector has emerged as one of the most rapidly growing, profitable and significant sectors of the global economy” (Empson et al., 2015: 1). Sharma (1997: 758) argues that without professional service firms (PSFs) “business as we know it would come to a grinding halt”. Professional and business services is one of the fastest-growing sectors in the world (BLS, 2017; OECD, 2015). This sector accounts for almost 12 percent of EU GDP (EC, 2017), and 18 percent of US private-sector GDP (USITC, 2016).

In response to their growing economic importance, PSFs have received increasing scholarly attention since the 1990s (Empson, 2001b; Hinings and Leblebici, 2003; von Nordenflycht, 2010). In particular, there is a growing interest in PSFs as their characteristics are presumed to set them apart from other firms. Organization theorists have argued that PSFs require distinctive theories of management and organization (Empson, 2001b; Greenwood et al., 2005;

Løwendahl, 2005; Maister, 1997; Malhotra and Morris, 2009; Malhotra et al., 2006; von Nordenflycht, 2010). Previous literature on PSFs has primarily focused on classical PSFs such as law firms, accounting firms and architectural firms (Cooper et al., 1996; Empson, 2001a; Greenwood et al., 1990; Jonsson, 2015; Pinnington and Morris, 2002; von Nordenflycht, 2010). These firms are characterized by a professionalized workforce with a particular knowledge base, educational background, and strong preferences for individual autonomy (von Nordenflycht, 2010). However, research has indicated that there are considerable differences among the various types of PSFs (Løwendahl, 2005; Malhotra and Morris, 2009; von Nordenflycht, 2010; von Nordenflycht et al., 2015). Although PSFs share a “common set of characteristics that impose certain managerial challenges, the organizational outcomes that stem from those shared challenges may be quite different depending on *other* characteristics that vary from one industry or firm to the next” (von Nordenflycht et al., 2015: 136, emphasis in original). This thesis focuses on an under-researched context, namely technical and engineering consulting (TEC).

1.1 The TEC firm’s role in the organization and development of engineering knowledge

Modern technology-intensive firms increasingly rely on a dual system consisting of an *internal* core of employees complemented by an *external* network of consulting firms and manpower agencies (Nesheim and Hunskaar, 2015; Nesheim et al., 2007). Today, considerable engineering capacity is sourced through engineering services and consulting firms (Teece, 2003; Tether and Tajar, 2008). In general, the project-based form of organizing has had a growing significance in a wide range of industries, such as construction, telecommunication, software, computer hardware, and consulting (Sydow et al., 2004; Whitley, 2006). In addition, this is an organizational form that has gained increasing ground in firms working with complex problem-solving, as it has been found to be an ideal form for managing technological uncertainty, complex tasks, and problems (Hobday, 2000). These prominent shifts towards greater flexibility in work arrangements, as well as in organizational forms, have had significant effects on the labor market for engineers, which, in turn, have impacted the growth of the TEC industry.

The growth of the TEC industry is suggested to be driven by the shift towards knowledge specialization, flexible organizing, and the externalization of the workforce (Brusoni et al., 2001; Davis-Blake and Uzzi, 1993; Gambardella and Torrasi, 1998; Løwendahl, 2005; Matusik and Hill, 1998). In addition, Berggren et al. (2011: 6) claim that “products, systems, processes, and services embody an increasing number of rapidly evolving components and subsystems and draw on a broadening range of technologies and knowledge fields.” Accordingly, the increase in technological complexity has led a growing number of firms to rely on TEC firms in order to master advances within relevant knowledge areas (Berggren et al., 2011; STD, 2017; Teknikföretagen, 2015). Hence, TEC firms have become increasingly important actors with regard to innovation, knowledge development, and the transfer of knowledge among industries (BLS, 2017; EC, 2017; STD, 2017; Teknikföretagen, 2015). As a consequence of this development, a growing ratio of newly graduated engineers, such as programmers, software engineers, systems engineers, electrical engineers, and mechanical engineers are expected to

enter the job market through a TEC firm (Teknikföretagen, 2015; WEF, 2016). In that respect, TEC firms are assuming a variety of roles concerning the management and organization of engineers and the development of engineering expertise, including recruitment, individual competence development, and assignment rotation to ensure that relevant knowledge and competence are being sourced to its clients (Malhotra, 2003; Teknikföretagen, 2011; Wright et al., 2001).

Prior research has emphasized two main reasons for the reliance on external resources, numerical flexibility and functional flexibility, which are central for understanding the growth of the TEC industry. Numerical flexibility stresses the emerging economic model of core employees surrounded by buffer pools of temporary workers (Atkinson et al., 1984; Handy, 1989; Kalleberg, 2001). It is thought that headcount can quickly be increased and decreased in line with changes (Atkinson et al., 1984) to respond to higher degrees of environmental volatility. The arguments for hiring external human resources have traditionally revolved around achieving greater numerical flexibility of labor and minimizing labor costs (Davis-Blake and Uzzi, 1993; Kalleberg, 2001; Marler et al., 2002). In other cases, the explanations center on the requirements to maintain functional flexibility. Client organizations seek particular expertise, typically specialized technical expertise, that they either find difficult to develop internally or for which they do not see a long-term need (Gambardella and Torrisi, 1998; Matusik and Hill, 1998). Functional flexibility may expand the breadth of knowledge sources within the client organization (Leiponen and Helfat, 2010) providing greater opportunities to tap into complementary knowledge bases and technologies (Bessant and Rush, 1995). Undeniably, these factors are important for explaining the growth of the TEC industry and the services offered by TEC firms. However, this thesis argues that numerical flexibility and functional flexibility explain only part of the TEC industry's growth, and it aims to demonstrate that further explanations pertain to the knowledge-based advantages that TEC firms can attain through the organization and development of engineering knowledge. This thesis suggest that it seems particularly important to uncover the knowledge-based advantages attained by TEC firms in order to fully grasp the functions of these firms. A more comprehensive understanding of the functions of TEC firms might be gained by exploring their capabilities.

TEC firms offer professional services that are knowledge intensive, involve a high degree of interaction with the client organization, and are performed by highly educated individuals with substantial expertise (Empson et al., 2015; Løwendahl, 2005; von Nordenflycht, 2010). These firms rely on individual expertise, recruit highly educated individuals, and thrive on the cultivation and transfer of knowledge (Empson, 2001a; Løwendahl et al., 2001). Hence, knowledge that resides in the individual employees provides a foundation for competitive advantage for these firms (Hogan et al., 2011). As the TEC firms' success to a great extent hinges upon the knowledge of their organizational members, "their ability to proactively and dynamically manage knowledge assets is naturally critical to their performance" (Harmon et al., 2018: 17). The TEC firms addressed in this thesis operate as knowledge-intensive agencies where innovation, technology development, knowledge transfer, client needs, and employee requirements are intermeshed to form the basic functions of the firms and shape their business rationale. The employees, i.e. technical consultants, are employed by the TEC firms that are

responsible for managing them, but a large number of the consultants perform their work in client organizations where they work in inter-functional project settings (Bredin and Söderlund, 2011a). After completing their assignment, the consultants return to the TEC firm for reassignment (Cappelli and Keller, 2013). Hence, the consultants are “changing tasks, teams, and workplaces on a continuous basis” (Bredin and Söderlund, 2011a: 2218). Consequently, the work of technical consultants differs from that of the workers employed through classical PSFs. TEC firms do not have a professionalized workforce (Malhotra and Morris, 2009), meaning that there is a lower degree of individual autonomy. Although engineering is grounded in a technical knowledge base, engineers have not been able to maintain exclusive jurisdictional control over their profession due to the fact that the engineering specialization has risen out of several subspecialties. This has resulted in a low degree of social closure (Abbott, 1988; Malhotra and Morris, 2009). In addition, technical consultants are an integral part of their clients’ innovation processes as both the consultants and the client contribute to the problem-solving process through tight teamwork (Nikolova et al., 2009). These characteristics of TEC firms have implications for how human capital and knowledge is organized and developed in such firms (Malhotra and Morris, 2009; von Nordenflycht et al., 2015).

This thesis contributes to PSF literature by illustrating the heterogeneity among PSFs through the study of TEC firms. Previous research has called for studies that illuminate the heterogeneity among PSFs (Malhotra and Morris, 2009; von Nordenflycht, 2010; von Nordenflycht et al., 2015), as these differences “affect the nature of the professionals’ work and, in turn, the organization and management of firms across different professional sectors” (Malhotra and Morris, 2009: 895). Due to the fact that prior research has mainly focused on classical PSFs, TEC firms and the roles they play regarding the organization and development of engineering knowledge and the transfer of knowledge among problem-solving contexts remain insufficiently researched areas of inquiry (von Nordenflycht, 2010). Accordingly, the overall aim of this thesis is to investigate the organization and development of engineering knowledge, and the roles of the TEC firm and the technical consultants in the transfer of knowledge among assignments, projects, client organizations, and industries.

More specifically, this thesis contributes to the strategic management of PSFs by focusing on the capabilities of TEC firms. Despite the increasing scholarly attention regarding how PSFs strategically manage human capital and knowledge (Skjølsvik et al., 2017), previous research has failed to fully grapple the nature and specific capabilities central for TEC firms. In addition, this thesis centers on the variation of capabilities among TEC firms. Prior research has indicated that the differences within professional service industries can be attributed to characteristics such as firm size, firm strategy, maturity, and flexibility (Løwendahl, 2005; Malhotra and Morris, 2009; von Nordenflycht, 2011; von Nordenflycht et al., 2015). Hence, the thesis illustrates the heterogeneity among PSFs by exploring the capabilities central for TEC firms with regard to the organization of engineering knowledge as well as the heterogeneity within the TEC industry by investigating how capabilities differ among TEC firms. Moreover, this thesis contributes to current literature by suggesting a multi-level perspective addressing two levels of analysis: the organizational level and the individual level. Prior research on capabilities has mainly focused on the organizational level of analysis until about a decade ago when the concept of micro-foundations was introduced into strategy research (e.g. Felin and

Foss, 2005; Gavetti, 2005; Lippman and Rumelt, 2003). However, prior research has still not solved the multilevel problem (Felin and Foss, 2005; Felin et al., 2015; Floyd and Splettek, 2011; Foss and Pederson, 2016). Previous studies have argued that researchers interested in exploring organizational capabilities should focus on investigating the relationships between the organizational level and the individual level, as the individuals' roles have an impact on organizational advantages (Felin et al., 2015; Foss and Pederson, 2016), which this thesis aims to do. This requires an understanding of organizational processes, organizational structures, as well as the working conditions of the technical consultants and of how these are connected. Hence, beyond illuminating an under-researched empirical setting, this thesis is theoretically significant as it offers insights into the capabilities of TEC firms by utilizing a multilevel perspective. This is important as TEC firms might encounter challenges that theories and models developed for classical PSFs cannot adequately account for (Empson et al., 2015; Malhotra and Morris, 2009; von Nordenflycht et al., 2015).

1.2 The nature of technical consultants' work

One of the most prominent changes in the nature of work has been the project-based mode of organizing work (Barley and Kunda, 2004; Hobday, 2000; Maylor et al., 2006; Whitley, 2006). The project-based organization has had increasing significance in new as well as established industries (Ekstedt, 2009; Whitley, 2006; Whittington et al., 1999). According to Whitley (2006: 77), project-based work has become the "new logic of organizing." Similarly, Barley and Kunda (2004) argue that an increasing number of firms are turning to project teams as a way of organizing productive activities.

[...] more and more organizations are turning to project teams as a model for organizing productive activities. Unlike functions or divisions, projects have limited life spans and rely on temporary concentrations of resources and personnel that can be jettisoned or redeployed when the project ends (Barley and Kunda, 2004: 304).

While projects can be vastly different, there are a number of common denominators. Prior research illustrates that a project is a temporary organization centered on a specific task carried out by a team in a limited amount of time (Bakker, 2010; Ekstedt, 2002; Turner and Müller, 2003). Hence, for the individuals working in these contexts, working life is characterized by flexibility, temporariness, and boundarylessness (Bakker, 2010; Kalleberg, 2001; Kamp et al., 2011). These changes in the nature of work imply that individual project workers' careers become based on transiency as they consistently move from project to project and adapt to new work environments. In addition, as project teams often consist of temporary constellations of resources, traditional organizational boundaries become blurred (Barley and Kunda, 2004; Kamp et al., 2011; Lindkvist, 2005). In line with this, Turner et al. (2008: 578) argue that "every time a new project or program starts or an old one finishes the human resource configuration of the parent organization changes," which can lead to multiple and ambiguous belongings. Grabher (2004: 1509) claims that "individual project participants are faced with the challenge of aligning their conflicting loyalties to the core team, the firm, the client, and their personal networks."

Previous research has illustrated that temporary workers are increasing in numbers in project-based organizations (Bredin and Söderlund, 2011b; Ekstedt, 2002; Matusik and Hill, 1998). Hence, “the PBO [project-based organization] is often characterized by *heterogeneity in employment relations*” (Bredin, 2008: 28, emphasis in original). Hence, the nature of the technical consultants’ work is characterized by complex problem-solving together with engineers employed by the client organization as well as other temporary workers (Matusik and Hill, 1998). As discussed in Section 1.1, technical consultants are employed by the TEC firm, which is responsible for managing them, but a large number perform their work in client projects as members of teams that are managed by the client organization (Barley and Kunda, 2006; Cappelli and Keller, 2013). The technical consultants’ assignments in client projects usually last for several months, and, in some cases even years, depending on the project’s scope and complexity (Borg and Söderlund, 2014). In some cases, assignments may also overlap. After completing their assignment, technical consultants return to the TEC firm for reassignment (Cappelli and Keller, 2013). Technical consultants assume various resource, expertise, and specialists roles in complex development and engineering projects in technology-based firms (Söderlund and Bredin, 2011). They are called upon when the stock of engineering resources within the client organization is not sufficient or capable of handling the development and engineering work that is to be executed, making technical consultants important actors for technology and systems development in client organizations (Borg and Söderlund, 2014; Söderlund and Bredin, 2011).

Technical consultants perform their work in cross-functional teams (Kunda et al., 2002; Lindkvist, 2005; Matusik and Hill, 1998), as a result, their work situation is characterized by “rapid socialization, speedy deliveries and tough deadlines” (Söderlund and Bredin, 2011: 98). Technical consultants move from project to project on a recurrent basis, frequently collaborating with new team members (Söderlund and Bredin, 2011). In other words, they “continuously enter into and adapt to new contexts, new organizational settings, and new projects” (Borg and Söderlund, 2014: 183). This implies that “there isn’t time to engage in the usual form of confidence-building activities that contribute to development and maintenance of trust” (Meyerson et al., 1996: 167). Based on these characteristics, this thesis argues that the technical consultants’ work context does not correspond to the conventional image of the knowledge community characterized by intimacy, shared understanding, and situated learning (Brown and Duguid, 1991; Lave and Wenger, 1991) in which individuals work together for a longer period of time with others who have similar backgrounds and expertise (Amin and Roberts, 2008). The rotation among assignments, which is a central aspect of technical consultants’ work (Bredin and Söderlund, 2011b; Söderlund and Bredin, 2011), is contradictory to several integral principles of knowledge development in knowledge communities. Consequently, due to high mobility, dynamism, and temporariness, the work context of technical consultants, to a greater extent, resembles a knowledge collectivity (Lindkvist, 2005). Lindkvist (2005: 1189) claims that:

[...] these kinds of groups consist of diversely skilled individuals, most of whom have not met before, who have to solve a problem or carry out a pre-specified task within tightly set limits as to time and costs. As a result they tend to become less well-

developed groups, operating on a minimal basis of shared knowledge and understandings.

In such a context, individuals who enter a problem-solving context must collaborate and integrate their knowledge with individuals with whom they have limited joint working experience (Lindkvist, 2005). When the knowledge collectivity dissolves, participants either move back to their home community or move on to another knowledge collectivity. Technical consultants' working life is, in this manner, affected by temporariness as they move among assignments, projects, client organizations, and industries on a recurrent basis (Borg and Söderlund, 2014; Bredin and Söderlund, 2011b; Söderlund and Bredin, 2011). Hence, technical consultants must deal with ambiguous belongings to a higher degree than engineers employed by the client organization (Packendorff, 2002).

1.2.1 Technical consultants as mobile engineers

Technical consultants have been referred to as *mobile engineers* in prior literature, as they frequently move among problem-solving contexts (Sankowska and Söderlund, 2015; Söderlund and Bredin, 2011; Song et al., 2003). Research has documented that technical consultants are increasing in numbers in project-based organizations (Bredin and Söderlund, 2011b), and firms hire technical consultants because of their unique expertise and the difficulty of organizing such expertise in-house (Bessant and Rush, 1995; Gambardella and Torrisi, 1998; Matusik and Hill, 1998). "Clients want to benefit from the consulting firms' broad experience and, more importantly, have access to the knowledge that emerges from this experience" (Sarvary, 1999: 97). A primary reason for client organizations to hire consultants is to "[gain] access to consultant knowledge" (Davenport and Prusak, 2005: 305; Werr, 2002: 92). In line with this, Nesheim et al. (2014) argues that clients are interested in enlarging their own resource base by absorbing knowledge from hired consultants. The knowledge transfer from consultants to client organizations is, thus, itself a significant motivator of such arrangements (Davenport and Prusak, 2005; Werr, 2002).

The literature regarding knowledge transfer within client-consultant relationships has documented consultants' ability to transfer knowledge to client organizations (e.g. Berthoin Antal and Krebsbach-Gnath, 2001). Sarvary (1999: 98) claims that:

Through the consulting assignments, the consultant is connected to many firms in different industries. As a result of this central position, the consultant is aware of a large set of business problems as well as a large set of solutions. Problems and solutions may not always match within an industry. In fact, if they do, industry participants are likely to be aware of them. However, they are typically not aware of solutions that exist in other—especially unrelated—industries.

Similarly, Clegg et al. (2004: 1350) claim that consultants are "a source of noise" that disrupts established ways of doing at the client site. Handley et al. (2007: 183) argue that consultants' status as outsiders accounts for their "ability to introduce new knowledge or to surface previously ignored knowledge" within the client organization. In other words, consultants' outsider status enables them to bring an external view to the client organization, and thereby, contribute with knowledge and expertise (Creplet et al., 2001). McKenna (2006: 12) proposes

that “consultants have flourished primarily because they have remained outside the traditional boundaries of the firm.” On the same note, Borg and Söderlund (2015a) show that consultants, thanks to their outsider status, may bring new perspectives to problem-solving contexts that encourage knowledge transfer. Likewise, Tempest and Starkey (2004) demonstrate that labor mobility among organizations may enhance creativity and business development. Glückler and Armbrüster (2003) emphasize that client organizations improve their business and efficiency by hiring consultants, at the same time as consultants learn from their assignments with leading-edge clients.

It is evident that consultants are important actors in the transfer of knowledge within and among client organizations. Bessant and Rush (1995: 102) argue that technical consultants “act rather like bees, cross-pollinating between firms, carrying experiences and ideas from one location or context into another.” In that respect, Malhotra (2003) suggests that the nature of the technical consultants’ work bears analogy to that of Hargadon and Sutton’s (1997) technology brokers, as the consultants bridge “ideas and knowledge gained from disparate industry clients” (Malhotra, 2003: 954). From this perspective, technical consultants can be seen as knowledge brokers, who facilitate the flow of knowledge among client organizations and industries (Bessant and Rush, 1995; Creplet et al., 2001; McKenna, 2006; Sarvary, 1999).

Research addressing knowledge transfer within client-consultant relationships has, however, primarily focused on management consultants (e.g. Handley et al., 2007; Ko et al., 2005). Although management consultants and technical consultants are similar in a number of respects, such as the ones presented above, the nature of technical consultants’ work distinguishes them from management consultants. This, in turn, affects the transfer of knowledge to client organizations. Management consultants usually work in teams and take on roles as advisors in client organizations (Hicks et al., 2009; Holmemo et al., 2018; Werr and Stjernberg, 2003; Werr et al., 1997). Thus, they are “external specialists and so have no organizational responsibility” (Clark and Salaman, 1996: 155). The technical consultants, on the other hand, often enter client projects independently and take part in complex problem-solving alongside members of the client organization and other technical consultants (Matusik and Hill, 1998; Söderlund and Bredin, 2011). Consequently, they are involved in the knowledge integration processes in client projects to a larger extent (Söderlund and Bredin, 2011). Another salient feature pertaining to technical consultants is their frequent and regular rotation among client organizations (Borg and Söderlund, 2014). The work of technical consultants is more akin to that of individuals employed by a staffing agency, although, their responsibilities and contribution to the client’s innovation processes are substantially different.

This thesis contributes to current literature by exploring how the mobility inherent in the technical consultants’ work affects the transfer of knowledge within and among problem-solving contexts. The thesis proposes an alternative form of knowledge transfer which highlights the importance of individual agency and contextual understanding. This process emphasizes the roles of the individual consultant, the TEC firm, and the client organization in the transfer and development of knowledge within and among assignments, projects, client organizations, and industries. This dynamic has not been readily covered in previous literature on knowledge transfer in consultant-client relationships.

1.2.2 Technical consultants and liminality

The concept of liminality has been used to describe a work position that is betwixt and between traditional organizational structures (Tempest and Starkey, 2004), which is common both for project-based work and nonstandard work arrangements (Garsten, 1999; Sturdy et al., 2009). The concept of liminality originates from anthropology where it denotes a ritual transition between two states or status, such as a ritual initiating an adolescent into adulthood or rituals between seasonal changes (van Gennep, 1960). This transition phase in the rite of passage has also been referred to as the *liminal* phase, which is typically ambiguous and, as argued by Turner (1982: 24), can be likened to “a sort of social limbo which has few (though sometimes these are most crucial) of the attributes of either the preceding or subsequent statuses or cultural states.”

The concept of liminality has been adopted from anthropology into management and organization literature (Söderlund and Borg, 2018). Previous studies have described liminality as a transient phase in a rite of passage. The rite of passage allegory has been used to explain how individuals experience liminality in various development programs (Eriksson-Zetterquist, 2002; Tansley and Tietze, 2013). Moreover, liminality has also been utilized to define the position of individuals for whom organizational boundaries and/or organizational belongings are temporary and ambiguous (e.g. Garsten, 1999; Tempest and Starkey, 2004; Zabusky and Barley, 1997). Tempest and Starkey (2004: 507) describe working in a liminal position as “existing at the limits of existing [organizational] structures.” Thus, workers holding liminal positions continuously exist in blurred and ambiguous organizational settings, as they continuously move from one context to another (Ellis and Ybema, 2010). Tansley and Tietze (2013) claim that liminality is an inherent feature of a consultant’s work, as the consultant continuously “[accepts] temporality of assignments and relationships” (Tansley and Tietze, 2013: 1813). For the technical consultants addressed in this thesis, liminality is most often a long-lasting work condition, and consequently, their work situation, in itself, constitutes a liminal position at work.

The literature has indicated that liminality has both negative and positive consequences for individuals working in transient and mobile work contexts (Garsten, 1999; Sturdy et al., 2006; Tempest and Starkey, 2004). Working in liminal positions can result in reduced access to certain organizational information and resources (Garsten, 1999), such as learning activities that support specialist knowledge (Tempest and Starkey, 2004). However, liminality can also result in an increased feeling of freedom, as individuals working in such contexts are “liberated from the social structures that define the experiences of regular employment” (Garsten, 1999: 607). Moreover, the mobility inherent in liminal work situations is found to have positive effects on learning as it broadens individuals’ learning opportunities (Tempest and Starkey, 2004). The authors argue that liminality enables individuals to gain access to different learning contexts and, thereby, broadens their repertoires of knowledge. Similarly, as individuals are not limited by existing social structures liminality at work can lead to increased innovative possibility (Howard-Grenville et al., 2011; Johnson et al., 2010; Zabusky and Barley, 1997).

Borg and Söderlund (2014) argue that people who work in liminal positions deal with liminality by adopting different practices. Studies have indicated that some individuals are better at

reaping the positive effects of liminality, such as seizing opportunities for learning and using their liminal positions to broaden their knowledge bases (Borg and Söderlund, 2015a; Tempest and Starkey, 2004). This indicates that individuals possess different levels of liminality competence (Borg and Söderlund, 2015a). Individuals holding the highest level of liminality competence perceive their work as knowledge transfer, and they consider one of their “major missions in work to use knowledge from other firms and contexts in the current assignment” (Borg and Söderlund, 2015a: 270). According to Borg and Söderlund (2015b) three processes are important for the development of liminality competence: (i) understanding the value of in-betweenness, (ii) embracing the role as inside-outsider, and (iii) translating liminal experience through reflexivity.

This discussion illustrates that liminality can have a positive effect on the transfer of knowledge to and among various problem-solving contexts (Borg and Söderlund, 2015a; Clegg et al., 2004; Handley et al., 2007; McKenna, 2006). However, the extent to which consultants leverage their prior knowledge may vary substantially according to their liminality competence (Borg and Söderlund, 2015a). Consultants must, thus, learn how to master their liminal positions at work. This entails learning how to deal with the ambiguity inherent in their work situation (Garsten, 1999; Turner, 1982) and handling temporary assignments and relationships as they exist in blurred and ambiguous settings with no clear belonging (Czarniawska and Mazza, 2003; Ellis and Ybema, 2010; Tansley and Tietze, 2013). The liminal work situation also requires that consultants are able to handle stress and reduced access to information and learning opportunities (Garsten, 1999; Tempest and Starkey, 2004). Previous research has claimed that individuals holding liminal positions often receive fewer formal training opportunities than “regular employees” (Cohen and Mallon, 1999; Finegold et al., 2005; Garsten, 1999; Hoque and Kirkpatrick, 2003; Legge, 1998; Tempest and Starkey, 2004). Thus, technical consultants are mainly left to themselves to deal with their liminal work situations. Prior studies have contributed with important insights into liminality by, for example, investigating how liminality competence can be developed through on-the-job training. However, these studies call for more research on how liminality competence can be developed through competence development activities (Borg and Söderlund, 2015a; Borg and Söderlund, 2015b). This thesis contributes to current literature by exploring how the technical consultants’ liminality competence can be developed through formal training, which has, thus far, been an under-researched topic (Kaiser et al., 2015; Kinnie and Swart, 2012; Spanuth and Wald, 2017). The thesis suggest that consultants can learn to deal with their liminal positions at work and develop liminality competence through the use of *distancing techniques*. By reflecting on their work experience, consultants distance themselves from their work situation and, thereby, gain new perspectives on their work.

1.3 Aim and research questions

The overall aim of this thesis is to investigate the organization and development of engineering knowledge, and the roles of the TEC firm and the technical consultants in the transfer of knowledge among assignments, projects, client organizations, and industries. More specifically, this thesis addresses the following research questions:

RQ1. What is the nature of a TEC firm, and which capabilities are central to the TEC firm with regard to the organization of engineering knowledge?

RQ2. How do capabilities differ among TEC firms?

RQ3. How does the mobility inherent in technical consultants' work affect the transfer of knowledge within and among problem-solving contexts?

RQ4. How do technical consultants develop their liminality competence, and their ability to transfer knowledge within and among problem-solving contexts through formal training?

1.4 Thesis outline

This thesis is comprised of four papers and an extended summary. The extended summary provides a background to the four appended papers in the second part of this thesis, and summarizes their main contributions. The thesis outline is presented below.

Chapter 2 presents the theoretical background of this thesis. This thesis is based on the knowledge-based view of the firm. This chapter illuminates the characteristics of professional service firms, and the heterogeneity across professional service firms. Subsequently, neo-professional service firms are discussed, and their managerial challenges are illustrated. In addition, this chapter deals with the knowledge management in professional service firms, focusing on knowledge transfer, and the impact of labor mobility on the transfer of knowledge among problem-solving contexts.

Chapter 3 describes and motivates the methodological choices of this thesis. This chapter describes the four studies conducted within the boundaries of six TEC firms, which lay the foundation for this thesis. Moreover, the chapter gives an extended description of the data collection methods used in each study, and portrays how the empirical material was analyzed. Finally, this chapter describes how the use of multiple qualitative methods, multiple data sources and multiple investigators strengthens the trustworthiness of this thesis.

Chapter 4 summarizes the four appended papers that form the basis for this thesis and connects them to the aim and research questions.

Chapter 5 presents a synthesized discussion, which addresses the research questions based on the findings and contributions of the appended papers.

Chapter 6 concludes this thesis, and presents contributions, practical implications and suggestions for future research.

The second part of this thesis consists of the complete versions of the four papers.

Chapter 2

Theoretical background

This chapter presents the theoretical background for this thesis. It begins by highlighting that this thesis is based on the knowledge-based view of the firm. Subsequently, the characteristics of professional service firms are discussed, and four types of professional service firms are presented that illuminate the heterogeneity across such firms. This chapter addresses neo-professional service firms, which are the focus of this thesis, and examines two managerial challenges associated with these types of firms. Thereafter, knowledge management in professional service firms is discussed. Further, the importance of knowledge transfer, which is central for the existence of professional service firms, is emphasized. A number of methods through which professional service firms can manage knowledge transfer are presented. Next, the impact of labor mobility on knowledge transfer among problem-solving contexts is discussed. The chapter ends by summarizing the theoretical background.

2.1 Knowledge-based view of the firm

This thesis builds on the knowledge-based view (KBV) of the firm (e.g. Grant, 1996b; Kogut and Zander, 1992; Spender, 1996a). The KBV is an extension of the resource-based view (RBV) (e.g. Barney, 1991; Penrose, 1959), and views knowledge as a firm's most strategic resource (Grant, 1996b). Hence, the nature of the most critical resource according to the KBV is intangible and dynamic (Curado and Bontis, 2006). Previous studies have argued that knowledge can be embedded in organizational culture, routines, processes, documents and individuals (Davenport and Prusak, 1998; Grant, 1996a; Grant, 1996b; Nelson and Winter, 1982; Spender, 1996a; Spender, 1996b). As knowledge-based resources are usually unique and socially complex, the KBV suggest that these assets may produce long-term competitive advantage (Alavi and Leidner, 2001). According to Kogut and Zander (1992), competitive advantage can be created through the creation, transfer and transformation of knowledge.

According to Grant (1996b) firms exist to integrate the specialized knowledge of their employees. Grant (1996b: 112; emphasis in original) calls for “dispensing with the concept of *organizational knowledge* in favor of emphasizing the role of the individual in creating and

storing knowledge.” The author argues that there are four coordination mechanisms through which firms integrate the specialist knowledge of their members: (i) rules and directives, (ii) sequencing, (iii) routines, and (iv) group problem solving and decision making. The coordination mechanisms depend on a common knowledge for their operation. The first three mechanisms efficiently integrate knowledge at a low communication and learning cost, however, the fourth mechanism requires more personal forms of integration. The more sophisticated the common knowledge among the team, the more efficient integration will be. However, Grant (1996b) claims that there is a trade-off between the breadth of knowledge and the level of common knowledge. Consequently, an increased breadth of knowledge, leads to decreased levels of common knowledge. Hence, for firms relying on the breadth of knowledge, the challenge lies in effectively integrating a number of different specialists.

Grant (1996b) suggests that the view of the firm as an integrator is helpful for the analysis of organizational capabilities. Organizational capability is defined as the outcome of knowledge integration (Grant, 1996a). According to this view, the capabilities of PSFs depend on the firms’ mechanisms of integration (Grant, 1996b). As knowledge and expertise of the PSF’s employees is used directly to serve clients, it must be integrated and managed to create value (Hitt et al., 2001). In order to integrate knowledge, these firms rely on organizing principles through which relationships among individuals, groups, and organizations are structured (Kogut and Zander, 1992; Løwendahl et al., 2001).

2.2 Professional service firms

The primary activity of the PSF is to create value for its clients through the application of expert knowledge (Empson, 2001a; Løwendahl, 2005). In order to create value for its clients, the PSF must be able to “attract, mobilize, develop and transform” the employees’ knowledge (Løwendahl et al., 2001: 912). This indicates that the PSF competes in two markets simultaneously, the *output market* for the services it provides to its clients, and the *input market* for its employees (Maister, 1997). Hence, the PSF is an economic institution where both client needs and employee requirements are intermeshed to form the basic functions of the firm (Løwendahl, 2005; von Nordenflycht, 2010). As “people and client relationships are the main assets of the PSF, dependence on these highly mobile and highly portable assets creates significant complexities in terms of how PSFs approach their client relationship and human resource management activities” (Empson et al., 2015: 3).

2.2.1 Characteristics of professional service firms

Von Nordenflycht (2010) states that previous studies on PSFs have, to a large extent, only defined the term *professional service firm* indirectly by, for example, presenting a list of firms that can be classified as PSFs. Thus, the author argues that explicit criteria are needed to describe what constitutes a PSF and suggests that the definition of PSFs should focus on the characteristics of these firms rather than on examples of specific firms and industries.

One of the few authors who has identified distinctive characteristics that define PSFs is Løwendahl (2005). Løwendahl (2005) singles out five characteristics that distinguish PSFs from more traditional firms, for instance manufacturing firms, in order to describe the uniqueness of PSFs. The first characteristic, *intangible inputs and outputs*, denotes that the

inputs, such as the knowledge and expertise of the employees, as well as the outputs, such as the production processes, are intangibles. *Interaction* implies that it is crucial to manage the interaction process with the individual client effectively in order to be able to develop solutions that satisfy the client. The following characteristic, *individual judgment and local solutions*, refers to the fact that PSFs are dependent on individuals who hold valuable expertise and the ability of retaining a close relationship with the clients. *Innovation* is a significant part of PSFs operations as these firms, in many cases, develop new solutions for each client. The last characteristic, *information asymmetry*, indicates that PSFs must always be one step ahead of their clients as they are hired because they possess unique expertise that is difficult for the clients to organize in-house.

Building on Løwendahl's (2005) work, von Nordenflycht (2010) has identified three central characteristics that are frequently associated with PSFs: knowledge intensity, low capital intensity, and professionalized workforce. The author claims that these characteristics have been denoted as distinctive characteristics in the literature (von Nordenflycht, 2010: 159). *Knowledge intensity* denotes that the PSF's outputs rely on a complex body of knowledge. Thus, the PSF is dependent on knowledgeable and skilled employees in order to produce outputs (von Nordenflycht, 2010). Two managerial challenges arise from knowledge intensity: (i) retaining and directing the intellectually skilled workforce (Greenwood and Empson, 2003), and (ii) assessing the quality of the individual expert's output, which is primarily challenging for the PSF's clients (Løwendahl, 2005). *Low capital intensity* indicates that a PSF's production primarily involves the firm's human assets (von Nordenflycht, 2010). This characteristic has two significant implications: (i) it increases the individuals' bargaining power, as the employees' knowledge and expertise is crucial for the production of outputs (Teece, 2003), however, in contrast, (ii) it reduces the need for external capital, which allows the PSF to better handle the challenges resulting from knowledge intensity as it can "adopt more autonomy and informality to better satisfy employee preferences" (von Nordenflycht, 2010: 162). According to Torres (1991), there are three features that characterize a profession: a particular knowledge base, regulation and control, and ideology. The last characteristic, *professionalized workforce*, encompasses the two latter features: self-control and ideology (von Nordenflycht, 2010). The managerial challenges stemming from a professionalized workforce are: (i) the individuals' preference for autonomy (Alvesson and Kärreman, 2006), (ii) the professionals' resistance against organizational forms that threaten the interest of their clients (Løwendahl, 2005), and (iii) muted competition, which refers to barriers of entry to the occupation and professional codes that prevent competition (von Nordenflycht, 2010).

Empson et al. (2015), building on Løwendahl (2005) and von Nordenflycht (2010), define a PSF according to four characteristics: primary activity, knowledge, governance, and identity. *Primary activity* centers on the fact that PSFs apply specialist knowledge in order to create customized solutions to their clients' problems. The intensive interaction between the professionals and their clients distinguishes PSFs from other types of firms. According to Empson et al. (2015) customization is one of the central concepts in the definition of a PSF; it is from this concept that the three additional characteristics flow. The second characteristic, *knowledge*, includes the professionals' specialist technical knowledge, and their in-depth knowledge of clients. The concept of knowledge includes expertise and know-how in addition

to the knowledge that firms and individuals develop about their clients over time. The combination of these two types of knowledge leads to the co-production of knowledge with the clients (Faulconbridge, 2015; Fincham, 2006). The third characteristic, *governance*, focuses on the fact that professionals within PSFs require extensive levels of individual autonomy, which is linked to low levels of managerial authority and intervention. The last characteristic, *identity*, denotes that the individuals within a PSF view one another as professionals and are viewed as such by their clients and competitors. Thus, the PSF is an important site where “professional identities are mediated, formed and transformed” (Cooper and Robson, 2006: 416). Empson et al. (2015) claim that only if a firm possesses all four defining characteristics can it be called a PSF in the fullest sense.

2.2.2 Heterogeneity across professional service firms

In order to illustrate the heterogeneity across professional service firms, von Nordenflycht (2010) proposes a taxonomy of four types of PSFs. *Classic PSFs* is the first category of knowledge-intensive firms; these firms have the highest degree of professional service intensity, and they meet the three characteristics of knowledge intensity, low capital intensity, and professionalized workforce. *Professional Campuses* differ from the first category by being more capital intensive. The third category, *Neo-PSFs*, is different from *Classic PSFs* as it has a non-professionalized workforce. *Technology Developers* meet only one of the three characteristics, knowledge intensity, and have the lowest degree of professional service intensity.

Von Nordenflycht (2010) argues that prior research on PSFs has mainly focused on a narrow set of firms, which can unambiguously be defined as PSFs, such as law firms or accounting firms. However, the taxonomy presented above illuminates the “multiple sources of PSF distinctiveness” (von Nordenflycht, 2010: 156). In line with this, Løwendahl (2005) claims that it is important to note that PSFs differ substantially from one and other. PSFs vary both among and within professional service industries in a number of respects, including size, maturity, industry characteristics, and flexibility, which are a result of past behaviors and present strategic priorities (Løwendahl, 2005). However, prior research has primarily focused on distinguishing PSFs from more traditional firms. Malhotra and Morris (2009: 896) argue that “the notion of similarity or homogeneity predominates much of the organization studies literature on professional service firms.” In order to understand the organization and management of PSFs, it is important to identify both sources of homogeneity and heterogeneity (von Nordenflycht et al., 2015). Von Nordenflycht et al. (2015) identify knowledge intensity and customization as the sources of homogeneity, however, as the common characteristics of PSFs have been discussed in Section 2.2.1, this section will focus on the heterogeneity across PSFs.

According to von Nordenflycht et al. (2015), there are three sources of heterogeneity that have organizational implications for PSFs: (i) definitional heterogeneity, consisting of professional jurisdiction and professional ideology; (ii) non-definitional heterogeneity, containing the nature of knowledge, the degree of client capture, the degree of face-to-face client interaction and capital intensity; and (iii) heterogeneity within an industry comprising firm size and firm strategy. The characteristics of professional jurisdiction and professional ideology define the increasing degrees of professional service intensity (von Nordenflycht, 2010). *Professional*

jurisdiction refers to the exclusive control or claim over the application of an area of knowledge in a certain domain (Abbott, 1988). It involves the formation of institutions that accredit members, the establishment of standards of professional behavior, and disciplinary control over members (von Nordenflycht et al., 2015). The second characteristic *professional ideology* is related to a set of norms, such as the preference for autonomy and the responsibility to protect the interests of clients; the norms pertain to both ethical codes and preferences developed during professional training (Alvesson and Kärreman, 2006; Leicht and Lyman, 2006; Løwendahl, 2005).

Non-definitional sources of heterogeneity stem from two streams of literature; the characteristics of the nature of a knowledge base and the degree of client capture stem from the sociology of professions literature; and the degree of face-to-face client interaction and capital intensity stem from management and organizations literature (von Nordenflycht et al., 2015). Malhotra and Morris (2009) argue that the differences in the *nature of knowledge* affect how professional work is conducted and, consequently, also the organization of PSFs. Building on Halliday (1987), the authors differentiate between three types of knowledge: (i) normative knowledge, concerned with matters of value; (ii) technical knowledge, concerned with matters of fact; and (iii) syncretic knowledge, combining both normative and technical knowledge. *Client capture* denotes the degree to which the process of production of professional services, such as cost, timing, and delivery, can be controlled or influenced by clients (Dinovitzer et al., 2015; Greenwood et al., 2005). The third characteristic, *the degree of face-to-face client interaction*, is tied to the characteristic of customization as interaction is an important part of delivering customized services (von Nordenflycht et al., 2015). However, there is variation among PSFs regarding the importance, degree and frequency of face-to-face interaction (Malhotra and Morris, 2009). The characteristic of *capital intensity* refers to the extent to which the PSF's production involves significant amounts of non-human assets (von Nordenflycht et al., 2015). As abovementioned, von Nordenflycht (2010) argues that a PSF's production primarily involves the firm's human assets, however, recent studies have illustrated that there is also heterogeneity in the degree of capital intensity (e.g. von Nordenflycht et al., 2015).

Firm size is regarded as one of the sources of heterogeneity within an industry (von Nordenflycht, 2011; von Nordenflycht et al., 2015). The authors argue that the variation in size among PSFs within an industry drives the variation in the characteristics of the degree of client capture and capital intensity. A high degree of client capture occurs when PSFs are dependent on a few clients, which is more common for smaller firms. As firms grow, they adapt to changes in scale and scope, as adding scale and scope "tends to increase the amount of 'non-producing' overheads – office expenses and personnel that do not directly generate client revenue." This leads larger firms to be more capital intensive (von Nordenflycht et al., 2015: 152). Finally, the characteristic of *firm strategy* refers to two strategic choices made by PSFs: (i) the nature of work they pursue, and (ii) the geographic and functional scope (Maister, 1997). Through a study of the effects of human capital on the diversification strategy of law firms, Hitt et al. (2001) found that human capital is useful when implementing service and geographic diversification. The "positive moderating effect of human capital on strategy-performance relationships, [suggests] that the prestige of partners, their tacit knowledge gained through experience, and their social capital can be helpful in the implementation of their firm's strategy" (Hitt et al.,

2001: 23). However, the authors claim that the simultaneous implementation of service and geographic diversification requires significant coordination.

2.2.3 Neo-professional service firms

This thesis argues that the TEC firms addressed herein can be classified as neo-PSFs. According to von Nordenflycht (2010), neo-PSFs are characterized by knowledge intensity and low capital intensity. The author argues that two managerial challenges arise from knowledge intensity. The first challenge relates to the problem of retaining and directing skilled employees (Greenwood and Empson, 2003). The second challenge regards opaque quality, which refers to cases where the quality of an individual expert's output is difficult for the PSF's clients to assess (Løwendahl, 2005; von Nordenflycht, 2010). This challenge brings about the need for firms to signal quality to their clients (von Nordenflycht, 2010). The second characteristic of low capital intensity indicates that a firm's production mainly involves human assets, which increases the individuals' bargaining power (von Nordenflycht, 2010). Von Nordenflycht (2010) argues that low capital intensity coupled with knowledge intensity creates a situation where there is no guarantee that the human assets will come back to work the following day. Thus, in this situation, it is critical to maintain effective development and employee retention methods to ensure that the employees remain with the firm.

2.2.3.1 Developing and directing skilled employees

The PSF relies on the skills and experience of its employees to generate output, hence, a PSF's performance is highly dependent on its human capital (Swart and Kinnie, 2010). Pennings et al. (1998: 426) define the human capital of PSFs as "knowledge and skills of its professionals that can be used to produce professional services." Empson et al. (2015) claim that the fact that the individuals employed by PSFs are highly mobile assets impacts the PSFs approach to human resource management. In addition, directing skilled employees is found to be problematic in PSFs as these individuals have a strong preference for autonomy (Empson et al., 2015; Lorsch and Tierney, 2002; Teece, 2003). In order to circumvent this problem, Malhotra et al. (2006) argue that PSFs should focus on guiding and persuading their employees rather than commanding them to perform certain tasks.

Previous literature has illustrated that PSFs have taken different approaches to managing their human resources. This thesis identifies two models that resemble the approaches used to manage human resources in TEC firms: (i) the expertise-oriented system (Doorewaard and Meihuizen, 2000), and (ii) the centripetal model (Swart et al., 2015). However, it is important to note that these models are not a perfect fit to the approaches used by the studied TEC firms. The two approaches will be elaborated below.

Doorewaard and Meihuizen (2000: 47) have pointed out that "[e]xpertise orientation requires creative and innovative competences in order to find solutions to unprecedented problems and to derive from these solutions new procedures for similar problems in the future." The culture and image of an expertise-oriented firm are important selling points both for the output and the labor market. The corporate culture encourages individual professionals to develop a personal reputation and an own way of dealing with client problems. This approach focuses on mobilizing the employees and requires outcomes of creativeness and entrepreneurship, which

influences the way work is structured. The professionals perform their tasks in temporary and flexible project-teams, in which they have the autonomy to deliver customized solutions for their clients. Recruitment and selection practices in expertise-oriented firms rely on formal and informal talent assessments, such as personal references, the professionals' informal networks, and creativity tests. Training in such firms is considered to benefit both the organization and the professionals. Training and development practices are based on general training programs, such as internal courses intended both for junior and senior professionals, which are complemented by coaching and mentoring of junior professionals by senior mentors. During these programs, junior professionals learn *tricks of the trade* from their senior mentors, and the seniors benefit from the exchange of fresh ideas and experience. The aim of these initiatives is to widen and deepen professional expertise and experience to meet market demands. Expertise-oriented PSFs do not rely on long-term employment relationships, thus the level of employee turnover is relatively high. The focus lies on a *grow or go* principle that only leaves room for top expertise in which the professionals follow an internal career path to the top or leave the firm. However, the professionals that leave are offered the help they need by the PSF, such as assistance in starting their own firm or the permission to take over some of the PSF's clients. This is not the case for the studied TEC firms, they have not adopted the *up or out* approach to careers. Several workers employed by these firms have worked in mid-level and expert roles without becoming managers. Thus, the career systems employed by the TEC firms are surprisingly flat, which differs sharply from the conventional, quite hierarchical models adopted by other PSFs (Doorewaard and Meihuizen, 2000).

The focal point for the human resource management practices of the centripetal model is within the boundaries of the firm (Swart et al., 2015). The model centers on retaining valuable human capital. In other words, resourcing is value-driven and focuses on the professional's potential and previous expertise. In order to encourage experimentation and future development in addition to stimulating innovation, the PSF offers broad job designs and rotation of roles between client assignments. The training and development initiatives focus on developing firm-specific skills; emphasis is on maintaining generalist, architectural, and specific domain knowledge. In addition, in order to build institutional trust, the PSF organizes informal knowledge-sharing events where professionals can discuss professional skill development and client experience. In the centripetal model, the performance management systems are linked to the culture and values of the firm. The main client contact in the centripetal model is between senior professionals and the client. This is not the case for the studied TEC firms, in the majority of TEC firms, both junior and senior professionals engage in close client interaction. The centripetal model is associated with cooperative internal social capital, such as the sharing of knowledge between teams, and entrepreneurial external social capital, as the clients do not have direct influence on which professionals will be working on their accounts.

2.2.3.2 Managing client relationships

The second managerial challenge of opaque quality brings about the need for firms to signal quality to their clients (von Nordenflycht, 2010). PSFs are dependent on having client relationships (Broschak, 2015). Previous studies have illustrated that PSFs are knowledge-intensive organizations consisting of professionals who deliver customized services to their

clients (Fosstenlökken et al., 2003; Løwendahl, 2005; von Nordenflycht, 2010). In addition to this definition, it is important to mention that the output of PSFs is intangible, and the professional services are co-produced through interaction with client firms (Løwendahl, 2005). Hence, client relationships are crucial for the viability of PSFs (Broschak, 2015). Skjølsvik et al. (2007) argue that when selecting clients and developing client relationships, PSFs should focus on long-term knowledge development and not only short-term benefits.

In order to develop an understanding of how PSFs are managed, it is important to comprehend the nature of their client relationships, as it indicates which features of the firm and behavior of professionals and managers contribute to success of client relationships (Broschak, 2015). Prior research argues that client relationships can either be relational or transactional. The dominant view has been that client relationships in PSFs are relational, as the output of the PSF is co-produced through the interaction between the PSF and the client firm (Løwendahl, 2005; Maister, 1997; Sharma, 1997). Relational client relationships are characterized as involving a long-term relationship built on trust and commitment and considerable interaction between the PSF and the client firm (Løwendahl, 2005). Transactional client relationships, on the other hand, are short-termed where price rather than commitment drives the relationship and where the client keeps the PSF at arm's length (Uzzi, 1997).

Malhotra and Morris (2009) claim that the nature of client relationships differs among different types of PSFs. The authors argue that PSFs differ based on the two aforementioned characteristics, client capture and the degree of face-to-face client interaction. Client capture refers to the extent to which the process of production can be controlled or influenced by the client firm (Greenwood et al., 2005). "Client capture is most likely to occur where the professional works for large corporate clients or important brokers in a network and is either dependent on maintaining good relations to secure further work or finds that the resource expertise of the client matches that of the professional adviser" (Malhotra and Morris, 2009: 915). The authors argue that the degree of client capture affects the pricing structure of the professional services; the higher degree of client capture, the bigger the client firm's influence on the pricing method for the professional's work. Malhotra and Morris (2009) compare law, accounting, and engineering consulting firms and conclude that engineering consulting firms have a higher degree of client capture than law and accounting firms, which indicates that they are prone to have fixed-fee pricing imposed by their clients. The second characteristic, the degree of face-to-face client interaction, affects the physical structure of the PSFs, such as the geographical dispersion of offices. The authors argue that engineering consulting firms require a higher degree of face-to-face interaction with their clients in the production process than law and accounting firms. This indicates that engineering consulting firms are more inclined to have widely dispersed permanent and temporary offices.

The nature of client relationships not only differs across PSFs but also within the same industry (von Nordenflycht et al., 2015). Nikolova et al. (2009) identify three different models of client-consultant interaction: (i) the expert model, (ii) the critical model, and (iii) the social learning model. *The expert model* is associated with the assumption that professionals solve client problems with the help of scientific theories and techniques. Within this model, the consultant is seen as an expert who is responsible for diagnosis and problem-solving (Nikolova et al.,

2009). The consultant holds a position of power in the client-consultant relationship, as he/she possesses abstract knowledge that is superior to the client's specific knowledge. Hence, the role of the client is primarily one of information provider. *The critical model* takes a skeptical view, and emphasizes that the professional expert's knowledge is socially constructed rather than objective and dependent on legitimacy through the articulation of a specific, yet ambiguous, metaphorical and context-dependent language (Alvesson, 1993; Alvesson, 2001). The consultant's role is that of an impression manager or a storyteller, who tries to persuade the client through the use of management rhetoric, which leaves the client as a passive actor who is not capable of evaluating the actions of the consultant (Nikolova et al., 2009). The final model, *the social learning model*, views both consultants and clients as important and active players in the problem-solving process. Hence, there is a balanced relationship in this model, where both parties have valuable knowledge to contribute to the diagnosis of client problems and the generation of solutions to the problems. In such client-consultant relationships it is important to develop effective communication and a shared meaning and understanding (Schein, 1999; Schön, 1983). Nikolova et al. (2009) argue that although the three models have previously been viewed as independent models, most client-consultant relationships contain elements of all three models.

2.3 Knowledge management in professional service firms

PSFs rely almost exclusively on highly mobile knowledge-intensive human assets for generating firm performance (Teece, 2003; von Nordenflycht, 2010). Consequently, an important strategic concern for PSFs is the management of knowledge. Knowledge management involves the processes of creating, storing, transferring, and applying knowledge (Alavi and Leidner, 2001). Previous studies have illustrated that performance can be improved by introducing knowledge management (Lara et al., 2012). However, Mawdsley and Somaya (2015) claim that there is a need for deeper understanding of the particular knowledge management mechanisms that underlie PSFs' capabilities and performance. The authors argue that prior research concerning knowledge management in non-partnership PSFs, such as public or private corporations, has been scarce.

Faulconbridge (2015) argues that in order to understand how PSFs are organized and managed, there is a need to analyze the characteristics of knowledge and learning in PSFs. The author claims that three questions are relevant to ask in order to discern the nature of knowledge and learning in PSFs: (i) what form does knowledge take in PSFs? (ii) what is the relationship in PSFs between organizational and individual knowledge? and (iii) how can PSFs generate the conditions for new expertise to emerge? (Faulconbridge, 2015: 428)

The first question requires that attention be paid to the relationship between data, information, and knowledge in order to gain a deeper understanding of how knowledge might exist and be developed within PSFs (Faulconbridge, 2015). In other words, the distinction between "know what" and "know how" is relevant in answering the first question. "Know what" is related to the knowledge that graduates bring to the PSF through their accredited qualifications, while "know how" concerns the knowledge that the professional has accrued through experience of working with the production and delivery of services and can be likened to expertise (Faulconbridge, 2015). This distinction corresponds strongly with the distinction between

explicit and tacit knowledge (Tywoniak, 2007). Explicit knowledge is objective and, therefore, can fairly easily be articulated (Nonaka and Takeuchi, 1995). It can be expressed in words and numbers, and it is codified and transferred through, for example, hard data, procedures, and universal principles (Nonaka, 1994; Nonaka and Takeuchi, 1995). Tacit knowledge, on the other hand, is personal and rooted in an individual's actions, making it hard to formalize (Nonaka, 1994; Nonaka and Takeuchi, 1995). Thus, "we know more than we can tell" (Polanyi, 1966: 4). Nonaka (1994) argues that tacit knowledge can be transferred through the interaction between individuals; however, the success of the transfer rests on the individuals' shared experience. Moreover, previous studies have indicated that tacit knowledge can be articulated through the use of metaphors and storytelling (Ambrosini and Bowman, 2001; Nonaka, 1994). Tsoukas (1996), however, argues that tacit and explicit knowledge should not be viewed as two distinct types of knowledge. The author claims that tacit knowledge is a prerequisite for the use of explicit knowledge.

The second question relates to the extent to which a PSF can create a competitive advantage in a market by capturing, commoditizing, and reusing knowledge (Faulconbridge, 2015). PSFs rely heavily on the "know how" of the individuals employed by the firms. Hence, PSFs are dependent on the retention of key individuals and their tacit expertise. However, PSF characteristics, such as knowledge intensity and low capital intensity, create a situation where the assets of PSFs go down the elevator at the end of the day, and the firms cannot control whether they come back, which renders such organizations fragile (Løwendahl, 2005; Maister, 1997; von Nordenflycht, 2010). In order to reduce this fragility, it is important for PSFs to create organizational assets out of individualized tacit knowledge, though there are significant uncertainties regarding whether PSFs can accomplish this (Faulconbridge, 2015). Prior research has, however, indicated that individual skills can be transformed to collective knowledge by creating policies which facilitate individuals to transfer knowledge within the firm (Fosstenløkken et al., 2003; Løwendahl et al., 2001). Robertson et al. (2003) illustrated that collective identity can be used as a means to take advantage of the individual expertise and transform it to an organizational resource. Through a study of knowledge creation in consulting firms, Robertson et al. (2003: 853) found that "[m]anagers focused on developing a collective social identity grounded in elitism (and, therefore, in the identity, status and reputation of individual consultants), thus unlocking and leveraging individual creativity as an organizational resource."

The final question is related to the two distinctive perspectives that exist in the knowledge management literature (e.g. Cook and Brown, 1999; Empson, 2001b; Werr and Stjernberg, 2003). The perspectives are often referred to as the objectivist perspective and the practice-based perspective (Hislop, 2013). The objectivist perspective, also denoted as "the epistemology of possession," regards knowledge as a commodity that people possess, where the transfer of knowledge is governed by an internal market (Cook and Brown, 1999; Davenport and Prusak, 1998; Szulanski, 1996). This has been the dominant perspective in the knowledge management literature (Schultze and Stabell, 2004). The practice-based perspective is denoted as "the epistemology of practice," as human activity is central to its conception of knowledge (Cook and Brown, 1999). Within this perspective, knowledge is regarded as something people do, rather than something that they possess (Blackler, 1995). This perspective on knowledge

has been influenced by research on communities of practice and learning in practice (Brown and Duguid, 1991; Lave and Wenger, 1991). The practice-based perspective suggests that knowledge develops from practice i.e. by conducting activities and gaining experience (Brown and Duguid, 1991). Blackler (1995: 1032) claims that:

[I]t is a mistake to assume that embodied, embedded, embrained, uncultured and encoded knowledge can be sensibly conceived as separate from each other. Knowledge is multi-faceted and complex, being both situated and abstract, implicit and explicit, distributed and individual, physical and mental, developing and static, verbal and encoded.

Although, the two perspectives have been seen as two distinctive views of knowledge, previous research has demonstrated that they should not be seen as substitutes for one and other but rather be viewed as complimentary (e.g. Haas and Hansen, 2007; Werr and Stjernberg, 2003). However, it is important to understand the distinction between the two perspectives as they dictate how PSFs can engage in knowledge management and create a context in which collective learning and innovation can flourish (Faulconbridge, 2015).

2.3.1 Knowledge transfer

Knowledge transfer is denoted as one of the core knowledge processes in the knowledge management literature (von Krogh et al., 2001). Prior research has indicated that firms need to transfer and acquire new knowledge in order to sustain competitiveness (Kogut and Zander, 1992). Von Krogh et al. (2001: 421) claim that “in the knowledge economy a key source of sustainable competitive advantage and superior profitability within an industry is how a company creates and shares its knowledge.” Knowledge transfer is particularly interesting to study within the context of PSFs, as knowledge is considered both the input and the output of such firms (Empson, 2001b; Løwendahl, 2005; Maister, 1997). Thus, knowledge transfer is central for the existence of PSFs.

In line with Yakhlef (2010: 42), knowledge transfer in this thesis is viewed as “a dynamic, interactive process of translation and negotiation of meaning between individuals bringing to the table different forms of knowledge and understandings.” Knowledge transfer has been labeled in alternative but related ways in prior literature (van Wijk et al., 2008). Studies have used labels such as knowledge sharing (Hansen, 1999; Tsai, 2002) and knowledge flows (Gupta and Govindarajan, 2000; Schulz, 2001). Knowledge transfer has been studied within various contexts, such as groups (Argote and Ingram, 2000; Kane et al., 2005), networks (Guechtouli et al., 2013; Inkpen and Tsang, 2005), projects (Cacciatori et al., 2012; Landaeta, 2008), and strategic alliances (Mowery et al., 1996; Simonin, 1999). Prior research has demonstrated that knowledge transfer can occur through a range of mechanisms, such as communication (Levine et al., 2000; Stasser et al., 2000), personnel rotation (Kane et al., 2005), and training (Moreland and Myaskovsky, 2000; Thompson et al., 2000).

The transfer of tacit and explicit knowledge is regarded as fundamentally different. The objectivist perspective prefers explicit over tacit knowledge. Consequently, its knowledge transfer models are primarily occupied with the transfer of explicit knowledge. “From the objectivist perspective, the easy transferability of explicit knowledge represents one of its

defining characteristics” (Hislop, 2013: 26). Knowledge is primarily captured and transferred through information technology or information systems. This view has been referred to as the IT perspective (Hislop, 2013). The practice-based perspective takes a human perspective and centers on the idea that knowledge is socially embedded and transferred through a dialog between individuals (Hislop, 2013; Kalling and Styhre, 2003). “[P]actice-based theories adopt a more holistic, constructionist position in which the various elements of thinking, doing and being, and the social, cultural, historical and material settings within which they are actively situated, are conceived in relationships of co-constitution” (Marshall, 2008: 414). Knowledge transfer, according to this perspective, involves two people constructing meaning (Hislop, 2013). Bolisani and Scarso (2000) refer to knowledge transfer as a “language game,” as dialogue and language are crucial within such a process. The acquisition and transfer of knowledge within the practice-based perspective occurs through two interrelated processes: (i) immersion in practice, e.g. on-the-job learning; and (ii) social interaction (Gherardi, 2000; Lam, 1997; Lam, 2000).

Knowledge transfer, both from internal and external sources, has been found to contribute to organizational performance (Argote and Ingram, 2000; Darr et al., 1995; Galbraith, 1990; Steensma and Lyles, 2000; Szulanski, 1996; van Wijk et al., 2008). However, Argote (1999) argues that effective knowledge transfer can be difficult to achieve. Previous research has identified several factors that can hinder knowledge transfer, such as (i) knowledge tacitness (Teece, 1986), (ii) knowledge embeddedness (Kogut and Zander, 1992), (iii) knowledge ambiguity (van Wijk et al., 2008), (iv) low absorptive capacity (Cohen and Levinthal, 1990), and (v) lack of trust (Levin and Cross, 2004). Tacit knowledge has been found difficult to transfer as this type of knowledge is rooted in practice and, thus, cannot be fully articulated (Nonaka, 1994; Nonaka and Takeuchi, 1995; Polanyi, 1966; Teece, 1986). Embedded knowledge can hinder the transfer of knowledge as it is highly context-specific (Kogut and Zander, 1992). Prior research has indicated that knowledge can be embedded in individuals, tools, and routines (Argote and Ingram, 2000; McGrath and Argote, 2001; Szulanski, 1996; Walsh and Ungson, 1991). Knowledge ambiguity is “the inherent and irreducible uncertainty as to precisely what the underlying knowledge components and sources are and how they interact” (van Wijk et al., 2008: 833). Knowledge ambiguity has, in this manner, been identified as a major obstacle for effective knowledge transfer within as well as among organizations (Szulanski, 1996; van Wijk et al., 2008). The literature has also demonstrated that differences in the content of a knowledge base may lead to difficulties in transferring the knowledge. “Recipients might be unable to exploit outside sources of knowledge” (Szulanski, 1996: 31), resulting from a lack of absorptive capacity. Absorptive capacity is largely a function of the recipient’s prior knowledge (Cohen and Levinthal, 1990; Szulanski, 1996). Trust has been found to increase knowledge transfer (Dirks and Ferrin, 2001; Levin and Cross, 2004), as “it reduces apprehension about the veracity of knowledge, thereby, diminishing the tendency to question the knowledge’s accuracy” (Argote et al., 2003: 577). Previous studies have indicated that trust increases individuals’ willingness to share useful knowledge (Andrews and Delahaye, 2000; Tsai and Ghoshal, 1998) as well as absorb new knowledge (Carley, 1991; Mayer et al., 1995).

2.3.1.1 Strategies for knowledge transfer

PSFs must strive to develop strategies for managing knowledge transfer in order to make the most of their knowledge assets (Criscuolo et al., 2007). However, the impact of knowledge transfer on performance depends on individual, organizational, and environmental characteristics (Levine and Prietula, 2012). In line with this, Morris and Empson (1998: 620) argue that “a variety of knowledge management strategies coexist within the professional services sector. The choice of knowledge management strategy will be influenced by the nature of the knowledge base which underlies the professional service and how that firm is positioned in its specific sector.” Haas and Hansen (2005) argue that contrary to the belief that the utilization of knowledge resources leads to better performance, utilizing knowledge can, in certain instances, in fact hamper performance. The authors demonstrate that the utilization of knowledge resources is strongly situationally dependent and that it varies according to the needs of the focal task unit. Hence, Haas and Hansen (2005: 20) claim that “the focus should be less on how much firms know than on how they use what they know.” Consequently, knowledge management approaches should be selected carefully, as their value depends on the situation (Haas and Hansen, 2005).

Hansen et al. (1999) argue that professional service firms, more specifically management consulting firms, employ two distinct strategies for managing knowledge transfer: the codification strategy and the personalization strategy. The first strategy, *codification*, centers on IT, and it is mainly used by organizations who deliver standardized solutions to their clients (Hansen et al., 1999). In these settings, knowledge can be articulated, codified, and disseminated to other members of the organization through databases. The *personalization* strategy, on the other hand, demands the use of tacit knowledge (Hansen et al., 1999). This strategy centers on the generation of new knowledge, which requires interaction among knowledgeable individuals. Organizations utilizing this strategy provide their clients with highly customized solutions to unique problems. Hansen et al. (1999) claim that it is crucial for organizations to pursue only one of these strategies, as organizations trying to implement both strategies simultaneously risk failing at both. Based on a study of knowledge codification in audit and consulting firms, Janicot and Mignon (2012) found that the codification strategy improves value regarding the time taken to complete services. These improvements can be attributed to knowledge bases and the use of interactive technology. However, the authors argue that the extent of the improvements depends on the type of IT used and the industry in which the PSF operates.

Contrary to Hansen et al. (1999), Werr and Stjernberg (2003) claim that closer attention should be paid to the relations between tacit and explicit knowledge in understanding knowledge management in management consulting firms. Based on their analysis of the knowledge systems present in two management consulting firms, the authors have identified three interrelated knowledge elements: methods and tools, cases, and experience. *Methods and tools* and *cases* are characterized by explicit organizational knowledge that is made available to others through electronic knowledge management systems. Although, these two knowledge elements rely on the same type of knowledge, it is important to note the differences between them. Methods and tools have a broad application area, as they produce general knowledge.

Moreover, methods and tools provide the organization with a common language. Cases, in contrast, are tied to one specific setting, making their general applicability limited. Werr and Stjernberg (2003) have found that cases make highly individual knowledge available to an organization. In combination with discussion, cases transfer portions of the tacit knowledge, required to create a solution, to other consultants. *Experience* is characterized by tacit individual knowledge, and it is transferred through extended face-to-face interaction. Werr and Stjernberg (2003: 895) conclude that “each knowledge element contributed to the overall knowledge system by leveraging the value of the other knowledge elements.” By providing a shared language, the methods and tools facilitate the exchange and codification of experience, whereas the cases produce narratives that contribute to the translation of general knowledge to specific cases. The authors state that the two explicit knowledge elements are reliant on the experienced consultant ability to translate them to the task at hand.

Similarly, Haas and Hansen (2007) argue that explicit and tacit knowledge should be viewed as complimentary with respect to knowledge transfer. Based on a study of 182 sales teams in a management consulting firm, the authors find that different types of knowledge affect task performance differently. Haas and Hansen’s (2007) findings indicate that codified means of knowledge transfer, such as using high quality electronic documents, improve work efficiency, but do not enhance the quality of the work. Whereas personalized means, such as drawing on advice from experienced colleagues, improves the quality of consultants’ work output, and signals competence to clients but does not save time. Thus, Haas and Hansen (2007) argue that the two knowledge types should not be viewed as substitutes for each other.

Through a study of management consulting firms, Powell and Ambrosini (2012) found that the firms implement multiple approaches to knowledge management, which enable them to target specific knowledge-related objectives. The pluralistic approach encompasses documented and undocumented knowledge and knowledge management tools that enable access to and the transfer of this knowledge. The authors argue that firms alter their approach to knowledge management based on contextual and learning-based reasons. In line with this, Powell and Ambrosini (2017) have emphasized the importance of the pluralistic approach while studying how management consultants choose between knowledge transfer alternatives and the factors driving their choices. The authors have found that the leadership and the consultants have different perspectives on the perceived value of different knowledge transfer approaches. Leadership emphasizes increased reach and rapid search, while the consultants find social networks to be superior. Powell and Ambrosini (2017) argue that the consultants base their decisions on the perceived benefits of the knowledge content and the estimated process costs. Thus, when choosing knowledge management tools, it is important to consider implementing multiple approaches as there might be differences in the motives for why some tools are used while others are not.

2.4 Labor mobility as a facilitator for knowledge transfer

McGrath and Argote (2001) identify three basic elements in which knowledge is embedded in organizations: members, tools, and tasks. These three elements are referred to as knowledge reservoirs by the authors, as the term reservoir implies that knowledge can be reused. Argote

and Ingram (2000) argue that knowledge transfer is achieved by moving knowledge reservoirs among units or by modifying them at a recipient side.

One knowledge reservoir is especially interesting for this thesis, namely *members*, as knowledge in PSFs, such as TEC firms, is highly individualized and embedded in individual members (Alvesson, 2000; Starbuck, 1992). Previous research has indicated that the mobility of knowledge workers among firms has important implications for organizational performance, given the potential for firms to gain human capital (Kacmar et al., 2006; Shaw et al., 2005), and benefit from inter-organizational learning (Rosenkopf and Almeida, 2003; Song et al., 2003).

Given that a number of the individuals employed by a PSF, such as technical consultants, perform their work in client organizations, it is important to understand the impact of mobility on knowledge transfer. Prior studies have argued that mobility is a powerful tool for facilitating knowledge transfer within and among organizational contexts (Galbraith, 1990), as individuals are able to transfer both tacit and explicit knowledge and alter it to better fit new contexts (Allen, 1977; Berry and Broadbent, 1987). The literature has found that labor mobility facilitates: (i) the transfer of human capital (Almeida and Kogut, 1999; Campbell et al., 2012a; Campbell et al., 2012b; Rosenkopf and Almeida, 2003; Song et al., 2003; Wezel et al., 2006); (ii) the transfer of social capital (Dokko and Rosenkopf, 2010), resulting in enhanced quality of client relationships (Somaya et al., 2008); and (iii) the transfer of knowledge back to source organizations through the development of new social ties (Corredoira and Rosenkopf, 2010).

However, several studies have found specific conditions under which labor mobility is most likely to result in effective knowledge transfer. Rosenkopf and Almeida (2003) have found that the more technologically similar the firms are, the less likely they are to draw on the others' knowledge stock. Similarly, Song et al. (2003: 361) argue that mobility is more likely to result in inter-firm knowledge transfer when: (i) the hiring firm is less path-dependent, (ii) the hired engineers possess technological expertise distant from that of the hiring firm, and (iii) the hired engineers work in noncore technological areas in their new firm.

It follows that the hiring of technical consultants could bring new knowledge to client organizations, but the extent to which the consultants leverage their prior knowledge may vary substantially based on the attributes of both the client organizations (Song et al., 2003) and the competence of mobile engineers (Borg and Söderlund, 2015a). Borg and Söderlund (2015a) argue that some technical consultants are better at taking advantage of the mobility inherent in their work situation; these mobile engineers view their work as knowledge transfer. They are competent in drawing on their experiences from prior and diverse problem-solving contexts, which enables them to bring new knowledge to the client organization (Borg and Söderlund, 2015a). In addition to bringing new knowledge to their current assignment and the client organization, these technical consultants continuously look for opportunities for acquiring new knowledge to broaden their repertoire of skills (Borg and Söderlund, 2015a).

2.5 Summary

Previous research has argued that it is important to identify sources of both homogeneity and heterogeneity to understand the organization and management of PSFs (von Nordenflycht et al., 2015). TEC firms are similar to other PSFs in a number of respects; they are characterized by (i) knowledge-intensity, (ii) low capital intensity, (iii) having a highly educated workforce, (iv) an emphasis on knowledge application and knowledge creation, and (v) a high degree of interaction with the client organization (Løwendahl, 2005; von Nordenflycht, 2010). However, there are a number of characteristics that distinguish them from the PSFs discussed in the literature. TEC firms do not have a professionalized workforce. Consequently, TEC firms cannot rely on strong jurisdictional control or social closure (Abbott, 1988; Malhotra and Morris, 2009). The engineering specialization has arisen out of several subspecialties, which has led TEC firms to expand their range of specializations. TEC firms have broadened their scope to better respond to technical and product complexity and have, consequently, accrued multi-disciplinary capabilities (Fosstenløkken et al., 2003; Malhotra and Morris, 2009) that enable their clients to tap into a much broader knowledge base and diverse expertise (Barley and Kunda, 2004; Hogan et al., 2011). The characteristic of jurisdictional control distinguishes TEC firms from other PSFs, such as law and accounting firms (Malhotra and Morris, 2009; von Nordenflycht et al., 2015). In addition to jurisdictional control, TEC firms differ from other PSFs based on the characteristics of client capture and the degree of face-to-face client interaction. TEC firms have a higher degree of client capture and require a higher degree of face-to-face interaction with their clients than classic PSFs, and this affects the pricing models of professional services and the geographical dispersion of offices (Malhotra and Morris, 2009). Finally, TEC firms differ from other PSFs due to the nature of the technical consultants' work. Technical consultants are assigned to work in client projects, and a large number work under the supervision of managers from the client organization (Barley and Kunda, 2006; Cappelli and Keller, 2013). In addition, technical consultants are involved in knowledge integration processes in client projects to a larger extent, as they work in complex development and engineering projects alongside engineers employed by the client organization as well as other consultants (Matusik and Hill, 1998; Nikolova et al., 2009; Söderlund and Bredin, 2011). This distinguishes them from, for example, management consultants.

In order to be able to produce professional services, PSFs must focus on the management of human capital along with relationships with clients and other network partners (Broschak, 2015; Swart et al., 2015), which are two central managerial challenges facing neo-PSFs, such as TEC firms (von Nordenflycht, 2010). TEC firms must be able to attract, recruit, develop, and mobilize technical consultants in order to create value for their clients (Doorewaard and Meihuizen, 2000; Løwendahl et al., 2001). They focus on retaining valuable human capital (Swart et al., 2015). While the focus of conventional career models adopted by PSFs lies on a *grow or go* principle (Doorewaard and Meihuizen, 2000), the career systems adopted by TEC firms are *flatter*. Developing close client relationships is crucial to be able to create value for clients in the context of technical consulting (Broschak, 2015). The nature of client relationships differs across PSFs (Malhotra and Morris, 2009). TEC firms have a higher degree of client capture than classic PSFs, such as law and accounting firms, which indicates that the TEC firms' clients have a greater influence on the pricing methods and are, consequently, more likely

to impose fixed-fee pricing (Malhotra and Morris, 2009). Moreover, as TEC firms require a higher degree of face-to-face interaction with their clients in the production process, they are more inclined to have a number of widely dispersed offices (Malhotra and Morris, 2009). The majority of the client relationships in TEC firms can be classified as the social learning model, where both the technical consultant and the client contribute to the problem-solving process (Nikolova et al., 2009). By fostering close client relationships, TEC firms enable their clients to more easily assess the quality of the individual consultant's output.

Prior research has indicated that organizational results can be improved through the use of knowledge management tools (Lara et al., 2012), making knowledge transfer crucial for PSF performance. This thesis argues that knowledge transfer in the context of technical consulting is a dynamic process (Yakhlef, 2010), facilitated through labor mobility, i.e. mobility among assignments, projects, client organizations, and industries. Hence, knowledge transfer in this context involves more complex processes of (i) developing knowledge by applying prior experience to new situations, and (ii) adapting and co-creating knowledge with clients. Hence, TEC firms must be able to create opportunities for intra-organizational knowledge transfer; this process can be enabled through organizational culture and human resource practices (Cabrera and Cabrera, 2005; Lam, 2005; Moreland and Myaskovsky, 2000). In addition, the TEC firms must be able to organize for the transfer of engineering knowledge among assignments, projects, client organizations, and industries (Malhotra, 2003). They must be able to facilitate the development of individual skills to take part in the knowledge integration processes in client projects (Söderlund and Bredin, 2011) by ensuring that technical consultants stay on the move in order to develop their competence. The success of knowledge transfer also rests to a great extent on the competence of the consultants (Borg and Söderlund, 2015a), as TEC firms rely on the knowledge of their employees to produce their outputs (Løwendahl, 2005; von Nordenflycht, 2010). In order to reap the benefits of their mobile and transient work situation and transfer knowledge within and among problem-solving contexts, consultants must be able to effectively enter new assignments, hand over completed assignments, and leave project teams and client organizations, as well as move among diverse problem-solving contexts where they take on new challenging assignments (Borg and Söderlund, 2014). Staying on the move is, therefore, critical for the success of knowledge transfer in this context.

In order to understand how TEC firms can achieve and maintain competitive advantage, it is important to investigate the organization and development of engineering knowledge to uncover the nature of TEC firm capabilities. This requires an understanding of the interaction between the organizational level and the individual level in the formation of capabilities (Felin and Foss, 2005; Felin et al., 2015; Foss and Pederson, 2016). Figure 1 summarizes this chapter by illustrating how organizational processes and individual skills interact to form capabilities in TEC firms.

Figure 1. Summary of the theoretical background.

Chapter 3

Methodology

This chapter presents and motivates the methodological choices, and describes the overall research process. The chapter begins with a description of the research approach chosen for this thesis. Thereafter, the research process, consisting of the four studies, is illustrated. The rationale for selecting the specific cases is subsequently described, in addition to a brief introduction to each case-study firm. Next, the two phases of the research process are presented. These phases portray the data collection methods used, and describe how the empirical material was analyzed. The chapter ends with an elaboration on how validity was established throughout the research process, and how this strengthens the trustworthiness of the findings of this thesis.

3.1 The research approach

According to Johnston (2014: 206), the research approach is influenced by ontological and epistemological assumptions. The ontological assumption that informs this thesis is founded on the view of reality as a social construction (Morgan and Smircich, 1980). Morgan and Smircich (1980: 494) argue that:

The social world is a continuous process, created afresh in each encounter of everyday life as individuals impose themselves on their world to establish a realm of meaningful definition. They do so through the medium of language, labels, actions, and routines, which constitute symbolic modes of being in the world. Social reality is embedded in the nature and use of these modes of symbolic action.

According to Hudson and Ozanne (1988), individuals construct meaning based on the context. In this thesis, I have been guided by these assumptions. For these reasons, the studies have been conducted in *natural* settings where it has been essential to grasp and understand the specific context at hand. This will be elaborated on in the following sections of this chapter.

Epistemology, i.e. the nature of knowledge, relies on a set of basic assumptions that concern the view of reality. However, according to Avenier and Thomas (2015), there is a lack of agreement among researchers on the classification of the epistemological frameworks utilized

within contemporary organization and management studies. Traditionally, scholars have made a distinction between positivistic and interpretivist approaches (Hudson and Ozanne, 1988; Johnston, 2014; Prasad and Prasad, 2002). The interpretivist approach is often considered to be based on the view of reality as a social construction (Gioia et al., 2012; Gioia and Pitre, 1990). Interpretivists comprehend individual truths and subjective meanings of the individuals in the studied contexts with an emphasis on *verstehen* as depicted by Weber (1947) or understanding. “The core idea of interpretivism is to work with [the] subjective meanings already there in the social world; that is to acknowledge their existence, to reconstruct them, to understand them, to avoid distorting them, to use them as building-blocks in theorizing” (Goldkuhl, 2012: 138).

Interpretivists consider that the best path to understanding is via the utilization of the human instrument (Hudson and Ozanne, 1988; Lincoln and Guba, 1985). I assume that the participants in the four studies encompassing this thesis are knowledgeable agents, and I view myself as a member of the social reality (Lincoln and Guba, 1985). Thus, my assumption is that the participants are capable of explaining their thoughts, intentions, and actions. My role as a researcher is to give an adequate account of the participants experience, by highlighting their interpretations (Gioia et al., 2012). As will be evident in the coming sections, my coauthors and I have not taken it upon ourselves to impose prior theories on the participants in order to explain their experience.

According to Goldkuhl (2012), an interpretive study requires a holistic understanding of the studied context. This thesis strives to create a holistic understanding of the studied context, which means studying both the organizational level and the individual level in order to gain a comprehensive picture of TEC firms. TEC firms rely on the knowledge and skills of their consultants to produce their outputs (Løwendahl, 2005; von Nordenflycht, 2010; von Nordenflycht et al., 2015), which indicates a tight coupling between the organizational level and the individual level. This will be discussed in more detail in the following sections. As opposed to pure interpretivists, who consider their findings purely idiosyncratic, my aim is to extract transferable concepts that allow the findings of this thesis to be applied to broader contexts (Lincoln and Guba, 1985). This will be discussed in Section 3.8.

3.1.1 A qualitative approach

The aim of this thesis is to investigate the organization and development of engineering knowledge and the roles of the TEC firm and the technical consultants in the transfer of knowledge among assignments, projects, client organizations, and industries. This makes the qualitative approach suitable for several reasons. First, this thesis seeks to illuminate an under-researched topic, making this research exploratory. A number of researchers claim that it is advantageous to use a qualitative research approach for exploratory aims (Creswell, 2007; Strauss and Corbin, 1998). Exploratory aims are “particularly well-suited to new research areas or research areas for which existing theory seems inadequate” (Eisenhardt, 1989: 549), which makes inductive theory building a suitable approach for this thesis (Eisenhardt and Graebner, 2007; Graebner et al., 2012). Second, this thesis strives to understand the organization and development of engineering knowledge in the context of technical consulting. According to Miles and Huberman (1994), qualitative research reveals the complexity within the context being studied, and it is favorable when studying processes. Finally, it is important to understand

the views and experiences of those participating in the study in order to analyze the roles of the TEC firm and the technical consultants in the transfer of knowledge among problem-solving contexts. Qualitative research gives the researcher the opportunity to grasp the experiences of the participants (Corbin and Strauss, 2008). In line with this, Strauss and Corbin (1998: 11) argue that “qualitative methods can be used to obtain the intricate details about phenomena such as feelings, thought processes, and emotions that are difficult to extract or learn about through more conventional methods.” Creswell (2009: 4) states that “qualitative research is a means of exploring and understanding the meaning individuals or groups ascribe to a social or human problem,” based on building a holistic and complex picture formed with words, which reports detailed views of informants and is conducted in a natural setting.

Based on a literature review of strategic management in PSFs in the period 1991-2015, Skjølsvik et al. (2017) found that the majority of articles published in the field adopted a qualitative approach, and that, since 2013, there has been a significant decline in quantitative articles. Graebner et al. (2012: 278) argue that qualitative data possess three characteristics that provide potential advantages over quantitative data: (i) qualitative data are open-ended, (ii) qualitative data can be concrete and vivid, and (iii) qualitative data are often rich and nuanced. The authors argue that these three characteristics permit qualitative data to capture details and mechanisms that cannot easily be captured by quantitative data.

By doing qualitative studies I have had the privilege to enter into the world of the participants (Corbin and Strauss, 2008). Thus, the qualitative research approach has allowed me to gain deeper insight into the field and satisfy my interests while conducting research (Tracy, 2012). However, this involvement can be problematic as it can lead to preconceptions (Alvesson and Kärreman, 2011). I have tried to remain sensitive to how my interpretations shape the findings of this thesis. One way is by allowing for alternative interpretations to emerge through a systematic research design (Whittemore et al., 2001). This will be elaborated on in Section 3.8. By entering into the world of the participants, I have had the possibility to gain an understanding of the organizational context, the organizational processes, the individuals’ work situation, and the advantages and challenges related to their work situation. This rich data provided me with the opportunity to discover new concepts, which can, in turn, lead to the advancement of existing theories. This I find intriguing. In addition to contributing to research, my ambition has been that the participants find the research process rewarding and learn from it.

3.1.1.1 A case study approach

This thesis builds on a case study approach. Many researchers advocate the use of a case study approach for gaining in-depth understanding of the context being studied (Eisenhardt, 1989; Eisenhardt and Graebner, 2007; Flyvbjerg, 2011; Yin, 2009). This approach is advantageous because it allows for a multifaceted description of the phenomenon under study (Flyvbjerg, 2006). Eisenhardt (1989: 534), for example, argues that this particular strategy of inquiry centers on “understanding the dynamics present within single settings.” According to Merriam (1994), case studies are favorable when studying practical problems – questions, situations, or challenges that occur in daily life. Moreover, Stake (1995) argues that the case study approach is advantageous when exploring programs, events, activities, processes, or individuals in depth, which is in line with the aim of this thesis. According to Stuart et al. (2002) case studies can

provide the means for refutation or extension of existing theories due to their observational richness, and should, thus, not only be viewed as a method appropriate for understanding. In addition, Siggelkow (2007) argues that case studies not only extend existing theories, but they also offer new perspectives on the world through empirical observations. This is what this thesis aims to do.

Case studies can be comprised of either single or multiple cases (Yin, 2009). This thesis comprises both a single-case study and a multiple-case study. A single-case study of a Scandinavian TEC firm is the basis for Papers I, III, and IV. Previous research has often pointed to the fact that single-case studies provide little basis for scientific generalization as they are too situation-specific, however, more recently, this specific characteristic of single-case studies has come to be regarded as an opportunity (Dubois and Gadde, 2002). According to Dubois and Gadde (2002) learning from a single case should be regarded as a strength rather than a weakness. An in-depth single-case study can develop valuable insights regarding the studied phenomenon. Consequently, the single-case study, herein, provided an in-depth understanding of how engineering knowledge is organized and developed in the context of technical consulting. In addition to the single-case study, this thesis builds on a multiple-case study of six TEC firms headquartered in Sweden, which is the empirical focus of Paper II. The multiple-case study design is frequently associated with a series of independent experiments that confirm or disconfirm emerging insights (Eisenhardt, 1991; Yin, 2009). The aim of the multiple-case study was to further explore the organization of engineering knowledge within TEC firms to discern similarities and differences among the firms. An advantage of the multiple-case study design is that it allows for a wider exploration of the research question(s), higher robustness, and a stronger base for theory building (Baxter and Jack, 2008; Eisenhardt and Graebner, 2007; Yin, 2009). However, Dyer and Wilkins (1991: 616) argue that in order for multiple-case studies do allow for deep conceptual insights, the researcher must be able to “understand and describe the context of the social dynamics of the scene in question to such a degree as to make the context intelligible to the reader and to generate theory in relationship to that context.” In order to gain a comprehensive understanding of the context being studied (Dyer and Wilkins, 1991), the multiple-case study extends the findings of the single-case study regarding the organization of engineering knowledge.

A multilevel approach

Case studies can employ a holistic design, covering a single level of analysis, or an embedded design, including multiple levels of analysis within one case study (Yin, 2009). Both the single-case study and the multiple-case study apply an embedded design, conducting research on two levels of analysis: the organizational level and the individual. Research has indicated that scholars interested in studying organizational capabilities and knowledge should devote more attention to enhancing the understanding of the interactions between the organizational level and the individual level, as the individuals' roles in affecting organizational advantages have been largely overlooked (Felin and Foss, 2005; Felin et al., 2015; Floyd and Sputtek, 2011; Foss and Pederson, 2016). This thesis aims to explore the relationships between the organizational level and the individual level to discover how engineering knowledge is organized, developed, and transferred in the context of technical consulting.

Previous studies claim that multilevel research in the management field has largely been quantitative (Felin et al., 2015; Foss and Pederson, 2016). Thus, they advocate the need for qualitative research for understanding multilevel phenomena (Hitt et al., 2007; Mathieu and Chen, 2011). In line with this, Foss and Pederson (2016) argue that the favored methods, i.e. quantitative methods, in the field of strategy are not suitable for capturing behaviors and interactions required for understanding microfoundations. An alternative method for empirical microfoundational research is small N case studies that are exploratory and can lead to new theoretical insights (Felin et al., 2015). However, a challenge might be that they are costly, as they require sampling on at least two levels of analysis (Foss and Pederson, 2016). Another challenge pertaining to qualitative research is the question of generalizability, since small N case studies are usually exploratory. However, this challenge can be turned into a strength, as small N case studies can provide an understanding of microfoundations by exploring the interactions between levels of analysis (Foss and Pederson, 2016), which this thesis aims to do. Finally, when conducting multilevel research, it is important to align the level of theory, i.e. the level at which one aims to provide theoretical insights, with the level of measurement, i.e. the level from which data was collected, and the level of analysis, i.e. the level at which data are analyzed (Rousseau, 1985). Research has indicated that this challenge pertains to quantitative research (Hitt et al., 2007; Mathieu and Chen, 2011), however, it is also relevant for qualitative research. This thesis has strived to develop a multilevel theory by exploring the relationships between the organizational level and the individual level. The data collected and analyzed pertaining to the organizational level spans multiple organizational levels, and builds on interviews with top managers, middle managers, and consultant managers. While the data concerning the individual level, has been collected through interviews and observations of technical consultants.

3.2 The research process

This thesis is based on four studies corresponding to the four papers of this thesis, appended in the second part of this thesis. The research process can be divided into two phases and four studies, as illustrated in Figure 2 below. Papers I, III, and IV are based on a single-case study of one TEC firm, while Paper II is based on a multiple-case study of six TEC firms.

Figure 2. The research process.

The first phase encompasses the three studies conducted in a Scandinavian TEC firm, presented in Papers I, III, and IV. The purpose of the first study “*Exploring the organization of engineering knowledge*” was to enhance the understanding of the organization of engineering knowledge in a TEC firm. The study consists of two interview studies, comprising interviews with managers on multiple organizational levels and interviews with technical consultants conducted in one of Scandinavia’s leading TEC firms. One of the main findings of this study was the identification of two capabilities, swift transition and knowledge cycling, which create the foundation for the organization of engineering knowledge in the context of technical consulting. These results are presented in Paper I.

The initial study sparked interest in investigating further how knowledge transfer in technical consulting is enabled by the mobility inherent in the technical consultants’ work situation, which resulted in Paper III. The aim of the study “*Exploring knowledge transfer in technical consulting*” was to explore how scheduled labor mobility facilitates knowledge transfer and knowledge development among problem-solving contexts. The study comprises interviews with managers and consultants, conducted during the first study, and follow-up interviews with senior consultants, working for one of Scandinavia’s leading TEC firms. Moreover, interviews were carried out with consultants who had participated in the firm’s introductory development program for newly graduated engineers, in addition to client representatives. This study develops the notion of knowledge cycling as a process, consisting of four phases, which facilitates knowledge transfer and knowledge development through scheduled rotation of consultants among problem-solving contexts.

During the process of writing Paper III, it became evident that formal training plays an important role in the process of knowledge cycling. Therefore, the study “*Exploring an*

introductory development program” was initiated, which resulted in Paper IV. The purpose of the study was to explore how a TEC firm develops its consultants to prepare them to deal with their mobile work situation. The study is based on observations as well as interviews carried out with the developers of, leaders of, and participants in the introductory development program (henceforth IDP). One of the main results of this study is the identification of three processes that enable the consultants to deal with their mobile and transient work situation and enhance their ability to transfer knowledge to and among problem-solving contexts.

The second phase of the research process encompasses the study based on the multiple-case study of six TEC firms: “*Exploring heterogeneity among TEC firms.*” The purpose of this study was to further investigate TEC firm capabilities and explore how these capabilities differ among TEC firms. The study builds on interviews with managers and consultants conducted during the first study. In addition, interviews were conducted with top managers, middle managers, consultant managers, and individual consultants working for five TEC firms. Moreover, interviews were carried out with experts and analysts. The study identifies four capabilities. It illustrates that the differences in these capabilities stem from the organizational processes of the firm and the individual skills of the technical consultants. Based on these differences the study identifies two ideal types of firms. These results are presented in Paper II.

Tables 1 and 2 below give an overview of the data collection process in the two phases of the research process. The first column in the tables depicts the methods used to collect the empirical material, and it specifies who the respondents were. The second column shows the total number of times an activity was carried out, for example the number of interviews conducted. The third column indicates how long each activity lasted. Finally, the last column illustrates who participated in collecting the data, as the four studies are based on joint collaboration with other researchers.

Activity	Quantity	Duration	Participating researcher(s)
Phase I: Single-case study			
Interviews			
Interviews with managers	20	45 minutes – 2.5 hours	S. Pantic-Dragisic, J. Söderlund & E. Borg
Interviews with consultants	20	1 – 2.5 hours	J. Söderlund & E. Borg
Follow-up interviews with senior consultants	4	1 – 3 hours	S. Pantic-Dragisic
Interviews with client representatives	10	1 – 1.5 hours	J. Söderlund & E. Borg
Interviews with developers of the IDP	3	1 – 2 hours	S. Pantic-Dragisic & E. Borg
Interviews with leaders of the IDP	4	1 – 1.5 hours	S. Pantic-Dragisic & E. Borg
Follow-up interviews with participants of the IDP	11	45 minutes – 1.5 hours	S. Pantic-Dragisic & E. Borg
Observations			
Observations of administrative meetings with leaders of the IDP	3 (13 participants)	2 – 4 hours	S. Pantic-Dragisic & E. Borg
Participant observations of the IDP	9 (36 participants and leaders in total)	5 hours	S. Pantic-Dragisic & E. Borg
Observations of the examination of the IDP	2 (24 participants and leaders in total)	8 hours	S. Pantic-Dragisic & E. Borg
Workshops			
Workshop with managers	1 (11 participants)	3 hours	S. Pantic-Dragisic & J. Söderlund
Workshop with managers involved in the IDP	1 (4 participants)	2 hours	S. Pantic-Dragisic & E. Borg

Table 1. Overview of the data collection process: Phase I.

Activity	Quantity	Duration	Participating researcher(s)
Phase II: Multiple-case study			
Interviews with experts and analysts	3	1 – 2 hours	J. Söderlund
Alpha			
Interviews with managers	20 ¹	45 minutes – 2.5 hours	S. Pantic-Dragisic, J. Söderlund & E. Borg
Interviews with consultants	20 ¹	1 – 2.5 hours	J. Söderlund & E. Borg
Beta			
Interviews with managers	3	1 – 1.5 hours	S. Pantic-Dragisic & J. Söderlund
Interviews with consultants	2	1 – 1.5 hours	S. Pantic-Dragisic
Gamma			
Interviews with managers	4	45 minutes – 2 hours	S. Pantic-Dragisic & J. Söderlund
Interviews with consultants	2	1 – 1.5 hours	S. Pantic-Dragisic
Delta			
Interviews with managers	4	45 minutes – 2.5 hours	S. Pantic-Dragisic & J. Söderlund
Interviews with consultants	2	1 – 1.5 hours	S. Pantic-Dragisic
Epsilon			
Interviews with managers	3	1 – 1.5 hours	S. Pantic-Dragisic
Interviews with consultants	2	1 – 1.5 hours	S. Pantic-Dragisic
Zeta			
Interviews with managers	3	1 – 2 hours	S. Pantic-Dragisic & J. Söderlund
Interviews with consultants	2	1 – 1.5 hours	S. Pantic-Dragisic

Table 2. Overview of the data collection process: Phase II.

¹ These interviews were conducted during the first study in Phase I.

3.3 Case selection

In the following sections, the rationale for selecting the case-study firms included in the single-case study as well as the multiple-case will be discussed.

3.3.1 Single-case study

Alpha was chosen as the empirical focus for a number of reasons. The first reason for choosing this specific TEC firm is that it is a highly successful firm in a market characterized by intense competition. Alpha is assuming an increasing responsibility for human resource management activities, such as recruitment, mentoring, competence development, job rotation, and retention. Alpha has invested a vast amount of resources in developing its employees to become the best technical consultants, not only with regard to engineering but perhaps more so as knowledge workers, knowledge integrators, and collective problem-solvers, to ensure that relevant knowledge and competence are sourced to its clients.

The focus on knowledge and learning was another important reason for choosing Alpha. During the last 15 years, the management of Alpha has been developing methods for the transfer of knowledge and experience in order to make problem-solving more effective. Writing as a means of reflection is at the heart of these methods. Throughout the internal competence development activities, the employees learn by reflecting on their work experiences through writing about and discussing these experiences with their coworkers. Thus, the majority of managers as well as consultants have practiced putting their work experiences into words. This is beneficial as they are used to reflect on how they perform their work, why they make certain decisions, and which consequences these decisions might have. This particular knowledge strategy makes Alpha an extreme example that offers possibilities for theorizing in new and interesting ways (Eisenhardt and Graebner, 2007; Siggelkow, 2007).

Finally, the last reason for studying Alpha is the managers' interest in this research project. Their enthusiasm and the general access to numerous people, to information, and internal documents within Alpha have benefited this study greatly. This provided ample opportunity to reach a comprehensive understanding of Alpha, which is critical in any well-grounded single-case study (Dyer and Wilkins, 1991).

3.3.2 Multiple-case study

The sampling method chosen for the multiple-case study was theoretical sampling (Eisenhardt and Graebner, 2007). The multiple-case study focuses on a selected number of major players within the TEC industry that are rich in information in order to explore the organization of engineering knowledge. The selected cases were chosen because of their potential to illustrate the question under study and their likelihood to offer theoretical insights (Eisenhardt and Graebner, 2007).

In addition, criterion sampling was used (Patton, 2002). The TEC firms were chosen on the basis of three criteria; (i) their turnover; it should be more than 500 MSEK, (ii) the number of employees; they should have more than 500 employees, and finally (iii) their length of activity in the TEC industry; they should have been active for a minimum of 20 years. These specific criteria were emphasized as the aim was to target TEC firms that were established and

successful in the TEC industry, had assumed responsibilities for human resource management, and had developed approaches for organizing engineering knowledge. Six TEC firms, headquartered in Sweden, were chosen. Three of the firms are active on the Scandinavian market, and the remaining three are active on the international market. Five of the firms are publicly traded, and one is privately held. The firms are successful in a highly competitive market. In order to ensure that relevant knowledge and competence are source to their clients, the TEC firms have taken on increasing human resource responsibilities for activities such as recruitment, rotation, and competence development.

3.4 The case firms

The following sections give an overview of the six case-study firms comprising this thesis. The case firms were anonymized, meaning that anonymity was offered to the participants. Thus, the firms will be referred to by pseudonyms.

3.4.1 Alpha

The sole empirical focus of Papers I, III, and IV was one of Scandinavia's leading TEC firms, headquartered in Sweden. In Paper II it represents one of the six TEC firms included in the multiple-case study. The firm is referred to by various pseudonyms throughout the different papers, in order to protect the authors' anonymity during the review processes. In Papers I and IV the firm is referred to as *Advanced Engineering*, in Paper III, it is denoted as *Swift Tech*, and in Paper II, it is called *Alpha*. The firm will be referred to as Alpha throughout this thesis.

Alpha has expertise in a wide range of areas such as information security, system integration, systems development, communications, mechanical engineering, logistics, and risk management. Alpha works both towards public and private clients, and it operates in a wide range of industries, such as aviation and defense, automotive, infrastructure, telecom, medical technology, environmental technology, as well as finance and banking. Alpha has grown considerably in recent years both through organic growth and acquisition, and 80 percent of the personnel have a master's degree in engineering. The majority of employees are men, although the share of female workers is steadily growing and has, today, reached about 25 percent. Most of Alpha's employees work in projects in client organizations, where they assume various resource, expertise, and specialist roles depending on client needs.

Continuous learning and competence development are embedded in Alpha's culture. Its mission is to meet client needs and develop people with a desire for learning. In order to fulfill this mission, the TEC firm has invested in a wide range of internal competence development activities. The emphasis on competence development helps Alpha attract talented engineers, which gives the firm an advantage over its competitors. Alpha has developed two competence development programs. The first program is directed towards senior consultants and project managers, and the goal is to learn from each other's experience. During the program, the participants build their professionalism and courage while learning from each other. The second competence development program is an introductory development program created for newly graduated engineers. The aim of the IDP is to make a participant a capable technical consultant faster. Throughout the program the participants increase their abilities to: (i) act independently in their assignments, and (ii) cooperate with colleagues in the client organizations. Moreover,

the IDP enhances consultants' understanding of the business operations within Alpha as well as at client sites. In addition to these competence development programs, the firm has a number of technological competence networks and internal courses to further strengthen and support on-the-job training.

Alpha provides innovative solutions to its clients through close client relationships. The firm provides support to its clients throughout the whole project chain, from studies, testing, and verification to training. As Alpha is active in a number of different industries, it contributes added value to its clients by actively transferring knowledge among client organizations and industries.

3.4.2 Beta

Beta provides professional consulting services within a wide range of areas, such as architecture, structural engineering, installation, infrastructure, water and environment, project management, energy, and IT. The firm works both towards public and private clients. Beta has grown considerably in recent years, and, today, 70% of its employees are male, and 30% are female. Moreover, the majority of the employees have a master's degree within areas such as engineering, architecture, or environmental studies. Beta has grown both organically and through acquisitions. It plans to continue to grow in this manner, as both types of growth are important for its value creation. The firm's ambition is be the most acknowledged multi-disciplinary TEC firm on the market.

The firm's goal is to offer its clients the best technological competence available on the market. In order to do that, Beta must be able to attract the brightest technological talents, as its employees work in and contribute to client projects. Furthermore, the firm provides both its newly graduated and experienced engineers with continuous competence development in order to keep their knowledge current. This is done through competence development programs, leadership development programs, and learning within client assignments. Thus, Beta creates value for their employees by aspiring to be the most attractive employer for engineers and architects, in addition to offering their employees possibilities for professional and personal development.

Beta is a strong competitor in the industry for technical consulting because it offers a wide range of different competence. This gives it an advantage, as clients want to hire TEC firms that can coordinate multiple disciplines. This trend in turn leads to greater consolidation of the industry. In order to make it easy for its clients to do business with Beta, the firm has chosen to focus on simplicity. It, therefore, utilizes a decentralized and customer-driven organizational structure. Beta delivers consulting services throughout their clients' project chain, from preliminary studies to design.

3.4.3 Gamma

Gamma specializes in a range of different areas such as communications, software development, and business critical IT. Gamma works with clients both within the public and the private sectors. The firm sells its services to a wide range of different industries such as the telecom, automotive, public services and utilities, and finance. The firm has grown steadily the

last decade. Today, approximately 80% of the workers are male, and 20% are female. The proportion of female coworkers has been stable the last five years. Most of Gamma's employees have an academic background, and the majority of employees have a master's degree in engineering.

Gamma is dependent on attracting talented employees to be able to supply the right competence to its clients' projects. Thus, the firm has put a lot of resources in improving its recruitment process and employer branding. In addition, in order to close the gap between the competence that the firm possesses and the competence that its clients need, Gamma continuously works with competence development. The firm has established a formal competence development program that offers courses within different technological areas. The technological areas are chosen on the basis of the businesses that Gamma conducts with its clients and the investments it is planning to make in the future.

Gamma does not develop its own products to compete with its clients; rather the focus is on providing consulting services and expertise to clients and client projects to support its client business, operations, and product development. The firm's expertise and skills originating from the telecom industry are transferred to its clients that work in other industries such as finance. This allows its clients to benefit from knowledge and expertise from other industries, which in turn increases the clients' competitiveness.

3.4.4 Delta

Delta specializes within areas such as embedded systems, industrial IT, and management consulting. Furthermore, Delta supplies its services to clients within a wide range of industries, such as the telecom, automotive, life science, defense, and engineering. The firm's workforce has had stable growth the last five years, and, today, 90% of the employees are male, and 10% are female. The majority of Delta's employees have an academic background, and about 50% have a master's degree in engineering. The firm's growth strategy has been to grow both organically and through acquisitions. Delta has chosen to acquire other firms in order to gain access to new clients and talented employees.

Delta has a passion for knowledge that it actively shares and transfers to its clients. The firm aspires to be a workplace that stimulates learning and technological development through a competence development process that ensures that Delta's competence match its business strategy. Delta takes on technically challenging assignments in order to gain new knowledge, and the employees gladly share their knowledge and experience both with colleagues and clients. The consultants appreciate the variation in the assignments that Delta offers, as they get the opportunity to work with a number of different clients and broaden their knowledge bases.

Delta aims at being the leading TEC firm in the business areas of embedded systems and industrial IT. The firm creates value for its clients by using ready platforms and modules, which means that it can offer its clients faster development of higher quality. Delta's "know how," acquired from previously completed development projects, benefits both the firm as well as its clients.

3.4.5 Epsilon

Epsilon works towards both public and private clients, and it is active in a number of industries, such as automotive, defense, telecom, and life science. It specializes in product development and IT in these industries in addition to process development for industrial and energy plants. Epsilon has grown throughout the years both organically and through acquisitions. Today, 75 percent of the employees are male, and 25 percent are female. The majority of the employees have a master's degree in engineering.

Epsilon has been ranked as one of the most attractive employers for young engineers a number of years. Being an attractive employer ensures that the firm can recruit competent engineers, which, in turn, strengthens its customer offering and competitiveness. The firm's ability to attract skilled engineers is crucial for its success. Epsilon has managed to recruit competent employees by building a strong brand, offering continuous development opportunities, and interesting projects. A lot of its competence development revolves around on-the-job training; however, the firm also offers formal training to its consultants. Epsilon has an internal development department that offers a number of courses, competence development programs, and leadership programs both for newly graduated engineers and senior consultants. The competence development initiatives are pervaded by the firm's values and its view of good business acumen.

Epsilon's business model focuses on strengthening its clients' competitiveness, which enables the clients to become leading in their areas of expertise. This is done through the efficient use of all of Epsilon's competence and experience. As Epsilon is present in many industries, it has the advantage of cross-fertilization. Epsilon's strength lies in the fact that it can combine competence and experience from different industries and market segments in order to develop innovative solutions for its clients.

3.4.6 Zeta

Zeta's clients are found in industries such as automotive, energy, life science, and telecom. The firm offers its services throughout the clients' entire product development cycles – from strategy and technology development to design and product information. Zeta aims to provide maximum added value to its clients and exceed their expectations. Zeta has grown considerably in recent years both organically and through acquisitions. Today, 70 percent of its workforce are male, and 30 percent are female.

Zeta has developed an organizational culture where consultants can thrive, develop, and grow in their roles. Zeta focuses on recruiting individuals who are driven by genuine curiosity for other people and their behavior, as people who use the products and services that the firm develops are at the core of its work. In addition to recruiting individuals who embody the firm's values, Zeta has continuously invested in internal competence development. The firm runs development programs, offers a number of courses and arranges development days, which are run by their own consultants. The consultants have individual development plans, which are a crucial part of their career development. These plans also shape the expectations that exist between a consultant and the manager. In addition, Zeta offers leadership development

programs. The aim of these programs is to best support individuals who aspire to become leaders and help them take the next step in their development.

Knowledge about users, design and technology throughout the product development process has been Zeta's core competence for three decades. The firm's solutions are based on innovation, expertise, and the courage to challenge its clients. Zeta has the advantage of meeting its clients locally, but it also benefits from an international network. The firm has a strong tradition within technical development. Zeta benefits and creates value for its clients by offering broad competence and knowledge from a number of industries. The firm contributes with its expertise to its clients throughout the development cycle, from strategy development and design, through production to evaluation.

3.5 Phase I: Single-case study

Phase I includes three studies: "Exploring the organization of engineering knowledge", "Exploring knowledge transfer in technical consulting", and "Exploring an introductory development program". These studies will be discussed in detail in the following sections.

3.5.1 Exploring the organization of engineering knowledge

The aim of this study was to explore the organization of engineering knowledge by exploring the nature and capabilities of a TEC firm.

3.5.1.1 Data collection

The primary source of data for this study was qualitative interviews with managers and consultants employed by Alpha. The interviews with managers and consultants were complemented with additional sources, such as interviews with client representatives, books written about the case-study firm, internal documents, presentations, and reflection reports written by consultants. These sources served as a means for understanding Alpha's history, culture, and recent developments.

The qualitative interview was chosen as a data collection method in order to obtain both facts and the respondents' opinions about the studied phenomenon (Yin, 2009). This data collection method has been utilized in previous influential studies dealing with issues similar to those investigated here, such as Barley and Kunda's (2004) study on technical contractors. Interviews are an efficient method to collect rich empirical material, and explore social and personal matters in-depth (DiCicco-Bloom and Crabtree, 2006; Eisenhardt and Graebner, 2007). In line with this, Denscombe (2010) argues that interviews are the most suitable method when the researcher's aim is to gain an understanding of the respondents' feelings, views, and experiences. My experience from interviewing the engineers is that they were surprisingly open and willing to discuss their views and experiences. One reason for this might be their interest in the research project, and another reason might be the fact that engineers are driven by problem-solving, which is a central aspect of their work.

The respondents were selected based on representativeness and quality sampling (Alvesson, 2011). Representativeness focuses on getting a comprehensive understanding of the studied phenomenon and avoiding possible skewed views of individuals. Thus, a wide variety of

respondents should be included in the study. Quality sampling centers on the characteristics that make the respondents particularly relevant as informants, such as their knowledge about the studied phenomenon, their experience, or their interest in the research project. The interviewed managers had different areas of responsibility within the case-study firm, and they were selected based on their knowledge of the TEC firm's culture, organization, business strategies, operations, and processes. The consultants work within different business units in Alpha, and they were chosen based on their work experience. Eisenhardt and Graebner (2007) argue that interview data may be biased by the respondents' recollection of impressions and experiences of events in retrospect. This bias can be limited by "using numerous and highly knowledgeable informants who view the focal phenomena from diverse perspectives" (Eisenhardt and Graebner, 2007: 28). In order to avoid this bias, respondents were selected based on representativeness and quality sampling.

Interviews with managers and consultants

The study was initiated with a start-up meeting between Jonas Söderlund, and the division manager of the largest division within Alpha. This meeting had two purposes; (i) to ensure that the manager was interested and willing to participate in the research project, and (ii) to describe the focus of the research, how it was to be conducted, and which results could potentially be expected.

Following the meeting, interviews were conducted with managers and consultants working for Alpha. The interviews were semi-structured, implying that they focused on a number of predetermined themes (DiCicco-Bloom and Crabtree, 2006; Flick, 2014). Gioia et al. (2012: 19) argue that semi-structured interviews are ideal "to obtain both retrospective and real-time accounts by those people experiencing the phenomenon of theoretical interest." Before conducting the interviews, interview guides, organized around predefined themes, were constructed. The interview guides had a flexible design, consisting of open-ended questions, which allowed follow-up questions to be posed. Rubin and Rubin (2012) use the term *responsive interview* to describe this style of interviewing. This interview style permits the researcher to develop a comprehensive picture of the studied phenomenon from the interviewees' point of view (Flick, 2014).

Jonas Söderlund and I conducted 16 interviews with Alpha's managers; we conducted eight of these interviews together, while I solely carried out seven, and Jonas Söderlund carried out the remaining interview. Eisenhardt (1989) argues that multiple investigators enhance both the creativity and the confidence in the results. In addition to the 16 interviews conducted by Jonas Söderlund and me, four interviews with Alpha's managers were carried out by a colleague within the research group, Elisabeth Borg, and Jonas Söderlund. These interviews were included in order to strengthen the representativeness of the study. As abovementioned, the respondents were selected based on representativeness and quality sampling (Alvesson, 2011) and included managers with diverse competence and areas of responsibility, such as the CEO, human resource manager, division managers, business-unit managers, senior project managers, and consultant managers. The interviews with the managers focused on Alpha's strategic development, its business model, and its business strategies. At the beginning of each interview, the interviewer(s) presented the research project and themselves and asked the interviewee to

elaborate on his/her background. This contributed to the creation of trust between the interviewer(s) and the interviewee (Rubin and Rubin, 2012). Further, the interview guides included questions about the firm's vision and mission, leadership, organizational structure, culture, knowledge processes, human resources, consultant careers, consulting assignments, competence development, and client relationships. In addition to these predefined themes, the interviews included a number of follow-up questions. The follow-up questions were used to clarify the statements made by the interviewees and to gain a more in-depth understanding of the themes covered by the interview guide (Rubin and Rubin, 2012). These interviews lasted between 45 minutes and 2.5 hours, and all were recorded and transcribed.

The interviews with Alpha's consultants were conducted by Elisabeth Borg and Jonas Söderlund. The data from these interviews was used for various purposes, such as studying the practices technical consultants rely on to cope with their transient work situations (Borg and Söderlund, 2014). The rationale for including the interviews with the consultants in this phase of the research process was to gain a comprehensive understanding of Alpha at the organizational level and the individual level. In total, Elisabeth Borg and Jonas Söderlund carried out 20 interviews with consultants employed by Alpha. As for the managers, representativeness and quality sampling was utilized to select the respondents (Alvesson, 2011). The sample included respondents who represented different engineering areas of expertise and had experience from working on several consulting assignments. Moreover, the consultants included in the study worked at different client sites and in different business units within the case-study firm. These interviews were also semi-structured (DiCicco-Bloom and Crabtree, 2006; Flick, 2014), and lasted between 1 and 2.5 hours. The interview guide included questions about the consultant's background, their work situation, and the advantages and challenges related to it, their current and previous assignments in client projects, and the transition between assignments. Moreover, the consultants were asked about what it entails to be a technical consultant, and which qualities a good consultant should have. All interviews were recorded and transcribed. For more details on how this interview study was conducted see Borg (2014).

3.5.1.2 Workshop

After conducting and analyzing the interviews, Jonas Söderlund and I held a workshop with eleven managers working within Alpha. The objective of the workshop was to discuss the initial data analysis and the results of the study. The workshop was initiated with a presentation of the research project, followed by a presentation of the study. Then the managers were divided into four groups to discuss their views of the analysis in detail. This gave us the opportunity to gain insight into the managers' reflections about the analysis. The workshop concluded with a general discussion, which provided us with valuable input on how to further develop the analysis.

3.5.1.3 Data analysis

In seeking qualitative rigor in the three studies based on the single-case study and the study based on the multiple-case study, this thesis adopted the "Gioia methodology" (Gioia et al., 2012). This thesis strives to provide an explicit description of the progression from raw data to

themes in conducting the analysis, and this was accomplished through the building of data structures (Gioia et al., 2012).

Thematic analysis was utilized to analyze the empirical material collected in the two phases of the research process. Several researchers have argued that thematic analysis is the most commonly used qualitative analytical method (Braun and Clarke, 2006; Guest et al., 2012; Howitt and Cramer, 2008). This analytical method is used for “identifying, analysing and reporting patterns” within the empirical material (Braun and Clarke, 2006: 79). In line with this, Guest et al. (2012: 10) argue that thematic analysis focuses on “identifying and describing both implicit and explicit ideas within the data, that is, themes.”

In the initial stage of the analysis, I familiarized myself with the data (Braun and Clarke, 2006). The process of transcription was utilized to get acquainted with the empirical material (Riessman, 1993). Through transcribing the data, I gained a comprehensive understanding of the content. Another method used to familiarize myself with the breadth and depth of the material was reading the transcripts written by my colleague Elisabeth Borg. While reading through the transcripts, I searched for meaning within the content (Braun and Clarke, 2006). Subsequently, codes were generated from the empirical material. In this second stage, each interview was coded separately using descriptive codes (Saldana, 2009). A descriptive code “summarizes the primary topic of the excerpt” (Saldana, 2009: 3). In the following stage, the transcripts were reread, and similar codes were discovered across transcripts. Next, overarching themes were created by combining different codes (Braun and Clarke, 2006). This stage resulted in a collection of candidate themes. The following stage of the analysis centered on reviewing the overarching themes created. During this stage, some themes were abandoned, as there was a lack of support for them in the empirical material, while other themes were combined to form a broader theme (Braun and Clarke, 2006).

Defining the themes is the last stage of the analysis before a report is written. Defining the themes entails “identifying the ‘essence’ of what each theme is about /.../, and determining what aspects of data each theme captures” (Braun and Clarke, 2006: 92). Four main themes were identified through the analysis of the interviews with managers and consultants: (i) organizational activities fostering rotation, (ii) individual activities fostering rotation, (iii) organizational activities fostering mobility of knowledge, and (iv) individual activities fostering mobility of knowledge. The themes revolve around creating an organizational culture that centers on continuous learning, building close client relationships in order to understand the needs of the clients for particular competence, and facilitating internal knowledge transfer through competence development activities, as well as external knowledge transfer through mobility among problem-solving contexts. The themes also reflect technical consultants’ ability to utilize both social and technical skills to quickly enter new assignments, cultivate trust within the project team, discern the technical aspects of an assignment, and make use of the mobility inherent in their work situation in order to transfer knowledge and develop their competence. Subsequently, the themes were grouped into two overarching dimensions: swift transition and knowledge cycling.

After the preliminary analysis, a workshop was held with eleven managers working within Alpha, see Section 3.5.1.2. The aim of the workshop was to ensure that the identified scheme

was both recognized and affirmed by Alpha through member checking (Lincoln and Guba, 1985). The feedback from the managers provided valuable input on the essence of swift transition and knowledge cycling. Moreover, the interaction between the TEC firm and the technical consultants in the formation of swift transition and knowledge cycling was emphasized. After the workshop, the preliminary analysis was extended, and a larger emphasis was put on the interaction between the organizational level and the individual level, which led to refinements in the definitions of swift transition and knowledge cycling. Swift transition centers on the TEC firm's ability to respond to client needs by swiftly allocating consultants to client projects, and technical consultant's ability to enter new assignments swiftly, develop trust, and establish a position in the team to add value to the project and the client organization. Knowledge cycling concerns the TEC firm's ability to rotate consultants among projects and client organizations, at certain points in time, to allow for the transfer of knowledge among problem-solving contexts, and technical consultants' ability to develop competence through the mobility inherent in their work situation and transfer knowledge and lessons learned among client organizations.

The results from the data analysis are illustrated in Figure 3. The phrases on the figure's left side constitute the first-order categories (employing the language used by respondents). The first-order categories were then grouped into second-order analytical themes represented by the ovals in the middle. The two boxes on the right illustrate the overarching dimensions, which represent the two identified capabilities. Figure 3 demonstrates how first-order categories relate to second-order themes and, through those themes, to the overarching dimensions.

Figure 3. Data analysis: Exploring the organization of engineering knowledge.

3.5.2 Exploring knowledge transfer in technical consulting

The aim of this study was to explore how scheduled labor mobility facilitates knowledge transfer and knowledge development among problem-solving contexts.

3.5.2.1 Data collection

As in the previous study, the primary source of data was qualitative interviews with managers and consultants employed by Alpha. The interviews with managers and consultants conducted during the preceding study were complemented with follow-up interviews with senior consultants, interviews with consultants who had participated in the introductory development program for newly graduated engineers, and client representatives.

Interviews with managers and consultants

The 40 interviews carried out with managers and consultants in the preceding study were supplemented with four follow-up interviews with senior consultants employed by the case-study firm, conducted by myself. These interviews were conducted in order to clarify and expand on the descriptions of previously interviewed consultants. The four consultants were suggested by one of the division managers because of their experience from working on several consulting assignments, client organizations, and industries, moreover, they had experience of working in managerial positions. These interviews were semi-structured (DiCicco-Bloom and Crabtree, 2006; Flick, 2014) and lasted between 1 and 3 hours. The interview guide included questions about the consultant's background, a typical consulting assignment, and the advantages and challenges related to it, the consultant's current and previous assignments, and the different phases of a consulting assignment – entering the assignment, working within the assignment, and exiting the assignment.

This study was complemented with eleven interviews conducted with consultants who had participated in the IDP offered by Alpha. The rationale for including these interviews was that, during the program, the consultants frequently wrote about and discussed their work situation and the advantages and challenges related to it. The program centers on developing the consultants' competence with regard to understanding their roles as technical consultants, understanding their assignments and gaining a better understanding of how to handle their assignments. During the program, the participants develop and learn through reflecting on their work experience. Interviews with program participants lasted between 45 minutes and 1.5 hours and revolved around issues such as the participants' experience of the program, their development throughout the program, and the lessons learned during the program. For more details on the program see Section 3.5.3.

Interviews with client representatives

In addition to the interviews with managers and consultants employed by Alpha, ten interviews were conducted with client representatives. These were carried out by Jonas Söderlund and Elisabeth Borg. These interviews were conducted in order to gain a nuanced picture of Alpha and the knowledge contributed by its consultants to client projects and organizations. The respondents were chosen based on representativeness and quality sampling (Alvesson, 2011), and they included managers with diverse competence and areas of responsibility. The

interviewed client representatives were line managers and team leaders employed by two of Alpha's largest clients, who had worked closely with consultants employed by Alpha. The interviews were semi-structured (DiCicco-Bloom and Crabtree, 2006; Flick, 2014), lasted between 1 and 1.5 hours, and they addressed the client representatives' experiences of hiring and working with consultants, in general, and their experience of working with Alpha's consultants, in particular. All the interviews included in this study were recorded and transcribed.

3.5.2.2 Data analysis

As in the previous study, themes were defined as the last step of the analysis. This step of the analysis was conducted in two primary stages. In the first stage, the results of the preliminary analysis were related to biological cycling discussed in Brown and Nathwani (2005), which resulted in the development of the idea of *knowledge cycling*. In its strictest definition, biological cycling is the "scheduled rotation of one class of antibiotics with one or more different classes exhibiting comparable spectra of activity" (Brown and Nathwani, 2005: 6). Analogous to biological cycling, knowledge cycling is implemented by the scheduled rotation of technical consultants among assignments, projects, client organizations, and industries. It captures how knowledge transfer and knowledge development are facilitated through the mobility inherent in the technical consultant's work situation.

In the second stage of the analysis, four main themes were identified: (i) *entering an assignment*, (ii) *building experience*, (iii) *contributing to the project*, and (iv) *shifting to a new assignment*. These themes are related to the different phases of a consulting assignment, and illuminate the mobility inherent in consultants' work situation. The first theme centers on the TEC firm's ability to respond to client needs for particular competence and resources, and match the right resources to the needs of the clients. In addition, it focuses on the technical consultants' ability to analyze the problem-solving context, become a part of the project team, and identify the boundaries of the assignment. The second theme revolves around the TEC firm's ability to facilitate on-the-job training and formal competence development, and consultants' ability to develop experience through formal training activities as well as on-the-job training. The third theme concerns the TEC firm's ability to build trust to support its consultants in the search for knowledge, and consultants' ability to take the initiative, identify solutions, and suggest improvements in order to add value to the project and the client organization. The final theme zeros in on the TEC firm's ability to stimulate and organize for mobility among problem-solving contexts and to develop consultants with broad competence, as well as consultants' ability to utilize the mobility inherent in their work situation and to search for new learning opportunities.

Figure 4 illustrates the findings of the data analysis. The phrases presented within the four quadrants are first-order categories, which employ the language used by the respondents. The headings in these quadrants represent second-order analytical themes. The cycle in the figure depicts the process that consultants undergo during an assignment. Moreover, the figure highlights the client representatives' role in the process of knowledge cycling, and it illustrates the ongoing dynamic among the TEC firm, the consultant, and the client organization. The figure also illustrates two important aspects of knowledge cycling: project task familiarization

and project organization familiarization. Project task familiarization refers to the proximity to the problem-solving process. Gradually, the consultant becomes more familiar with the task and acquires a better understanding of the inherent technical challenges. Project organization familiarization, on the other hand, denotes the proximity to the team relations. Over time, the consultant becomes part of social arrangements at the problem-solving site. As the process of knowledge cycling illustrates, the consultant moves along these two interrelated dimensions during the process, where the four phases of knowledge cycling vary in their relative extent of focus on project task familiarization versus project organization familiarization.

Figure 4. The knowledge cycling loop in technical consulting.

3.5.3 Exploring an introductory development program

The aim of this study was to explore how a TEC firm develops its consultants to prepare them to deal with their mobile work situation.

3.5.3.1 The Introductory Development Program

The first version of the IDP was launched in 2007; by the end of 2012, 18 IDP classes had been started. The program runs over a period of 24 months, and the IDP classes consist mainly of recently graduated engineers. One IDP class is made up of 10-12 participants, who go through the 24-month long program together. During these two years, the participants continue to work on their consulting assignments. Each class is most often led by two consultant managers employed by Alpha, who lead and administrate the program. On rare occasions there is only a single leader.

Alpha’s policy is that all employees recruited straight out of university should start the program within their first months at the firm. During the course of the program, the IDP participants work in their consulting assignments. Previously, IDP classes consisted of consultants working on different projects within the same client organization. However, the classes started more recently are comprised of consultants working for various clients and different projects within the client organizations.

The program focuses on developing technical consultants’ professionalism. Professionalism, in this context, is described as understanding both the technical and social aspects of the work situation. During the IDP, the participants go through three different development stages simultaneously: (i) experience-sharing seminars, (ii) sparring talks and coaching sessions, and (iii) formal technical and business courses. For an overview of the structure of the IDP, see Figure 5 below.

Figure 5. The structure of the Introductory Development Program.

The first development stage consists of nine five-hour seminars focusing on experience sharing between the participants. The participants are expected to come prepared to each seminar, meaning that they are to read a number of texts connected to the topic of the seminar, and then write a reflection of approximately one page that relates the texts to their personal work experiences. At the seminar, each participant reads his/her reflection out loud, and a discussion on the reflection follows. During the discussions, the other participants relate the reflection read to their own experiences; they discuss their work situation, the challenges, and how they react

and act towards the challenges they meet. The seminars are divided into three blocks with three seminars in each block. The first block deals with the consulting assignment, and it aims at making the consultants more independent in their assignments. The second block revolves around the operations in the client organizations, and its objective is to increase the interaction at the client site. The final block addresses the business, and the purpose of this block is to increase understanding of both the TEC firm's and the client's business. Within each block, the general theme of the block is divided into three predefined topics, such as *personal leadership*, *roles*, or *dual loyalties*, each of which is dealt with during one seminar.

The second development stage involves sparring talks in pairs during the first block of the program and coaching sessions in the following two blocks. During the sparring talks, two consultants, working in different projects, meet up twice a month to discuss their work assignments in order to understand them better. After the first block, the sparring talks evolve into coaching sessions. As for the sparring talks, the consultants meet twice a month to coach each other in order to reach their long-term goals. The final development stage consists of a number of formal technical and business courses that the consultants are expected to take in order to finish the program.

At the end of the program, the participants go through an examination seminar. The participants prepare for this seminar by reading through all their reflections, from the nine previous seminars, and writing a short paper reflecting on what they have learned during the last 24 months. The structure of the examination seminar is similar to all other seminars; each participant reads his/her paper out loud, and, then, a fellow participant, appointed by the IDP leaders, gives his/her comments on the paper before the leaders open up for a more general discussion on the paper. At the end of the seminar, the participants receive a diploma for finishing the program if they have successfully completed all the program activities.

3.5.3.2 Data collection

Multiple qualitative methods were used to study the IDP. This strengthened the trustworthiness of the results (Yin, 2009). First, developers and leaders of the IDP were interviewed to create an understanding of the program. Next, observations were made during administrative meetings with the IDP leaders. Subsequently, nine IDP seminars and two examination seminars were observed, and finally follow-up interviews with the IDP participant were conducted regarding their experiences of the program. The data collection for this study was conducted together with a colleague, Elisabeth Borg. This enhanced the creative potential of the study and improved the confidence in our results (Eisenhardt, 1989).

Interviews with IDP developers and leaders

The study of the IDP was initiated by interviewing two business developers at Alpha who had created the program. A business unit manager involved in the development and management of the IDP was also interviewed. These interviews were semi-structured (DiCicco-Bloom and Crabtree, 2006) and lasted between 1 and 2 hours. The purpose of these interviews was to gain a better understanding of the program; how the program was structured, what the goals of the program were, and which learning outcomes could be expected from the program. After this, five IDP leaders were interviewed. These five leaders were suggested by one of the IDP

developers because of their experience in leading the program. The interviews with the IDP leaders were semi-structured and lasted between 1 and 1.5 hours. The interviews covered topics such as the leaders' background, the design and process of the program, the main learning outcomes, and the participants' development throughout the IDP. All the interviews were recorded and transcribed. In addition to these interviews, three observations were made during administrative meetings concerning the IDP. These meetings lasted between 2 and 4 hours. The discussions at these meetings revolved around the IDP leaders' role, the challenges in running the program, and potential improvements of the IDP. The IDP leaders also shared lessons they had learned from the program. Careful field notes were taken during the meetings, focusing on the discussions between the IDP leaders.

Participant observations of the IDP

Following the interviews and the observations of the administrative meetings, observations of nine five-hour IDP seminars and two examination seminars were conducted. The reason for putting the focus on the seminars and not on the other development stages of the program, is that the seminars are considered to be the essence of the program. By observing the seminars, the IDP participants' work experiences could be captured, which enhanced the understanding of how they perceive their work situations, what they find rewarding and challenging with their work, and how they face the challenges they come across (Denscombe, 2010). It was also possible to observe which matters the IDP leaders highlighted as important during the program.

Marshall and Rossman (1989: 79) define observation as "the systematic description of events, behaviors, and artifacts in the social setting chosen for study." The main focus during the observations of the seminars was on the discussions produced by the participants. This was done in order to thoroughly capture their work experiences. According to Creswell (2007), the role of the observer can range from being a complete observer to going native. These particular observations are classified as participant observations. A number of researchers have argued that the main advantage of participant observations is the development of trust (DeWalt and DeWalt, 2010; Schensul et al., 1999). DeWalt and DeWalt (2010) argue that the access to knowledge about events and behaviors rests on the development of trust through participant observation. Participant observation, in this case, implied that my colleague, Elisabeth Borg, and I, as all other participants in the program, had to read a number of texts, write our own reflections connected to the texts, read our reflections out loud during the seminar, and discuss them with the other participants. We participated actively during these discussions. However, during the remaining time of the seminars, while the other participants' reflections were processed, my colleague and I focused on the discussion among the other participants and wrote careful field notes (Creswell, 2007; Denscombe, 2010). As a result of our participation in the program, we were quickly accepted as part of the group as we managed to gain the participants' trust early on in the process. This implied that the participants more openly shared their personal experience with us and the rest of the participants.

According to Guest et al. (2013: 93), observations can be "subject to the bias of the researcher regarding what to note or record." The authors argue that the researcher's views and assumptions can limit the recorded material. This bias was minimized in this study by taking detailed notes of what happened, what was said, and by whom during the seminars. Moreover,

the researchers' own views and reflections were separated from the descriptive notes and written down on the edges of the field note protocol (Creswell, 2007). By distinguishing between the descriptive notes and the researchers' own reflections, we ensured that we did not bias the recorded material (Cole, 2013).

The participant observations of the seminars were conducted in three separate IDP classes, in parallel. In practice, this implied that we followed one seminar block with every class. These classes were chosen based on opportunistic sampling (Patton, 2002), meaning that we took advantage of the opportunity that three classes started a different seminar block at the time when this study was initiated. The participant observations were carried out in this manner: Block 1 (three seminars) with class X, Block 2 (three seminars) with class Y, and Block 3 (three seminars) with class Z. As my colleague and I did not jointly conduct all nine participant observations, a detailed account of the process follows. We conducted the participant observations together for the three seminars in Block 1 with class X. In Block 2, we jointly followed the first seminar with class Y, the participant observations for the second seminar were conducted by my colleague, and I carried out the participant observations of the third seminar in Block 2. My colleague solely executed the participant observations for Block 3 with class Z.

In addition to the participant observations of the IDP seminars, two examination seminars were observed. As preparation for these seminars, we read the participants' reflections on what they had learned during the program; however, my colleague and I did not write reflections ourselves neither did we participate in the discussions of the participants' reflections throughout the seminars. Thus, during the examinations, our sole focus was on writing thorough field notes on what occurred and what was said by the participants. My colleague and I jointly observed the first examination while my colleague carried out the second observation by herself. Each examination seminar lasted eight hours.

Follow-up interviews

Eleven follow-up interviews were carried out with consultants who had participated in the IDP, in addition to the participant observations. The interviewees were participants who had finished the first block of the IDP and participants who had finished the program in its entirety. These consultants were chosen to gain a fuller view of the lessons learned during and after the program. The interviews were semi-structured (DiCicco-Bloom and Crabtree, 2006) and revolved around issues such as the participants' expectations of the IDP, their experiences of the program, their development during the IDP, and the program's effect on their daily work. The interviews lasted between 45 min and 1.5 hours and were all recorded and transcribed.

3.5.3.3 Workshop

Elisabeth Borg and I held a workshop with four managers involved in the design and execution of the IDP. The aim of the workshop was to discuss the preliminary data analysis and the findings of the IDP study. A short presentation about the study was given before a general discussion with the participants was initiated. The managers discussed their thoughts on the analysis of the study, and they pointed to aspects that they thought had been captured well, as

well as aspects that could have been more emphasized in the analysis. Thus, the workshop provided input for further interpretation of the empirical material.

3.5.3.4 Data analysis

The empirical material gathered in the third study of the research process was initially coded independently by Elisabeth Borg and me, which resulted in two coding schemes. The coding schemes were compared before moving on to the next stage of the analysis. Based on the analysis of the interviews and observations conducted during the IDP study, three main themes were defined: (i) defining the assignment, (ii) defining the belonging, and (iii) defining the client. The three themes depict the participants' experience of their mobile and transient work situation, the perceived advantages and challenges connected to this work situation, and the lessons learned during the IDP.

The first theme centers on the challenges of unclear assignments and ambiguous roles. The analysis identified that consultants address and deal with these challenges by defining the boundaries of the assignment and carving out a role for themselves in the project. The second theme revolves around unclear organizational belonging. Consultants dealt with this ambiguity by reflecting on "in-betweenness", which enabled them to become more self-confident in the role of a consultant. The third theme centers on the ambiguous client. The consultants found it challenging not knowing who they create value for. Nevertheless, creating value for the clients was emphasized as an important aspect of consulting work. The advantage of being a consultant is the ability to distance oneself from the task at hand in order to present the client with an outside view and, thus, bring new knowledge to the project and the client organization. After the preliminary analysis, a workshop was held with four managers involved in the development of the IDP, see Section 3.5.3.3. The aim of the workshop was to validate the initial analysis through member checking (Lincoln and Guba, 1985). The feedback from the managers provided valuable input on the themes identified, which resulted in the analysis being extended, focusing on further clarifying the connections between the quotes, themes, and findings of the study.

Three processes increasing consultants' liminality competence were identified, based on the identified themes: (i) identifying the core of an assignment, (ii) embracing "in-betweenness," and (iii) broadening the scope of action. Table 3 depicts the relation between the representative quotes, themes, and the three processes.

Quote	Interpretation	Theme	Process
How can I give the client what he/she wants without it disrupting the tasks I was hired to do? I think it is a balance, giving them what they want but also having the courage to question their decisions. How do we know that the client is competent? Do we ask them: "Why are we doing this?" (Field notes, seminar 7)	Reflecting on the context and the role of a consultant	Defining the assignment – knowing what to do	Identifying the core of an assignment
It can feel like cheating to ask others, but it's not. It is like standing on the shoulders of giants. If there are people who have an idea of what should be done, I think it's better to ask them. (Field notes, seminar 3)	Asking questions in order to identify the core of the assignment		
Many consultants kindly and quietly sit in their office and do what they are told, but I don't think that is enough. You have to show that you can handle other tasks as well; I can, for example, take a team leader role when the opportunity arises. This way, the client sees that I am willing to contribute more than my fellow colleagues. (Interview Consultant B)	Creating a role for oneself in the project		
By doing a good job you can be loyal to both; you will satisfy the client and improve the reputation of [Alpha] by showing that [Alpha] consultants perform well on their assignments. (Field notes, seminar 9)	Reflecting on "in-betweenness"	Defining the belonging – becoming more confident in the role of consultant	Embracing "in-betweenness"
Taking on tasks outside the comfort zone is a good challenge. It accelerates your development and enables you to acquire new knowledge. However, it cost a lot of energy, which means that you cannot remain there permanently. (Field notes, seminar 1)	Moving beyond "safe-zones" in the project		
The program makes people question their professional roles and, thus, find their professional roles faster. This leads to the fact that they become better at what they do, as they are doing something they are passionate about. You become more secure; security leads to questioning and questioning leads to the choice of doing something different. (Interview Consultant D)	Becoming more secure in the role of a consultant		
It is difficult to know which tasks are important when you do not know what the client's business model looks like, how they make money. This makes it difficult to understand their needs. (Field notes, seminar 1)	Reflecting on the client's business	Defining the client – creating value at work	Broadening the scope of action
We create value for the clients by shifting among assignments because it gives us the opportunity to see different angles. (Field notes, seminar 8)	Distancing oneself from the task at hand		
My colleagues think it is positive that consultants enter into the project with a different view of knowledge, new ideas, and diverse experience. (Field notes, seminar 8)	Using the role as insider-outsider – taking on more responsibility in the client organization		

Table 3. Data analysis of the IDP.

3.6 Phase II: Multiple-case study

Phase II includes the study “Exploring heterogeneity among TEC firms”. The study will be discussed in detail in the following sections.

3.6.1 Exploring heterogeneity among TEC firms

The aim of this study was to explore TEC firm capabilities and how these capabilities differ among TEC firms.

3.6.1.1 Data collection

The primary source of data for this study was qualitative interviews with managers and consultants employed by six TEC firms headquartered in Sweden. In addition, interviews were conducted with experts and analysts within the TEC industry in order to get a nuanced picture of the industry. Apart from the interviews each case study report draws upon a large amount of data encompassing various secondary material, such as industry reports, corporate websites, annual reports, internal documents, and presentations. These documents were used to supplement the data collected through the interviews and to build a holistic picture of each TEC firm.

Interviews with managers and consultants

The 20 interviews carried out with managers and the 20 interviews conducted with consultants during the first study at Alpha were complemented with interviews carried out in five additional TEC firms: Beta, Gamma, Delta, Epsilon, and Zeta. The single-case study conducted within Alpha provided in-depth understanding of the nature of a TEC firm; in what respect it differs from other PSFs, the strategic challenges facing such firms, and the capabilities that seem to be central to achieve and maintain competitive advantage. The purpose of the multiple-case study was to broaden the understanding of TEC firms and allow for a contrasting analysis among different TEC firms.

This study encompasses both the organizational level and the individual level (Felin et al., 2015; Floyd and Sputtek, 2011) as Paper I illustrated that TEC firm capabilities arise from an interaction between the two levels. The preceding study provided an understanding of whom to interview within the five TEC firms to gain a better understanding of their businesses and operations. The respondents were chosen based on representativeness and quality sampling (Alvesson, 2011), and they represented employees at multiple organizational levels, such as CEOs, human resource managers, division managers, business-unit managers, senior project managers, consultant managers, and individual consultants. The interviewed managers had different areas of responsibility within the TEC firms, and they were selected based on their knowledge of the firm’s culture, organization, business strategies, operations, and processes. The consultants represented different engineering areas of expertise, and they were chosen based on their assignment histories; they had experience from working on several consulting assignments.

The interviews carried out with managers and consultants were semi-structured (DiCicco-Bloom and Crabtree, 2006). The interviews comprised 17 managers employed by Beta,

Gamma, Delta, Epsilon, and Zeta; Jonas Söderlund and I jointly conducted five interviews, while I solely carried out ten interviews, and Jonas Söderlund conducted the remaining two interviews. The interviews lasted between 45 minutes and 2.5 hours, and addressed organizational culture, organizational structure, leadership, and strategies regarding growth, internationalization, human resources, knowledge processes, competence development, and client collaboration. The interviews with the consultants covered the consultant's background, their work situation and the advantages and challenges related to it, the consultant's current and previous assignments in client projects, and the different phases of a consulting assignment. Ten interviews were carried out with consultants, which I conducted solely, and these lasted between 1 and 2.5 hours.

Interviews with experts and analysts

In addition to the interviews with managers and consultants employed by the six TEC firms, three interviews were carried out with experts and analysts, and these were conducted by Jonas Söderlund. The interviews were carried out in order to obtain a nuanced picture of the TEC industry. The respondents were selected based on purposeful sampling, and they provided rich information on the questions under study (Patton, 2002). The respondents included one representative from the Swedish Federation of Consulting Engineers and Architects, two representatives from the Association of Swedish Engineering Industries, and one analyst employed by a Scandinavian financial services group. The interviews were semi-structured (DiCicco-Bloom and Crabtree, 2006; Flick, 2014) and lasted between 1 and 2 hours. The interviews focused on topics such as the development of the TEC industry, TEC firm strategies, and the firms' future opportunities and challenges in the industry. All the interviews conducted during the multiple-case study were recorded and transcribed.

3.6.1.2 Data analysis

The data analysis was carried out by first building individual case descriptions and then conducting a cross-case analysis to construct conceptual insights (Eisenhardt, 1989). According to Eisenhardt (1989), within-case analysis is one of the central features of analyzing case data as it involves comprehensive case study write-ups. The write-ups are key to the creation of insights as they aid researchers in coping with large volumes of data (Eisenhardt, 1989; Pettigrew, 1990). As for the preceding studies, thematic analysis was utilized to interpret the empirical data (Braun and Clarke, 2006; Guest et al., 2012) in the first stage of the analysis. Both individual accounts and the accounts for all participants have been stressed as important aspects of within-case analysis (Ayres et al., 2003). Consequently, the interviews conducted for each case were analyzed both individually and on an aggregated level.

Based on the analysis, four themes were identified: (i) service delivery, (ii) understanding client needs, (iii) knowledge transfer, and (iv) mobility among problem-solving contexts. The first theme revolves around the type of services the TEC firm primarily delivers to its clients and consultants' ability to swiftly enter assignments in order to create value for the client. The second theme concerns the TEC firm's ability to build close client relationships in order to understand and respond to the needs of their clients and consultants' ability to understand client needs to suggest improvements and identify alternative solutions to the client's problems. The third theme centers on the TEC firm's ability to facilitate knowledge transfer among

assignments, projects, client organizations, and industries, and consultants' ability to transfer knowledge gained in prior assignments to the current assignment. The fourth theme revolves around the TEC firms' ability to organize for mobility among problem-solving contexts and offer their consultants challenging assignments, and consultants' ability to take the initiative for and utilize mobility to develop their competence. Subsequently, elaborate case descriptions were written for each case, and these included data from both the interviews and the secondary material.

In the second stage of the analysis a *cross-case analysis* was conducted. The case descriptions were analyzed in detail to identify similarities and differences across the six firms (Eisenhardt, 1989; Yin, 2009). Cross-case analysis forces the researcher "to go beyond initial impressions, especially through the use of structured and diverse lenses of the data" (Eisenhardt, 1989: 541). The cases were first compared to identify similarities and to refine the case descriptions of each case. Subsequently, differences among the firms were identified based on the four themes from the first stage of the analysis. Table 4 presents the results of the data analysis. On the left are the representative quotations. The column in the middle represents the first-order categories, which are phrases that were created by using the language of the respondents. These phrases illustrate the organizational processes and the individual skills. Subsequently, the first-order categories were grouped into second-order themes, representing the four capabilities identified: (i) service delivery, (ii) understanding client needs, (iii) knowledge transfer, and (iv) mobility among problem-solving contexts. The figure illustrates how the capabilities differed among firms based on the organizational process and the individual skills of the consultants, and it illustrates that the interaction between these two levels fosters TEC firm capabilities.

Representative quotations	First-order categories	Second-order themes
CV sales, consulting business as we know it, are basic services. We want to be a supplier that offers a different value. /.../ If you have something more to offer you reach the next step, Consulting 2.0. At this step you can offer other services such as delivering work packages. (Manager I, Alpha) As of today, only 20 percent of our deliveries are work packages. (Manager I, Delta)	Delivering services to clients through resource consulting	Service delivery
First, you should understand what the assignment is about and your role in the assignment, the project description, and what the requirements and objectives are. You need to get to know the people, who they are, how they work, and which roles they have. (Consultant A, Alpha) When entering an assignment, one must be attentive and listen – “be a sponge”! One must understand the culture, become part of the social context and show that one is willing to contribute. (Consultant A, Gamma)	Entering new assignments swiftly and establishing a position in the project team that adds value to the client	
Resource consulting is becoming more and more competitive. /.../ We combine different disciplines to become a strong and unique player on the market. (Manager I, Epsilon) We are interested in supplying a broad range of competence to our clients. (Manager I, Beta)	Exploiting multi-disciplinarity to deliver services to clients, and utilizing synergies among knowledge areas to deliver a larger quantity of work-packages	
You are expected to contribute to the project from day one; you enter the project then you start running. You have to take initiative and form your own role in the project in addition to finding your place socially. (Consultant A, Zeta)	Entering new in-house projects swiftly, and integrating own knowledge with that of the project team members to create value for the client	
By understanding the clients’ businesses and needs, we can provide our expertise on how technology can improve the clients’ innovation processes and in turn their competitiveness. (Manager I, Gamma) We are trying to work as close with the clients as possible, every consultant is like a piece of puzzle, if you choose the wrong piece it does not matter how hard you push it, it just will not fit. It is like that with consultants, too. If you know what the workplace looks like and the people they are looking for, then you can estimate where the consultants should work. (Manager II, Alpha)	Building close client relationships in order to understand client needs, and responding to client needs by matching the needs with individual skills	Understanding client needs
Consultants should “talk the clients’ language.” A consultant needs to take initiative and be proactive, meaning that he needs to come up with alternative solutions to the clients’ problems. /.../ A consultant can make the clients’ work processes more efficient by introducing experience and methods from previous assignments. (Consultant A, Delta)	Gaining an understanding of client needs to be able to suggest improvements that enhance the client’s processes	
In order to understand our clients’ businesses and needs, we have to be geographically close to our clients. This enables us to deliver high quality services to our clients. (Manager I, Zeta) It is very important that we match the client’s needs with the right resources. (Manager II, Epsilon)	Building close client relationships in order to understand client needs, and allocating entire project teams internally to respond to the client needs	
By understanding the client’s needs I can identify alternative solutions and make work more efficient. (Consultant A, Beta)	Gaining an understanding of client needs to be able to identify alternative solutions to client problems	

Table 4. Data analysis: Exploring heterogeneity among TEC firms.

Representative quotations	First-order categories	Second-order themes
When you gather consultants from different contexts, the influences from other businesses and firms come naturally. As an individual you might gain knowledge about all those firms in ten years. But if you gather a team of consultants and talk about these things, you have the possibility to accelerate your own experience curve. (Consultant B, Alpha) Consultants want to be able to work in a project and then bring that knowledge and expertise with them into another project (Manager II, Delta)	Facilitating internal knowledge transfer through formalized competence development, and enabling external knowledge transfer among problem-solving contexts	Knowledge transfer
When you enter a client firm as a consultant, you are often bringing knowledge from other firms. This is why you should not keep quiet about good ideas, instead you have to try to influence the client's business. This is an important part of a consultant's role, as long as the suggestions are thought through. (Consultant C, Alpha) As a consultant it is your job to contribute to the assignment by sharing your knowledge from previous assignments and client organizations. (Consultant B, Gamma)	Applying knowledge gained in prior problem-solving contexts to the current assignment	
Consultants' ability to convert the knowledge and experiences gained in previous assignments to viable solution for our clients is crucial for our business and our competitiveness. (Manager II, Beta) Our clients are eager to learn from our experience. The consultants play a very important role as they transfer experiences among different industries. That is the excitement of this job, switching among firms and industries. (Manager I, Zeta)	Facilitating knowledge transfer among problem-solving contexts, and utilizing cross-fertilization in order to increase the clients' competitiveness	
One should be able to quickly enter new assignments and apply what one has learned on previous assignments to the new context. (Consultant A, Epsilon)	Applying knowledge gained in prior problem-solving contexts to the current in-house project	
We know that there are many strong forces making people stay in a project and in an organization. We need to provide the mechanism to ensure that these forces are not too much in control, otherwise our experience is that learning will suffer. (Manager III, Alpha) As an employer we must keep our consultants constantly in the exciting phase of their careers /.../ If a consultant wants to move to a new assignment, then he will move, either with [the firm] or on his own, which means that somewhere after 1 and a half years we must think about moving him to a new assignment. (Manager IV, Alpha)	Creating policies to facilitate the mobility of knowledge among assignments, and regularly rotating consultants among problem-solving contexts	Mobility among problem-solving contexts
There is a very good reason why people, including myself, prefer working for this kind of organization. It is much more dynamic and offers greater possibilities for learning as you see so many different places and projects. (Consultant D, Alpha)	Utilizing mobility to seize opportunities for learning and broadening competence	
I would say that our turnover of employees is too high; the reason for the turnover is the lack of rotation. We must act on this; we must offer our consultants challenging assignments. (Manager I, Epsilon)	Offering consultants challenging assignments in which they can broaden their competence	
I am becoming too specialized; I have to change assignments to remain an attractive consultant. (Consultant A, Epsilon) It is important to regularly move among assignments in order to build competence. (Consultant A, Beta) You lose the opportunity to broaden your competence by staying too long on one assignment. New assignments create new energy. (Consultant B, Zeta) The consultant has to take initiative for mobility among assignments. (Consultant A, Gamma)	Taking initiative for mobility among problem-solving contexts in order to broaden competence	

Table 4. Continued.

3.7 My contribution to the papers

In the following sections, my contributions to the four papers included in this thesis will be discussed.

3.7.1 Paper I

Pantic-Dragisic, S. & Söderlund, J. Knowledge-based advantages of the TEC firm: Swift transition and knowledge cycling. *Under review for publication*.

My main responsibility in the first draft of the paper was analyzing the interview data, as well as writing the methodological and empirical sections. Jonas Söderlund framed the paper, while we jointly discussed the analytical ideas, after which Jonas Söderlund completed the first version of the paper. The paper was then submitted to the IRNOP conference, *The International Research Network on Organizing by Projects*, in Oslo in 2013, where I presented it. After receiving comments from reviewers and conference participants, we worked in iterations revising the paper before submitting it to the *Academy of Management Annual Meeting*, where it was accepted as a divisional paper in the Technology and Innovation Management Division. I presented the paper in Philadelphia in 2014. We again worked in iterations revising the paper based on the comments we received from reviewers and conference participants. The paper was then included in my licentiate thesis, where we received additional comments, after this I took the lead in revising the paper before submitting it for publication. After receiving comments from the reviewers and the editor of the journal, we jointly developed a plan for revising the paper. I took the lead in revising and restructuring the paper, in addition to providing more empirical substantiation to the paper. We worked collaboratively on improving the framing of the paper and furthering the conceptual contribution. After receiving the second round of comments from the editor and the reviewers, we worked in several iterations to improve the analysis of the paper.

3.7.2 Paper II

Pantic-Dragisic, S. & Söderlund, J. Heterogeneity of capabilities among professional service firms: A study of technical and engineering consulting firms. *Working paper*.

The idea for the paper emerged through a discussion between Jonas Söderlund and myself; we wanted to gain a deeper understanding of the organization of engineering knowledge by exploring TEC firm capabilities and how these capabilities differ among TEC firms. We had discussed the design of the study at an early stage. I was responsible for the execution of the study. I wrote the first full draft of the paper, which was then submitted to the PSF conference, *Professional Service Firms Annual Conference*, where I presented it in Stockholm in 2017. Jonas Söderlund and I then discussed suggestions received for improvements, which I took the lead in implementing. The paper was then presented at an internal PhD workshop. After the workshop, I rewrote the paper based on comments received. Subsequently, Jonas Söderlund and I discussed the framing, analysis, and the contributions of the paper, after which I revised and restructured the paper.

3.7.3 Paper III

Pantic-Dragisic, S. & Söderlund, J. (2018). On the move to stay current: Knowledge cycling and scheduled labor mobility. *Management Learning* 49 (4): 429-452.

The idea for this paper was developed jointly by Jonas Söderlund and me as Paper I sparked our interest in further advancing the notion of knowledge cycling. As in Paper I, I was responsible for analyzing the empirical material. We jointly framed the paper, and I wrote the methodological and empirical sections, while we wrote the analytical section together. The paper was then revised in iterations before it was submitted to the OLKC conference, *The International Conference on Organizational Learning, Knowledge and Capabilities*, where I presented the paper in Oslo in 2014. After the conference, we worked in iterations revising the paper based on comments received. The paper was then included in my licentiate thesis, where we received a number of suggestions for improvement. After the seminar, Jonas Söderlund and I discussed the improvements to be made, which I took the lead in implementing. The paper was then submitted to the *Academy of Management Annual Meeting*, where it was accepted as a divisional paper in the Technology and Innovation Management Division. I presented the paper in Anaheim in 2016. After the conference, the paper was further revised through a number of iterations before being submitted for publication in *Management Learning*. After receiving the reviewers' and editor's comments, we jointly developed a plan for revising the paper, and I took the lead in implementing the changes. Subsequently, we jointly worked on the framing and analysis of the paper along the lines suggested by the editor and the reviewers. Before the paper was accepted for publication, we tightened the paper and further developed the analytical model and the contributions of the paper.

3.7.4 Paper IV

Pantic-Dragisic, S. & Borg, E. (2018). Creating the mobile engineer: A study of a training program for engineering consultants. *European Journal of Training and Development* 42(7/8): 381-399.

The idea for this paper was developed in collaboration with Elisabeth Borg during a PhD course, *The Dynamics of Knowledge Integration*, at Linköping University. At that time, Elisabeth Borg was the first author of this paper. Elisabeth Borg and I jointly collected the empirical material and analyzed the empirical data. In developing the first draft of the paper Elisabeth Borg and I created a structure for the paper; Elisabeth Borg took the lead in framing the paper, while we wrote the methodological and empirical sections jointly. After this, we discussed the analytical ideas, which Elisabeth Borg took the lead in implementing. The paper was then submitted to the IRNOP conference, *The International Research Network on Organizing by Projects*, in Oslo in 2013, where it was presented by Elisabeth Borg. The same year, the paper was also submitted to the NFF conference, *Nordic Academy of Management*, in Reykjavik. At this conference, we presented the paper jointly. The paper was then revised in iterations based on the comments we received at the conferences. In 2014, the paper was included in Elisabeth's doctoral thesis, and it was presented at the *Academy of Management Annual Meeting*, where it was accepted as a divisional paper in the Human Resources Division. I presented the paper in Philadelphia in 2014. After the conference, I took over the main

responsibility for the paper and became the first author. I took the lead in implementing the suggestions for improvements by reframing the paper and revising the methodological, empirical, and analytical sections. It was then included in my licentiate thesis, after which I revised the paper based on comments received and submitted it for publication (for which it was later rejected, due to the fact that it was out of scope). Subsequently, I submitted it for publication in *European Journal of Training and Development*. After receiving the reviewers' and editor's comments, I revised and restructured the paper based on their comments and suggestions.

3.8 Establishing trustworthiness in qualitative research

Qualitative research has often been critiqued for lacking rigor, thus, the concept of validity has been transformed a number of times (Gioia et al., 2012; Whittemore et al., 2001). Initially, the validity and reliability standards utilized in the positivistic research traditions were applied to qualitative research (LeCompte and Goetz, 1982). However, these standards were found to be incompatible with the underlying assumptions of qualitative research, which led to various transformations in the conceptualization of validity (Whittemore et al., 2001). Today, numerous perspectives and definitions of validity exist, in addition to criteria for establishing validity in qualitative research (Creswell, 2007). Based on previous literature, Whittemore et al. (2001) have synthesized the validation criteria for qualitative research. The authors present a reconceptualization of the concept of validity and discuss four primary criteria for obtaining validity in qualitative research. In addition to the four criteria, I have chosen to include the criterion of transferability (Lincoln and Guba, 1985), in order to account for the applicability of the results of this thesis. The criteria are discussed in detail below.

The first criterion for obtaining validity in qualitative research is *credibility*. Credibility refers to the match between the research results and the experiences of the participants or the studied context (Lincoln and Guba, 1985). Lincoln and Guba (1985) propose using triangulation as one technique for establishing credibility. Combining multiple qualitative methods “offers enormous potential for generating new ways of understanding the complexities and contexts of social experience” (Mason, 2006: 10). The aim of this thesis was explored from different perspectives and has included multiple qualitative methods, multiple data sources, and multiple investigators. The descriptions of the two phases of the research process illustrate how interviews, observations, and secondary material were used to study the case-study firms. The bias of retrospective sense-making was mitigated by combining interviews and observations (Eisenhardt and Graebner, 2007). In addition, multiple data sources were utilized. Interviews were conducted with managers from different levels of an organizational hierarchy and consultants employed by the TEC firms, as well as client representatives. For instance, the study “*Exploring an introductory development program*” consists of interviews with the IDP developers, leaders and consultants participating in the program. Moreover, observations were carried out during administrative meetings with IDP leaders, IDP seminars, and IDP examinations. The third type of triangulation employed in this thesis is investigator triangulation. Several researchers have argued that the use of multiple investigators enhances the credibility of the findings (Eisenhardt, 1989; Merriam, 1994). A number of interviews conducted during the four studies were carried out jointly with Jonas Söderlund or Elisabeth

Borg. During the interviews, one of us executed the interview while the other took notes. Follow-up questions were asked throughout the interviews to gain an in-depth understanding of the participants' experiences and to ensure that their statements were understood correctly (Rubin and Rubin, 2012). In addition, a total of 14 observations were conducted, of which eight observations were carried out together with Elisabeth Borg. Both Elisabeth Borg and I took through field notes during these observations. The second technique used to establish credibility was member checking. Lincoln and Guba (1985: 314) argue that member checking is "the most critical technique for establishing credibility." The research process herein included member checking executed through workshops with managers. During the workshops, the preliminary analyses and findings were presented to the participants. The objective of the workshops was to get the participants' views on our analyses and findings, which in turn provided input for further interpretation of the empirical material and the development of analyses. The combined techniques of triangulation and member checking contributed to a broad understanding of the case-study firms.

The second criterion, *authenticity*, is tightly coupled with the criterion of credibility. Authenticity denotes the awareness of the researcher of subtle differences in the experiences of the participants (Lincoln, 1995). In order to establish authenticity, Whittemore et al. (2001) claim that the researcher must be conscious of the influence he/she might have on the participants. To ensure authenticity during the research process, I entered the interviews and observations with an open mind, and with the objective to gain a comprehensive understanding of the TEC firms. I did this at both the organizational level and the individual level, which made me observant of the differences in the participants' experiences. In addition, anonymity was offered to the participants to encourage them to be open about their experiences. Oliver (2010) argues that anonymity frees the respondents to express their true feelings. Thus, participants should be more willing to provide information if they are offered anonymity. Although anonymity can imply a lack of transparency, it has not affected the results of this thesis in any way. The results have been analyzed and presented in an inclusive and representative manner. Triangulation and member checking were used as techniques to establish authenticity and ensure credibility. The triangulation of methods, data sources and investigators contributed to a nuanced picture of the participants' experiences. Moreover, the workshops with the managers were used as techniques to identify alternative interpretations within the data.

Criticality is the third criterion for obtaining validity in qualitative research (Whittemore et al., 2001). Criticality involves the portrayal of a systematic research design and a critical analysis of the research process. This methodological chapter demonstrates the use of a systematic research design and the critical assessment of every stage of the process. First, the rationale for choosing a qualitative research approach was described. Then the strengths of a case-study design were discussed. Following this, the research process, based on the four studies conducted, was illustrated, and the choices of data collection and sampling methods were depicted. Finally, thematic analysis was utilized to analyze the empirical material, and each stage of the analytical process was accounted for. Marshall (1990) argues that the researcher needs to be critical in his/her search for alternative interpretations within the empirical material. The techniques of triangulation and member checking were used to uncover different interpretations. Moreover, I have searched for alternative explanations throughout the analytical

process by rereading the transcripts from the interviews and field notes, and reviewing the codes and themes created. The data collected for the study "*Exploring an introductory development program*" was coded separately by Elisabeth Borg and me, and it was later merged into one coding scheme. This allowed alternative interpretations to emerge during the first stages of the analytical process (Kvale, 1997).

The fourth criterion, *integrity*, refers to a critical reflection on and the modest presentation of the research findings. The criterion of integrity is closely linked to criticality. Whittemore et al. (2001: 531) claim that "integrity must be evidenced in the process to assure that the interpretation is valid and grounded within the data." Integrity was established through the same techniques as criticality, a systematic research design, triangulation, member checking, and a critical analysis of every stage of the research process. The analysis demonstrates how the coding process was performed and how the themes were defined, which assures that the interpretation is grounded on the empirical material. In addition, the four papers included in this thesis have all been accepted to and presented at academic conferences in addition to being submitted to journals. Thus, they have been peer-reviewed. The quality and validity of the papers were evaluated through the peer-reviews, which further enhanced the integrity of the research.

The criterion of *transferability* concerns the applicability of the findings to broader contexts (Lincoln and Guba, 1985). As the criterion of external validity has been found to be incompatible with the qualitative research approach (Whittemore et al., 2001), Lincoln and Guba (1985: 297, emphasis in original) argue that we should move "from a question of generalizability to a question of transferability. Transferability inferences cannot be made by an investigator who knows *only* the sending context." Whittemore et al. (2001) claim that rather than being generalizable and objective, qualitative research is contextual and subjective. Thus, it is not the investigator's "task to provide an *index* of transferability" (Lincoln and Guba, 1985: 316, emphasis in original). Descriptive data was provided in order to make transferability judgments possible (Lincoln and Guba, 1985). I have aimed at providing a thick description of the studied context by presenting a detailed description of the case-study firms and the nature of the technical consultants' work. Moreover, the organization and development of engineering knowledge, and the roles of the TEC firm and the technical consultants in the transfer of knowledge among assignments, projects, client organizations, and industries are thoroughly discussed in the latter chapters of this thesis.

Chapter 4

Summary of papers

This chapter summarized the four papers, that constitute the basis of this thesis, and presents their main findings. The complete versions of the four papers can be found in the second part of this thesis.

4.1 Paper I

Pantic-Dragisic, S. & Söderlund, J. Knowledge-based advantages of the TEC firm: Swift transition and knowledge cycling. *Under review for publication*.

This paper takes its departure in the professional service firm literature, and it argues that TEC firms and the roles they play, more generally, in the organization of engineering knowledge remain insufficiently researched areas of inquiry despite their growing importance in a number of industries. The purpose of this paper is to enhance the understanding of the organization of engineering knowledge by exploring the nature and capabilities of a TEC firm. More specifically, this paper aims at uncovering the knowledge-based advantages that this type of firm is able to develop. Toward this end, this paper is based on a single-case study of one of Scandinavia's leading TEC firms. It spans multiple organizational levels and is based on 40 interviews with senior managers, middle managers, consultant managers, and consultants employed by the case-study firm.

This study demonstrates that the TEC firm has additional roles to play than merely solving the problem of numerical and functional flexibility, which is the predominant view in prior research. The paper offers a supplementary analysis to this dominant view pertaining flexibility by identifying knowledge-based advantages that a TEC firm seems able to achieve. More specifically, two capabilities were identified: swift transition and knowledge cycling. Swift transition revolves around the TEC firm's ability to swiftly allocate consultants to client projects, and technical consultants' ability to quickly enter new assignments in order to add value to the project and the client organization. Knowledge cycling concerns the TEC firm's ability to rotate its consultants among problem-solving situations, at certain points in time, to allow for the transfer of knowledge among problem-solving contexts, and technical consultants'

ability to transfer knowledge and develop competence through the mobility inherent in their work situation. The study illustrates that these two capabilities are formed through interaction between the organizational level and the individual level, and that the link between the capabilities creates the foundation for the successful organization of engineering knowledge.

4.2 Paper II

Pantic-Dragisic, S. & Söderlund, J. Heterogeneity of capabilities among professional service firms: A study of technical and engineering consulting firms. *Working paper*.

This paper departs from the professional service firm literature, which argues that PSFs are heterogeneous, and it calls for a more detailed understanding of the differences among PSF. This includes making clearer distinctions between the characteristics of PSFs and the required capabilities. The aim of this paper is to further investigate the nature of TEC firms. More specifically, the purpose of this paper is to explore the capabilities critical for TEC firm competitiveness, and how these capabilities differ among TEC firms. The paper is based on a comparative multiple-case study of six TEC firms headquartered in Sweden. The study comprises 70 interviews with top managers, middle managers, consultant managers, and individual consultants, as well as industry experts.

This study discerns four capabilities critical to the success of TEC firms: (i) service delivery, (ii) understanding client needs, (iii) knowledge transfer, and (iv) mobility among problem-solving contexts. The results illustrate that these four capabilities differ among TEC firms based on the organizational processes of the TEC firm and the individual skills of the technical consultants. Building on the organizational processes and the individual skills, this paper identifies two distinct types of TEC firms, which we denote as *resource-capitalizer* and *project-capitalizer*. The findings of the study further demonstrate that capability development in TEC firms is human centered, and it arises from the interaction between the organizational level and the individual level. Furthermore, the paper demonstrates the heterogeneity among PSFs by studying the nature and capabilities of TEC firms, and illustrates the heterogeneity among TEC firms by clarifying how the four identified capabilities differ among the studied firms.

4.3 Paper III

Pantic-Dragisic, S. & Söderlund, J. (2018). On the move to stay current: Knowledge cycling and scheduled labor mobility. *Management Learning* 49 (4): 429-452.

This paper takes its departure in situated learning theory, and it illustrates the criticality of mobile knowledge for the development of local knowledge through the notion of knowledge cycling. This paper focuses on the scheduled rotation of technical consultants among problem-solving contexts, and emphasizes the importance of mobility in transferring extant knowledge to new contexts and acquiring new knowledge. This paper aims to describe how the process of knowledge cycling unfolds, and to explain how scheduled labor mobility facilitates knowledge cycling among problem-solving contexts. The paper is based on a single-case study of one of Scandinavia's leading TEC firms. The study comprises 44 interviews with managers and technical consultants working for the case-study firm. In addition, eleven interviews were carried out with consultants who had participated in the case-study firm's introductory

development program for newly graduated engineers during which the participants reflected on and discussed their work experiences. Finally, ten interviews were conducted with client representatives to obtain a holistic picture of the case-study firm and the knowledge contributed by its consultants.

This study further develops the notion of knowledge cycling, identified in Paper I. Knowledge cycling builds on the scheduled rotation of technical consultants among problem-solving contexts enabling the transfer and development of knowledge. Four main phases, constituting the process of knowledge cycling, were identified: (i) entering an assignment, (ii) building experience, (iii) contributing to the project, and (iv) shifting to a new assignment. Through these phases, contextual understanding is built throughout an assignment. The process of knowledge cycling consists of two critical aspects: project task familiarization and project organization familiarization. The consultants' knowledge is developed in diverse settings and encompasses domain knowledge (project task familiarization), as well as relational issues (project organization familiarization). The paper emphasizes that knowledge cycling rests on the close interaction among the consultant, the TEC firm, and the client organization.

4.4 Paper IV

Pantic-Dragisic, S. & Borg, E. (2018). Creating the mobile engineer: A study of a training program for engineering consultants. *European Journal of Training and Development* 42(7/8): 381-399.

The paper departs from liminality literature, and it illustrates how organizations can work to develop their employees to better deal with their liminality situations. The aim of this paper is to explore how a TEC firm approaches the development of engineering consultants to prepare them to deal with liminal at work. More specifically, this paper addresses how a training program can increase consultants' liminality competence. This paper is based on a single-case study of an introductory development program (IDP) for newly graduated engineers in one of Scandinavia's leading TEC firms. The paper relies on 18 interviews with developers of, leaders of, and participants in the IDP. In addition, the empirical material consists of nine participant observations conducted during the program, as well as observations carried out during three administrative meetings with IDP leaders and two examinations of the program.

This study identifies three processes that develop the consultants' liminality competence: (i) identifying the core of an assignment, (ii) embracing "in-betweenness," and (iii) broadening the scope of action. The results indicate that the IDP enhances the liminality in the consultants' work positions, and does not focus on lowering the ambiguity experienced by the participants. The participants' role as engineering consultants was emphasized throughout the program. The discussions highlighted the consultants' points of view, by focusing on issues such as their ability to identify the core of an assignment and add value to the project and client organization by emphasizing their position as inside-outsiders. The paper illustrates that a good engineering consultant is someone who can continuously cast and recast oneself for different audiences and to enter and distance oneself from different organizational units and organizations instantaneously.

4.5 Summarizing the four papers

Table 5 below summarizes the four papers with respect to the research questions addressed, and the data collection methods used. In addition, the table sums up the main findings of the papers.

Paper	Research question addressed	Data collection methods	Findings
Paper I	RQ1 and general aim	20 interviews with managers and 20 interviews with consultants	This paper singles out knowledge cycling and swift transition as two salient capabilities within the TEC firm.
Paper II	RQ2 and general aim	37 interviews with managers, 30 interviews with consultants and three interviews with experts and analysts	This paper identifies four TEC firm capabilities: (i) service delivery, (ii) understanding client needs, (iii) knowledge transfer, and (iv) mobility among problem-solving contexts. This paper illustrates how these capabilities differ among TEC firms, and it identifies two ideal types of firms: <i>resource-capitalizer</i> and <i>project-capitalizer</i> .
Paper III	RQ3 and general aim	20 interviews with managers and 24 interviews consultants, in addition to eleven interviews with IDP participants and ten interviews with client representatives	This paper develops the notion of knowledge cycling as a process consisting of four phases: (i) entering an assignment, (ii) building experience, (iii) contributing to the project, and (iv) shifting to a new assignment.
Paper IV	RQ4 and general aim	Three interviews with IDP developers, four interviews with IDP leaders, eleven interviews with IDP participants, in addition to three observations of administrative meetings, nine participant observations of the IDP and two observations of IDP examinations	This paper identifies three processes that enable consultants to manage their liminal work situation and increase their liminality competence: (i) identifying the core of an assignment, (ii) embracing “in-betweenness” and (iii) broadening the scope of action.

Table 5. Overview of the four papers comprising the thesis.

Chapter 5

Discussion

This chapter addresses the research questions and discuss them based on the findings presented in the four appended papers. This chapter begins by comparing the studied TEC firms to neo-PSFs. The chapter then portrays the capabilities of swift transition and knowledge cycling, and it illuminates the interplay between these capabilities. This is followed by an illustration of the heterogeneity among TEC firm capabilities. Subsequently, the process of knowledge cycling is presented, which illustrates how knowledge transfer and knowledge development are facilitated through the mobility of consultants among problem-solving contexts. The chapter ends by depicting how a formal competence development program can develop technical consultants' ability to master their liminal work situation, and enhance their ability to transfer knowledge among assignments, projects, client organizations, and industries.

5.1 TEC firms as neo-professional service firms

This thesis demonstrates that TEC firms differ from classical PSFs in a number of respects, which has consequences for the nature of the technical consultants' work and the organization and development of engineering knowledge. TEC firms have a *flatter* hierarchy, which differs from the more hierarchical models adopted by more conventional PSFs (Doorewaard and Meihuizen, 2000). In other words, TEC firms have not adopted the *up or out* approach to careers. Moreover, the firms host a multi-disciplinary knowledge base, as opposed to classical PSFs (Fosstenlökken et al., 2003; Malhotra and Morris, 2009). The TEC firms are non-partnership PSFs, they are public and private corporations, which differs from the ownerships structure used by a number of other PSFs (Anand et al., 2007; Greenwood et al., 1990). Finally, TEC firms face a fierce competition from self-employed consultants and small firms, as the entry barriers to the TEC industry are generally low.

This thesis argues that the TEC firms addressed, herein, resemble neo-PSFs (von Nordenflycht, 2010), which has an impact on the nature of these firms (Malhotra and Morris, 2009; von Nordenflycht et al., 2015). In that respect, the studies presented in this thesis offer both a more nuanced description of the characteristics of neo-PSFs, and a more elaborate understanding of

TEC firms. Chapter 2 illustrated that neo-PSF are characterized by knowledge intensity and low capital intensity (von Nordenflycht, 2010), and it discussed the two managerial challenges associated with these types of firms (i) retaining and directing skilled employees (Greenwood and Empson, 2003), and (ii) opaque quality (Løwendahl, 2005; von Nordenflycht, 2010). Papers I and II illustrate that the six studied TEC firms invest in a wide range of internal learning opportunities, in order to retain their employees and create a stronger corporate culture. However, the culture fostered by the TEC firms is different from conventional corporate cultures that promote a shared collective identity (Alvesson and Lindkvist, 1993). Instead, the findings indicate that the culture revolves, to a much larger extent, around learning and competence development and of promoting individual autonomy and employability (Doorewaard and Meihuizen, 2000; Empson et al., 2015; von Nordenflycht et al., 2015). The firms broaden their employees' learning opportunities through competence development programs, internal courses, and competence networks (Doorewaard and Meihuizen, 2000). Apart from developing consultants' competence, the networks are important tools for sharing knowledge and experience across departments and business units (Swart et al., 2015). The results demonstrate that on-the-job training is an important element of knowledge development, as the consultants accelerate their development through challenging assignments (Hicks et al., 2009). Prior research has demonstrated that formal training in connection with on-the-job training develops the employees' abstract and contextual knowledge (Hislop, 2008). Although the studied TEC firms invest in learning and competence development, Alpha fosters a particular kind of *knowledge culture* with strong emphasis on formal competence development and on-the-job-training. This is illustrated in Papers I, III and IV. The TEC firm's culture revolves around continuous learning and competence development. Alpha has invested in activities centered on learning from experience, and it engages regularly in reflective activities to enhance learning (Bolton, 2014; Bradbury et al., 2010). During the last 15 years, the management of Alpha has been developing methods for the transfer of knowledge and experience in order to make problem-solving more efficient. The findings show that these learning opportunities make the consultants more confident in their roles, and they increase the willingness of consultants to take on more challenging assignments.

The studied TEC firms direct their consultants through guidance (Malhotra et al., 2006), i.e. consultant managers guide the consultants through continuous dialogue in order to satisfy the consultants preference for autonomy (Empson et al., 2015; Lorsch and Tierney, 2002; Teece, 2003). To maintain this ability, the majority of the consultant managers work part-time as consultants in client projects. Papers I and II indicate that, by doing so, they can better understand and relate to consultants' situation, better understand what goes on in client assignments, and stay tuned to what goes on out in the field. The ongoing dialogue between the consultant managers and the consultants centers on consultants' current assignments, the shift to future assignments, and consultants' competence development in connection with future assignments.

The challenge of opaque quality refers to cases where the quality of the individual expert's output is difficult for clients to assess (Løwendahl, 2005; von Nordenflycht, 2010). This brings about the need for firms to signal quality to their clients (von Nordenflycht, 2010). In order to signal quality to their clients, the studied TEC firms focus on developing close client

relationships (Broschak, 2015; Løwendahl, 2005). The findings indicate that being geographically close to their clients is an important part of the TEC firms' business strategy (Malhotra and Morris, 2009): "We have the advantage of meeting our clients locally" (Manager, Zeta). In addition, it is important to gain an understanding of what clients need, how clients work, and what the client culture dictates. Papers I, II and III demonstrate that it is important to discern the problem-solving conditions set by the internal structuring of the client organization, as this discernment aids the TEC firms in matching client needs with the right resources. This emphasizes the importance of matching the right resources to the needs of the client for successful service delivery.

Low capital intensity denotes that a firm's production does not involve large amounts of nonhuman assets (von Nordenflycht, 2010). The studied TEC firms' production requires primarily the knowledge and competence of their employees. Thus, the majority of the studied firms do not offer products, but rather focus on recruiting and developing capable technical consultants. Von Nordenflycht (2010) argues that knowledge intensity coupled with low capital intensity creates a situation where the firm cannot control whether the employees leave work one evening and do not come back the following day. In order to try to circumvent this challenge, it is important that the firm implements effective retention methods. In addition to the methods discussed above, Papers I, II and III indicate that the mobility among assignments, offered by the firms, is important for retaining consultants (Barley and Kunda, 2004; Borg and Söderlund, 2014; Swart et al., 2015). This is crucial as the consultants "do not want to end up in the situation where a lot of regular employees end up – holding desperately on to their desks and their tasks" (Manager, Alpha). In other words, a lack of assignment rotation and challenging assignments can affect employee turnover negatively.

5.2 TEC firm capabilities

Previous studies have highlighted two main reasons for the reliance on external resources: numerical flexibility and functional flexibility (Atkinson et al., 1984; Handy, 1989; Kalleberg, 2001; Matusik and Hill, 1998). This thesis, however, demonstrates the incompleteness of the traditional flexibility analysis, and it shows that TEC firms have other roles to play than merely solving the problem of numerical flexibility and functional flexibility. The findings illustrate that these additional roles pertain to the creation of knowledge dynamics and the development of specialized technical expertise and social skills. These alternative accounts enhance the understanding of the organization of engineering knowledge as a driver for innovation (Consoli and Rentocchini, 2015), and might be one of the explanations for the increasing importance of TEC firms (BLS, 2017; EC, 2017; WEF, 2016).

The following sections present the capabilities of *swift transition* and *knowledge cycling*. This thesis argues that the interplay between these particular capabilities is crucial for the successful organization of engineering knowledge and the transfer of knowledge among assignments, projects, client organizations, and industries. The capabilities of swift transition and knowledge cycling were identified in Paper I and further developed in Paper III.

5.2.1 The capability of swift transition

The capability of swift transition rests on the TEC firm's ability to meet client needs by quickly allocating consultants to projects at the client site. Staying on the move has been singled out as critical for the success of mobile engineers employed by the TEC firms (Barley and Kunda, 2004; Borg and Söderlund, 2014). The findings demonstrate that in order to make sure that the consultants stay on the move, it is important to create plans for future assignments in collaboration with the consultants, which consider the mobile engineer's abilities, competencies, and personal development. The firms have been devoted to building the ability of swiftly responding to client requirements for resources and engineering expertise by quickly moving their consultants among problem-solving contexts. However, swift transition is not only about quickly responding to client needs and ensuring that the consultants stay on the move; it is also about ensuring that the movements occur with greater precision and less friction, which requires a good understanding of the clients' technologies and problem-solving contexts. The firms have developed this ability by fostering close client relationships (Broschak, 2015; Løwendahl, 2005; Malhotra and Morris, 2009; Nikolova et al., 2009). The studied TEC firms have considerable experience from working closely with their clients. This has provided them with an understanding of their clients' businesses and needs as discussed in Paper II. It is crucial that the firms strive to meet client needs in order to provide high quality services. By gaining a deeper understanding of the client needs for particular competence, the firms are able to match the right consultants with the needs of their clients. It is critical that the firms offer their clients the right competence at the right time. "We are trying to work as close with the clients as possible, every consultant is like a piece of puzzle, if you choose the wrong piece it does not matter how hard you push it, it just will not fit. It is like that with consultants too" (Manager, Alpha). The findings indicate that clients value the fact that TEC firms have the ability to recognize where consultant would fit, and that they are not only trying to sell a consultant.

However, this thesis argues that equally important for the effectiveness of swift transition, is the technical consultants' ability to swiftly enter new assignments and problem-solving contexts. Mobile engineers have to possess the necessary skills to master swift transition, as they usually move into projects where there is a need to focus on rapid solutions and to adjust quickly to the team and project requirements at large (Lindkvist, 2005; Meyerson et al., 1996). Thus, they are required to quickly get involved in the project teams and problem-solving contexts in which they enter (Borg and Söderlund, 2014). The findings show that upon entering a new assignment, mobile engineers must unravel their roles in the assignment and the project team, both in terms of the technical as well as the social elements. This means that they need to untangle the nature of their technical task as well as their social roles in the project team (Barley and Kunda, 2006; Borg and Söderlund, 2014). Hence, the results demonstrate that in order to swiftly become a part of the project team and be able to add value to a project, the consultants must establish themselves in their new work situation by building trust among their team members and carving out a role for themselves in the project. "Quite often it feels like arriving to the platform when the train has already left; as a result, you basically start your first day by running to catch up" (Consultant, Alpha).

In order to become part of the problem-solving contexts quickly the consultants must be driven; they have to read up on relevant literature, search for answers by being inquisitive, contribute with their knowledge to the project team, and seize the opportunities that present themselves as indicated in Paper III. Apart from swiftly entering new problem-solving contexts, developing trust and establishing a position in the project team that adds value to the project and the client organization, mobile engineers must also be able to successfully hand-over assignments to the project team and the client organization before leaving the assignment (Borg and Söderlund, 2014). The findings highlight the importance of making a successful exit from the project, as there is no chance for redemption if the hand-over is unsuccessful. The consultants develop this ability through recurrent movements among assignments, projects, and client organizations.

5.2.2 The capability of knowledge cycling

In addition to the capability of swift transition, the capability of knowledge cycling is central to the successful organization of engineering knowledge and the transfer of knowledge among problem-solving contexts. The notion of knowledge cycling is further developed in Paper III.

The notion of knowledge cycling draws on ideas of biological cycling where it refers to “the scheduled rotation of one class of antibiotics with one or more different classes exhibiting comparable spectra of activity” (Brown and Nathwani, 2005: 6). The knowledge cycling notion is developed by relating the findings of the thesis to biological cycling (Brown and Nathwani, 2005) and explains how knowledge transfer and knowledge development is facilitated by the mobility inherent in a technical consultants’ work situation. A principal aspect of knowledge cycling is the ongoing nature of knowledge transfer between a mobile engineer and the focal context. This thesis suggests that knowledge cycling is an alternative and advanced form of knowledge transfer that illustrates the importance of individual agency and contextual understanding. According to situated learning theory, knowledge is ingrained in practices and contexts (Lave and Wenger, 1991). This stream of literature emphasizes the importance of contextualizing knowledge before understanding how it is transferred across different knowledge communities (Brown and Duguid, 2001). As documented in prior research, labor mobility is essential for knowledge transfer (Song et al., 2003). Yet, despite its importance and value, one could argue that knowledge transfer by way of labor mobility is at odds with widely acknowledged preconditions for situated learning (Brown and Duguid, 1991; Wenger, 1998). This thesis argues that the notion of knowledge cycling illustrates that mobile knowledge (Hoopes and Postrel, 1999) is crucial for local knowledge development.

Applying the concept of biological cycling (Brown and Nathwani, 2005) to an organizational context requires a few adjustments. This thesis suggests that knowledge cycling entails the scheduled rotation of individuals among organizational contexts to allow for the transfer and development of knowledge. Hence, the focus is on individual consultants with diverse backgrounds and experience, who rotate among problem-solving contexts with different cultures and standard operating procedures. The typical consulting assignment lasts between one and two years. However, the findings of this thesis indicate that consultants should stay a shorter time on their assignments in order to be able to develop new skills, as lengthy assignments can be deteriorating for mobile engineers’ development and employability, which is discussed in Paper II. However, mobile engineers should stay long enough on their

assignments to mature in their roles and be able to contribute with added value to the project and the client organization. Hence, the effectiveness of knowledge cycling rests on the balance between rotating the consultants among problem-solving contexts in order for them to stay current, and allowing them to stay long enough on one assignment to be able to add value to the new problem-solving context and develop their knowledge further. This indicates that prior research advocating that the more time spent on one assignment, the more skills are developed (Nightingale et al., 2011) does not necessarily apply to the context of technical consulting. It can be argued that a TEC firm functions as an organization that better transfers and distributes knowledge among organizational contexts (Kogut and Zander, 1992; Malhotra, 2003). The findings show that TEC firms contribute to innovation by enabling the mobility of knowledge among assignments, project, client organizations, and industries.

As for the capability of swift transition, consultants' abilities are equally important for the success of knowledge cycling, since mobile engineers are the ones who transfer knowledge among various problem-solving contexts. The findings demonstrate that the consultants have an important role in the transfer of knowledge among problem-solving contexts. The scheduled rotation among problem-solving contexts enables them to contribute with knowledge and experience, which a client organization is not able to acquire on its own. Hence, in order for knowledge cycling to be effective, mobile engineers must be able to apply the knowledge acquired in prior problem-solving contexts to the current assignment (Creplet et al., 2001; Handley et al., 2007; Rosenberg, 2009). In addition, the findings show that the consultants must be able to learn from the current assignment and acquire new knowledge that can be transferred to future assignments. In order to accomplish this, mobile engineers must develop liminality competence (Borg and Söderlund, 2015a; Borg and Söderlund, 2015b; Sturdy et al., 2009). According to Borg and Söderlund (2015a: 270), consultants that possess a high liminality competence perceive their work as knowledge transfer, and they consider one of their "major missions in work to use knowledge from other firms and contexts in the current assignment [and] acquire new knowledge to build on the existing repertoire." The findings indicate that mobile engineers create value for the project and the client organization by taking initiative, suggesting improvements, and identifying alternative solutions. Consultants can provide fresh perspectives (Clegg et al., 2004) more easily than the client's engineers as they are able to distance themselves from the problem-solving context, as indicated in Paper IV. In addition, the mobile engineers must acquire new knowledge, which build on their existing repertoire of skills (Borg and Söderlund, 2015a), and can be transferred to benefit future assignments.

5.2.3 The interplay between swift transition and knowledge cycling

The capabilities of swift transition and knowledge cycling are tightly coupled. This thesis argues that the link between the two capabilities creates the foundation for the successful organization of engineering knowledge. The findings of this thesis highlight that the two capabilities transcend organizational levels and are formed through interaction between the organizational level and the individual level. Figure 6 illustrates the link between capabilities and organizational levels.

Figure 6. The interplay between swift transition and knowledge cycling.

Swift transition is closely linked to knowledge cycling as it is crucial for consultants to move swiftly from one problem-solving context to another and learn how to interact swiftly with other members in the clients' project teams. In addition, in order for knowledge cycling to be successful, the TEC firm must be able to match the right consultant to the needs of the client and ensure that the consultant stays long enough on his/her assignment to understand the problem-solving context and learn the task well enough to be able to transfer the knowledge acquired to other contexts. At the same time, the consultant should stay short enough to stay current and be able to engage in knowledge processes to broaden his/her repertoire of skills. Hence, the TEC firm must be able to rotate its consultants among problem-solving contexts in order to keep their competence current. Table 6 summarizes the key processes, practices, and individual skills pertaining to the two capabilities.

Swift transition	Knowledge cycling
<i>Key processes</i>	
Identifying client needs early, matching client needs with individual skills, swiftly entering and quickly comprehending new problem-solving situations	Identifying learning opportunities, accumulating knowledge, transferring knowledge to new problem-solving contexts
<i>Core practices</i>	
"Swift rotation": stay on the move	"Scheduled rotation": stay short enough but also stay long enough
<i>Individual skills</i>	
"Moving in, moving out": quickly entering new assignments, handing over assignments and tasks to team members when leaving	Absorbing and transferring: learning from assignments and tasks, transferring lessons learned to the client organization

Table 6. Comparing capabilities: Swift transition and knowledge cycling.

5.3 The heterogeneity among TEC firm capabilities

Paper II illustrates the heterogeneity among TEC firms (Løwendahl, 2005; Malhotra and Morris, 2009; von Nordenflycht et al., 2015) by demonstrating how capabilities differ among firms. Four distinct capabilities were distinguished through the study of six TEC firms: (i) service delivery, (ii) understanding client needs, (iii) knowledge transfer, and (iv) mobility among problem-solving contexts. The differences among firms regarding the four capabilities stem from the firm's organizational processes and the individual skills of the technical consultants. Based on the identified differences, two types of firms were identified: *resource-capitalizer* and *project-capitalizer*. These two types of firms are ideal types, thus, there are firms that are a combination of the two.

TEC firms resembling *resource-capitalizers* mainly deliver their services to clients through the use of resource consulting. To be a successful resource consultant, the technical consultant must have the ability to enter new assignments swiftly, and establish a position in the project team that adds value to the client (Barley and Kunda, 2006; Borg and Söderlund, 2014). The TEC firms must also be able to identify client needs swiftly and match client needs with individual skills through close client collaboration (Broschak, 2015; Løwendahl, 2005; Malhotra and Morris, 2009; Nikolova et al., 2009). It is equally important that technical consultants have the ability to gain an understanding of client needs to be able to suggest improvements that improve the clients' processes (Kvålshaugen et al., 2015). *Resource-capitalizers* put a strong emphasis on the individuals' professional development, which is achieved through formalized competence development initiatives and on-the-job training. As indicated in Papers III and IV, competence development and on-the-job training enables consultants to learn how to quickly enter new assignments, develop trust, and establish a position in the project team that adds value to the project and the client (Barley and Kunda, 2006; Borg and Söderlund, 2014; Meyerson et al., 1996; Nikolova et al., 2015). The capabilities of service delivery and understanding client needs identified in this type of firms are closely coupled to the capability of swift transition identified in Paper I. *Resource-capitalizers* have the ability to identify opportunities in which consultants can apply lessons learned from previous assignments and broaden their competence. Moreover, these firms ensure that knowledge is reflected upon in order to enhance learning (Bolton, 2014; Bradbury et al., 2010; Messmann and Mulder, 2015). These initiatives make consultants more confident in their roles as discussed in Paper IV, and they enable consultants to apply knowledge gained in prior problem-solving contexts to the current assignment (Creplet et al., 2001; Handley et al., 2007; Rosenberg, 2009). *Resource-capitalizers* center on scheduled rotation among assignments, projects, client organizations, and industries as discussed in Paper III. These firms have policies in place regarding the mobility among problem-solving contexts. Thus, they regularly rotate their consultants among different problem-solving contexts in order to transfer knowledge among contexts and keep consultants' competence current. In order to keep their competence current, consultants must have the ability to utilize mobility to seize new opportunities for learning (Borg and Söderlund, 2015a). Previous studies have indicated that consultants that possess both technical and social skills are more successful in handling continual shifts among problem-solving contexts (Borg and Söderlund, 2014). Capabilities of knowledge transfer and mobility are strongly linked to the capability of knowledge cycling identified in Paper I.

TEC firms that belong to the type of *project-capitalizer* center on devising strategies to utilize their multi-disciplinarity (Fosstenløkken et al., 2003; Malhotra and Morris, 2009). This enables them to expand their portfolio of services and offer their clients a larger quantity of work packages. The findings indicate that this is due to the fact that clients want to hire TEC firms that can coordinate multiple disciplines by efficiently exploiting the synergies among their knowledge areas to deliver high quality services to their clients. This trait can partly be attributed to firm size, as the findings indicate that large TEC firms are able to coordinate multiple disciplines and exploit the synergies among their knowledge areas. Prior studies have identified firm size as one of the sources of heterogeneity among PSFs within the same industry (von Nordenflycht, 2011; von Nordenflycht et al., 2015). Consultants involved in in-house projects must have the ability to enter new projects swiftly, and integrate own knowledge with that of the team members with the goal of creating value for the client. As consultants working in in-house projects usually stay within the project from beginning to end, they do not feel like they are “arriving to the platform when the train has already left” (Consultant, Alpha), as resource consultants might feel. Project-capitalizers must also be able to build close client relationships (Broschak, 2015; Løwendahl, 2005; Skjølsvik et al., 2007) in order to understand client needs and allocate entire project teams internally to respond to client needs. Thus, the focus is not on swiftly allocating the best consultants to projects at the client site as illustrated in Papers I and III. In addition, consultants must possess the ability to gain an understanding of client needs to be able to identify alternative solutions to client problems (Nikolova et al., 2009). *Project-capitalizers* focus on facilitating knowledge transfer among problem-solving contexts and utilizing cross-fertilization in order to increase clients’ competitiveness (Nesheim et al., 2014). However, in order for the project to be successful it is equally important that the consultants apply knowledge gained in prior problem-solving contexts to the current project (Clegg et al., 2004; Handley et al., 2007). *Project-capitalizers* recognize that mobility among assignments, projects, client organizations, and industries is important for consultants’ development and employability. However, historically, the frequency of rotation in these firms has been dictated by client needs. Hence, these firms lack policies regarding the mobility of consultants among assignments, projects, client organizations, and industries. According to the findings of Paper III, this can hinder consultants’ development as they become too specialized and lose the ability to apply the knowledge acquired in prior problem-solving contexts to future assignments (Creplet et al., 2001; Handley et al., 2007; Rosenberg, 2009). In addition, if they stay too long in one assignment, their development will stagnate and they will not be able to acquire new knowledge that can be transferred to future assignments (Borg and Söderlund, 2015a). The findings indicate that the lack of mobility can even lead to higher employee turnover, it is, therefore, important that the firms strive to keep their consultants mobile. The firms must also have the ability to offer consultants challenging assignments in which they can develop their competence. Consultants working in this context must drive their own development to a larger extent and be able to take initiative for mobility among problem-solving contexts in order to broaden their competence (Tempest and Starkey, 2004). However, the findings indicate that consultants’ wishes for mobility are not always met due to the fact that managers either find it unprofitable or wish to preserve client relationships (Broschak, 2015). Table 7 illustrates how the four capabilities differ among the two types of firms.

	Resource-capitalizer	Project-capitalizer
Service delivery	Organizational processes: Delivering services to clients through resource consulting	Organizational processes: Exploiting multi-disciplinarity to deliver services to clients, and utilizing synergies among knowledge areas to deliver a larger quantity of work-packages
	Individual skills: Entering new assignments swiftly, and establishing a position in the project team that adds value to the client	Individual skills: Entering new in-house projects swiftly, and integrating own knowledge with that of the project team members to create value for the client
Understanding client needs	Organizational processes: Building close client relationships in order to understand client needs, and responding to client needs by matching needs with individual skills	Organizational processes: Building close client relationships in order to understand client needs, and allocating entire project teams internally to respond to client needs
	Individual skills: Gaining an understanding of client needs to be able to suggest improvements that enhance the client's processes	Individual skills: Gaining an understanding of client needs to be able to identify alternative solutions to client problems
Knowledge transfer	Organizational processes: Facilitating internal knowledge transfer through formalized competence development, and enabling external knowledge transfer among problem-solving contexts	Organizational processes: Facilitating knowledge transfer among problem-solving contexts, and utilizing cross-fertilization in order to increase the clients' competitiveness
	Individual skills: Applying knowledge gained in prior problem-solving contexts to the current assignment	Individual skills: Applying knowledge gained in prior problem-solving contexts to the current in-house project
Mobility among problem-solving contexts	Organizational processes: Creating policies to facilitate the mobility of knowledge among assignments, and regularly rotating consultants among problem-solving contexts	Organizational processes: Offering consultants challenging assignments in which they can broaden their competence
	Individual skills: Utilizing mobility to seize opportunities for learning and broadening competence	Individual skills: Taking initiative for mobility among problem-solving contexts in order to broaden competence

Table 7. Capabilities in the two ideal types of TEC firms.

5.4 Facilitating knowledge transfer and knowledge development through mobility

Paper III develops the notion of knowledge cycling as a process, which facilitates the transfer and development of knowledge through the mobility inherent in technical consultants' work. The process of knowledge cycling consists of four phases that correspond to the different phases of the consulting assignment: (i) entering an assignment, (ii) building experience, (iii) contributing to the project, and (iv) shifting to a new assignment.

The first phase, *entering an assignment*, builds on the capability of swift transition identified in Paper I. Hence, this phase rests on mobile engineers' ability to swiftly enter new assignments, analyze the problem-solving context and become part of the problem-solving situation (Barley and Kunda, 2006; Borg and Söderlund, 2014). It is not surprising that consultants see themselves as magicians, continuously aiming to exceed client expectations. Mobile engineers must also have the ability of establishing trust quickly in the new assignment and create a role for themselves in the team (Barley and Kunda, 2006; Meyerson et al., 1996; Nikolova et al., 2015). However, consultants must not only acquire knowledge about these interpersonal matters but also about the technical domain in which they will be working (Borg and Söderlund, 2014). Mobile engineers have a high level of technical knowledge when they enter an assignment, nevertheless, they must acquire an understanding of the new domain each time they enter a new assignment. Consultants acquire knowledge about the new domain by identifying knowledgeable colleagues who can guide them in their work. This phase is facilitated through the TEC firm's ability to swiftly respond to client needs for engineering expertise and match client needs with individual competence portfolios. In short, matching the right consultant to client needs is essential for the effectiveness of knowledge cycling. This is accomplished through close client relationships (Broschak, 2015; Løwendahl, 2005; Malhotra and Morris, 2009; Nikolova et al., 2009). In order for this phase to be successful, the client representatives must allow the mobile engineers to participate in the problem-solving context.

The second phase, *building experience*, involves the development of mobile engineers through both on-the-job training by way of challenging assignments, and competence development activities. The mobile engineers develop expertise through on-the-job training by way of participating in problem-solving processes in client projects. Previous studies have indicated that learning through participation enhances learning for all parties involved (Hicks et al., 2009). In addition to on-the-job training, TEC firms, such as Alpha, facilitate internal knowledge transfer and enhance consultants' development through formal training (Doorewaard and Meihuizen, 2000; Hislop, 2008). Furthermore, mobile engineers are encouraged to keep a consultant diary that reflects on their daily work situation in order to enhance learning and be able to easier retrieve lessons previously learned (Bolton, 2014; Bradbury et al., 2010; Messmann and Mulder, 2015). The findings of this thesis indicate that mobile engineers become more confident in their competence through on-the-job training in connection with formal training. Paper IV illustrates that the confidence built through formal training enables consultants to take on more challenging tasks that might lie outside of their assignment specification, and to access new learning opportunities that accelerate their

development. This indicates that client representatives must allow the consultant to learn from their organization and experience.

The third phase, *contributing to the project*, amounts to creating added value for the clients. Mobile engineers contribute to the project by sharing and applying knowledge acquired in other assignments, projects, client organizations, and industries in order to solve a particular problem in the current project (Bessant and Rush, 1995; Creplet et al., 2001; Handley et al., 2007; Malhotra, 2003). Consultants contribute to a project by combining their knowledge with that of their project team members toward the end of developing new knowledge (Okhuysen and Eisenhardt, 2002). This integration indicates that project team members share and apply their knowledge to solve a common problem. Consultants do not copy pieces of the puzzle from other client organizations in order to implement ready-made solutions in the current assignment but, rather, contribute with their knowledge about processes, methods and tools obtained in previous problem-solving contexts. Furthermore, mobile engineers add value to the project by taking initiative, suggesting improvements, and identifying alternative solutions. The TEC firm enables such contributions by building collective trust among the client, the TEC firm, and the consultant. The TEC firm supports the development of mobile engineers' knowledge bases, by facilitating transitions to new roles and projects (Borg and Söderlund, 2015a). The findings of this thesis illustrate that the ability to create value for the clients increases as the consultants mature in their consulting roles. In order for the consultants to be able to contribute, the client organization must have already developed sufficient absorptive capacity (Cohen and Levinthal, 1990), so it can learn from the hired consultants. In addition, the engineers employed by the client organization must be sufficiently open-minded to identify learning opportunities from the consultant's experience.

The final phase, *shifting to a new assignment*, concerns the transfer of consultants among problem-solving contexts. Previous research has indicated that labor mobility enhances inter-firm knowledge transfer (Almeida and Kogut, 1999; Rosenkopf and Almeida, 2003; Song et al., 2003). In order to effectively transfer knowledge among problem-solving contexts, mobile engineers must be able to transfer relevant knowledge to a new context as well as seize opportunities for learning in order to acquire new knowledge, which can then be transferred to future assignments (Borg and Söderlund, 2015a; Clegg et al., 2004; Handley et al., 2007). Consultants' ability to transfer knowledge among problem-solving contexts is enhanced through the development of liminality competence, as illustrated in previous research (Borg and Söderlund, 2015a) and Paper IV. A TEC firm facilitates this transfer of knowledge among assignments, projects, client organizations, and industries by organizing for mobility. This phase requires that the TEC firm deliberately searches for clients who might provide fertile soil for consultants to acquire knowledge, learn, and develop their competence (Borg and Söderlund, 2015a; Løwendahl et al., 2001). The findings highlight the importance of mobility in keeping consultants' competence current, and demonstrate that broad competence is central for consultant employability. Thus, it is important that consultants do not become too focused on a single technology. This phase can only be successful if client representatives are willing to let consultants move on to new assignments. Table 8 illustrates the characteristics of knowledge cycling.

What is knowledge cycling?	The process of intentionally moving individuals, at certain intervals, among problem-solving contexts in order to stimulate knowledge development and knowledge transfer. It involves ensuring a balance between staying long enough to learn from and contribute to local knowledge processes yet also ensuring rotation to foster consultants' ability to learn from experience and maintain a necessary distance from local problem-solving processes.
Why is knowledge cycling important?	Knowledge cycling is especially important when transferring more complex problem-solving knowledge across diverse problem-solving contexts. It is essential to encourage local knowledge development by making use of global problem-solving knowledge. It adds knowledge breadth and variation to local problem-solving processes through the infusion of "cosmopolitan" knowledge.
In which organizational contexts is knowledge cycling important?	In knowledge-intensive, project-based teamwork; also, when there are significant knowledge complementarities among problem-solving contexts to add "noise" and/or "new flavor."
When is knowledge cycling most important?	In times of fairly rapid knowledge development that could benefit from learning across diverse problem-solving contexts. Knowledge cycling may be especially important in knowledge areas where there are complementarities among problem-solving contexts and where the variety of problem-solving techniques allows for both knowledge transfer and new knowledge development.
What characterizes the knowledge-cycling process?	An initial phase of entering a problem-solving context (responding to client needs, understanding client needs, analyzing the problem-solving situation). A second phase of building experience around the assignment (facilitating and developing through formal training as well on-the-job training). A third phase of contributing to the project (building collective trust, sharing knowledge, using previous experience to create value for the clients). A final phase of shifting to a new assignment (switching resource for learning purposes, capitalizing on mobility, searching for new learning opportunities). These phases focus in different ways to promote project task familiarization (gaining a better understanding of the technical domain, understanding the technical problems) and also to promote project organization familiarization (understanding the project's context, the organization, the members of the organization, and the project team members).
What is the individual consultant's role in knowledge cycling?	The individual brings knowledge from prior problem-solving contexts—knowledge that pertains to both the technical and social elements of problem solving—and applies those lessons learned to the new context.
What is the [TEC] firm's role in knowledge cycling?	The [TEC] firm assigns and transfers individual consultants to client contexts in which their knowledge can be further developed. The [TEC] firm matches the individual's requirements for learning with the client's needs for problem solving and knowledge transfer.
What role does the client organization play in knowledge cycling?	The client organization absorbs and shares experience, giving responsibility to consultants to take on challenging and instrumental tasks. The client has a dual role in both ensuring that the consultant can enter a new assignment effectively and in allowing the consultant to move on and learn from projects and solutions in particular projects.

Table 8. Characteristics of knowledge cycling.

5.5 Developing liminality competence through formal training

Paper IV presents the findings from an introductory development program (IDP) designed by Alpha for newly graduated engineers. The general aim of the IDP is to develop mobile engineers' professional expertise. The creators of the program depict professional expertise as an understanding of both the technical and social elements of work. Unlike other firms, one of the challenges faced by TEC firms, such as Alpha, is that the competence development of their employees should focus on leveraging technical consultants' performance in an organizational context different than the TEC firm, i.e. the client organization. Hence, liminality is an inherent feature of a consultant's work situation (Tansley and Tietze, 2013). Mobile engineers' work situation, in itself, constitutes a liminal position at work (Ellis and Ybema, 2010; Tempest and Starkey, 2004). Handley et al. (2007: 183) argue that mobile engineers' liminal status accounts for their "ability to introduce new knowledge or to surface previously ignored knowledge" within the client organization. Thus, consultants' liminal status enables them to transfer knowledge to and among assignments, projects, client organizations and industries (Borg and Söderlund, 2015a; Creplet et al., 2001; Handley et al., 2007; McKenna, 2006). However, Borg and Söderlund (2015a) claim that mobile engineers must first learn to master their mobile and transient work situations before they can reap the positive effects of liminality and be able to transfer knowledge among problem-solving contexts. This thesis argues that one way to accomplish this is through the use of *distancing techniques*.

The analysis of the IDP in Paper IV demonstrates that, in the process of learning how to deal with their liminal positions at work, consultants make use of distancing techniques. The distancing techniques consist of writing about and discussing the ambiguities present in consulting work and the challenges connected to these ambiguities. Hence, the program becomes a space in which mobile engineers are "allowed to think about how they think, about the terms in which they conduct their thinking, or to feel about how they feel in daily lives" (Turner and Schechner, 1988: 413). In this manner, the consultants raise their awareness of different aspects of liminality through the use of distancing techniques. The IDP allows the participants to cognitively take a step back and reflect on their work experience in order to survey the liminal dimension of their work (Messmann and Mulder, 2015; Nansubuga et al., 2015; Warhurst, 2013). Borg and Söderlund (2015b: 189) claim that "liminality competence is connected to the ability to reflect on the work situation and to engage in a meta-analysis of the individual's role in the work situation." By distancing themselves from the challenges in their assignments, mobile engineers gained new perspectives on their work.

Based on the analysis of the IDP, Paper IV identifies three processes which increase mobile engineers' liminality competence: (i) identifying the core of an assignment, (ii) embracing "in-betweenness," and (iii) broadening the scope of action.

The first process, *identifying the core of an assignment*, centers on defining the tasks that lie at the core of consultant assignments. The participants reflect on and discuss the issues of unclear assignment boundaries continuously during the IDP. In line with the findings of Papers I and III, the discussions emphasize the need of untangling both the technical and the social elements of a consulting assignment (Borg and Söderlund, 2014). In order to clarify the ambiguities inherent in their work situation, mobile engineers reflect on the context and the role of a

technical consultant (Messmann and Mulder, 2015). During the IDP, the consultants discuss the importance of establishing trust, asking the right questions to define the boundaries of their assignment, and creating a role for themselves in the project team. These discussions aid the participants in identifying the tasks that lie at the core of their assignments. Identifying the core of the assignment provides mobile engineers with an understanding of the knowledge and skills relevant for the current assignment.

The second process, *embracing “in-betweenness,”* makes mobile engineers more confident in the role of a consultants. The consultants embrace in-betweenness by reflecting on their multiple belongings and affiliations during the IDP (Kinnie and Swart, 2012), thus, increasing their understanding of their liminal positions at work. This develops their liminality competence (Borg and Söderlund, 2015a). During the IDP, mobile engineers continuously confessed short-term belonging to the project team, the client organization, and the TEC firm, shifting their descriptions of “we” and “they.” This is connected to the positive aspects of freedom often associated with liminality (Garsten, 1999; Sturdy et al., 2006; Tempest and Starkey, 2004). Furthermore, mobile engineers have stressed that the IDP made them feel more relaxed and secure in their roles, and it taught them how to step outside their safe-zones to challenge themselves and take on greater responsibility in a project and the client organization. Consultants argue that this ability enables them to acquire new knowledge through challenging tasks. Hence, the increase in confidence allows mobile engineers to seize learning opportunities (Tempest and Starkey, 2004) and acquire new knowledge to build on the existing repertoire of skills (Borg and Söderlund, 2015a). The importance of seizing learning opportunities is also emphasized in Papers II and III.

The final process, *broadening the scope of action*, enables mobile engineers to see the value of being an inside-outsider. During the IDP, consultants reflect on the client’s business in order to address any ambiguity surrounding the client (Warhurst, 2013). This broadens their scope of action, and allows them to take on tasks that lie outside the scope of their assignment specifications. During the IDP, mobile engineers discuss how an outside view and a distance from the task at hand enables them to identify alternative solutions to the problems that they encounter in their projects. In relation to the findings from Papers I and III, the participants we observed argued that they can more easily distance themselves from the task at hand than the engineers employed by the client organization, as they frequently move among problem-solving contexts. Remaining distant yet close enough is central to ensuring that mobile engineers help to broaden the search activities of the client firms (Leiponen and Helfat, 2010). Thus, distancing oneself from the task at hand, the assignment and the project, and making use of the role as an insider-outsider arises as an important aspect of consulting work. This enables mobile engineers to contribute with new knowledge to a project and the client organization by transferring knowledge obtained in previous assignments.

The three processes discussed above develop consultants’ ability to deal with their liminal work situations, and these processes enhance the liminality competence of the consultants and enable them to perceive their work as knowledge transfer (Borg and Söderlund, 2015a). Paper IV illustrates that mobile engineers develop the capabilities of swift transition and knowledge cycling through the IDP by learning to master their liminal positions at work. During the IDP,

the participants reflect on their current problem-solving contexts and their roles as technical consultants, which enables them to define the core of their assignments and create a role for themselves in a project team (Barley and Kunda, 2006; Borg and Söderlund, 2014; Nikolova et al., 2015). Moreover, the IDP makes mobile engineers more confident in their roles and enables them to continuously cast and recast themselves for different audiences (Ellis and Ybema, 2010). This allows them to shoulder greater responsibility and seize opportunities for learning (Borg and Söderlund, 2015a). Finally, by distancing themselves from the task at hand, and making use of their roles as inside-outsiders, mobile engineers can transfer knowledge obtained in other problem-solving contexts to their assignments, projects, and client organizations (Borg and Söderlund, 2015a; Borg and Söderlund, 2015b; Creplet et al., 2001; Handley et al., 2007).

Chapter 6

Conclusions

This chapter presents the conclusions and contributions of the research in the thesis. The chapter summarizes the main conclusions from the four appended papers and offers a synthesis of their main findings. Furthermore, this chapter presents practical implications, as well as suggestions for future research.

6.1 Conclusions and contributions

This thesis addresses the TEC firm, a specific type of firm, that has, thus far, been under-researched despite its growing importance in a number of industries. (Berggren et al., 2011; BLS, 2017; EC, 2017; STD, 2017; von Nordenflycht, 2010; WEF, 2016). It is noteworthy that TEC firms have become increasingly important with regard to innovation, knowledge development, and the transfer of knowledge among problem-solving contexts in technology-based industries, but also assumed prominent roles for a range of other industries, and sectors. The aim of this thesis was to investigate the organization and development of engineering knowledge and the roles of the TEC firm and the technical consultants in the transfer of knowledge among assignments, projects, client organizations, and industries. The thesis draws on the knowledge-based view of the firm in presenting a characterization of the TEC firm, its central capabilities, as well as the development of individual skills.

6.1.1 Conclusions

Prior research has offered a rather simplified view of the TEC firm. Most research has highlighted the TEC firm as assuming two predominant roles – to solve the related problems of numerical flexibility and functional flexibility (Atkinson et al., 1984; Handy, 1989; Kalleberg, 2001; Matusik and Hill, 1998). In contrast, the findings of this thesis demonstrate that TEC firms have other roles to play than merely solving the two flexibility problems. This thesis demonstrates that numerical flexibility and functional flexibility explains only part of the TEC industry's growth. More specifically, the thesis shows that additional explanations refer to the knowledge-based advantages accrued by TEC firms through the organization and development

of engineering knowledge. This seems particularly important to fully grasp the functions of these firms, as well as acknowledge the underlying reasons for the growth of the TEC industry.

This thesis argues that a fuller description and acknowledgement of the functions of a TEC firm might be gained by exploring its capabilities. Indeed, the organization and development of engineering knowledge as well as the roles of the TEC firm and the technical consultants in the transfer of knowledge among problem-solving contexts are illuminated through this thesis. This thesis identified two capabilities in the single-case study: swift transition and knowledge cycling. The capability of swift transition centers on a TEC firm's ability to swiftly respond to client need by allocating consultants to the client projects and matching client needs with individual skills, and the technical consultants' ability to swiftly enter new assignments, develop trust, and establish a position in the project team that adds value to the project and the client organization. The capability of knowledge cycling revolves around the TEC firm's ability to rotate consultants among problem-solving contexts, at certain points in time, to allow for the transfer of knowledge, and technical consultants' ability to apply lessons learned to new problem-solving contexts and develop competence through the mobility inherent in their work situation. The findings indicate that the capabilities of swift transition and knowledge cycling are tightly coupled, and that the link between the two capabilities creates the foundation for the successful organization of engineering knowledge.

In addition to the capabilities of swift transition and knowledge cycling, four additional capabilities were identified in the multiple-case study: (i) service delivery, (ii) understanding client needs, (iii) knowledge transfer, and (iv) mobility among problem-solving contexts. This thesis illustrates that the four identified capabilities differ among the six studied firms; the differences stem from the organizational processes of each TEC firm and the individual skills of its technical consultants. Hence, this thesis emphasizes that the interaction between the organizational level and the individual level is crucial for the formation of TEC firm capabilities. Based on these differences, the thesis identified two ideal types of firms, denoted as the *resource-capitalizer* and the *project-capitalizer*. This thesis indicates that the capabilities accrued by *resource-capitalizers* are directly linked to the capabilities of swift transition and knowledge cycling. The capabilities of service delivery and understanding client needs overlap with the capability of swift transition, while the capabilities of knowledge transfer and mobility among problem-solving contexts are coupled with the capability of knowledge cycling. The *project-capitalizers*, on the other hand, develop capabilities that are more geared toward the delivery of work-packages, thus, differing from the capability of swift transition in which the focus lies on swiftly allocating consultants to projects at client site. Moreover, *project-capitalizers* differ from firms that have accrued the capability of knowledge cycling, as they lack policies regarding the rotation of consultants among problem-solving contexts.

Moreover, this thesis develops the notion of knowledge cycling as a process, which illustrates how knowledge transfer and knowledge development are facilitated through the mobility of consultants among problem-solving contexts. The process of knowledge cycling consists of four phases: (i) entering an assignment, (ii) building experience, (iii) contributing to the project, and (iv) shifting to a new assignment. This process illustrates how consultants transfer and develop knowledge over the course of their assignment, facilitated by mobility among problem-

solving contexts. Thus, knowledge cycling is an interactive process involving both knowledge transfer and knowledge development. Moreover, the process highlights the importance of close collaboration among the consultant, the TEC firm, and the client organization.

Finally, the results of this thesis suggest that consultants can develop the capabilities of swift transition and knowledge cycling through formal competence development initiatives. This thesis illustrates that consultants can learn how to deal with their liminal positions at work and develop liminality competence through the use of distancing techniques. It identifies three processes through which consultants develop liminality competence that enables them to perceive their work as knowledge transfer: (i) identifying the core of an assignment, (ii) embracing “in-betweenness”, and (iii) broadening the scope of action. Moreover, this thesis illustrates that a good technical consultant is able to continuously cast and recast him/herself for different audiences, and enter and distance him/herself from different assignments and client organizations in an instant.

6.1.2 Theoretical contributions

First, by focusing on TEC firms, this thesis contributes to the literature on PSFs by illuminating the heterogeneity among PSFs (Malhotra and Morris, 2009; von Nordenflycht, 2010; von Nordenflycht et al., 2015). Despite recent advancements in the area of PSFs, there is still a dearth of studies that identify the specific characteristics across a variety of PSFs. Beyond the empirical setting, this study is theoretically significant as it offers insights into the challenges facing TEC firms (Empson et al., 2015; Malhotra and Morris, 2009; von Nordenflycht et al., 2015). More specifically, this study adds to the research on the strategic management of PSFs, by illustrating the importance of TEC firm capabilities. Extant research on the strategic management of PSFs is scarce, which is somewhat surprising as strategy is expected to be strongly present in PSFs (Mawdsley and Somaya, 2015; Skjølsvik et al., 2017). Furthermore, the thesis illustrates how capabilities differ among TEC firms, hence, it demonstrates the heterogeneity among TEC firms (Løwendahl, 2005; Malhotra and Morris, 2009; von Nordenflycht et al., 2015).

Second, this thesis demonstrates that the interaction between the organizational level and the individual level is critical for the formation of capabilities in TEC firms. Prior literature has emphasized the importance of exploring the interaction between the organizational level and the individual level to uncover the development of capabilities, as the individuals' roles in affecting organizational advantages have received limited scholarly attention (Felin and Foss, 2005; Foss and Pederson, 2016; Salvato, 2009). This thesis has illustrated that the nature of capabilities in TEC firms is human-centered (Hitt et al., 2001). Consequently, capability development in TEC firms is not solely affected by the problem domain but also by human resource factors. Thus, this thesis contributes to the literature by demonstrating that in order to gain a better understanding of the organization and development of engineering knowledge and the capabilities accrued by TEC firms, there is need to account for the organizational processes, skills, and working conditions of the technical consultants as well as the interaction between the organizational level and the individual level.

Third, the notion of knowledge cycling yields new insights of how knowledge transfer in the context of technical consulting should be viewed. This thesis proposes that knowledge cycling is an alternative and advanced form of knowledge transfer, in which the importance of individual agency and contextual understanding is illustrated. The process of knowledge cycling incorporates both knowledge transfer and knowledge development. In addition, it illustrates the ongoing dynamic among the individual consultant, the TEC firm, and the client, in which both the consultant and the client are important and active players in the problem-solving process (Nikolova et al., 2009). Consequently, the consultant co-creates knowledge with the client. This dynamic is not readily covered in previous literature. This thesis responds to Mawdsley and Somaya's (2015) call for more research on the knowledge management mechanisms that underlie PSFs' capabilities, and it contributes to a deeper understanding of the knowledge processes within TEC firms. More specifically, it illustrates the centrality of mobile knowledge (Hoopes and Postrel, 1999) for the development of local knowledge (Brown and Duguid, 1991; Szulanski, 1996). Hence, the findings emphasize prior literature's contradictory results regarding stable versus mobile drivers for knowledge transfer.

Finally, the findings of this thesis provide a greater understanding of how engineering knowledge can be developed through competence development. The thesis demonstrates that technical consultants can develop the capabilities of swift transition and knowledge cycling through formal training by learning to master their liminal positions at work. Prior research has indicated that liminality is an important competence for employees working in the contexts of technical consulting (Borg and Söderlund, 2015a; Borg and Söderlund, 2015b). This thesis suggests that the ability to swiftly enter new assignments, establish trust and carve out a role in the project team, as well as the ability to transfer knowledge among problem-solving contexts and seize opportunities for learning, can be developed through formal training. Prior studies have indicated that individuals holding liminal positions often become marginalized and receive fewer formal training opportunities than workers employed through standard work arrangements (Garsten, 1999; Legge, 1998; Tempest and Starkey, 2004). The thesis contributes to knowledge about how liminality competence can be developed through formal training, which has, thus far, been an under-researched topic (Kaiser et al., 2015; Kinnie and Swart, 2012; Spanuth and Wald, 2017).

6.1.3 Practical implications

The results of this thesis demonstrate that capabilities in the context of technical consulting are human-centered and developed through an interaction between the organizational level and the individual level, which has implications for how TEC firms organize and develop engineering knowledge. Moreover, the capabilities differ among firms, based on the firm's organizational processes and the individual skills of technical consultants. Firms that are able to coordinate multiple disciplines and utilize the synergies among their knowledge areas are more successful in delivering a larger quantity of work packages to their clients. Thus, they are able to climb higher up in the clients' value chains, which according to the findings of this thesis is the goal of most TEC firms. Moreover, this thesis illustrates that it is important to cultivate close relationships with clients. Managers must strive to gain a deeper understanding of the clients' technologies and problem-solving contexts in order to understand the clients' need for

particular resources. Moreover, the results indicate that it is crucial that the TEC firms offer the right competence at the right time, which requires that managers are able to match the right resources to the needs of the clients.

Second, the TEC firms must ensure that their consultants have the skills necessary to engage in knowledge processes in their assignments. In order to be able to participate in collective knowledge processes within and among problem-solving contexts and co-create knowledge with the client, the consultants must possess both technical knowledge and social skills. This should be considered as an important aspect when recruiting consultants. These individual skills can be enhanced through on-the-job training and competence development initiatives that develop liminality competence. The findings of this thesis indicate that TEC firms can aid technical consultants in dealing with liminality at work, by facilitating the development of liminality competence through competence development initiatives. These initiatives should be carefully designed in order to support individuals exhibiting lower levels of liminality competence in reducing or overcoming the negative effects of liminality. The results illustrate that such competence development initiatives should focus on how the individuals perceive their work. This can be achieved through the use of distancing techniques. Distancing techniques can initiate change in how individuals think about their work, as awareness of different aspects of liminality is raised through the use of distancing techniques. This indicates that competence development initiatives should go beyond solely focusing on developing specific knowledge and skills used in performing work and should stress how individuals perceive liminality at work.

Finally, this thesis illustrates that organizing for mobility is an important aspect in the context of technical consulting. The preference for mobility has important implications for the organization and management of technical consultants. In order to successfully organize for mobility, managers must strive to create a balance between staying long enough on each assignment in order to add value to that context and maximize the learning from the current assignment, and rotating among assignments to stay current and remain able to engage in knowledge processes that broaden consultants' competence. The findings of this thesis indicate that many TEC firms lack policies regarding the mobility of consultants among problem-solving contexts. The lack of mobility can deteriorate a consultants' competence as they can become too specialized and lose the ability to engage in knowledge processes that broaden their repertoire of skills. Moreover, lack of mobility can also lead to higher employee turnover, as consultants might choose to leave the firm due to this lack. Hence, in order to deal with this problem, TEC firms must strive for mobility and offer their consultants assignments in which they can be challenged and develop their competence.

6.2 Future research

This thesis has made several contributions, however, it has also raised a set of new questions and opened up hitherto unexplored avenues for future research. Below, three main suggestions for future research are addressed.

The first avenue for future research would be to improve the understanding of TEC firm capabilities by studying the heterogeneity among firms. The findings of this type of study could

further elaborate on patterns in terms of the development of such capabilities. Moreover, future research should center on gaining greater insight into the factors that enable the process of knowledge cycling: How can organizations foster and facilitate knowledge cycling, and which competence do consultants need to possess in order to thrive as *knowledge cyclers*? In connection to this, future research should focus on the characteristics of the individuals involved in the process of knowledge cycling by studying individual competence, knowledge sharing behavior, knowledge hiding behavior, and analytical reasoning. Finally, in order to enhance the understanding of the qualities of knowledge cycling, it would be interesting to further investigate the type of knowledge being cycled. Such a study could indicate whether certain types of knowledge lead to larger effects in the client organizations.

The second avenue for future research would be to focus on the client. This thesis has primarily focused on the TEC firm and its technical consultants; however, it has illustrated that the TEC firms and its technical consultants work in close interaction with the client organization. Thus, in order to gain a holistic picture of this type of work arrangement, it is important for future research to focus on the client organization. The issue of how client organizations decide which arrangements to use has received limited scholarly attention and could, thus, be one direction for future research. It is important for future research to investigate the practices used by client organizations when hiring technical consultants. Previous research has indicated that many organizations strive to formalize their purchasing practices, although it has been argued that the purchasing of professional services is difficult to formalize (Pemer and Skjølsvik, 2016; Pemer et al., 2014; Werr and Pemer, 2007). Thus, it would be interesting to explore to what extent the purchasing practices of professional services in the TEC industry are formalized, and what impact the formalization has on TEC firm capabilities. Another suggestion for future research would be to investigate the advantages of hiring technical consultants who can master liminal work positions. In connection with this, it would also be interesting to study how technical consultants are perceived and utilized in client projects. This type of study should focus on whether client organizations have practices in place to absorb the knowledge and experience that consultants bring with them from other projects, client organizations, and industries so that they do not become vulnerable when the consultants leave for new assignments.

The third avenue for future research would be to further investigate the nature and development of liminality competence as it has important implications for the transfer of knowledge within and among problem-solving contexts. In that respect, this thesis calls for additional individual-level studies to understand the TEC firm, and how it can shape knowledge development paths for its organizational members. In particular, future research should further explore how liminality competence evolves through both on-the-job training and competence development initiatives in order to enhance the understanding of its nature and development, and how the individual copes with liminality throughout the process of knowledge cycling. Moreover, it would be important to study the benefits of hiring consultants with a particular level of liminality competence, to unveil the individual differences with regard to the participation in the process of knowledge cycling. It would be interesting to explore which consequences this might have for the transfer of knowledge within and among problem-solving contexts.

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FACULTY OF ARTS AND SCIENCES

Linköping Studies in Arts and Sciences, No. 762
Department of Management and Engineering (IEI)

Linköping University
SE-581 83 Linköping, Sweden

www.liu.se