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Knowledge sharing dynamics in international subcontracting arrangements: The case of Finnish high-tech SMEs

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ABSTRACT

This paper focuses on an under-researched topic of knowledge sharing dynamics in international subcontracting relationships of SMEs. Based on in-depth qualitative analysis of three Finnish high-tech firms, our findings reveal that not only cost and performance expectations motivate SMEs for international subcontracting, but also the factors like lack of in-house alternatives, the volatility of workload, and need for speed in growth-related activities such as deliveries play an important role. We further found that the SMEs try to balance internal risks/uncertainty and external risks/uncertainty throughout international subcontracting. Our paper contributes to the extant literature by being one of the first studies to specifically highlight the range of knowledge sharing and knowledge protection mechanisms used in international subcontracting in SME-SME relationships in which partners come from different institutional settings and physical locations. Moreover, this paper is one of the few studies to specifically highlight the role of time in knowledge sharing from the buyer's point of view as well, specifically by emphasizing the need to balance the internal and external risks during the life-cycle of international subcontracting while balancing short-term challenges and long-term strategic development plans.

1. Introduction

Knowledge transfer within firms, between firms, and in international networks is an extensively researched phenomenon in management studies. There is substantial literature on knowledge transfer within multinational enterprises (MNEs) in the international context, exploring the direction of knowledge flows, as well as types, effectiveness, and efficiency of knowledge transfer, among others (Zeng et al., 2018). This stream of literature has increased our understanding of the extent and type of knowledge flows from headquarters (HQs) to subsidiaries, from subsidiaries to HQs (reverse knowledge transfer), between subsidiaries (lateral knowledge transfer) (Rabbiosi, 2011; Mudambi et al., 2014), and the challenges that international context imposes on knowledge transfer efficiency (Gaur et al., 2019). Studies concentrating on knowledge transfer between firms have had a strong emphasis on horizontal

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relationships such as strategic alliances and joint ventures (see, e.g., Ho and Wang, 2015; Yang et al., 2014). Here two main approaches to studying interorganizational learning have been identified by Yang et al. (2014). The structural approach focuses on the influence of governance structure on facilitating learning, and the process approach concentrates on learning in different stages of relationships and mechanisms facilitating learning and knowledge transfer (Yang et al., 2014).

However, much of the research that examined knowledge transfer and learning in interorganizational relationships has focused on buyer-supplier relationships between larger firms operating in manufacturing sectors (Squire et al., 2009; Khan et al., 2015; Uzunca, 2018). As such, there is a relative dearth of research on knowledge sharing dynamics in international subcontracting relationships where small and medium enterprises (SMEs), with distinct characteristics, are engaged in such relationships (Balle et al., 2019; Im and Rai, 2008). SMEs as part of an interorganizational context face particularly daunting challenges related to knowledge transfer (Jones and Macpherson, 2006), given that such firms lack absorptive capacity and differences in their knowledge management activities and processes compared to larger firms (Durst and Edvardsson, 2012). SMEs, in general, are also relatively weak in using formal and systematic approaches and apply a more unstructured and short-term approach towards organizational learning (Durst and Edvardsson, 2012). Thus, it is essential to consider the specific features of SMEs like lack of resources, smallness, flexibility, and informality and their implications for international knowledge management and exchange processes when examining knowledge transfer in the SMEs context (Durst and Edvardsson, 2012). Furthermore, while prior research has tackled cases when SMEs act as contractors for other enterprises (e.g., Murphree and Anderson, 2018; Prashantham & Birkinshaw, 2020), SMEs' -especially from the high-tech sector- engagement in international subcontracting relationships has not been sufficiently researched, particularly in their approaches to learning and knowledge sharing mechanisms.

In view of the research gaps we identified, we aim to analyze the *knowledge-sharing characteristics* of SMEs in their international subcontracting relationships in high-tech sectors (specifically the software industry). Furthermore, subcontracting can potentially include sensitive knowledge, which may involve strategic decision-making and has the potential to offer firms a competitive advantage. We, therefore, also explore if the *timing* has any role in knowledge sharing, i.e., whether firms share such knowledge at the start of subcontracting relationships or whether the trust that is built over time determines if such knowledge is going to be shared. In so doing, we analyze both the mechanisms and timing of knowledge sharing in international subcontracting relationships. We utilize explorative multiple case study design as a research methodology to explore this in the context of Finnish software firms. The empirical context is three Finnish software SMEs, acting as buyers (contractees), and their international subcontracting relationships with SMEs selling software development services (contractor) from emerging markets. The context of emerging markets is particularly important as it alludes to the unique challenges and opportunities involved in the relationships between software SMEs from developed countries and their suppliers from the countries that are economically, institutionally, and culturally different.

The contribution to interorganizational knowledge sharing literature offered by our study is three-fold. First, our findings advance interorganizational knowledge sharing research by pointing out the range of knowledge sharing and knowledge protection mechanisms used in international subcontracting in SME-SME relationships in which partners come from different institutional settings. Our research sheds light on the unique aspects of SME-SME relationships between partners of different backgrounds and their implications for knowledge sharing characteristics, as most of the previous studies have focused either on MNEs and their subsidiaries (e.g., Lee et al., 2020; Monteiro et al., 2008; Noorderhaven and Harzing, 2009) or MNEs and their supply chain partners (e.g., Duanmu and Fai, 2007; Khan et al., 2015; Rungsithong and Meyer, 2020). As such, we highlight knowledge sharing dynamics as experienced by SME contractees from developed countries and reveal that motives for, mechanisms of, and control processes of international subcontracting exhibit distinct characteristics due to differences in institutional settings and physical locations. For example, we find that the lack of alternatives, workload volatility, and the need for speed in growth-related activities motivate SMEs to try international subcontracting rather than traditional motives of cost and performance expectations.

Second, the findings increase the understanding of the role of time in knowledge sharing from the buyer's point of view, specifically by emphasizing the need to simultaneously balance both the internal and external risks during the life-cycle of international subcontracting and short-term challenges and long-term strategic development plans. With relatively limited discussion on the role of time in knowledge sharing context, these findings provide a much fine-grained view of the role of time and knowledge sharing mechanisms in interorganizational knowledge sharing context (cf. Szulanski et al., 2016).

Third, we suggest viewing knowledge sharing strategies in international contracting relationships in relation to mechanisms to be used to deal with the different challenges, which vary depending on the contractee's subcontracting experience and activities that are being subcontracted. In so doing, we show that while SMEs balance between internal risks/uncertainty and external risks/uncertainty throughout subcontracting activities, they also have to balance between shorter-term challenges, problems, and expectations and the longer-term goals and outcomes in subcontracting. Thus, we highlight the ambidextrous nature of knowledge sharing dynamics in SME-to-SME subcontracting context (e.g., Im and Rai, 2008).

The rest of the paper is organized as follows. The next section offers a discussion on theoretical background followed by empirical research design and findings. The paper concludes with a presentation of implications, limitations, and future research directions.

2. Theoretical background

2.1. Knowledge-driven interorganizational relationships

An extensive body of research on interorganizational relationships offer useful insights into the drivers, nature, and outcomes of relationships between organizational partners (e.g., Beugré and Acar, 2008; Dwyer et al., 1987; Dyer and Singh, 1998; Emanuela, 2012; Parmigiani and Rivera-Santos, 2011; Son et al., 2016). Traditionally, this line of research has focused predominantly on

relationships that facilitate the flow and exchange of tangible goods between a buyer and a seller (e.g., Alderson and Martin, 1965; De Ruyter et al., 2001; Dwyer et al., 1987; Grawe, 2010; Parmigiani and Rivera-Santos, 2011). As such, the fundamental premise of interorganizational relationships has, until relatively recently, been lowering transaction costs and improving performance through greater relational involvement between buyers and suppliers.

However, scholars have increasingly recognized the softer, more intangible aspects of interorganizational relational exchange between partners of different characteristics; not only between buyers and suppliers of goods but also between service providers (e.g., Ashok et al., 2018; Beck and Plowman, 2014; Dyer and Hatch, 2006; Valtakoski, 2017). As such, knowledge-related intangible elements have increasingly been acknowledged as a critical aspect of interorganizational relationships (Griffith et al., 2006; Kotabe et al., 2003; Liu et al., 2010; Thomas et al., 2011; Vaccaro et al., 2010). It is increasingly understood that interorganizational dyads are not only domains of physical exchange but also are domains in which tacit and explicit knowledge is exchanged, and partners learn from each other. External knowledge sources (e.g., customers, suppliers, and strategic partners) often enable having access to add institutionalizing 'new' knowledge in the firm (Jones and Macpherson, 2006). In fact, as the new dominant-logic of value creation is no longer products but services (Vargo and Lusch, 2004), knowledge and learning have become indispensable elements of interorganizational relationships. They may even prevail over a product-driven aspect of interorganizational relationships.

Since knowledge-intensive value creation involves complexities, a higher degree of intangible and cognitive resources, the locus of knowledge creation is more likely to be in interorganizational networks than in individual firms or individual employees (Griffith et al., 2006; Håkansson, 1989; Liu et al., 2010; Vaccaro et al., 2010). Moreover, industry-specific characteristics may limit the possibilities to rely on only internal knowledge resources (Weber and Tarba, 2014). This is a case, e.g., for firms operating in the IT sector, which can be described as highly competitive, dynamic, and uncertain (Camio et al., 2018; Finoti et al., 2017). In the software sector, the key to SMEs' survival is rapid technological development (Hilmola et al., 2003), and recombination of knowledge related to different domains (e.g., Lew et al., 2016). They need new ways of knowledge acquisition and development that enable better use of external sources. In this vein, knowledge-driven relationships provide firms with greater opportunities to access unique knowledge and learning mechanisms to tackle hypercompetitive environments and face heightened uncertainty, complexity, and ambiguity (Blome et al., 2014).

Knowledge-driven interorganizational relationships have key attributes that make them distinct. First, such relationships are established so that partners' relational infrastructure supports knowledge exchange and interorganizational learning more so than product exchange. As such, boundary spanners and their role as knowledge conveyors (particularly that of tacit knowledge) are heightened (Ebers and Maurer, 2014; Liu et al., 2014). Second, as the primary unit of exchange between partners is knowledge, such relationships are more exposed to behavioral complexities (Oliveira and Lumineau, 2018). Thus, the role of trust is heightened as a primary enabler of willingness to share tacit/strategic knowledge (Emanuela, 2012; Squire et al., 2009), and the partners may become more prone to/subject to discrimination (Uzunca, 2018). Third, in line with different types of knowledge involved in the exchange, e.g., technological knowledge, process knowledge, and managerial knowledge, partners need distinct mechanisms to acquire, capture, assimilate, store, disseminate, and utilize external knowledge within their organizational boundaries. Knowledge sharing and interorganizational learning are inextricably intertwined (Dyer and Hatch, 2006; Valtakoski, 2017) and entail unique mechanisms across organizational boundaries. Below, we delve deeper into interorganizational learning mechanisms to overview the means by which firms and their boundary spanners share their knowledge and learn from each other.

2.2. Interorganizational learning mechanisms

Interorganizational scholars have long examined how firms learn through interorganizational relationships (Uzunca, 2018). This line of research has found that aggregate patterns of partner-specific experience and interactions, such as interorganizational collaboration and coordination (Dyer and Hatch, 2006; Zollo et al., 2002), relational capabilities (Gölgeci et al., 2019), and relationship-specific social capital (Dyer and Singh, 1998), can lead to improved learning and knowledge sharing related performance outcomes both for each partner and for their relationship. Extant research also highlights that interorganizational learning and knowledge sharing is a multilevel phenomenon and involves interactions at both firm and individual levels as carried out by boundary spanners (Berghman et al., 2013; Carmeli et al., 2021; Martinkenaite and Breunig, 2016).

Firms may follow formal, informal, or hybrid knowledge sharing and learning mechanisms with distinct implications of each choice (Estrada et al., 2016). Likewise, interorganizational learning mechanisms can also be categorized into mechanisms for knowledge recognition, assimilation, and exploitation (Berghman et al., 2013). Furthermore, firms may support interorganizational learning through knowledge exploration and/or exploitation processes (Park et al., 2015). Accordingly, the list of potential interorganizational learning mechanisms can be much longer depending on the context and timing of interorganizational knowledge sharing (e.g., Szulanski et al., 2016). Nonetheless, a common underlying characteristic of such mechanisms is that they are all underpinned by highly complex and multifaceted cognitive and behavioral elements that are manifested at the interface of individuals and information. As such, interorganizational learning mechanisms require boundary spanners to be proactive in accessing and extending appropriate interorganizational relationship (Jones and Macpherson, 2006) but is also marred by cooperative behaviors that may result in misappropriation and curb learning (Estrada et al., 2016).

One of the critical challenges associated with interorganizational learning is finding and maintaining the fine balance between knowledge exchange and knowledge protection (Yang et al., 2014). In micro-companies and many SMEs, owners are often the key decision-makers and gatekeepers of information (Jones and Macpherson, 2006; McDowell et al., 2009). Thus, their perception about the role of sharing vs. protecting knowledge in contributing to the firm's success is important. For instance, Turkish family SMEs operating in the manufacturing sector had a very controlling approach and wanted to prevent the outflow of even basic knowledge (Bozbura, 2007). Thus, they could not appropriately balance between knowledge exchange and protection. However, owner-managers

may also be entrepreneurially oriented, which may lead to controlling only selected elements while opening up to some knowledge sharing (Jones and Macpherson, 2006). The importance of sharing knowledge and capturing information was found to be particularly important for SMEs involved in partnerships producing innovative products and processes (Martínez-Costa et al., 2019). In industries such as the IT sector, in which short life cycles of technologies are common, innovation generation is critical (Camio et al., 2018). This often requires SMEs to partner with competitors (Gnyawali and Park, 2009), leading to a risk of opportunistic behavior, which, on the other hand, emphasizes the importance of balancing knowledge exchange and protection. However, SMEs with innovative cultures seem to be ready to take these risks and share relevant knowledge to get the benefits (Martínez-Costa et al., 2019). This is in line with the fact that for SMEs to implement controls and structures for protecting knowledge would be a challenge and against their creative and flexible character (Coleman and Oconnor, 2008).

The complexity of business conditions has been found to have an effect on information sharing practices also for SMEs so that in the context of simple business conditions, only limited information is shared while complex business conditions require more information to be shared (Welker et al., 2008). Nevertheless, the type of information shared has been found to have an important effect on performance (Son et al., 2019). Liao and Barnes (2015) offer further support in the SME context that information sharing as such did not increase knowledge acquisition. Rather, the relationship quality between partners improved knowledge acquisition, indicating an essential role of commitment and trust. Thus, in micro and small firm context, the decision to exchange or protect information and knowledge can be linked to the characteristics of the owner/CEO, organizational culture, industry characteristics, business complexity, and relationship characteristics.

Another critical characteristic in interorganizational learning is the short-term vs. long-term strategic approach. In general, SMEs have been found to lack systematic knowledge management strategies and policies as well as formal techniques and processes for knowledge transfer (Bejerse, 2000; Chen et al., 2006; Hutchinson and Quintas, 2008; McAdam and Reid, 2001). The majority of the learning in small companies is incidental, reactive, and short-term oriented (Matlay, 2000). Still, some SMEs approach knowledge management in a more proactive, structured, and strategic way (Cerchione et al., 2016; Hutchinson and Quintas, 2008; Matlay, 2000). The short-term vs. long-term strategic approach towards knowledge management is also reflected in the approach towards partnerships. For SMEs, long-term partnerships together with absorptive capacity may mitigate the negative effect of dependence on partners and the related risk of opportunistic behavior (Prajogo et al., 2020). On the other hand, both partners' commitment through knowledge and process sharing fosters long-term relationships between small companies leading to improved performance (Adams et al., 2012). Still, it was found that micro firms rely more on relational variables such as trust, while SMEs are more dependent on formal communication processes (McDowell et al., 2009).

2.3. Knowledge sharing and timing in international subcontracting relationships

A large body of research in international business examine firms' decision to expand to foreign markets and/or outsource their activities to the offshore location (e.g., Adomako et al., 2019; Kedia and Lahiri, 2007; Pisani et al., 2018; Singh and Gaur, 2013; Ørberg Jensen and Petersen, 2013). This line of research highlights that most firms have either unique motives to internationalize or are compelled to span their activities across national boundaries as a result of external (e.g., competitive or institutional) forces (Hutchinson et al., 2007; Roza et al., 2011). However, they face an amplified set of challenges when operating in international contexts that require a unique set of strategies and activities to tackle constant change (Oliva Fábio et al., 2019; Weber and Tarba, 2014).

International subcontracting relationships are a particular type of knowledge-driven interorganizational relationship that entails close involvement and concerted knowledge sharing between partners (Murphree and Anderson, 2018). Depending on the importance and complexity of sub-contracted processes, concentrated transfer of tacit and experiential knowledge is imperative to the survival and performance of the relationship in such relationships. Especially when sub-contracted processes involve knowledge-intensive activities such as professional services and information technology (IT), contractees and contractors are compelled to work closely to ensure that activities are executed effectively and integrated closely into the contractees' larger system.

As examined in various streams of research such as global value chains (Gereffi et al., 2005) and transaction cost economics (Brouthers, 2013), firms outsource (externalize) some of their activities when such activities are considered non-core/non-value-adding/unprofitable activities, and when they are able to slice those activities into components that can be sub-contracted. That said, in most cases, especially in knowledge-intensive service activities, sub-contracted processes remain integral, if not a central, component of the firm's overall value offering and entail close knowledge integration between interacting parties.

As noted above, knowledge sharing is a challenging task on its own due to its unique characteristics and mechanisms involved since organizations have to move people, tools, and systems to facilitate knowledge transfer (e.g., Argote and Ingram, 2000). However, international settings impose additional complexities and challenges to knowledge sharing between partners. Among them is the cultural distance between partners, amplified behavioral uncertainty (Beugré and Acar, 2008), knowledge distribution challenges (Tippmann et al., 2013), lack of absorptive capacity of the party receiving knowledge, lack of credibility on the part of the source of knowledge, lack of motivation by either party, strenuous relationships between the source and recipient, and causal ambiguity stemming from the complexity of knowledge (Dyer and Hatch, 2006). Especially when the majority of knowledge is tacit, as is the case with international service subcontracting relationships, additional challenges arise with codifying and transmitting knowledge between parties of different national backgrounds (Guo et al., 2018).

While the most common assumption on the primary knowledge flow between a contractee and contractor is upstream towards the contractor (Giuliani et al., 2005), the opposite is also possible when the contractee's capabilities lag behind that of the contractor's. Accordingly, interorganizational knowledge sharing and learning opportunities are a two-way street and may follow unpredictable patterns. In fact, knowledge asymmetries between the partners may provide opportunities for greater learning experiences, especially

for those who lag behind and lack sufficient resources to create their own knowledge at competitive levels.

Interorganizational learning is an indispensable element of strategic renewal in SMEs, as they lack internal resources for superior knowledge creation (Jones and Macpherson, 2006). Therefore, although SMEs may face serious size-related challenges in interorganizational relationships such as power asymmetry (Murphree and Anderson, 2018), they can potentially leverage being contractors to other firms as a learning opportunity. That said, extant research offers little insights into how SMEs manage knowledge sharing and learning mechanisms with their partners and handle complexities of international subcontracting relationships when they lack formal knowledge management practices, resources, and defined structures.

Furthermore, knowledge sharing in international subcontracting relationships has important time-related components (Schilling, 2002; Thomas et al., 2011). In a world where speed is a critical factor in surviving fierce competition (Carmeli et al., 2021; Oliva Fábio et al., 2019; Weber and Tarba, 2014), firms increasingly face time pressure with their interorganizational knowledge sharing and learning activities in terms of the timely acquisition, processing, and leverage of knowledge (Thomas et al., 2011). Likewise, beyond speed, timing is an important question concerning interorganizational knowledge sharing (Schilling, 2002). However, little is known about when it is the best time to share specific knowledge types between international subcontracting partners and its association with the types of mechanisms used for knowledge sharing.

3. Empirical research design and method

3.1. Research method

As indicated in the theoretical part, current literature on international subcontracting between SMEs offers quite limited explanations regarding mechanisms and strategies related to knowledge sharing. In order to get a rich and in-depth insight into the under-researched area, we found the qualitative case study approach appropriate (Yin, 2009; Ledford and Gast, 2018). International subcontracting among SMEs is a poorly understood phenomenon. The lack of prior theories and testable hypotheses justifies an exploratory study (Eisenhardt, 1989; Ketokivi and Choi, 2014) to systematically understand the timing and mechanisms of knowledge sharing among SMEs-to-SMEs business exchange.

Our data were collected from three Finnish SMEs in 2020 using semi-structured expert/elite interviews. Commonly, public databases do not reveal which high technology SMEs are involved as buyers in international subcontracting. Hence, in the absence of an accurate sample frame, probability sampling could not be used. For this reason, we used convenience and snowball sampling strategies and chose our three firms based on the fact that we had good insight into these firms' international subcontracting over a long time. The key informants in these firms were willing to participate in this study. In general, the convenience sampling method is applicable to qualitative studies. It is typically used when members of the target population are easily accessed, geographically proximate, available at a given time, or are willing to participate in the study (Etikan et al., 2016). Studies show that, in reality, most international studies use nonprobability samples of some forms (Albaum and Peterson, 1984; Reynolds et al., 2003; Rowley, 2014). We acknowledge that nonprobability sampling is not the best representation of the population, yet it is widely used on occasions in which "random" selection is impossible (Etikan et al., 2016).

Following the principles of nonprobability sampling (Uprichard, 2013), the cases were purposefully selected to account for and illustrate the peculiarities of and phenomenon and the international context studied (Curtis et al., 2000). More specifically, the criteria used to select the companies were that they were operating in the high-tech sector and representing SMEs buying international subcontracting that includes knowledge sharing. Our data is based on three firms that have undertaken eight separate international subcontracting initiatives in emerging markets, including Russia (two cases), India (two cases), Belarus, Poland, Bangladesh, and Ukraine. These cases provide rich data of international software subcontracting relationships—three SMEs buying software services from foreign subcontracting SMEs.

The first case firm, QPR, is a Finnish high-tech SME that sells its software products for business customers in various countries. At QPR, we interviewed two key managers, the product owner (two separate interviews) of older generation software products and the software development team's leader. The team leader supervises 12 software developers in two different cities in Finland. QPR started its Russian subcontracting in 2003, and this relationship lasted for six years. The product owner recalled that one of the firm owners had some ownership also in this Russian subcontracting firm, "There were something, but I am not quite sure what it was." After the Russian partner, the firm began to buy software development from an Indian partner in 2010. Indian subcontracting lasted only for six months, and in 2011, it was followed by an agreement with another Russian firm (Russian II).

The second case firm, Oura, is a relatively young and fast-growing Finnish SME designing and manufacturing products consisting of both tangible artifacts and software applications, focusing on the consumer sector. Software forms an elementary part of the firm's products. Thereby, we interviewed the firm's CTO (chief technology officer). The firm has been subcontracting software development from India during 2017–2018, and after the Indian partner, the firm made a subcontracting deal with a Polish firm in 2019. This relationship lasted approximately seven months.

The third case firm, VividWorks, is a Finnish high-tech SME that offers software as a service (SaaS), used by businesses and consumers. We interviewed the CEO (chief executive officer) and co-founder of the firm who is a member of the board of directors (two rounds of interviews). VividWorks has carried out software subcontracting in three phases, from Bangladesh, Ukraine, and Belarus. Software subcontracting from Bangladesh started in 2007 and lasted for one year. The firm made then subcontracting contract with the Ukrainian firm in 2010, and this relationship also lasted for one year. The third subcontracting deal with Belarussian firm started in 2015 and ended in 2018.

3.2. Data analysis

All interviews followed a semi-structured thematic guideline (see [Appendix 1](#)). As a part of senior company management, all interviewees were well informed of their firms' subcontracting deals and knowledge-sharing routines. They had either participated in buying international subcontracting or been responsible for managing international subcontractor's work. Most of the interviewees were having both of these roles. We let the interviewees speak freely on the themes and recorded and transcribed all the interviews to obtain rich data. It appeared natural for the interviewees to follow a timeline of their experiences, tying aspirations, doings, events, observations, explanations, and reflections into a series of continuums. In coding the data, we followed [Saldana's \(2016\)](#) codes-categories-concepts frame to explore and interpret emerging themes. Coding as a process allows data to be consolidated for meaning and explanation ([Grbich, 2012](#)). For doing this, we used both a priori codes coming from theory and codes emerging from data ([Lichtman, 2013](#)). After transcribing and accomplishing the first-round content analysis, we scrutinized the interviews to find out possible new, emerging themes from the discussions with the firm representatives. [Appendix 2](#) presents the codes, categories, and concepts derived from theory and those that emerged from the empirical data. We noticed that the last interviews were repeating similar themes and issues, and hence, we assumed to have reached the point of data saturation.

4. Findings

In the following, emergent themes are presented according to the paper's aims as they emerged from the data by starting with international subcontracting *motives* (Chapter 4.1) and continued with analyzing the *content* of what is subcontracted, core, or non-core activities (Chapter 4.2). This serves as a starting point for analyzing the *mechanisms* of knowledge sharing and control (Chapter 4.3) in international subcontracting activities and characterizing the international subcontracting *context* (Chapter 4.4.) and its influence on the activities. This part is ended by presenting the *outcomes* of international subcontracting, i.e., issues related to performance and experience (Chapter 4.5). Building on the interview guide, the order of presentation follows the idea of showing the connections between the emerged themes; why companies started international subcontracting, what and how they did in practice, how the situation or context influenced their action, and what kind of consequences international subcontracting provided the focal SMEs.

4.1. Motives for international subcontracting

Lack of resources appeared as the key characteristic of all firms in our data and was closely related to their age. Our three SMEs had resource limitations; they were facing a lack of software developer resources. Finland, known for its high technology sector, had an excess demand for software developer resources. Firms were competing over the scarce resources. For example, the CEO of VividWorks claimed that *"Our Romanian case was related to the idea that we wanted to grow as a firm faster than by recruiting our own staff. At that point, at the beginning of our growth, we thought that to speed up the order-delivery cycle, we could buy the resources from abroad. And we had the financial possibility to do it."* The CEO of VividWorks noted that *"At that point, we just had a serious shortage of developers, especially for the customer delivery bulk production. Something had to be made. We thought to scale it by taking in a team of one senior and two junior developers. And a Finnish project manager."* At the same time, VividWorks was also buying subcontracting locally. Subcontractor's developers were working on the firm's premises. The CEO of VividWorks observed that *"We were intentionally using subcontracting to balance the volatility of workload. It worked excellently as they really become part of the team. They could adopt any role and position flexibly."* In a very similar manner, QPR product owner noted, *"The Russian subcontracting was more or less buying of resources, we did not purchase larger entities, as a matter of fact, I do not recall that we ever ordered such holistic projects."* He continued, *"Regarding QPR's decisions to outsource, it was a period of outsourcing boom. Software firms were looking for good and cheap outsourcing partners to generate more outcomes at a lower cost. At that time, it was difficult to find skilled resources; it was difficult to recruit them."* The team leader of QPR confirmed this and noted, *"We bought resources, maybe in some cases we bought some product features that took at most three weeks development time."*

In some cases, foreign subcontracting firms could extend the size of the development team and customer service to cover different time zones. The CTO of Oura points out, *"At that time I was the only person developing our back end system. The Indian team had three to four persons. Thus, this gives an idea of the size of this extended team. Also, the Indian partner was operating in a different time zone, so I thought that we could extend the time-span and ensure that our servers stay up and running."*

Consequently, an excess demand for developers in Finland also meant rising salaries, that is, the increasing cost of software development. Hence, on many occasions, the price of the subcontracting was a primary driver. As the CEO of VividWorks noted, *"The reason for choosing Ukrainians over Finns was the cost related to the nature of available work. In practice, Ukraine was a coincidence. It did not matter where they come from if they were cheap."* In a similar manner, the product owner of QPR recalled, *"In those days, software subcontracting was 'in', all software firms were doing this, the idea was to gain cost benefits."* The product owner continues, *"Also, it was difficult to increase our own software development capacity, it was very difficult to recruit software developers in Finland at that time, and the price level of domestic software developers was radically increasing."* Regardless of being relatively small and young, Oura was implementing the core features and most demanding development tasks by itself. Yet, Oura could not afford to employ all desired resources in-house. When needed, it bought supplementary development resources as the CTO recalls, *"Hourly price of software development was remarkably lower than in Finland."*

In some cases, motives for buying subcontracting were mixed. The CEO of VividWorks pointed out, *"The first phase started in 2007 when the company needed extra resources to speed up customer deliveries, and bought via the contact from another Finnish company subcontracting services, in practice one person for 3D modeling, from Bangladesh with extremely low price. The company was not happy with the productivity of the arrangement, and it lasted about a year."* Based on this experience, VividWorks made an arrangement with a Finnish

company, yet the developers were based in Ukraine. As the CEO explains, “*The project manager was based in Oulu, Finland, and two junior developers and one senior developer were based in Ukraine.*” This second subcontracting period started in 2010 and lasted a bit longer. Again the idea was to extend the team's resource base to serve a big customer project in the US. This arrangement was a bit more expensive, close to normal Finnish price levels, but what was sought after was that the arrangement would work better. Similarly, the Product Owner in QPR noted, “*If domestic resources would have been available, why to go abroad [...] everyone understands that foreign outsourcing, by no means, is not easier.*”

However, the quest for low costs has sometimes backfired, leading the SMEs to look for alternative, closer arrangements. Regarding the Polish subcontracting, the CTO of Oura observed that, “*This case was driven by the low price. ... Now we are ending this deal, as I said, we decided based on the price, yet, their development is being bundled with testing, and the deal comes with a half testing resource. In the end, the deal was not cost-efficient. Finnish subcontractors are able to provide more at the same cost. It is easier to have developers in the same office. Moreover, now we have hired a highly talented Android developer in-house.*” In QPR, the product owner stated, “*In general, we are aiming at having few highly experienced software developers within our own organization, their tasks should be so demanding and challenging that they do not have to do routine development, we buy resources to develop such tasks.*” In Oura, the CTO noted that “*Our system is highly complex and consists of diverse engineering areas. Until these days, it has been an impossibility to have all necessary competences in-house.*”

Even if the motives for foreign subcontracting were related to narrow resource bases, SMEs had the luxury to restrain development to dedicated software design partitions. The CEO of VividWorks phrased this quite well, “*We have always had the principle the product platform is not created outside the house. However, customer deliveries can be outsourced. We never thought of establishing our own low-cost development unit.*”

All in all, firms had a variety of drivers and motives in their international subcontracting decisions. SMEs could have core development in-house, and when needed, they outsourced the development of the bulk software components. International subcontracting and the international business context in which these relationships were embedded formed the basis of knowledge exchange between the parties.

4.2. Contents of international subcontracting

Choosing what kind of work is subcontracted, whether core or non-core and on what grounds it is subcontracted is crucial for a high technology firm. For this, the SMEs developed different kinds of principles. The CTO of Oura explained, “*Our philosophy is that we have one to two extremely skilled developers per engineering area, and when needed, we outsource the rest. For a small and relatively young firm, this has been the only feasible way to the products done to the point they are today. Hence, our subcontractors play a crucial role.*” He continued, “*As of today, we could also hire developers, yet, I want to keep the bar high, I want to hire only the most skillful developers, a highly skilled team appeals to other highly skilled developers. Lowering standards leads to a vicious cycle. The other side of the coin is that there are not available highly skilled resources, such recruiting is slow. In sum, we do not hire anyone whose competences we are not sure about, so to fill possible gaps, we outsource.*”

In VividWorks, the CEO defined the firm's subcontracting policy as “[...] *not related to the core of the product but the core of the customer delivery project. Our product was a configurator, and in every delivery, we had to produce customer's contents into 3D models. We subcontracted part of the customer delivery, so what we bought was not related to product core but service core at a sufficient level of quality.*” Similarly, the QPR team leader stressed that “*We held the overall design responsibility, we made the specifications, the Russian subcontractor executed the given tasks.*” The team leader continued, “*Software code was reviewed here in Finland, that is, they developed, and we reviewed, also the quality assurance was done here in Finland.*”

Regarding the subcontracted tasks, the QPR team leader explains, “*With the Indian subcontractor, during the ramp-up, we tried to start with simple tasks. The ramp-up was kind of a trial period. We gave simple and easy tasks, such that we could assess the outcomes as quickly as possible.*” To ramp up the work, the team leader of QPR noted, “*We gave them [Indian subcontractor] small incremental development tasks. It could be that we tried some specific Delphi project; we did not get very far with it.*” However, QPR also had different experiences, as the team leader noted, “*The [Russian II] team also tested their outcome; they had a dedicated test person. We were quite happy with the testing quality.*”

However, knowledge sharing appears different in non-core compared to core activities. The CEO of VividWorks observed that “*When we do non-core, which in our terminology is content creation or customization, we share knowledge and information at the same level as if the customers would do the job themselves. There is the platform, interfaces, and then there is the content-related work. And when we do core, we give the code to be debugged, but not the access to version management to update something but allowed access to the source code. Based on this, they provided suggestions for our own R&D. In sum, experience and time turn practices towards like they were part of us.*” In the same line of thought, he continued that, “*We tried to learn from our earlier mistakes and arranged the activity around the experience level of the developers, and moved closer to the core than non-core activities with the experienced ones.*”

In line with the literature, we found that non-core and non-value adding activities constituted the majority of the subcontracted services in case firms' international relationships. The above comments reflect the fact that firms are keen on developing certain core software modules in-house. In the absence of required developer resources, firms make trade-offs about which part of the development they outsource. Furthermore, firms may outsource bulk software development to keep their own highly skilled developers motivated.

4.3. Mechanisms of knowledge sharing and control in international subcontracting

Our data indicate some specific team-related characteristics when studying international SME contracting from a foreign SME. For the QPR, the Russian subcontracting team size - that was dedicated to the firm - varied between four and five developers. The team

leader in QPR mentioned that *“We tried to chew and prepare things here in Finland in order to deliver ready, unequivocal development tasks.”* The team leader praised, *“Communication with the Russian subcontractor was fluent, the chat was the most used tool, we also used e-mail, and in addition, once in a while, we had video conferences.”* He continued, *“Subcontracting from the Russian partner did not require any more work than normal leadership of a domestic software team.”* The product owner noted that *“Russian subcontractor could be described as our own distant team. We were operating already in two cities in Finland. The Russian team was no different in this setting. However, eventually, the ownership of the Russian company changed, which led to price negotiations. As a result, the contract was terminated.”* The Product owner added, *“Regarding the duration, it was often reasons beyond our control, changes took place at subcontractors' end, for example, changes in their ownership structures, which in turn, had an impact on the availability and price of their resources.”*

On the other hand, the QPR team leader explained, *“We were discussing directly with the developer team when buying subcontracting from the Indian partner. Those days we were using Skype chat and e-mails.”* When discussing the amount of supervision required, the team leader noted, *“Subcontracting with the Indian partner required continuous communication, several hours every day.”* The product owner added, *“Indian subcontractors required continuous communication.”* The agreement comprised four to five local developers. This relationship lasted for six months, and during this time, the firm insisted the Indian firm replace its project manager and some of the developers. As the Indian partner could not deliver acceptable outcomes, the firm terminated the contract.

For QPR, the Russian II subcontractor allowed the buyer to select among its developers. The team leader noted, *“We used the same developer tests that we use when we hire our own developers here in Finland. By doing this, we ended up having quite good resources.”* This subcontracting relationship lasted for three years, *“We think that at the time the contract was ending, the Russian partner needed these resources in other projects,”* the product owner considered.

Oura had been buying software development from India, mainly focusing on the firm's cloud services. The deal included one full-time developer and few other persons who could keep the server running in case of any malfunctions. *“In total, we were employing three to four persons,”* the CTO calculates. CTO of Oura pointed out that *“Hourly based subcontracting works fine in many cases, sometimes the technical quality has been acceptable, yet, the team fulfills only the given tasks, taking no initiatives. This demands continuous project management. In this regard, letting the subcontractor take responsibility for a larger entity might be a good idea.”*

It appeared that the SMEs are quite well equipped to control their foreign subcontracting. If the software belongs to the core (of the product or service) or not, the object of the subcontracting contract has a direct implication for knowledge sharing between the parties. The CTO of Oura explained, *“Risks were mostly related to customer data. We designed such technology that external partners can do some operations but do not have access to our customer-related data.”* He continued, *“The Indian subcontractor did not have access to our customer data, yet they had access to a certain part of our development environment. With this access, they could restart our server in case of a malfunction.”*

Trust is being built over time, QPR product owner explains, *“We started quite carefully, with small steps. We already had our commercial products on the markets. [...] As time passed, they [Russian subcontractor] were given larger entities to be developed. It is quite obvious that when they become familiar with our products, architecture, and software code, they are able to carry out more demanding tasks. Long relationship means that international partners become familiar with the software code, and little by little, parties must gain mutual trust so that one can give them demanding tasks to accomplish. It is a Finnish characteristic to trust people until something unpleasant occurs.”*

Regarding the presence or absence of trust, the product owner of QPR also noted that *“Someone visited the Russian site, at least at some point in time.”* QPR team leader continued, *“Version control system is typically opened for the subcontractor. We did evaluate related risks. We did consider if it would be possible for a subcontractor to do some harm. Yet, the possible harmful effect would have been very small from our point of view.”* In this regard, the product owner laughed, *“If they would steal a few million lines of code ... what an earth would they do with it?”* QPR was also deploying contractual control mechanisms. QPR team leader noted that *“We use contracts regarding the protection of our customer data. There are restrictions concerning outsourced development resources. Code signing key, a private key is never given to third parties.”* He continued, *“In cases in which the subcontractor had a permanent team developing software for us, along with the cooperation, their knowledge on our products increased. As a result, we were able to allocate them with more demanding tasks, which in turn, resulted in sharing more profound knowledge of our products and their structures. In the end, their best developers had reached a similar knowledge level if comparing to own developers. As an example, one of our software developers got his knowledge when working for the subcontractor, now he is on our payroll.”* Moreover, It seems that knowledge sharing yields positive results, *“In practice, risks are quite small; I can imagine that when dealing with sensitive areas, such that are related to our competitive advantage, knowledge sharing might involve some risk, yet, quite hypothetical. However, the benefits of knowledge sharing outweigh the risks. Without the needed knowledge, it is very difficult to complete the tasks. Second, such a lack of knowledge would require very detailed specifications from our end. It would be almost the same to do it by ourselves. Risk assessment today falls into the R&D. It should be an own area in the product management.”*

The level of trust seems to dictate the extent of the provider's access to the software development environment. Yet, trust seems not to have a remarkable impact on the means of communication. Oura was communicating with the Indian subcontractor using quite normal communication tools. The CTO explained, *“Our firm uses Slack as a communication channel.”* Similarly, the CEO of VividWorks noted, *“Subcontractors were seen as an extension to our own team. Their work was synchronized with ours, and they were seen as part of the customer delivery team.”* He continued, *“Our own Finnish 3D developer took the subcontractor to his team member and could act as manager and instructor. Our developer was one the founders of the company, and those days we were so small (seven people) that we did not have specific roles yet.”* This seemed quite common for the three firms.

Indeed, all three firms restricted, at least at some extent, foreign subcontractors' access to critical parts of the software code or business-critical customer data. Larger, more mature, and experienced firms (in terms of subcontracting experience) had a greater variety of protective means in their use.

The first formal knowledge exchange and protection mechanisms are the specifications and instructions. Version management is the most important knowledge-sharing mechanism tool in software development, enabling formal information exchange during

subcontracting. The CEO of VividWorks noted, “We thought whether it was a risk to allow the subcontractors to access our version management system, but then we just decided that our IP [intellectual property] was contractually controlled. We had only one version management system that included everything, and it might have been able to separate the product/platform core from the customer delivery project. However, the code of the platform was so central to delivery, and it would have made the work so much more difficult than we let them into our system.”

When discussing foreign subcontracting-related risks in general, concerning foreign subcontracting risks, the QPR team leader pointed out, “Our software solution is quite complex. Besides, our technology may appear exotic to an international partner.” He considered that “The risks of subcontracting relate to the outcomes, to the desired quality and the desired speed.” The product owners added, “There are also person-related risks. The subcontractor has all the means to swap persons, to take out a skillful developer from the team, and replace this person with a younger one. The subcontracting contract did not state dedicated developers by their names. Person swapping took place to some extent.” He continued, “From the subcontractor point of view, projects are good places to train new persons, and after they achieved certain skills, they can be sold as experienced developers into other projects.” Regarding possible risks, the CTO of Oura explained, “We also recalled a slight risk related to the invoicing if Indian developers do what has been agreed. However, a personal relationship with the Indian manager was being built over time. Otherwise, we would have done way more thorough risk analysis in this regard.” Core or non-core software subcontracting, the question is related to the direction of the knowledge transfer. “In many cases, there is a test period to determine if the subcontractor has the needed skills. In this case, if there is no earlier common history or knowledge, the cooperation starts from the non-core software development ... we have done this on a small scale. Then, say, we buy a group to do Java development as we do not have our own expertise in this field, and as a result, quite probably the outsourced code goes into our core. In this case, the knowledge transfer flows from the subcontractor to us.”

In the beginning, VividWorks did not make risk analysis, and the CEO shares, “We did not know about this kind of things, we just needed more resources. We were novices, although I had an experience of running international multi-site R&D in-house.” If there was anything business-critical that was not shared with the subcontractor, it was the customer data, the CEO continued, “On the code side, we opened everything for them, but on the business side we did not share anything, although with our customers we never signed NDAs (non-disclosure agreements), sales agreements were enough.” “In the second case [Ukraine], we had clear instructions for the subcontractors on how to work, the same orientation instructions that we had for our own new employees. However, not in the first case, we did not have any specific instructions.” He concluded, “The supplier was selected as one of us knew a guy who had just established a subcontracting company that used a Ukrainian subcontractor of thousands of employees. The agreements were made in Finland with a local organization with the idea that we are safe.”

It appears that the majority of informal and unstructured knowledge and information exchange in international subcontracting is related to identification and monitoring, and managing of risks and quality of work and deliverables.

4.4. Characteristics of the international subcontracting context

Our data indicate that different situational contingencies influence the subcontracting arrangements and furthermore, their subsequent success. Such situational factors include the cost level, time component, fierce competition, speed of operations, and the subcontractor firm's experience, motivations, and competences. In QPR, the product owner stressed that “The buying [subcontracting] decisions were business decisions, rather than based on the interests on the product development, in my opinion, especially Indian subcontracting was due to the lower prices. When looking back, experiences were not that good.” Thus, cost as a contextual factor influenced the decision, but related to expected outcomes. When asked if the team leader in QPR found any positive aspects from the Indian subcontracting, the team leader blunted, “I do not recall any successes, we tried with many different tasks thinking if this one would succeed ... but not. In my opinion, it was a cheat, and developers did not have any software development competences.” In this regard, the product owner stated, “The Indian subcontracting was a fiasco. It did not make any sense to start teaching them the basics of how to design software.”

Whereas the QPR based the outsourcing decision on business reasons, the situation of Oura was different. CTO of Oura noted that the firm was facing time-pressure to proceed with the subcontracting decision, “I was the only one doing this component in-house ... I was in a hurry, occasionally the quality of the code from the Indian partner was relatively low, and not always I had a chance to review their output that thoroughly. If you cannot supervise the quality continuously, the quality decreases.”

Concerning foreign subcontracting experience, attention can be paid to firm and individual level contingencies. The CEO of VividWorks noted that “We had a plan for five outsourced resources, although ended up with max three. What we learned, we had the idea to hire one senior developer and a bunch of juniors as the rest of the team, but it never went that way. The senior was doing junior-level work, got bored and left, and we were back in where we started. So, we kind of failed. Then we tried to train a second senior developer...” VividWorks CEO recalled that a similar thing also happened with juniors. “In the beginning, it started all right as everybody was putting their effort into it, them and us. However, it started to deteriorate when the juniors started to leave because they did not want to do the juniors' work when they got experience. They wanted to learn to write code, but our work is was not like that. It was just 3D modeling and delivering the results. After a while, they felt that they do not learn anything. And then they left. It was the nature of the work that caused it.” That said, the CEO considered that “I do not believe that we were able to tell the subcontractor the true nature of the work, we sold them the idea that we can grow this and they took the bait.” Simultaneously, the platform of VividWorks developed fast, adding to the complexity of the situation. The normal subcontracting practice is to outsource clearly defined packages. VividWorks “[...] outsourced a mess of a delivery project content creation on a transforming platform,” as the CEO recalls.

An important dimension is developers' competences. In QPR, the product owner noted that “Developers in the Russian subcontractor were skillful. In fact, one of these developers is now working for us.” In this regard, the team leader pointed out that “Competences among the Russian subcontractor developers varied. Yet, they all came with basic skills. They had some more experienced individuals and some with less experience.” The product owner continued, “Particularly one person had exceptional competences and could be responsible for more

demanding, larger development tasks.” The CEO of VividWorks also paid our attention to the competences, but from a different angle, “We concluded that they selected the wrong guy for us. He was a too slow 3D modeler.” He continued, “It was not a technical issue, we could have trained him better, but it was not technical. 3D developers are more artists than developers, and some just want to pay too much effort to finish, regardless of the time pressure. And then some understand the rules of the game and adapt to the need.”

In addition to individual developers' skills, foreign subcontracting providers came with diverse organizational and project management skills. Concerning the providers' managerial skills, the team leader of QPR explains that “The Indian experiment was a catastrophe. We were facing challenges on all possible fronts, starting from development tool license fees. In the beginning, Indian partners tried to use some freeware, against our very specific, concrete orders and guidance.” The team leader continued, “The Indian organization was peculiar. They had e.g., escalation managers, something we had never met before.” However, the QPR team leader noted that the “Development processes were not that different. The Indian subcontractor adapted quite nicely to our processes. It was the competence, the lack of Indian developers' competence, that became the biggest problem [...] and to some extent, the communication.” QPR product owners also mentioned that “QPR was using English as an internal office language, which had an impact.”

Yet communication with foreign subcontractors was smooth. Regarding subcontracting from an Indian partner, Oura CTO reflected, “Our firm had bought cloud software development before I joined the team. However, the Indian partner had proved to be trustable, and communication had been fluent. Indian manager had had his education in the USA; communication with him was frank and open. So, I decided to see if they could provide us with further services.” He continued, “I liked the local manager. He was competent and could lead the architect-related design, I also interviewed all other Indian developers, but the turnover rate of employees in India is extremely high. They change firms as often as their underwear, which was a challenge. As soon as you had a person to learn how to complete the tasks, he/she was gone, and a new person was taking over.” The CEO of VividWorks on his side observed that “We ran into very few cultural challenges, only challenges related to physical distance.” Although the first two experiments were not considered successful, he continued regarding the case of 3D modeling in Bangladesh, “It is not related to culture or nationality. It is about the artist's characteristics. Some of them do not understand how an engineer expects things to happen,” denoting the type of work outsourced.

In light of the data, the time horizon in subcontracting appears as an indirect and multifaceted theme. The CEO of VividWorks indicates that the timing aspect was related to subcontracting goals and the situation of the business context, yet influenced by the subcontracting experience, and describes the firm's first trial with subcontracting with the Bangladeshi subcontractor, “We got the feeling that this just does not work, and it took years to try next time. By this, ‘it did not work’ we mean that this did not turn out to become a long-term, lasting arrangement that we were looking for.” However, the next contract with the Belarussian firm yielded a long-lasting relationship.

In all cases, the SMEs were balancing between the short-term result expectations and strategic long-term development plans, especially due to their resource shortage. The time horizon issue also becomes visible when discussing the lessons learned by international subcontracting, specifically when discussing strategic learning and continuity of operations. Most firms observed that the decision to move on to a new subcontracting arrangement was based on the learnings from the previous experiences of subcontracting. To conclude, the time component – whether the firm was facing severe time pressures or had enough time to assess between available alternatives – played an essential role in subcontracting arrangements and in the subsequent success. Moreover, our interviewees highlighted the importance of foreign subcontractors' different skills. Lack of key skills typically was a reason to terminate the relationship.

4.5. The outcomes of international subcontracting

Our data show that many things did not work out as expected in hindsight, although many things were tried. CTO of Oura reflected on the Indian subcontracting relationship as follows, “When looking back, I have been wondering if it would have been a better idea to buy from a Finnish firm since the very beginning. All things would have proceeded more smoothly. We also tried to recruit, but our standards were so high that we ended up employing no one.” CTO concludes, “What I have learned is that you need to interview subcontractor's employees similarly if you were hiring them into your own team. In this regard, I have been favoring extended teams with continuous hour-by-hour invoicing, the number of needed hours in a month may vary. Now, when looking back, buying projects might have worked better.” QPR team leader gives a similar statement, “No savings [...] unless it counts that we learned how not to waste money in the future endeavors.” The product owner continued, “Small firm does not have the necessary contact base to select the most appropriate ones between available international subcontractors. This was especially the situation at the time we made our Indian deal.”

VividWorks dismantled the successful Belarussian arrangement due to cost-saving needs. “One of the subcontracted was architect-level person, and he was analyzing the platform and concluded that the whole product code needs to be rewritten to improve performance. That was it. Of course, he was right, but this is something that cannot be done,” the CEO observed. QPR that had experiences from three subcontractors over the past 15 years. When discussing if the previous experiences have had an impact on the new ones, the team leader noted, “We have had similar approaches, we have been very practical, and we have operated similarly if we had a new person coming in one of our domestic teams. Familiarization is followed by simple tasks.” In this regard, the product owner pointed out that “During this time our own processes have improved, it has been easier to include outsourcing as a part of software development. [...] all in all, Russian subcontracting deals were quite successful when considering the software development outcomes.”

Continuity was seen as important by the companies to ensure learning and reflection. The CEO of VividWorks noted that “We actively tried to find solutions to the challenges. We had one person who was in charge of all the subcontracting over the years that helped us to guarantee continuity and learning.” The team leader of QPR concluded, “After these international subcontracting projects, we have bought resources from Finland. We have bought consultancy resources who do software development as members of our teams, mainly regarding new product development competences, to ramp up our own competences to desired levels. These resources were very, very expensive.” The question

of what processes to subcontract remained in decision-makers' minds. The CEO of VividWorks formulated the dilemma of why to continue to try subcontracting, “*The vision was that we could give them the customer's specifications and tell that this is what we want. Maybe we could not tell them what the problem is. We just fought the details. Maybe it was a higher-level communicational challenge.*”

Following Table 1 summarizes the key findings of the study.

5. Discussion and conclusions

The aim of the paper was to examine the mechanisms and timing of knowledge sharing in international subcontracting relationships between SMEs in the high-tech context. Due to their limited resources and knowledge of international markets, high-tech SMEs face several challenges when it comes to starting, engaging with, and benefiting from international subcontracting relationships. As previous studies have largely focused on knowledge transfer in MNEs' and their suppliers' contexts, the SMEs-to-SMEs international subcontracting alludes to an important yet overlooked context to examine knowledge sharing mechanisms. Our findings shed new light

Table 1

Summary of the key findings.

Knowledge sharing characteristics in international subcontracting SME-SME relationships	
Motives for international subcontracting	<ul style="list-style-type: none"> • Access to software developer resources • Speed up the firm growth • Balance the volatility of workload • Extend the time span for development and customer service • Cost reduction
Subcontracting content	<ul style="list-style-type: none"> • Non-core • The core of the service instead of the core of the product
Context characteristics	Institutional level: <ul style="list-style-type: none"> • Cost level • Competition • Experience • Physical distance • Time zones Organizational level: <ul style="list-style-type: none"> • Contractors competences: organizational and project management skills Individual level: <ul style="list-style-type: none"> • Motivation and commitment of individual developers • Communications • Competence of developers • Communication through various means • Specification of instructions • Version-control system • Personal relationships • Trust • Supervision – quality control • Restricted access to some extent to critical code or customer data • Contractual control mechanisms
Knowledge sharing & protection / control (mechanisms)	<ul style="list-style-type: none"> • Motivation and commitment of individual developers • Communications • Competence of developers • Communication through various means • Specification of instructions • Version-control system • Personal relationships • Trust • Supervision – quality control • Restricted access to some extent to critical code or customer data • Contractual control mechanisms
Time horizon	Motives: <ul style="list-style-type: none"> • Short-term result expectations and strategic long-term development plans, especially due to the SMEs' resource shortage Choice of contractors: <ul style="list-style-type: none"> • Time-pressures or enough time to assess between available alternatives Subcontracting content: <ul style="list-style-type: none"> • <i>The early stage of the activity:</i> <ul style="list-style-type: none"> ◦ Competence & resource purchasing ◦ Simple, less important content • <i>Later stages of activity:</i> <ul style="list-style-type: none"> • More knowledge sharing • More complex content Contractor's commitment, motivation & experience <ul style="list-style-type: none"> • Competence of individual developers improved over time • Variation in individual motivation and commitment over time, related to possibilities for learning

on knowledge management in high-tech and complex interorganizational relationships involving SMEs from different institutional settings.

Interorganizational knowledge sharing is a daunting task on its own for SMEs. That said, it may quickly become further overwhelming when it is highly complex (i.e., technology-intensive) and executed by SMEs located in different institutional settings that often lack formal practices, resources, and well-defined structures for knowledge management and exchange. Likewise, when a firm outsources high-tech-related components or work, the need for and complexities of high-involvement knowledge exchange is amplified. As such, gaining in-depth and first-hand insights into the mechanisms and timing of knowledge sharing in international subcontracting relationships of high-tech SMEs is imperative.

Earlier research on motivations for international subcontracting indicates that firms aim to lower transaction costs and improve performance via increasing relational involvement, which in turn help deal with the risks, uncertainties, and ambiguities related to the subcontracting activity. While this research's findings generally confirm these generic notions, the details reveal novel complexities, tensions, and mechanisms in international subcontracting. For example, the findings indicate that it is not only cost and performance expectations that motivate SMEs to try international subcontracting, but also lack of alternatives, the volatility of workload, and the need for speed in growth-related activities such as deliveries as examples that may trigger the activity. Thus, the key questions of timing and knowledge sharing mechanisms are crucial for SMEs' subcontracting work. Knowledge sharing mechanisms play an essential role in the efficiency and effectiveness of knowledge sharing within and across organizations (e.g., Argote and Ingram, 2000; Szulanski et al., 2016), and our findings indicate that subcontracting can be perceived as a knowledge and resource exchange mechanism between firms under time pressure.

Our findings further indicate that the SMEs mainly outsourced non-core activities to other SMEs based in emerging markets and conducted core activities in-house to protect their key know-how. The SMEs kept in mind the cost-benefit as one of the key drivers when it came to international subcontracting to other SMEs operating in the sector. However, core activities were also outsourced if the SMEs' resources were scarce in terms of available time or competence. From the empirical and managerial perspective, the typical mode of international subcontracting appears to be the extended team mode that suits resource buying situations where the subcontracted content is not clearly defined and changes over time. As the literature suggests subcontracting the clearly defined tasks, it is somewhat surprising how dominant this mode was among the case firms. High-tech SMEs also target reaching scale, growth, and internationalization and not only optimizing cost and quality expectations in international subcontracting. However, had SMEs had a choice, they may never have started the activity in the first place. Consequently, on the one hand, the data shows that the SMEs balance between internal risks/uncertainty and external risks/uncertainty throughout subcontracting activities. While the SMEs face internal resource shortage-related issues to deal with, they also have external risks and uncertainties related to the characteristics of the international business setting and especially the subcontractor-contractee relationship where trust and credibility play a role. On the other hand, SMEs also have to balance between shorter-term challenges, problems, expectations, and success and the longer-term goals and outcomes in subcontracting. Despite the challenges, continuity of international subcontracting operations was considered important by the SMEs.

5.1. Theoretical implications

The findings suggest that since knowledge and strategic know-how are essential for SMEs to develop their competitive advantages, SMEs engaging in international subcontracting rely on specialized IT-enabled systems to develop, store, and protect their core knowledge. These findings contribute to the literature on knowledge accumulation and sharing through interorganizational relationships (Uzunca, 2018). The researched SMEs had developed clear principles or strategies regarding what kind of work was subcontracted and what kind of procedures were followed in subcontracting. These principles were also closely linked to the timely availability of internal resources and competences at hand. However, the findings also indicate that the SMEs were rather flexible with these principles; if something did not work out, they were ready to change the practices or relax their principles. A good example of this is the SMEs' relationship with knowledge protection. Since emerging markets often lack marketing supporting institutions and have weak intellectual property regimes (Khanna and Palepu, 2010), knowledge protection is generally considered fundamental for firms engaging in subcontracting activities. However, the focal SMEs had a rather *ambiguous* attitude to knowledge protection. If the subcontracted work required access to information or systems, access was granted even with the risk that the knowledge would leak out. As the most important thing for the SMEs was performance, i.e., to gain the expected results in time, they were ready to adapt to the situation and monitor the potential risks. This kind of *performance over protection* principle may partly be explained by the fact that the SMEs prioritized 'buying a deliverable' over exchanging or sharing knowledge. Likewise, although the SMEs bought resources but sometimes lacked competence that required detailed knowledge sharing to accumulate knowledge, the deliverables were prioritized over possible learning outcomes. Thus, *learning inside the firm was seen secondary to expected performance*. Moreover, a key part of the learning inside the firm was also related to performance evaluation and anticipation of contractees' future performance.

When the SMEs followed the performance over protection principle, they learned over time to pay attention to learning due to subcontracted work's nature and contractees' required competencies. These findings speak to the research on boundary spanners as the studied SMEs rely on experienced managers and entrepreneurs in facilitating communications, knowledge sharing, and the protection of knowledge (Berghman et al., 2013; Carmeli et al., 2021; Martinkenaite and Breunig, 2016). The knowledge management practices and sharing rely on the resource exchanges within SMEs-based on the competence and experience of the workers involved in subcontracting activities. Thus, SMEs' absorptive capacity becomes important to internalize knowledge (cf. Khan et al., 2019), especially related to the subcontractees' capabilities to perform and provide the expected deliverables. The idea was to have a team that would consist of senior and junior resources and that the assigned work would be divided according to competence and experience needs.

However, juniors learned, “got bored and left,” leaving the work to seniors for whom the work was even more boring, leading to increased risks in the international subcontracting projects. Intensive communications by the boundary spanners were required for monitoring and maintained an understanding of the situation, thereby dealing with the risks related to this *attrition of appropriate resources* as in the case of VividWorks. The same was also a concern for SMEs themselves. They had to keep their own highly skilled people motivated. Over time, the extended team model was found most suitable for subcontracting activities. Paradoxically, this led also to favoring domestic over international subcontracting in the SMEs. Contrary to the expectation that international subcontracting experience enables firms to decrease their dependence on individual employees, the *dependence on the individual appears as the permanent characteristic of SMEs' international subcontracting* on both contractor and contractee sides of the relationship.

From a strategic timing perspective, the SMEs' international subcontracting activities appear less as knowledge exchange and sharing, but competence or resource purchase that is characterized more by *competence doubt than credibility issues* at the early stages of the activity. In the Finnish context, ex-ante trust is a cultural characteristic (c.f., Arslan et al., 2021) that, in the case of international subcontracting, can be seen to cover competence appraisal and the consequent expectation to receive the deliverables on time. However, while trust in contractees' competences and performance was developed over time, monitoring was still needed to anticipate potential emerging risks. Considering the generally high educational and competence levels of the Nordic high-tech SMEs, informal communications and knowledge sharing mechanisms are preferred over formal ones, and open two-way knowledge flows are expected. Also, expectations placed on the sub-contractees competences and performance were high, as exemplified by the Oura case. This was well shown in the case of failed Indian subcontracting, where competence and delivery doubts could not be removed, leading to the activity's termination. The VividWorks case also showed that a too high level of competences at the contractor's side could also be considered a risk, as the results might fall outside their expected scope.

Finally, the role of distance in international subcontracting appeared a controversial thing for SMEs. On the one hand, the cultural distance was not recognized as such, but physical distance elements like time zones were. The SMEs' attention to receiving the deliverables on time and, as ordered, overran the more fine-grained concerns of cultural differences. What helps here is that software development processes and practices are the same everywhere. However, work-related cultural characteristics between “artists and engineers” were noticed. On the other hand, the extended team's closeness was appreciated, also in international subcontracting, as it made things easier to manage as similar practices could be followed on both contractee and contractors sides in the SMEs' small-scale activities. Overall, the study contributes to the extant literature, which has predominately focused on knowledge sharing in MNEs. In contrast, in this study, we provide a much finer-grained view of knowledge sharing and the challenges associated with global subcontracting, where tools systems and people become vital for the sharing and internalizing knowledge (cf. Argote and Ingram, 2000).

5.2. Managerial implications

Our research offers several managerial implications. First, it speaks to SME managers who want to disentangle complex knowledge sharing practices and make informed decisions about mechanisms and timing of knowledge sharing in international subcontracting relationships. Our findings highlight IT tools and relational mechanisms between boundary spanners as important means to transfer knowledge between international subcontracting partners. Therefore, we suggest that boundary spanners and managers balance technical and behavioral mechanisms when sharing knowledge. This means that there is no trade-off between technical competence and trust-building. Managers need to be successful in both if they want to succeed in knowledge sharing in the context of complex interorganizational arrangements of international subcontracting relationships.

Second, we find that knowledge exchange and knowledge protection are not mutually exclusive. While some types of knowledge must be shared effectively to succeed in international subcontracting relationships, some types of knowledge need to be protected. As such, we advise international SME managers to categorize their knowledge diligently and make a clear distinction between knowledge exchange and knowledge protection mechanisms to facilitate strategic knowledge sharing initiatives while safeguarding sensitive knowledge across national borders.

Third, SME managers need to carefully evaluate the risk and opportunities involved in subcontracting relationships, particularly where the subcontracting is undertaken in different institutional settings and physical locations. On the one hand, the managers should focus on cultivating long-term personal relationships to mitigate opportunism and protect key know-how. On the other hand, managers should focus on keeping core value chain activities in home markets to overcome knowledge leakages to their competitors.

5.3. Limitations and future research directions

This study has limitations that provide important opportunities for future research. First, we have studied only 3 SMEs and their international subcontracting partner SMEs based in emerging markets. Thus, future studies can broaden the sample and explore knowledge-sharing routines and their impact on innovation. Second, this study's findings indicate a dilemma for SMEs engaging in international subcontracting relationships on how to protect knowledge and find an optimal way of cooperation. Thus, there is scope for future studies to examine how SMEs find a balance in terms of protecting their core know-how and, at the same time, benefit from international subcontracting. Third, many SMEs engaging in international subcontracting can cooperate and compete at the same time. Thus, future studies need to examine how co-opetition facilitates the development of capabilities in SMEs. Lastly, there is a scope to pay more attention to the role of intermediary organizations such as trade agencies and how these organizations facilitate knowledge sharing in the international subcontracting context.

Appendix 1. The interview framework

Themes discussed:

Firm background, the scope of operations and the role and the extent of international subcontracting
 Motivations and drivers of international sub-contracting (over time)
 Descriptions of international subcontracting activities and experiences (over time)
 The role of knowledge exchange, knowledge sharing, knowledge protection
 The role of trust and credibility in international subcontracting
 Specificities rising from the international context in international subcontracting
 Outcomes of international subcontracting

Appendix 2. Themes, concepts and examples of categories/key words derived from theory and those that emerged from the empirical data. (Legend: Themes comprise Concepts that consist of (Categories and Keywords), *italics* denotes content that emerged from data).

Theme: Motivations and drivers for international subcontracting.

lack of resources (development, competence, extended team, resource competition)
 cost, quality, (cost, quality, price)
 volatility of workload (volatility)
 strategic goals (philosophy, principles)
 performance (perform, deliver)
speed, growth, scale (speed, scale)

Theme: Contents of international subcontracting

non-core activities (non-core, non-value-add, delivery project, nature of work)
 core activities (platform, product complexity)

Theme: Mechanisms of knowledge sharing and control in international subcontracting

Team (*team size, extended team*)
 clearly defined subcontracting (specifications, modules).
 knowledge (product, coding, modeling *level (junior, senior, skill)*)
 infrastructure (tools, processes)
 communications (openness, basis, amount, training)
 risk management (risk management)
 protection (IP, access, contract, sensitive)
 knowledge flow (skill, direction, training, communications)
 continuous subcontracting (continuity)

Theme: Characterization of the international subcontracting context

low cost (price, cost)
 competences doubts (knowledge level, experience, team)
 trust (trust, doubt)
 credibility (credibility)
 time pressure (in time, fast)
 dependence on individuals (depend)
 distance (cultural, physical)
 back to domestic (domestic subcontractors)

Theme: Subcontracting outcomes

experience (firm, *individual*)
 performance, productivity
 continuity (long-term, continuity)

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