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Swift Transition and Knowledge Cycling: Key Capabilities for Successful Technical and Engineering Consulting?

Abstract

The organization of innovation labor is undergoing major changes in technology-based and engineering-intensive industries worldwide. Those changes reflect fluctuating market demands and increasing task uncertainty, and they are characterized by three related developments: externalization of the workforce, development of new types of employment relations, and greater use of technical consultants. These trends have led to the technical and engineering consulting (TEC) industry becoming a major player in the organization of innovation labor and thus also in the development and transfer of engineering knowledge. Determining what underlies the growth of this industry and the performance of TEC firms requires a better understanding of their nature and capabilities. Our paper builds on an in-depth case study—spanning multiple organizational levels and incorporating 50 interviews with a leading Scandinavian TEC firm's top managers, middle managers, consultant managers, individual consultants, and clients as well as field observations and diary studies. These data lead us to posit two central capabilities associated with innovation labor in technical and engineering consulting: *swift transition* and *knowledge cycling*. The interplay between these capabilities, each of which arises from interactions between the firm level and the individual level, seems crucial for the successful development, organization, and supply of innovation labor and engineering knowledge.

Keywords: technical and engineering consulting firm, technical consultants, knowledge-based theory, firm capabilities, swift transition, knowledge cycling

1. Introduction

The provision of business and professional services is one of the world's fastest-growing sectors (OECD, 2015), and its growth is expected to continue unabated (BLS, 2017). This sector accounts for 18% of US private-sector gross domestic product (USITC, 2016) and for almost 12% of the European Union's GDP (EC, 2017). The management, scientific, and technical consulting industry is anticipated to grow at the sixth-fastest rate of any industry at least until 2024 (BLS, 2015). The most rapidly expanding segment is engineering services, which includes electrical engineering services, software developers, and technical analysts; that segment is expected to witness 5.3% growth annually until 2020 (WEF, 2016).

This rapid growth of technical and engineering consulting (TEC) has occurred largely in response to developments associated with workforce externalization (Davis-Blake and Uzzi, 1993) and specialization of innovation labor (Arora and Gambardella, 1994; Brusoni et al., 2001; Gambardella and Torrisi, 1998). Hence, TEC firms have taken a leading role in several technology-based industries with regard to the development, organization, and supply of innovation labor and engineering knowledge. They often undertake a range of tasks that include recruitment, career development, enhancement of engineering competence, and transfer of engineering knowledge (Malhotra, 2003; Teknikföretagen, 2015). The TEC sector facilitates supply of competent resources that client firms, for a variety of reasons, might find uneconomical or difficult to develop or mobilize in-house (Cappelli and Keller, 2013).

The type of TEC firm addressed in this paper operates as a knowledge-intensive agency whose technical consultants are assigned to work on innovation and technology projects of their client organizations. Although these consultants are employed by a TEC firm, their work is performed in complex development and engineering projects at the client's site—where they assume various resource, expertise, and specialist roles (Söderlund and Bredin, 2011) under the supervision of managers from the client organization (Barley and Kunda, 2006). These

consultants are thus the "mobile engineers" and "project-based knowledge workers" alluded to in prior research (Almeida and Kogut, 1999; Sankowska and Söderlund, 2015; Song et al., 2003), since they move from project to project on a recurrent basis, often transcending client organizations (Leiponen, 2006). In that respect, their work differs from many other professional service firms: consultants not only have less autonomy and jurisdictional control than do lawyers, accountants, and architects (Malhotra and Morris, 2009), but also are much more integral to the client's innovation process, typically developing knowledge and technical solutions in tight teamwork with client employees.

In several industries, the TEC firm has become an indispensable economic agent for transferring knowledge and for capitalizing on lessons learned from innovative firms within and outside the focal industry (Flowers, 2004; Malhotra, 2003; Teece, 2003). In light of the speed with which traditional functional departments have been downsized (Hobday, 2000; Lindkvist, 2004; Whittington et al., 1999), the TEC industry today plays a vital role in the knowledge development, knowledge transfer, and innovation processes of the "matrix economy" (Barley and Kunda, 2004) and high-tech sectors (Isaksson et al., 2016; Probert et al., 2013), wherein individuals move among projects, firms, and even industries. Thus, TEC firms operate as increasingly critical "skill containers" (Kristensen, 1996) that facilitate dynamic and fast-paced project-focused work in ever more flexible labor markets (Wachsen and Blind, 2016). This development has fundamental implications for how we view the nature and capabilities of such firms. As noted by Leiponen (2005), TEC firms can help broaden their clients' search activities—and thereby improve their innovative performance (Laursen and Salter, 2014)—by offering both a widening knowledge base and in-depth expertise related to specific technical domains (Flowers, 2004).

This paper builds on an inductive case study of a leading Scandinavian TEC firm referred to as Advanced Engineering (henceforth AE). This research design is appropriate

because an in-depth exploration of the nature and capabilities of TEC firms is necessary to appreciate their complex organization of engineering knowledge, the relationship between individuals and the organization, and the interlinked activities from which capabilities arise. Owing mainly to this complexity and to the sheer number of elements involved in such inquiries, these topics have received little attention in the scholarly literature (Malhotra and Morris, 2009; von Nordenflycht, 2010).

By focusing specifically on capabilities associated with innovation labor, we respond to the call by Felin et al. (2015) for more research on the extent to which capability development is affected by interactions between the organization and the individual. Our paper also speaks to the notion that theorizing about different types of expert and TEC firms should reflect their respective capabilities (Teece, 2003; von Nordenflycht, 2010), and it thereby demonstrates how capability development (in terms of the actual labor involved) unfolds in such contexts. Thus, we use the AE case study to examine the key capabilities to succeed with developing, organizing, and supplying innovation labor, and to identify activities that facilitate sustaining those capabilities, and to explore the interactions between the individual level and the organizational level—the interaction that precipitates capability development.

The paper proceeds as follows. Section 2 describes ongoing changes related to flexible work arrangements and the organization of engineering knowledge; it also explores the nature of capabilities in such contexts. In Section 3, we detail the research setting, our methods, and the fieldwork that underlies our theorizing. Section 4 presents the case study of AE and reports our empirical findings. Section 5 discusses those findings and distills the two key capabilities identified in our case study: swift transition and knowledge cycling. We conclude in Section 6 with a summary of our work and its implications for research and practice.

2. The organization of innovation labor and the nature of capabilities

It is widely acknowledged that the development, organization, and supply of innovation labor is a driver of industry evolution and innovation performance (Consoli and Rentocchini, 2015). So far, research has focused on two main factors to explain observed changes in the organization of innovation labor that trigger service provision by TEC firms: numerical and functional flexibility (Arvanitis, 2005).

Numerical flexibility is often heralded as the guiding organizing principle in the literature on "externalization" of the innovation workforce—especially as it concerns the employment of so-called free agents and the emerging economic models of core employees surrounded by buffer pools of contingent human resources (Atkinson et al., 1984; Handy, 1989; Kalleberg, 2001). The conventional arguments for hiring external innovation labor hinge on the advantages of minimizing labor costs and achieving greater numerical labor flexibility to cope with market volatility and technical uncertainty (Davis-Blake and Uzzi, 1993; Kalleberg, 2001; Marler et al., 2002).

The second explanation for the rise of TEC firms is based on increasing knowledge specialization and, more specifically, requirements for *functional flexibility*; on this account, client organizations seek specialized innovation labor and technical expertise whose internal development is deemed too difficult or otherwise unwarranted (Creplet et al., 2001; Gambardella and Torrisi, 1998; Matusik and Hill, 1998). Promoting functional flexibility may also expand the breadth of knowledge sources and the scope of search activities within the client organization (Leiponen and Helfat, 2010), providing greater opportunities to engage in parallel path strategies (Nelson, 1961) and to tap into complementary knowledge bases and technologies (Bessant and Rush, 1995).

Indeed, these two factors associated with the organization of innovation labor go a long way toward explaining the growth of the TEC industry and the nature of its offered services.

To an even greater extent, however, the hiring of technical consultants and mobile engineers has become a mechanism whereby clients can ensure that they not only remain current with new knowledge developments and technological advancements, but also learn from diverse application contexts (Criscuolo et al., 2007; Hopkins et al., 2011; Salter and Gann, 2003; Sarvary, 1999). A TEC firm may accordingly broaden the knowledge base (Brusoni et al., 2001) and expand the search activities (Laursen and Salter, 2014) of its clients.

Some five decades ago, Freeman (1968) argued that innovation requires inputs from different sources. He described how joint development can benefit both the contactor and the client: "The client receives the benefit of an experienced engineering and construction organization. […] The engineering and construction company, through its contribution and effort, broadens its own base and experience" (Freeman, 1968: 49). In this view, the hiring of external engineers is only partly explained by numerical or functional flexibility. A fuller account must also reference the knowledge-based advantages accrued by TEC firms (Grant, 1996), since their clients also benefit from the capabilities such firms build through their organizing of innovation labor, human resources, and engineering knowledge. Explanations must therefore move beyond conventional accounts based on numerical and functional flexibility to explore the additional services and capabilities accrued by modern TEC firms.

By "capabilities" we mean the learned and patterned behaviors of collective activity (Winter, 2003) that reside in a firm's organizational processes (Teece et al., 1997); capabilities draw on idiosyncratic knowledge that organizations build over time and that determines the long-term success of their operations (Salvato, 2009). This term highlights the essential role of strategic management in appropriately "adapting, integrating, and reconfiguring internal and external organizational skills, resource and functional competences to match the requirements of the changing environment" (Teece et al., 1997: 515). Along these lines, Eisenhardt and Martin (2000) point out that capabilities are required to integrate, reconfigure, acquire, and

divest resources. The main resources marshalled by TEC firms are *human* resources, so capabilities in that context pertain mainly to leveraging and enhancing the firm's human capital (Hitt et al., 2001).

Knowing how organizations develop, maintain, and advance their knowledge and capabilities is fundamental to understanding how firms and industries work and change (Dosi et al., 2003). As Richardson (1972) argues, organizations tend to specialize in activities for which their capabilities offer knowledge-based advantages as compared with their competitors. Similarly, Penrose (1959) underscores that such an analysis should address the firm's internal operations and how firms develop unique and idiosyncratic resources. In order to create competitive advantage and to leverage its pool of resources, the firm draws on its "organizational capabilities" (Chandler, 1990; Grant, 2002) and on the knowledge and experience of those working in the organization.

It is well known that professional service firms in general (von Nordenflycht, 2010), including TEC firms, can neither undertake projects nor solve complex problems without the knowledge and experience of their employees (Grant, 1996; Teece, 2003). So, in these settings, the individual professionals are a fundamental source of competitive advantage because they are unique, rare, and difficult to imitate (Barney, 1991). Much of the more recent research urge scholars interested in theories of the firm to explore how the firm level and the individual level interact to form capabilities (Felin and Foss, 2005; Salvato, 2009; Teece, 2007). In addition, the widely held view that much of technical and engineering consulting is carried out by teams resembling "knowledge collectivities" (Lindkvist, 2005) has far-ranging implications for the analysis of human resources, engineering knowledge, and firm–worker interaction during capability development.

Therefore, discerning the TEC firm's capabilities vis-à-vis the organization of innovation labor requires that we understand (a) how engineering knowledge is organized and

transferred among problem-solving contexts (Malhotra, 2003) and (b) how technical consultants *qua* innovation labor cope with their role's demands for greater flexibility and mobility (Borg and Söderlund, 2014). It is in that context also necessary to understand how these consultants interact with a team that is less well developed, how they adapt to new organizational contexts, and how they transfer knowledge among various instances of problem solving (Lindkvist, 2005). As remarked by Rosenberg (2009: 314), engineers transfer skills among contexts by employing methods "from one area of industry and transfer[ring] them to other areas that [are] unrelated in terms of final products." Thus, the mobility of innovation labor figures prominently in innovation performance and knowledge accumulation; here, "knowledge pollination" is a critical element (Bessant and Rush, 1995).

Salvato (2009) emphasizes the importance of investigating the organization–individual relationship to trace the evolution of capabilities; he also points out that previous research has tended to overlook the role of individuals in creating and sustaining competitive advantage. These circumstances are especially unfortunate when one considers the human-centered nature of capabilities and capability development in TEC firms (Hitt et al., 2001) and realizes how such distinctions could shed light on these firms' challenges concerning the development, organization, and supply of innovation labor. Hence, we are led to conclude that understanding the TEC firm's characteristics and capabilities calls for in-depth analysis of its management processes, its organizational structures, and the work scenarios of individual engineers and technical consultants: how they work in projects and how they collaborate with other team members and their clients. Such analysis is a central element of any attempt to explicate the relationship between organizational levels and organizational activities, which is especially relevant for the understanding of the nature and capabilities of the TEC firm.

3. Research methods and data

We view the qualitative single–case-study approach—given its "revelatory potential and richness of data" (Langley and Abdallah, 2011: 205)—as the best option for deriving a comprehensive model of TEC firm capabilities. Case studies are often advocated as the foremost path to a thorough understanding of the context and phenomenon being researched (Eisenhardt and Graebner, 2007; Flyvbjerg, 2011). As summarized by Eisenhardt (1989: 534), this mode of inquiry centers on the relationship between multiple factors and variables toward the end of understanding "the dynamics present within single settings", such as the dynamic between organizational levels and capabilities.

We had several reasons for selecting AE as the focus of this case study. First, it is a highly successful TEC firm in an industry characterized by intense competition. It is ranked as one of the top three Scandinavian firms in its primary technology fields and has, during the last two decades, repeatedly been rated as a top-tier supplier of advanced technical and engineering consulting services. Advanced Engineering also plays a prominent role in the supply of technical and engineering consulting services to many leading Scandinavian manufacturing and engineering corporations.

The firm does not offer products or systems solutions; instead, it focuses on hiring and developing capable engineers. Over the past 15 years, AE has assumed greater responsibilities for such human resource activities as recruitment, job rotation, and competence development. The firm has spent a significant amount of resources developing its employees to become the best technical and engineering consultants in their field; perhaps even more significant is its development of them as "knowledge workers", "knowledge integrators", and "collective problem solvers" capable of ensuring that relevant knowledge and competence are transferred among its clients. Advanced Engineering is an illustrative example that offers opportunities to

theorize in new and interesting ways (Daft and Lewin, 1993)—especially in light of its business model and knowledge strategy as well as its remarkable performance (Siggelkow, 2007).

The second reason for selecting AE is that the firm offered complete access to all members of the organization and to all internal written material (except for private and sensitive documents). We were invited to participate in meetings and in development and training programs for junior and senior employees; in addition, we were given access to consultant diaries (which AE employees kept as part of a parallel research project) and to the "reflection reports" written as part of competence development programs. Those diaries and reports gave us insight into the true nature and challenges of technical consulting: the day-to-day activities of consultants and the problems typically faced in their assignments. We also had the firm's approval to contact and interview anyone within the organization as well as its clients. This access afforded us ample opportunity to achieve a comprehensive understanding of AE's management and knowledge processes, a key ingredient in any well-grounded study of a single case (Dyer and Wilkins, 1991).

3.1. Data collection

We sought to collect an extensive and varied set of data so that we could identify contrasting results and explore perceptions at different organizational levels. The data therefore reflect multiple perspectives: those of managers, consultants, as well as clients. Table 1 summarizes the data used in this study.

[INSERT **TABLE 1** ABOUT HERE]

Our case study explicitly seeks to understand both the management level and the individual level as well as the interaction between these two levels (Felin and Foss, 2005; Floyd and Sputtek, 2011). Our intention was to develop an in-depth understanding of AE: what this company does, how the company performs its tasks and duties, and which capabilities are crucial for performing those tasks and duties. We were also especially interested in the skills

required of their technical consultants, the type of learning and knowledge process involved, and the relationship between the individual consultant and AE as an organization.

Our primary source of data consisted of 40 semi-structured interviews (DiCicco-Bloom and Crabtree, 2006) with managers and consultants at AE. Our selection of respondents was based on the criteria of representativeness and quality sampling (Alvesson, 2011). The interviewed AE managers represented different levels in the organizational hierarchy and were selected based on their knowledge of AE's culture, organization, business strategies, operations, and processes. Topics addressed in the interviews included culture, leadership, organizational structure, managerial responsibilities, knowledge processes, human resources, consultant careers, consulting assignments, competence development, and client collaboration.

The technical consultants interviewed had expertise in various areas of engineering and worked at different client sites. These respondents were chosen based on their assignment history, since we believed it was critical to interview those with experience working on several consulting assignments with different clients. The consultants were asked about their professional background, their work roles, their current and previous assignments in client projects, and the transition between assignments. Interviews also addressed actual work, the work situation of consultants, problems, and learning opportunities.

In addition, we conducted 10 interviews with selected major clients of AE, which accounted for more than half of the company's annual revenues. These additional interviews were conducted to obtain an outside and balanced view of AE's performance and to grasp more firmly the perceptions and outcomes of services provided by AE engineers. In this way, we targeted assessments of AE as compared with its competitors, and also the motives of clients for collaborating with AE—that is, rather than working with any of its competitors or adopting internal solutions (e.g., using in-house engineers or recruiting new employees). All interviews were recorded and then transcribed so as to facilitate interpretation and thereby maximize the

"richness of meaning" derived from them, which is one of the most important takeaways from—and favorable aspects of—a qualitative study (Alvesson and Sköldberg, 2009).

3.2. Data analysis

The empirical material was analyzed by way of data-driven thematic analysis (Braun and Clarke, 2006; Guest et al., 2012). That analysis began with detailed transcriptions of the interviews (Riessman, 1993). We read and then reread the transcripts to familiarize ourselves with the empirical material, after which the data were tagged using descriptive codes (Saldana, 2009). Codes viewed as being strongly similar across transcripts were collapsed into first-order categories that employed language used by the respondents. Each of the categories was also discussed to explore the central reasons for hiring AE consultants.

When developing these first-order categories, we discerned links among them that enabled us then to collapse the first-order categories into second-order themes. Four main themes emerged from this analysis: (1) organizational activities fostering rotation; (2) individual activities fostering rotation; (3) organizational activities fostering mobility of knowledge; and (4) individual activities fostering mobility of knowledge. The empirical account in Section 4 is structured around these four themes, which reflect the creation of an organization that features (respectively): continuous learning and competence development; understanding of the client needs for particular competence and resources; internal transfer of knowledge through competence development activities; and external transfer of knowledge through mobility among client organizations. These themes also reflect the ability of technical consultants to apply their social and professional skills soon after they enter a new problem-solving context, to cultivate trust with the project team, to discern an assignment's technical aspects, and to leverage the mobility that defines their employment for the purposes of transferring knowledge and developing their own competence.

After identifying the second-order themes, we grouped each into one of two overarching dimensions, *swift transition* and *knowledge cycling*, that correspond to the identified capabilities. In this way, we finalized the framework and linked the various phenomena that emerged from our data. The plausibility of our interpretations were strengthened by explicitly distinguishing between first- and second-order data (Van Maanen, 1979); we also conducted "member checking" (Lincoln and Guba, 1985) to ensure that AE's managers and consultants agreed with us about the interpretative scheme's validity. After the initial analysis, we arranged a feedback workshop with 11 of AE's managers to validate our findings through additional member checking. The feedback provided by managers gave us valuable information about the essence and nuances of swift transition and knowledge cycling, and it tended to emphasize the interaction—between the TEC firm and its technical consultants—propelling both the formation and the subsequent interaction of these two capabilities.

After the workshop, we extended our initial analysis by analyzing in greater depth the interaction between the firm and individual levels; this process led to refinements in our definitions of the identified capabilities. The capability of *swift transition* depends on (a) the technical consulting firm's ability to respond to clients' needs by swiftly allocating the best consultants for those clients' projects and (b) the ability of technical consultants to enter new assignments quickly, develop trust, and establish a position on the project team that adds value to the project and the client organization. *Knowledge cycling* captures (a) the TEC firm's ability to rotate its consultants among different problem-solving contexts at various times, thereby broadening consultants' competence and so facilitating knowledge transfer, and also (b) the ability of technical consultants to transfer knowledge and lessons learned among client organizations—and to exploit the mobility inherent in their work situation—toward the end of broadening their knowledge bases. Our analysis points to the capabilities of swift transition and

knowledge cycling as being critical for AE's functioning and performance as a provider of innovation labor and engineering knowledge.

[INSERT **FIGURE 1** ABOUT HERE]

Figure 1 presents the main results from our data analysis. The phrases on the figure's left side capture our first-order categories (in the respondents' language); concepts encompassed by the four ovals reflect our grouping of first-order categories into second-order analytical themes; and the two boxes on the right side show how the overarching dimensions emerged from this analysis. Thus, the figure illustrates our analytical reasoning by indicating how first-order categories relate to second-order themes and, through those themes, to the overarching dimensions.

3.3. Boundary conditions

Theorizing based on in-depth single case studies has long figured prominently in management and innovation studies (Lovas and Ghoshal, 2000; Mintzberg and McHugh, 1985). However, this approach suffers from the problem of offering a limited basis for generalization of the results (Weick, 1969; Yin, 1994). We have compensated for that limitation by explicitly framing our model within existing theory. Even so, we must acknowledge that this model is at best a tentative representation of the TEC firm's capabilities and capability development. More research is needed to validate the model in a greater variety of contexts—including comparisons among different kinds of TEC and other professional service firms.

4. Advanced Engineering: A TEC firm in action

Advanced Engineering has grown considerably in recent years and now has nearly 2,000 employees, of whom four in five have a master's degree in engineering. Most of these employees are men, although the share of female engineers is growing steadily and today accounts for about one fourth of the firm's workforce. Employees work on various kinds of

projects, and they usually focus on one project at a time in close collaboration with the client organization's staff. The clients of AE operate in a diverse set of industries, including telecommunications, aerospace, automotive, and medical technology. While on a consulting assignment, engineers are located at client sites and are supervised by one of the client organization's project or line managers. Advanced Engineering is renowned for its skilled employees and their knowledge within a number of specialist disciplines. The company can deploy expertise in such areas as systems integration, systems development, digital communications, software design, information security, and mechanical engineering.

The mission of AE is "to meet customer needs and develop people with a desire for learning" (Manager I). That mission has two core elements. First, consultants are assigned to a client organization for the purpose of filling one of its needs. Once on the client's site, consultants are expected to take the initiative, execute their tasks professionally, and add value to the client's business and innovation process. The second element of AE's mission is the professional development of consultants, who are responsible for learning as much as possible from their assignments so that they can later take on even more advanced assignments and thus subsequently add further value to AE and its clients. Interviewees frequently mention that "output" includes not only delivering value to clients but also taking part in and deriving benefits from an ongoing knowledge development process. Indeed, several managers emphasized that one of AE's core business ideas is the development and transfer of knowledge among projects and client organizations and even across industries. Client representatives likewise acknowledge that one reason for hiring an AE engineer is so that the client can participate in knowledge development and transfer processes involving other clients and a network of skilled problem solvers.

4.1. Organizational activities fostering rotation

Clients are eager to learn from their hired technical consultants. They want to know what the consultants have learned from previous assignments, and they want the consultants' input on how their current business and innovation processes can be improved.

> I rely on consultants because I need people with different experience, from other projects, organizations, and other sectors. We get many good ideas from our consultants, new thinking, and new energy. We are great within our own areas of expertise […] but might be missing expertise in other areas and we need to get people from the outside to refresh our minds. There is always a risk that you get stuck with your old ways of doing things. (Client representative VII)

Most of the AE managers we interviewed discussed the importance of AE engineers explaining to the client how they can increase the value of business processes:

> It is important to be able to visualize and package our offer. The good thing with it is that clients understand how we can add value to their business. The downside is that we play in the hands of our competitors; we shorten their time to market by visualizing what they also should be doing. (Manager II)

The clients claim not to be hiring simply "by the hour"; they are interested in more than simply completing the narrowly defined technical assignment or work package. However, these additional outcomes require a thorough understanding of the client's organization and environment. Each AE consultant must learn how to work with the client (and its employees) and must comprehend the client's knowledge, challenges, and innovation conditions. Since AE's clients are predominantly technology-based companies, it follows that consultants must keep abreast of technology developments if they are to increase the value of a client's business. One manager explained:

> This means that our people must understand the technology. […] We must be able to have a dialogue with the clients on how to solve their technical challenges. New technologies and methods are continuously evolving, which generally makes it important for us to able to explain to our clients how we can contribute to their business. (Manager III)

However, adding value involves more than the mere transfer of knowledge. AE's managers are committed to improving their clients' absorptive capacity, efforts that include devising ways to better understand the clients' culture, practices, and business rationale. This issue is mentioned repeatedly in our interviews with clients, who note the absolute necessity of creating conditions that enable hired consultants to "do a good job", to "enter projects quickly", and to articulate their problems and needs. Thus, AE consultants must be able to grasp the complexity of a client's organization, of its management and innovation processes, and of how all these factors are interrelated. This effort consumes a substantial amount of time, and—as we witnessed during workshops and training programs—the topic is frequently discussed by AE employees and managers. One manager put it this way:

> There is a big difference among client firms in their ability to work with consultants in general. Some of our clients really know how to work with us. Some just don't; in such situations, it becomes difficult for us and our consultants to do a good job, and to succeed with knowledge development and transfer. This is not always a matter of industry or firm; there can actually be quite big differences within the same organization. Nevertheless, it is something that we as an organization must deal with to make our business model work. (Manager IV)

Like many of its competitors, AE recognizes that an engineer becomes a successful consultant not only because of technical skills; the consultant also needs the social skills required for participation in collective learning processes within and across projects and client

organizations. Managers at AE often remark that the successful consultant must have a particular kind of "personality" that features "self-confidence", yet also "humility", and that reflects a "stable social life"—attributes that make it easier for consultants to handle the continuous shifts among assignments.

> I think we are very good at attracting and recruiting young and capable people. In fact, we have been a lot better than most of our clients. This is also what our clients tell us. Over time, we have gotten a sense of what the client wants, and we get an understanding of the client. We are aware that there is another side to the consultant than the technical one; we are good at recognizing the importance of the soft side to a greater extent than most of our clients and competitors. (Manager VI)

Clients often mention that AE is capable of recruiting individuals who fit their needs and can quickly adjust to the clients' problem-solving contexts:

> [AE's] recruiting procedures are very good. They have demonstrated over the years that they are capable of finding people that fit our needs and that work well with the people in our organization. I believe it is because they know our business and they know our culture and way of working. (Client representative II)

Once recruited, the consultant is offered career development support, assigned to an appropriate project, and paired with a mentor who provides feedback on tasks and on knowledge performance. Advanced Engineering has paid special attention to matching consultants and clients. That process is greatly facilitated by the long-standing relationship between AE and a few select clients:

> If you know what the workplace looks like, and what kind of people they are looking for, then you can better evaluate which of your consultants that could do the best job in that organization. The clients appreciate that we have the ability to recognize where

> people would fit, and that we are not only in it to sell a consultant. […] We need to understand the culture and processes of our clients. (Manager VII)

In commenting on these remarks, a client representative stressed that he expects consultants to do what they were hired to do while also contributing to knowledge development:

> We want the ideas, good ideas. We do not just want to pay for the hours. We want the consultants to repay us with their knowledge and ideas. They do the work, of course, […] but they need to give us the knowledge that comes out of the work as well. (Client representative III)

Staffing and "placement" are leading concerns for AE managers and their clients. These issues are typically addressed through negotiations aimed at specifying the client's needs and the consultant's competencies. A responsible *consultant manager* is the caretaker of the individual consultant's reputation and future career. This task includes convincing consultants that they can successfully tackle the client's problems—that is, increasing the odds of success by boosting consultants' self-confidence when preparing for the job. It is also essential that the consultant manager, in close dialogue with the client, create the right conditions for the assignment.

Of course, staffing and placement involve not only the appropriate matching of consultants and assignments but also the removal of consultants from assignments. The latter occurs when the assignment either is no longer developing the consultants' competence or is rendering consultants so specialized that they are seldom sought by other clients. Hence, AE managers must ensure that consultants are not becoming too specialized, too niche oriented, or too dependent on a particular technology or client organization. This responsibility encourages a manager to think strategically about the competence and professional development of consultants and to respond quickly when they ask for new challenges and development opportunities. One such response is to move consultants to a new assignment—either because

their current tasks are unsatisfying or toward the end of broadening the competencies of consultants who believe they have already acquired enough knowledge about a given technology.

Although managers carefully plan the placement of their consultants, several consultants expressed anxiety about taking on new assignments and moving into new client organizations.

> There are a lot of mixed feelings, both excitement and anxiety. But you cannot worry too much because this is the nature of the game, so to speak. There is little you can do about it, other than preparing yourself and doing your best to get into the assignment and into the new organization. (Consultant A)

Consultant managers play a critical role in resolving consultants' anxiety about their next assignment. Each such manager has the overall responsibility for 20–30 individual consultants. The manager's work includes, inter alia, exploring the needs and opportunities for new assignments, staying in touch with consultants, and knowing what they are doing and would like to be doing in the future. It is in these functions that many of the formal human resource management responsibilities reside:

> Competence development and career planning are responsibilities of the consultant managers. They should know when someone is interested in moving on and need to take the next step. […] They should help them change assignments. (Manager VIII)

An obvious question involves identifying the best time to move on. The interviewed managers state that consultants must sometimes be urged to undertake a different assignment, especially if they are satisfied with the current one. During our interviews, managers at various levels also referenced the central role that AE itself plays in this process: setting up the right assignment, helping consultants move into new assignments, and easing them out of assignments. One consultant manager gave the following example.

> When I review the competencies of the people in my unit, I might identify a few problems. For instance, […if] a consultant is getting a bit too narrow in his technical skills, then I might initiate a process of getting him into another assignment to broaden his repertoire of skills […] to make him see new things. (Manager IX)

Consultant managers keep the consultants employable by facilitating their rotation among assignments. Because some consultants might stay in the same assignment for several years, the managers must create strategies for inducing the relocation of consultants to new assignments. Such reassignment is seldom a straightforward proposition, however, and the process often reflects a dynamic interplay among the consultant manager, the individual consultant, and the client.

4.2. Individual activities fostering rotation

During the interviews, consultants frequently brought up the notion of a "good technical consultant". When we asked for a definition, respondents invariably stated that being a good consultant requires both technical and social skills. On the one hand, *technical* skills facilitate technical problem solving: figuring out what to do, understanding the client's technical system, and identifying possible technical solutions. On the other hand, *social* skills enable one to create relationships with others on the project team and in the client organization, to find out whom to approach with questions, and to establish trust with team members:

> It is always about establishing yourself in the project. Entering a new assignment and a new project takes a lot of energy, because you have to get to know people and earn their trust. You have to create a spot for yourself in this new organization. (Consultant B)

Both managers and consultants reference the necessity of social skills and especially the importance of "understanding the situation" (Manager III)—that is, knowing when to act and when to wait for more information:

> There is an expectation on you to be able to understand the problems quickly, and quickly become part of the team. […] We usually joke about it and say that the consultant must be a "cultural chameleon", you have to be very receptive to how the group works, you cannot run your own race. You must quickly pick up social codes, dress codes, behavioral codes and other things to become part of the group and the organization. (Consultant C)

Social skills are strongly associated with the need to establish trust upon entering new work situations and new organizations. They are also related to the process of creating a position on the project team and in the client's organization so that the consultant can add value to the client's innovation process. In the words of one consultant:

> It is important to understand that the client hires you to complete a certain assignment, but your role is not fixed. It is up to you to establish a position in the project team, since you define the boundaries of your assignment. This can be a difficult journey, as you are not completely free to do whatever you want. It must be in line with the client's requirements. (Consultant D)

In line with these considerations, client representatives remark that consultants must be flexible and willing to seize opportunities that might lie outside of their assignment specification:

> As a consultant, you have to be quite flexible. You have to become part of the context quickly; read the manuals, search for answers, contribute to the team, and seize the opportunities that present themselves. (Client representative IV)

It is noteworthy that not all interviewees describe this problem in strictly social terms. Some consultants tend to view the problem primarily from a technical standpoint, identifying difficulties related to design features and technical specifications. Most of these individuals

state that they are normally brought in when the project has already started, which can create some challenges. As one of them explained:

> My assignments have typically lasted around a year or so. When I enter new projects, the projects are already running more or less at full speed. And there is usually some kind of problem involved—which is part of the reason why they are bringing in me and other consultants to the project—they are either late or they are experiencing technical problems that they are struggling with. (Consultant E)

Yet, these consultants typically claim that, because they switch so often between different problem-solving contexts, they are better prepared to solve a variety of technical problems. Thus, a sequence of such assignments gives consultants the opportunity to obtain experience from many different projects and client organizations:

> Often there are issues that the employees of the client organization find difficult, while it looks pretty easy for those who come from the outside with perhaps another background and different experience. If you have experienced similar problems before it doesn't have to be too difficult to see what needs to be fixed. (Consultant C)

Apart from entering assignments quickly, establishing trust swiftly in the new work context, and becoming part of the problem-solving context by adapting to perceived technical and social roles in the project organization, consultants must ultimately also be able to hand over their assignments to other team members and to the client organization. This is another issue frequently discussed at management meetings: how to make a "clean" and "professional" exit. In other words, a consultant must be able not only to accomplish all needed tasks but also to hand over the assignment in a good state.

> It is equally important to have a plan on how to exit a project as it is how to enter it. You have to be smart and take the client with you on that journey from start to end. In the best of worlds, I act solely as a support the final week. Professionalism is key, even

> if you get kicked out of a project, you can't take it personally. If you do an unsuccessful handover, you don't have the chance to redeem yourself. (Consultant C)

4.3. Organizational activities fostering mobility of knowledge

Advanced Engineering's mission to "develop people with a desire for learning" has led top management to invest in several competence development activities. The firm has initiated competence development programs at various levels: for junior and newly recruited engineers as well as for senior consultants. These programs are critical for attracting and retaining employees. Managers and client representatives pointed out that less experienced engineers accelerate their experience when taking part in these programs, which are based on principles associated with reflection, articulation, sharing experiences, and learning from others. The goal in the case of young engineers is to help them more rapidly become capable technical consultants. For these consultants, the competence development program runs about two years and consists of three separate stages. During the program, consultants learn how to cope with their assignments and with the context in which they work; they also come to understand better not only AE's business but also the business and innovation processes of their clients. One of the managers summarized the program in this way:

> It is about understanding how it all fits together, which enables our people to do a better job and understand the role of the technical consultant. In addition, the participants learn a lot about how our clients work. (Manager I)

The development program for experienced consultants lasts approximately one year, and it comprises seminars and workshops in which participants meet to reflect upon their experience and problems. During this program, participants polish their professionalism, practice their humility, and build their courage while learning from each other. The consultants also develop their cooperation and communication skills, which are essential given that projects are frequently bedeviled by problems that result from misunderstandings. To strengthen its

support of on-the-job training, AE hosts a number of competence networks through which consultants can share experience and knowledge with experts in their technological domain:

> If you are working for a client, you acquire knowledge about their way of working. When you gather consultants from different contexts, the influences from other businesses and firms come naturally. As an individual consultant, you might gain knowledge about all those firms after 10 years. But if you gather a team of consultants and talk about these things, you accelerate your own experience curve. (Consultant F)

The focus on knowledge development is critical for AE's ability to attract new employees and also new clients. The company has established itself as a "knowledge leader" and has a strong brand name—among potential employees and potential clients both—as a preeminent knowledge-intensive firm. The AE managers highlight the need for organizational values that encourage knowledge development at all times. In many ways, AE fosters what people in the organization refer to as a "knowledge culture". It is interesting that the company seems to be united less by a strong common identity than by a shared engagement in the development and transfer of knowledge:

> The view on knowledge and the perception of knowledge development is what I believe unites us. It is probably the strongest cultural expression of this firm—that we are all interested in learning and sharing knowledge. (Manager III)

Managers regularly talk about the significance of "shoveling knowledge" across client organizations. In our interviews, managers at different levels frequently return to the statement that the value provided by TEC firms to society at large is the transfer of knowledge among industries, thus serving the higher purpose of advancing engineering knowledge.

> My experience is that society benefits from the technical consulting industry as it enables the mobility of knowledge among various other industries; this is how we create innovation. A labor market in which people do not move across industries does not have

> the same dynamic. The work we do is good for industrial development in general. That is the way I see it and that is, I think, why many of us are growing so rapidly. (Manager XI)

The interviewed managers remark that clients learn to appreciate the value that a technical consultant adds to their business and innovation process:

> We can increase our clients' efficiency, productivity, and quality by applying methods and tools from, for example, the aerospace industry to other industries such as telecommunications or medical instruments. (Manager II)

The clients of AE are well aware that consultants bring with them the knowledge and experience gained from previous assignments in other firms and industries.

> We want a certain rotation—this is a win–win situation for everyone. We are interested in hiring consultants that are willing to recurrently shift among assignments. I would say that this is one of the main strengths of technical consulting firms and particularly a firm like [AE]: they have employees that are more flexible and better able to take on new assignments and roles. (Client representative V)

According to AE's managers, clients are eager to take advantage of that type of expertise. One of the managers explained it in the following way:

> We frequently talk about the importance of "rubbing off" our knowledge on our clients. The clients have begun to appreciate this more and more. I believe that we are much better at this than our competitors. We want our clients to learn as much as possible from our consultants, nothing wrong with that. (Manager VI)

Advanced Engineering has geared its management and organization structure toward improving client relationships. The firm has five key account managers, and work is ongoing to maximize the client pool's quality—that is, to find clients capable not only of helping AE develop and grow but also of contributing to collective learning processes and knowledge

development. Top management has identified 11 top-priority clients, and AE currently has established strategic partnerships with five of them. Selecting the best clients is certainly a strategic issue, yet so is the firm's *mix* of clients:

> We constantly talk about our clients, our current as well as our future clients. We want to see possibilities for them to learn from each other. Sometimes, it is the clients who tell us that it would be good if we could get consultants who have experience from a particular industry. In most cases, it is people in our own organization who see the potential for cross-industry and cross-technology learning. […] Just as within a client organization, there exists an innovative power within a technical consulting firm; this power can be in form of methods, platforms, and solutions. /…/ we do not only sell individuals, we also add value. (Manager III)

Managers are thus expected to facilitate the transfer of knowledge among projects and client organizations and to identify such opportunities among problem-solving contexts. In addition, managers must consider prior experience because their aim is to staff clients' projects with appropriate resources:

> One client wanted an additional project manager for a large project that the organization was running. I knew how this organization worked, and I told him that I did not think that he needed a manager, but rather a quality assurance engineer with experience from similar projects and who is able to customize the rules and processes according to the changes being implemented. The client listened, and it turned out excellent. We are able to make such suggestions as we have prior experience from various projects and client organizations. (Manager V)

The assignments undertaken by consultants differ in several respects. Although some focus primarily on assuming a particular role in the client organization, most assignments are project oriented and last from about 12 to 24 months. Advanced Engineering has implemented

a policy under which few assignments are expected to last longer than 18 months. This policy preference for rotation has clear implications for staffing and competence development. Some managers believe that engineers should generally be given relatively shorter assignments so that they can develop new competencies and skills more rapidly. Other managers, and also some consultants, prefer longer assignments. Both managers and consultants acknowledge that consultants should remain long enough in one assignment to understand the problem, to increase the project's and/or client's value, and to maximize their learning from that assignment:

> The newly graduated engineers stay perhaps two years in the same assignment. In the beginning, it is important to stay longer in order to familiarize oneself with the assignment, [the] project, and the client organization to be able to add value. (Consultant G)

Client representatives argue that consultants should stay longer than a year in one assignment, as it usually takes some time for a consultant to contribute to the project and the client organization:

> Our experience is that it normally takes almost a year for a consultant to take on greater responsibility outside his assignment and start contributing to the project and the firm, which means that he or she needs to stay longer than only a few months in order to add value to our organization. (Client representative VI)

Those whom we interviewed emphasized that mobility among assignments is a prerequisite for the transfer of knowledge among projects, client organizations, and industries—and that mobility itself may be more important than deep learning. Therefore, consultants should stay long enough to learn from the focal problem-solving context but no longer than needed to maintain their ability to transfer knowledge among projects and client organizations:

> If we have consultants who have worked for [one client firm], then for [another client firm], and then they move to [a third client firm], then they bring with them solutions and different perspectives, which a client firm is not able to acquire on its own. (Manager X)

4.4. Individual activities fostering mobility of knowledge

From the consultant's perspective, the actual duration of assignments is of less consequence than is the opportunity to move among them. Many respondents indicated that mobility is better than stability, that permanence is suspect, and that there is always the danger of ending up like many of the client's own engineers: "holding desperately on to their desks and tasks" (Manager XI) without being mindful of their environment and circumstances. The interviewed managers and consultants tend to agree that, although the technical prerequisites are quite similar, the "job of a consultant and an incumbent engineer is very different" (Consultant H).

Echoing the managers' comments, consultants identify mobility as an effective developer of competence:

> I had worked with this system for about two years and it felt like I knew it by then. The work was pretty much done, I felt, and there were not many new tasks coming in. […] I thought it was time to do something else, because I did not learn much from my work there. It felt more like being a regular employee just getting the job done, and not much more than that. (Consultant I)

The client representatives argue that this situation puts pressure on the consultants who desire mobility and want to broaden their competence:

> As a client, I want to keep consultants that are skillful as long as possible in my organization, and if I have to let them go, I will try to bring them back in at the first opportunity. Then there are consultant managers who only want to make money, and forget that the consultants have to be mobile in order to develop. This puts the

consultants in a truly difficult situation. I think it's important to have a clear start and an end that all parties can agree upon. (Client representative VII)

Some argue that mobile employment is a unique talent in itself, and most agree that mobility provides opportunities for combining knowledge. Many consultants remarked that if they stay too long in one organization and in one assignment, they might just as well be "regular employees". However, that is not what they want or "should be", as they "have chosen the life and work of a consultant for a reason" (Consultant J).

I have shifted to new assignments quite often. When I come to the plateau where I feel that I do not learn anything new, and where I do not add value to the client, then I start looking for new opportunities. […] At some point in time your development starts to stagnate, I would say that you usually have two high-producing years. (Consultant C)

The consultants we interviewed consider as one of their strengths the ability to contribute various types of skills and experience gained from other projects, clients, and industries:

To look at issues with an outside perspective in relation to previous experience, that is one of the strengths of being a consultant […] and something I believe we should emphasize even more in the work with our clients. (Consultant G)

At the same time, the recurrent movement of consultants among problem-solving situations places higher expectations on them to create value within projects and client organizations.

As a consultant you can contribute to the project by bringing in technical knowledge, techniques, and methods. Another form is to bring in a different view of how reality works by discussing different perspectives, business models, and cases, for example. (Consultant C)

Large systems development projects are often quite similar despite differences in the product and specific technology. Hence, consultants claim that they can use previously

developed methods and observed processes to identify, fairly quickly, the same processes (albeit under different names) and problems in the current assignment. One consultant explained how knowledge from previous problem-solving contexts is used to improve processes in the current assignment:

> I know which mechanisms the previous client used to monitor events, and which mechanisms improved the processes. […] I want to introduce [them] here: how we made plans, how we followed up, and how we improved the methodology. I take a lot with me from my previous assignment to my new assignment. (Consultant K)

As consultants become more experienced, they learn to identify knowledge that is relevant to transfer and also learn how and when that knowledge should be transferred. In addition, experienced consultants are able to identify knowledge that may prove valuable in future assignments:

> Instead of spending time to learn about the client's product, I can take some of that time to learn about the development environment instead, the mechanisms of the programming language, as I will certainly use that knowledge in my next assignments. (Consultant L)

5. Discussion

As is evident from our case study, AE exhibits a number of characteristics traditionally associated with any professional service firm (von Nordenflycht, 2010); these include focusing on the recruitment of well-educated and talented individuals, strategically building long-term client relationships, and cultivating unique expertise that is difficult for clients to develop in-house. Not surprisingly, these traits have been thoroughly investigated in prior research on professional service firms (Empson, 2001; Fosstenløkken et al., 2003; Løwendahl, 2005; Løwendahl et al., 2001; von Nordenflycht et al., 2015).

However, our analysis of AE reveals that it differs from "classical" professional service firms (von Nordenflycht, 2010) in a number of respects: (i) it has a "flatter" hierarchy (its grouping of consultants into different categories is rather informal and is mainly used to guide the organization of knowledge); (ii) it has not adopted the "up or out" approach to careers (several employees have worked at mid-level and expert roles without becoming managers); (iii) it focuses more on actual results than on developing a "brand name" reputation (which clients indicate is less important to them than a proven track record and long-term engagement; cf. Greenwood et al., 2005); (iv) it is home to an extremely diverse knowledge base (whereas most other large professional service firms focus on just a few areas of expertise, such as accounting and law); (v) it faces more competition from small firms and freelancers (entry barriers are generally low in the TEC field, and such firms must compete with individual engineers who are self-employed; in fact, our interviewees indicate that much personnel turnover is explained by employees opting for self-employment or for starting their own business with other colleagues); and (vi) its ownership structure does not follow the "partnership" model favored by most professional service firms (Anand et al., 2007; Pinnington and Morris, 2002)—in particular, AE and its main competitors are either listed on a stock exchange or owned by a group of investors. We expect these characteristics to have consequences not only for the development of capabilities but also for the *type* of capabilities needed for the long-term development and performance of TEC firms more generally. Our findings indicate that these capabilities and their development are related to: (a) the organization of innovation labor, (b) how TEC firms employ innovation labor when they provide engineering knowledge, and (c) delivering services that enable the client's numerical and functional flexibility.

More specifically, this paper identifies two capabilities that are crucial for AE. We use our case-study findings to explicate how those capabilities may be combined to create a

foundation for the successful organization and transfer of engineering knowledge among diverse problem-solving contexts. Our analysis indicates that TEC firms can serve purposes beyond enabling numerical and functional flexibility (Atkinson et al., 1984; Handy, 1989; Kalleberg, 2001), which many scholars argue are the two main drivers of the TEC sector's continued growth. In this respect, we posit that TEC firms, such as AE, are motivated to create a particular kind of knowledge dynamic (Criscuolo et al., 2007) and to develop and offer skills that their clients may be hard pressed to develop internally. Our empirical findings indicate that skills related to social dynamics and teamwork are no less essential than is specialized technical expertise, and these individual-level observations bear implications for our understanding of the TEC firm's nature and capabilities more generally.

Our study suggests that TEC firms, in addition to increasing their clients' numerical and functional flexibility (Kalleberg, 2001), offer capabilities that those client organizations may find difficult to develop on their own. Malhotra (2003) likewise notes that the TEC firm's ability to organize, manage, and coordinate engineering knowledge is one of its most significant advantages. Advanced Engineering devotes considerable attention to understanding what its clients need, how they work, and how each client's internal structure sets the problem-solving conditions. That these are vital activities is confirmed by our interviews with AE's clients. Managers at AE emphasize the importance of withdrawing from assignments when their employees' services are no longer needed and of terminating contracts when there is little chance of adding value to a client's activities. In this sense, then, managers implement activities that would be difficult for a self-employed consultant—operating without any hierarchical or institutional guidance—to duplicate. The managers interviewed in our study frequently speak about "career moves" with regard to new challenges, new assignments, and new problem-solving contexts to ensure that they "stay on the move" and "stay current". These managers' responsibilities included creating plans for future assignments in collaboration with technical

consultants as well as strategically considering each consultant's abilities, competencies, and personal development when envisioning future projects and assignments. In many ways, this kind of "knowledge-centered career" is different from career trajectories associated with the up-or-out logic commonly observed in other professional service firms (Greenwood et al., 2005).

As seen in our empirical account, AE does not seek to build a strong and unified organizational culture and/or a common organizational identity; and even less does it encourage individuals to affiliate strongly with the organization (Alvesson and Lindkvist, 1993). Instead, the view among managers and senior consultants is that: (a) "adulation" of the firm amounts to attention that would more usefully be devoted to improving competence and developing knowledge; and (b) the "psychological" contract (Rousseau, 1995) between employer and employee should rather reflect the quality of knowledge and knowledge development processes. Therefore, from the individual consultant's standpoint, future employability is associated with being given opportunities to enhance one's competencies and to participate in relevant knowledge development initiatives and competence-enhancing technology projects. This kind of professional consultant identity—which differs markedly from an identity based on conventional, culture-based controls—accords well with the goals for which AE managers strive. Moreover, such identity orientation is also in accordance with the type of services that AE delivers to both clients and employees, services that center on the provision of knowledge development opportunities and access to networks with competent fellow engineers.

Indeed, "staying on the move" (Borg and Söderlund, 2014) is regarded as a critical condition for the success of technical consultants, since it most clearly distinguishes AE engineers from those employed directly by the client organization. Similar to Barley and Kunda's (2004) observations reported in their in-depth studies of technical consultants, our

respondents reveal that the greatest threat to their own development is to be "stuck at a desk" or to become "too similar to the clients' engineers". The interviewed consultants believe that they are different from the engineers employed by the client organizations and that—to ensure knowledge complementarities—they *should* be different. This belief is supported by our observations of AE's various training programs and by interviews with client representatives, who are keen to clarify that difference and to discuss how it should be maintained. Hence, we are motivated to identify mechanisms that could mediate between the individual and the organization in order to establish AE's unique and value-generating capabilities. At the same time, however, the AE consultant must be able to "fit in" while remaining socially distinct, offering knowledge and perspectives that are unique (Rink et al., 2013). Remaining distant but not too distant is the key to ensuring that consultants offer otherwise unavailable services and that they broaden the search activities of their client organizations (Leiponen and Helfat, 2010).

Advanced Engineering has initiated several activities intended to ensure that this knowledge dynamic remains active—in other words, that the individual consultant is assigned to appropriate projects and then learns from the assignments by contributing to those projects. This process unfolds in three stages: *moving in* (entering new assignments, understanding problem-solving contexts); *moving out* (exiting completed assignments and handing over the results); and *moving on* (building a career, taking on new assignments); see Borg and Söderlund (2014). Our data show that these three activities proceed mainly through interactions between the individual and the organization. Hence, our findings indicate that firms such as AE must always be looking for individuals who exhibit the qualities needed to move in, move out, and move on; it must also ensure that its consultants maintain and continuously develop the competence and skills required to engage in those three activities. For that purpose, and so consultants can work on the inside yet remain distant, they need to build "liminality competence" (Borg and Söderlund, 2015b; Sturdy et al., 2009) and thereby become adept at (a)

assuming the liminal roles (Swan et al., 2015) needed for contributing to knowledge processes across a wide spectrum of client projects and (b) tolerating a certain degree of ambiguity in their role and assignment.

Respondents also stress the importance of learning from experience and of engaging regularly in reflective activities to enhance their learning more generally (Bolton, 2014; Bradbury et al., 2010). In order to encourage these processes, AE has developed a variety of organizational mechanisms to promote reflection (Schippers et al., 2015); examples include the competence development programs and reflection reports described previously as well as the firm's internal technology and competence networks. Consultants are encouraged to reflect on their career, their current position, and their future assignments by way of consultant diaries and "reflection reports".

Although many of these activities could be organized by the client organization itself, there is a major component of AE's approach that results in engineers being rotated more advantageously, quicker, and with less friction: the firm has worked to promote regularly scheduled mobility and rotation in response to its general sense of market pressure and competition. In various ways, AE has also worked to promote mindfulness (Jassawalla and Sashittal, 1999) and to expand the reflective capacity of its employees—characteristics that are highly valued by clients and employees alike. Through these efforts, individuals become more aware of their role in the knowledge development process, of their contributions to the client's innovation process, and, it seems, of their own long-term development. As prior research has indicated, the market's ability to create these outcomes is severely limited by the "tacit" nature of much transferred knowledge and by the risk of explicit knowledge being expropriated (Grant, 1996; Leiponen, 2006).

Our case study demonstrates that AE has built the capabilities of swiftly responding to client needs for specific competencies and resources and of transferring consultants among

projects and client organizations. Several clients state specifically that the main reason they hire consultants through AE is because they need "capable resources quickly". Yet, AE managers point out that, besides responding to client requirements and ensuring that consultants remain on the move, the firm must assign a consultant whose experience and skills are a good match for the focal client's needs and also ensure that this matching of needs and resources continues to work properly. Advanced Engineering has developed this ability through close interactions with several of its clients over many years (cf. Løwendahl, 2005), which have provided the firm with a unique and thorough understanding of their technologies and problem-solving conditions. In this way, AE has developed the ability to ensure that rotation of consultants among problem-solving contexts occurs at the first opportune moment. We label this capability *swift transition*.

Equally essential for swift transition is the ability of technical consultants to enter and quickly comprehend new problem-solving situations. As the case demonstrates, AE's technical consultants are usually assigned to projects in need of immediate solutions and hence must rapidly adjust to the client's team and project requirements (Lindkvist, 2005; Meyerson et al., 1996). It is thus incumbent on these consultants to use their technical knowledge and social skills to determine their role in the assignment and on the project team (Barley and Kunda, 2006). Technical consultants working for AE establish their position on a project team by developing, as quickly as possible, trust among team members (Nikolova et al., 2015) and by creating a role for themselves through which value can be added to the project (Barley and Kunda, 2006; Meyerson et al., 1996). Being able to "enter assignments quickly", "build trust", and "assume certain roles"—and thereby to increase the project's and the client's value—are individual skills that clients view as being critical and also as typical of AE consultants. Although our client interviews indicate that market organization and the hiring of freelancers are usually sufficient for an effective transition with respect to providers of specialized services,

the processes and activities organized by AE often make this transition not only quicker but in most cases also better timed. These improvements derive most notably from the matching of clients and individual consultants via sophisticated procedures geared toward each party.

Besides swift transition, AE has developed another central capability—namely, *knowledge cycling*—which strengthens the organizational properties required to function as a fully operational TEC firm while complementing its clients' capabilities. Knowledge cycling requires that AE be able to locate diverse problem-solving situations from which to gain and accumulate knowledge that augments its current problem-solving capacities and that will subsequently add value to client projects. Thus, knowledge cycling is premised on AE being better able, than are other institutional arrangements, to develop and transfer knowledge (Kogut and Zander, 1992; Malhotra, 2003). As seen in our findings, knowledge cycling is based on the idea that individuals must circulate among assignments in order to stay current, yet must remain long enough in one assignment to add value in that context and to maximize their learning from the assignment. Hence, on a more general level, the notion underlying a TEC firm as an "organizational innovation" (Pettigrew et al., 2003) is that the individual consultant develops competence via mobility among different organizational contexts, which yields better outcomes than would result from the consultant remaining in one place indefinitely. Mobility thereby ensures that the lessons learned in one context will be transferred to other contexts; when organizational boundaries are crossed, it also leads to knowledge domains becoming more complementary and so contributes to the establishment of knowledge-centered "development coalitions" (Asheim, 2002).

Effective knowledge cycling also requires AE (a) to rotate its consultants among different problem-solving contexts at regular intervals, thereby broadening the consultants' competencies and thus facilitating knowledge transfer, and (b) to ensure that the consultant remains on each assignment long enough to understand its problem-solving context and to learn

tasks well enough so that the knowledge acquired can be transferred to other organizational contexts (Allen, 1977; Argote and Ingram, 2000; Rosenberg, 2009). That said, consultants should be reassigned soon enough that they can stay current and remain able to engage in knowledge processes that broaden their respective skill repertoires. We therefore show that prior research—according to which the more time spent on one assignment, the more skills developed (Nightingale et al., 2011)—need not apply in this context. The reason is that AE's search activities are, by design, mainly organized at the individual level because it seeks to increase the individual skills (Leiponen, 2005) on which firm-level capabilities ultimately depend.

One can reasonably argue that knowledge cycling differs from knowledge transfer and from traditional modes of organizing engineering knowledge (Jonsson, 2015; Yakhlef, 2007). In the case of AE, managers emphasize the significance of scheduled rotation among projects and client organizations. This corporate-wide policy is one way of inducing its engineers to opt for knowledge cycling, which prior research has shown to be an indispensable aspect of functioning knowledge collectivities (Lindkvist, 2005). That way, individuals are encouraged to continue working with new partners representing diverse areas of expertise (Meyerson et al., 1996). Such ongoing knowledge-centered collaboration with well-informed but new partners is a critical component of AE's functioning, as well as its "value proposition" to employees (Ulrich and Brockbank, 2005). Our informants explain that, over time, assignment rotation increases a consultant's ability to participate in knowledge processes, create trust, and carve out roles that promote continuous development of competencies (Barley and Kunda, 2006; Borg and Söderlund, 2014).

As illustrated in Figure 1, the capabilities of swift transition and knowledge cycling are closely linked and mutually constitutive. We argue that each is formed through interactions between the organizational level and the individual level (Felin and Foss, 2005; Felin et al.,

2015). *Swift transition* involves more than AE quickly moving consultants in response to client needs or adding staff to their development projects, and it goes beyond maintaining numerical flexibility and solving its clients' "peak" problems. Swift transition requires, in addition, that managers are able to identify client needs and match them with the appropriate human resources—and also that technical consultants are able to enter new problem-solving situations on demand and quickly engage in fruitful interactions with other members of the clients' project teams (Borg and Söderlund, 2014). Thus, AE's *raison d'être* consists of offering clients the services of consultants who are equipped to assume, almost immediately, a position that creates value and contributes to the client's focal project (which is often behind schedule). At the same time, *knowledge cycling* concerns not only AE's ability to encourage knowledge transfer by rotating its consultants among problem-solving contexts but also the technical consultant's ability to transfer knowledge and lessons learned among client organizations (Argote and Ingram, 2000; Song et al., 2003); thus, knowledge cycling transcends conventional solutions to the problem of functional flexibility. Our study, accordingly, showcases the close connections between individual skills and the development of organizational capabilities (Leiponen, 2005) as well as the role played by AE in addressing human capital deficiencies while organizing innovation and building organizational capabilities (Mohnen and Röller, 2005).

[INSERT **FIGURE 2** ABOUT HERE]

Our case-study findings are summarized in Figure 2, which illustrates schematically the links between the capabilities of swift transition and knowledge cycling—in addition to the dynamic interaction between the organizational level and the individual level in fostering these capabilities. This figure suggests how the organization–individual interaction enables capability development in TEC firms. Our findings also indicate that swift transition and knowledge cycling are the true drivers of a TEC firm's knowledge strategy and hence should

be considered when assessing the performance of TEC firms. Finally, in Table 2 we compare our two identified capabilities in terms of their key processes, core practices, and individual skills.

[INSERT TABLE 2 ABOUT HERE]

We have shown that swift transition and knowledge cycling are appropriate responses to the challenges faced by TEC firms; however, the same or similar circumstances may well be found in other contexts. One could therefore argue that the challenges faced by AE may be generic features of being a TEC firm. Yet, the particular solutions to those challenges undertaken by AE could well be contingent, and different solutions might be found in other times and places.

6. Conclusions and implications

This paper explores the nature and capabilities of TEC firms through a case study of Advanced Engineering. Our research is based on the notion that firms with characteristics similar to those of AE should foster knowledge processes within, across, and beyond their respective organizational and technological boundaries. Findings from our case study offer tentative evidence of the centrality of two capabilities: swift transition and knowledge cycling. Our analysis of these two capabilities offers further evidence for the human-centered nature of capabilities in TEC firms (Anand et al., 2007; Hitt et al., 2001).

Swift transition depends on the firm's ability to allocate technical consultants rapidly to client projects and also on the ability of those consultants to enter new project teams and problem-solving situations quickly and with good effect (Barley and Kunda, 2006; Meyerson et al., 1996). *Knowledge cycling* involves the firm's ability to rotate its consultants among problem-solving situations, thereby enabling the transfer of knowledge from one situation to another, as well as the ability of consultants to apply lessons previously learned to new

problem-solving contexts and to exploit the mobility inherent in their work situation—thus broadening their respective knowledge bases (Allen, 1977; Borg and Söderlund, 2015a; Rosenberg, 2009).

Our study documents the complementarity between search activities at the firm level and skills at the individual level, and it also indicates the potentially unique role played TEC firms in fostering such capability development activities. Both swift transition and knowledge cycling explain the increased demand for technical consultants in times of project turbulence, especially given the high standards associated with knowledge specialization and the need to integrate distributed and specialized knowledge (Brusoni et al., 2001; Grant, 1996; Lindkvist, 2005). In such circumstances, TEC services may be paramount for clients that must respond quickly to unexpected problems arising late in projects—while maintaining alternative and complementary knowledge bases that sufficiently overlap for the knowledge of consulting and client engineers to be integrated.

The research reported here augments the conventional analysis of innovation labor flexibility (Atkinson et al., 1984; Handy, 1989; Kalleberg, 2001). We have underscored that capability development in TEC firms resembling AE is human centered (Hitt et al., 2001); hence, such development is affected not only by the problem domain itself but also by human resource factors. Thus, we contribute to prior research by showing the need to account for wider organizational and professional issues—in addition to the narrower issues involving human resources and their development and organization—if the goal is a better grasp of the capabilities central to TEC firms.

In sum, this paper makes two main contributions. First, our analysis supplements the prevailing view, which emphasizes the need for numerical and functional flexibility of innovation labor, by identifying potential additional purposes served by the TEC firm on behalf of its clients. Second, we describe two important capabilities of a successful TEC firm that are

associated with the provision of innovation labor—swift transition and knowledge cycling—and explain how the individual and organizational levels interact to develop and sustain those capabilities.

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Table 1. Data collected

Data collection method	Quantity	Duration
Interviews with managers, senior managers, and board of directors	20	1–2.5 hours
Interviews with consultants	20	1.5–2.5 hours
Workshop with managers (11 participants)	1	3 hours
Interviews with client representatives	10	1–1.5 hours
Documents (internal documents, presentations, and reflection reports)	125	2 years
Diaries	13	3 months
Observations of meetings and training programs	14	2–8 hours

Table 2. Comparing capabilities: Swift transition and knowledge cycling

Swift transition	Knowledge cycling
Key processes	
Identifying clients' needs early on, matching clients' needs with individual skills, swiftly entering and quickly comprehending new problem-solving situations.	Identification of learning opportunities, accumulating knowledge, transferring knowledge to new problem-solving contexts.
Core practices	
"Swift rotation"; stay on the move to maintain ability to enter and leave. Fostering rotation to be able to ensure that clients have capable and value-producing resources on-site quickly.	"Scheduled mobility"; stay long enough to learn and contribute, but don't stay too long to stay relevant. Knowledge cycling facilitates learning from diverse settings.
Individual skills	
"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.

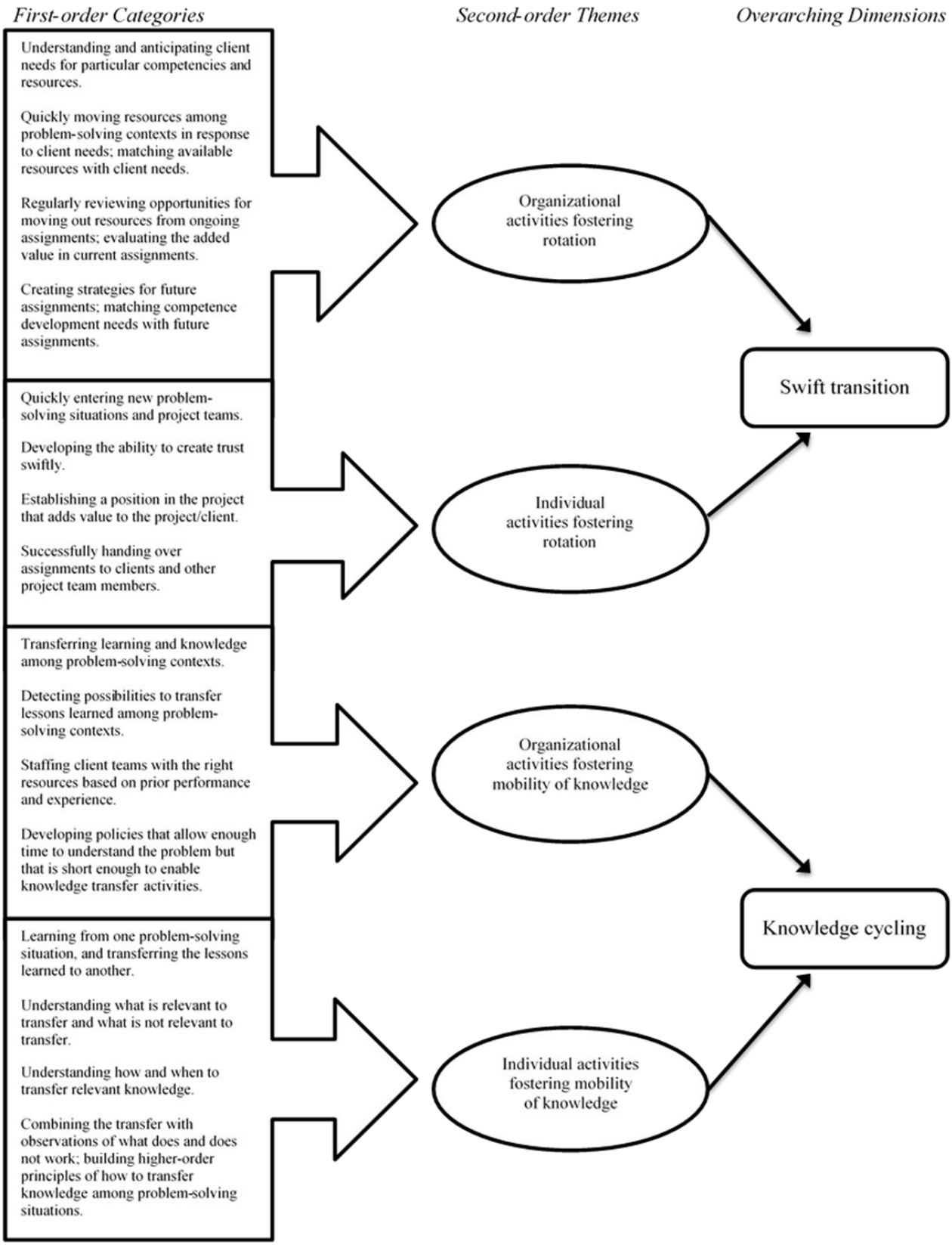

Figure 1. Data analysis

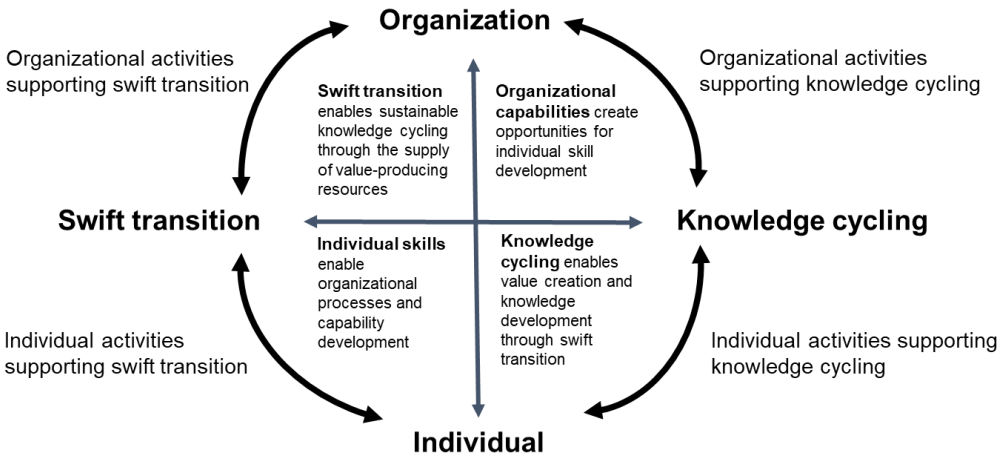

Figure 2. Swift transition and knowledge cycling: Interactions between capabilities and organizational levels