AALTO UNIVERSITY

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Degree Programme in Industrial Engineering and Management

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DIGITIZATION INITIATIVES AND CAPABILITY COGNITION – A MULTIPLE CASE STUDY IN FINNISH MANUFACTURING FIRMS

Thesis submitted in partial fulfillment of the requirements for the degree of Master of Science (Technology)

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Supervisor: Associate Professor Henri Schildt
Instructor: Riku Österman, M.Sc. (Tech.), Ph.D. Candidate

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ABSTRACT OF THE MASTER'S THESIS

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The objective of the research was to analyze how organizations identify, define, and develop opportunities and capabilities and match them together when facing a technological discontinuity. Three large Finnish manufacturing companies and their industrial internet initiatives formed the setting for this comparative case study.

The research methodology followed the abductive Gioia method, combining iteratively inductive analysis of qualitative interview data with findings from prior literature. The theoretical framework was a combination of strategy process research (resource allocation process view) and managerial cognition literature.

My findings suggest that the matching is iterative in nature, with the pattern alternating between inside-out identification of opportunities based on existing capabilities and outside-in definition of capabilities based on interpreted opportunities. The pattern of matching depends on managerial commitment. In a high-commitment regime, capabilities are built before all opportunities are clear. In a low-commitment regime, capability building follows the clarification of opportunities. The pattern of strategy making also varies depending on how the top management perceives the nature of the technological discontinuity.

Keywords: strategy process, managerial cognition, matching of opportunities and capabilities, technological discontinuity	Publishing language: English

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Työn tavoitteena oli tutkia, kuinka organisaatiot tunnistavat, määrittelevät ja kehittävät mahdollisuuksia ja kyvykkyyksiä sekä sovittavat niitä yhteen teknologisessa epäjatkuvuuskohdassa. Vertailevan tapaustutkimuksen kohteena olivat teollisen internetin hankkeet kolmessa suuressa suomalaisessa konepajateollisuusyrityksessä.

Tutkimusmetodologia noudatti abduktiivista Gioia-menetelmää yhdistäen iteratiivisesti laadullisen haastatteludatan perusteella toteutetun induktiivisen analyysin sekä aiempaan teoriaan perustuvat löydökset. Teoreettinen viitekehys oli yhdistelmä strategiaprosessitutkimusta (näkemys strategiasta resurssiallokaation tuloksena) ja johdon kognitiota käsittelevää kirjallisuutta.

Löydösteni perusteella mahdollisuuksien ja kyvykkyyksien yhteensovittaminen on luonteeltaan iteratiivista. Yhteensovittamisen suunta vuorottelee: mahdollisuuksia voidaan tunnistaa olemassa olevien kyvykkyyksien pohjalta, tai kyvykkyydet voidaan määritellä havaittujen mahdollisuuksien perusteella. Yhteensovittamistapa riippuu johdon sitoutumisesta. Kun sitoutuminen on suurta, kyvykkyyksiä voidaan kehittää ennen kuin kaikki mahdollisuudet ovat selvillä. Kun sitoutuminen on vähäistä, mahdollisuuksien selvittäminen edeltää kyvykkyyksien kehittämistä. Lisäksi ylimmän johdon käsitys teknologisen epäjatkuvuuskohdan luonteesta vaikuttaa strategiaprosessin organisointitapaan.

Asiasanat: strategiaprosessi, johtajien kognitio, mahdollisuuksien ja kyvykkyyksien yhteensovittaminen, teknologinen epäjatkuvuus	Julkaisukieli: englanti

PREFACE

Abductive research is like orienteering without knowing in advance where the goal or the control points are. Having a map from good prior literature helps, but a knowledgeable guide helps even more.

I was fortunate to have two. I would like to thank my instructor, M.Sc. (Tech.), Ph.D. Candidate Riku Österman, and supervisor, Associate Professor Henri Schildt for their invaluable input.

I would also like to thank my entire research team for the encouraging, collegial, and fun atmosphere making this trip so enjoyable.

Last but foremost, Hanna – you are the best.

Lauri Jaakkola

Helsinki, August 2015

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1 INTRODUCTION

Hopes towards the opportunities of digitization are huge across all industries, and manufacturing is not an exception. Digitization is, for instance, expected to improve the efficiency of operations, help firms differentiate from competition, as well as open new, unforeseen sources of revenue.

Although the digital technologies as such are hardly a new thing to the manufacturers, question marks still hang over the opportunities and the needed new capabilities to exploit them. The history of earlier major technological breakthroughs has shown that the greatest gains do not stem from the technology as such, but follow only after the organizational structures and processes are re-engineered to capture the new technology's full potential (Brynjolfsson & McAfee, 2014). Visions about opportunities and capabilities exist, but so far the great success stories of digitization have often come from consumer businesses, not manufacturing. The question in the firms seems to be: "When everyone is talking about the potential of digitization, what *exactly* is it that we should do?"

On a more granular level, the question culminates in the chicken-and-egg dilemma: "Which should we try to identify and define first, the opportunities or the capabilities?" Concrete business opportunities in for instance big data collection and utilization can be hazy, as the customers are often disinclined to allow externals access the equipment data without demonstrating the value. Especially quantifying the value in advance is a challenge if the business case is not crystal clear to the manufacturer itself either. On the other hand, investing in building technical and organizational capabilities such as data collection and storage systems and analytics can be a risky bet if the eventual purpose and payback are unclear. As the uncertainty about the future remains, the result is often competing cognitive 'frames', i.e., different understandings about what the firm should do (Kaplan, 2008). These competing understandings can persist, and are only resolved when the firm undertakes strategic decisions determining the fate of the strategic initiatives of its key employees.

From prior literature viewing strategy as a process, we know that the variation, selection, and retention of strategic initiatives are important in forming the basis

for organizational renewal: realized strategies are the outcome of various initiatives, out of which only a part follow the official, intended strategy and others are more autonomously defined and selected (Burgelman, 1983, 2005; Mintzberg, 1978; Mirabeau & Maguire, 2014). Initiatives, as such, are typically proposals for new businesses, capabilities, or capacity (Bower, 2005). The initiatives are selected to implementation in an iterative resource allocation process, in which the initiatives that are perceived successful receive more and more resources (Noda & Bower, 1996).

The managerial cognition research provides a complementary perspective by proposing that the building of organizational capabilities, which often takes place in strategic initiatives, is tightly interlinked with the interpretation of opportunities. According to Helfat and Winter (2011), organizational capabilities exist for a specific purpose. New purposes arise as managers identify new opportunities, leading to the matching of opportunities and needed capabilities (Eggers & Kaplan, 2013). This matching can result in the definition or assembly of a new capability, if a gap is interpreted between the current and the needed capabilities.

Although the role of the strategic initiatives imply that there is an interconnection between the two rich fields of research, the dynamics of how strategy work and capability cognition interact are not yet perfectly understood. For instance, what managers actually do in the matching process and in what sequence are the opportunities and capabilities defined have been identified as topics requiring more research (Eggers & Kaplan, 2013). In addition, the findings of this research indicate that there can be differences in how firms respond to a similar technological discontinuity, in this case the industrial internet as part of the broader digitization of manufacturing. In some cases, the response seems to focus on building capabilities, while in others the emphasis is more on defining and creating new customer solutions.

Differences in the organizations' established strategy processes could possibly contribute to these different dynamics. In one case firm, the primary management approach was portfolio management of bottom-up defined and promoted initiatives, whereas in two other case companies the approach was

more top-down structured spearhead programs and initiatives. Therefore, the differences in the strategy processes could alter the possible opportunity-capability matches perceived by managers at different hierarchy levels.

On the other hand, another potential explanation for the different dynamics could stem from how the top managers perceive uncertainty and deal with it. When organizations face a higher uncertainty about the external opportunities and threats, the identification of possible opportunities and the right organizational capabilities becomes more difficult. The more uncertain the possible scenarios and future outcomes are perceived to be, the more challenging it is to form and execute actionable strategies (Courtney, Kirkland, & Viguerie, 1997). Increasing uncertainty also forms a seedbed for competing cognitive frames, i.e., differing managerial perceptions about which opportunities and capabilities form the best match for the organization (Eggers & Kaplan, 2013; Kaplan, 2008). According to Kaplan (2008, p. 748), overcoming the uncertainty and spurring action necessitates the "resolution of framing contests". Depending on how the contest is resolved, it would seem plausible to suggest that the managerial cognition can also affect the strategy process.

Together, the presumed, potentially recursive interplay between the strategy process and managerial cognition sets the basis for the first research question of this thesis:

- How do the managerial cognition and organization's strategy process affect the pattern of matching opportunities and capabilities when responding to a technological discontinuity?

Following from the identification of what organizational capabilities are needed, another interesting question is how well organizations are aware of their *existing* organizational capabilities. A common part of the strategy-making in firms is the identification of so called capability gaps, i.e., differences between the needed and current levels of capabilities. Related to the framing contest, Eggers and Kaplan (2013, p. 323) have called for more research on the processes and actions by which managers can increase their "awareness and agreement" to avoid for example "the inefficient allocation of resources as different managers pull capabilities in different directions". Because a technological discontinuity, such

as the industrial internet, can imply a need for a leap to build new kinds of capabilities, I formalize the second research question as follows:

- How do managers identify and bridge the gaps between the existing and the needed organizational capabilities when responding to a technological discontinuity?

In addition to answering the two theoretical research questions, a further objective of my master's thesis is to provide more empirical understanding about how opportunities and capabilities are identified, defined, and developed in manufacturing firms responding to digitization of manufacturing. The reasons for selecting this research scope are twofold. First, in a country like Finland undergoing great economic challenges, there is an urgent call for more knowledge about actions that could increase the productivity (Borg & Vartiainen, 2015). For Finland's export-driven economy, the productivity of the large manufacturing firms is especially vital. With my thesis, I try to illustrate current opportunity-capability matching practices at some leading manufacturers in Finland.

Second, focusing on how different firms that share a similar traditional business-to-business manufacturing heritage respond to a partially same technological discontinuity – more specifically, the emergence of industrial internet – enables comparing the findings and possibly even generalizing some of them as recommended industry practices. Industrial internet is a broad concept which generally refers to the collection and integration of installed base equipment data with the aim to unveil and capture new value creation opportunities. The broad definition leaves room for a wide range of potential applications. Indeed, it is vital to note that the discontinuity is not necessarily that radical; only occasionally it leads to a rapid establishment of new businesses or drastic industry transformation. In manufacturing firms, industrial internet and digitization may rather be seen as a new step on a continuum that has started with automation and servitization development already some 20–30 years ago.

Starting from chapter 2, I first present the theoretical background of strategy process and capability cognition, and combine implied interconnections between initiatives and capabilities into a synthesizing framework. In chapter 3, I present the used research methodology and describe the data, as well as its collection and

processing. Data-based findings are discussed and synthesized in a dialogue with prior theoretical findings in chapter 4. In chapter 5, I discuss both theoretical implications to the resource allocation process literature and capability cognition research, as well as suggest managerial implications for practitioners. Finally, in chapter 6, I evaluate this study and its limitations, identify open questions for future research, and present my concluding remarks.

2 LITERATURE REVIEW

I have divided this literature review chapter into three parts. First, the resource allocation process theory of strategy-making, is presented in chapter 2.1. Second, the theoretical foundations of the capability cognition model are presented and discussed in chapter 2.2. In chapter 2.3, I synthesize the identified interconnecting parts of both theories and present an integrated framework suggesting possible reciprocal mechanisms between strategic initiatives and capability cognition before the empirical part of the thesis.

2.1 Strategy-making as a process of iterative resource allocation

To what extent do strategic initiatives actually follow from a deliberate strategic plan versus autonomous bottom-up activities? A commonly agreed view in the strategy process literature is that realized strategy is an outcome of both deliberate and emergent strategies (Mintzberg, 1978). Deliberate strategy is the realized part of intended top-down strategy which is never implemented entirely, whereas emergent strategy results from the autonomous strategic behavior all around the organization (Mintzberg, 1978; Mirabeau & Maguire, 2014).

Strategy process literature has emphasized the emergent strategy aspect, suggesting that decisions and actions constituting the strategy are in reality "distributed across multiple levels of an organization" (Noda & Bower, 1996, p. 159) and not centralized just around the top management. From the strategy process view, strategic actions – defined as initiatives – are given resources iteratively based on their perceived success (e.g. Burgelman, 1983; Noda & Bower, 1996). Initiatives that will eventually form the realized strategy are the ones that have survived this intra-firm selection environment, as well as the external selection environment, i.e., the market. Thus, strategy making is rather evolutionary in nature rather than following a rational, predetermined plan in a disciplined way. (Burgelman, 2005)

Because the initiatives may be either induced or autonomous, i.e., either aligned with the organization's prevailing concept of strategy or not, realized strategies typically contain elements of both deliberate strategic planning and emergent strategic behavior (Burgelman, 1983; Mintzberg, 1978; Mirabeau & Maguire, 2014). According to the cornerstone book by Bower (1970), the initiatives contain,

at the operating management level, proposals for business-unit strategies and new investments that pursue new business opportunities, new capacity, or – in effect – new capabilities (Bower, 1970, 2005).

In the original Bower-Burgelman (B-B) process which was named after the two pioneers of the research stream, there are four interlinked processes. *Definition* and *impetus* are core processes that lead to the establishment and selection of certain initiatives, and *structural* and *strategic context determination* are corporate-level processes that the top management can use to frame what kind of initiatives are proposed and selected (Burgelman, 1983).

Since the foundational and highly influential studies by Bower (1970) and Burgelman (1983), the resource allocation process model has received many revisions and extensions. The revised model by Bower and Gilbert (2005), presented in figure 2.1, provides a rather comprehensive summary of the findings. The central processes of definition and selection interact with each other and occur simultaneously across all the management levels, and are influenced by the corporate-level structural and strategic context as well as the external product market and capital market contexts (Bower & Gilbert, 2005).

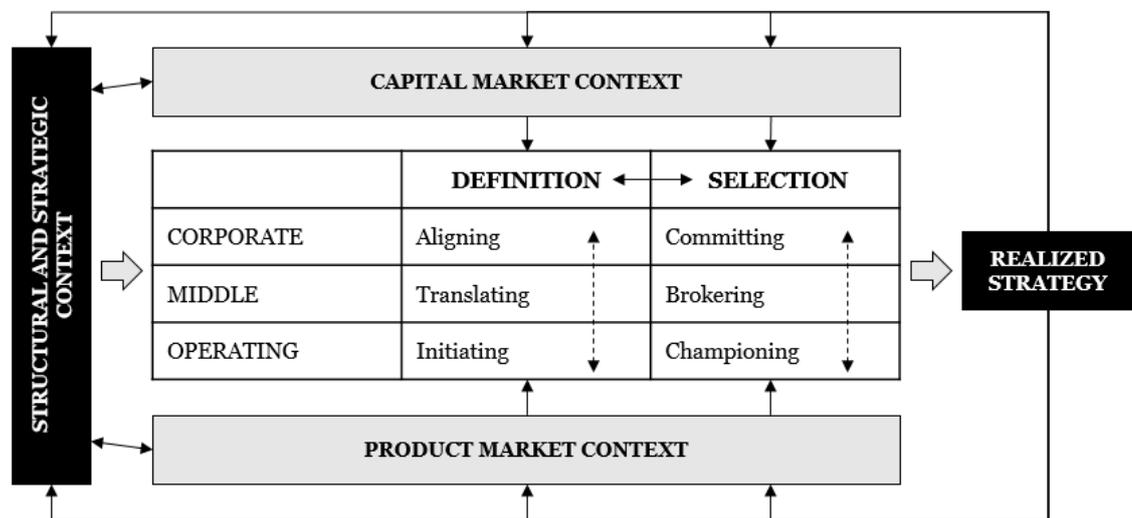***Figure 2.1.*** *A revised model of resource allocation process by Bower and Gilbert (2005).*

Although the undertone in many resource allocation process papers is that the initiatives emerge more often bottom-up than top-down, the revised model

acknowledges that both definition and selection processes can stem from any of the three layers of management: corporate (top), middle-level, or operating (Bower & Gilbert, 2005). In a normal situation, operating managers initiate and champion the proposals, middle managers translate the definitions to fit the strategic context and act as a filter for initiatives by brokering, and the top management aligns the initiatives to fit both the strategic context, corporate goals, and other initiatives, and then commit to the chosen ones by allocating more resources to them (Bower, 1970; Bower & Gilbert, 2005). However, the top managers influence the bottom-up process, if not directly, at least indirectly. Lovas and Ghoshal (2000, p. 875) have suggested that managers can "guide the evolution of strategy" by designing the "organization as an ecological system" on purpose. In practice, this would happen altering the strategic and structural contexts, e.g. the formal structure and organizational routines or the people working on the strategic initiatives (Lovas & Ghoshal, 2000).

The model takes into consideration also the effects of the product market context, originally emphasized by Christensen and Bower (1996), and the capital market context, brought to attention by Noda and Bower (1996). Both have been shown to influence the definition and selection processes, and they both also have a reciprocal effect to the structural and strategic context (Bower & Gilbert, 2005; Christensen & Bower, 1996; Noda & Bower, 1996).

First, product market is where the firm interacts with its customers by selling products or services and collecting payments. Christensen and Bower (1996) have shown that a firm's dependence on its existing customers can lead to a failure of capturing new disruptive business opportunities. Often, the radical technological innovation leading to disruption may even stem from the leading firm itself. However, the performance of the nascent technology is in many cases inferior to the dominant older technology. Because of this, the existing customers are not willing to switch to the new technology, and the lack of this important resource contribution makes the seller firm's salespeople and profit-and-loss-responsible managers reluctant to promote initiatives using the new technology. As a result, the new technology may be spun out or abandoned. If the technology finds a new, more suitable home from another market, its development may be accelerated to the point that its performance beats the old technology. At this stage, the

disruption in the original product market can be aggressive and lead to the failure of incumbent players. (Christensen & Bower, 1996)

Second, the capital markets, namely investors and lenders, also affect the definition and selection processes (Noda & Bower, 1996). Sull (2005a) has stated that while the normal bottom-up process of initiative definition and championing may work well for new investments, it does not effectively generate disinvestment initiatives. The reason for this lies in the personal biases and organizational myopia. At the lower levels of an organization, the perspective is more focused on an individual's own business unit and narrower across business units. Given this and the fact that the individuals' worries about the future of their own job, the bottom-up initiatives do not typically bring up disinvestments (Sull, 2005a). According to Sull (2005a), this kind of evaluation and decision-making is more natural for the corporate management's top-down initiatives, because their responsibility is by definition to take care about the owners' interests. If the biases have led to a harmful myopia also in the top management, the board of directors representing the owners or important lenders may decide to exercise their power and direct disinvestments, or certain new investments (Sull, 2005a).

A final important extension of the revised model, which is however not directly visible from the model picture, is the effect of cognitive frames on definition and selection as well as on the interaction between the processes. Gilbert (2005a, 2005b) has proposed that a strong threat perception leads to an aggressive resource allocation to disruptive technologies but at the same time "strategic plans will be rigidly defined" (Gilbert, 2005a, p. 288), i.e., the responsive initiatives and business models become narrowly defined. The narrow definition is an outcome of contraction of authority which is typical for threat situations and which "can block the traditional bottom-up process of resource allocation" (Gilbert, 2005a, p. 289). Therefore, strategic redefinition of the selection process is needed when responding to a threat, or else the organization may be stuck with invalid resource commitment patterns.

2.2 Managerial cognition and organizational capabilities

Organizational capabilities are sets of organizational skills used for a specific purpose (Helfat & Winter, 2011). According to Eggers and Kaplan (2013), new

purposes for new organizational capabilities arise as managers match their interpretations of the external opportunities and threats with the perceived organizational capabilities. Nevertheless, the same authors emphasize that the actual mechanisms leading to the creation of organizational capabilities are not yet fully understood. The standard model (figure 2.2) in strategic management research suggests that capabilities are formed from organizations' accumulated experience, i.e., prior performance. The resulting capabilities, on their behalf, drive the future organizational performance as they are deployed through the strategic choices by managers. (Eggers & Kaplan, 2013)
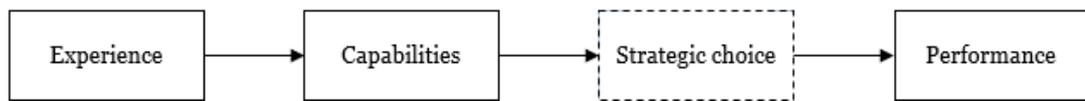

Figure 2.2. *The standard model of capabilities and performance according to Eggers and Kaplan (2013).*

In their recursive model (figure 2.3), Eggers and Kaplan (2013) suggest many improvements to the linear model. In addition to presenting five recursive links between different elements (dashed lines in figure 2.3), the model presents routines as the link between experience and capabilities. Routines are patterns of actions that constitute organizational skills, i.e., they are mutually agreed-upon, reliably repeated ways of doing things between multiple organizational actors. Routines are constructed out of experiences either with or without conscious effort, especially if the prior performance is perceived as positive, if the experiences bear a resemblance to existing routines, or if the experiences are repeated over time. Routines are building blocks from which capabilities can be assembled. (Eggers & Kaplan, 2013)

In the model, capability assembly from routines is activated when managers interpret a purpose for a new capability, while forming their understandings about what the organization can already do. These two cognitive processes interact with each other and making a distinction between them in reality may be difficult. (Eggers & Kaplan, 2013) The implication that follows from this is that cognition plays a pivotal role in the process of assembling routines into

capabilities. According to Helfat and Winter (2011, p. 1244), a capability exists only if there is a "specific and intended purpose" for it. Without the interpretation of a purpose, there are only routines and experience and no capability (Eggers & Kaplan, 2013). In addition, existing capabilities set frames for managerial interpretations of what the organization can already do (Eggers & Kaplan, 2013).
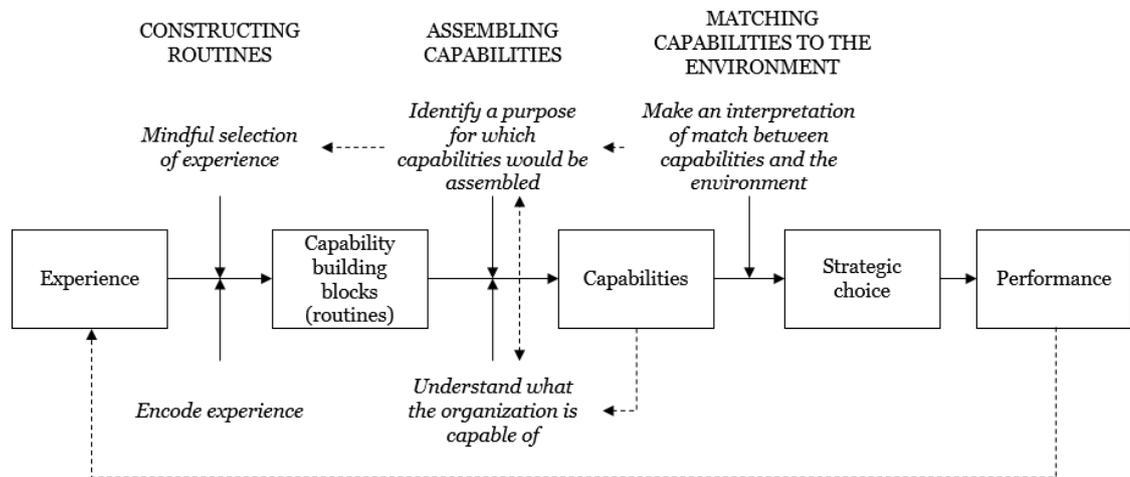

Figure 2.3. *A recursive model of cognition and capabilities by Eggers and Kaplan (2013).*

New purposes arise as managers interpret how well the existing capabilities match the identified opportunities and threats in the external environment. In the recursive model, matching process triggers the identification of a purpose for a capability. Furthermore, purpose identification can activate the mindful selection of experience for new routines, if suitable capability building blocks do not yet exist. (Eggers & Kaplan, 2013)

Despite the improvements, the recursive model still leaves many questions open, especially related to how the construction of routines, assembly of capabilities, and the matching of capabilities with the opportunities are actually done. Eggers and Kaplan (2013) themselves suggest multiple topics for further research. There is only little knowledge about how managers can and actually do influence the whole process. Starting from the experience encoding, it is not well known how managers intentionally influence the direction, volume and efficiency of the encoding. Second, it is still unclear what kind of actions managers at different hierarchy levels can and do take to increase the amount of possible capability building blocks. Third, the mechanisms of how managers experiment with

different capability building blocks, familiarize themselves with the existing routines and environmental opportunities, and agree mutually upon allocating resources to the development of certain capabilities over others, have also received only little attention so far. Finally, the specific steps of the matching process, especially regarding the opportunity identification in non-turbulent times and capability transformation and redeployment, are proposed by the authors. (Eggers & Kaplan, 2013)

2.3 Integrated model of strategic initiatives and capability cognition

Comparison of the resource allocation process model to the recursive model of capability cognition shows interesting similarities. Figure 2.4 presents an integrated framework adding the strategic initiatives to the capability cognition model by Eggers and Kaplan (2013). First, both models are evolutionary and recursive, meaning that they both are based on variation, selection, and retention that are repeated cyclically. In Eggers and Kaplan's (2013) model, variation in experience enables a greater variation in routines. A greater variety of these capability building blocks enables a greater variety of possible capabilities, and therefore a higher flexibility in possible strategic choices the managers can make. Selection and retention are also clearly present. Certain experiences are selected, mindfully or not, to become encoded into routines, and then preserved if proven useful in practice. Similarly, some routines may be selected in the assembly of new capabilities, and the capabilities are retained if the strategic choices giving the capabilities their purpose are successful. (Eggers & Kaplan, 2013)

Whereas the variation, selection, and retention of experiences form the basis for organizational capabilities, the variation, selection, and retention of strategic initiatives through resource allocation constitute the realized strategy (Burgelman, 2005). According to Burgelman (1983), bottom-up initiatives stem from the local problem-solving activities that link market needs with technical solutions. Clearly, this problem-solving would be likely based on the experience of the individuals and teams, and this experience would have been accumulated as a result of past positive and negative performances. Therefore, it could be argued that the same experience base that forms the micro-foundations of routines also provides the basis for initiatives.
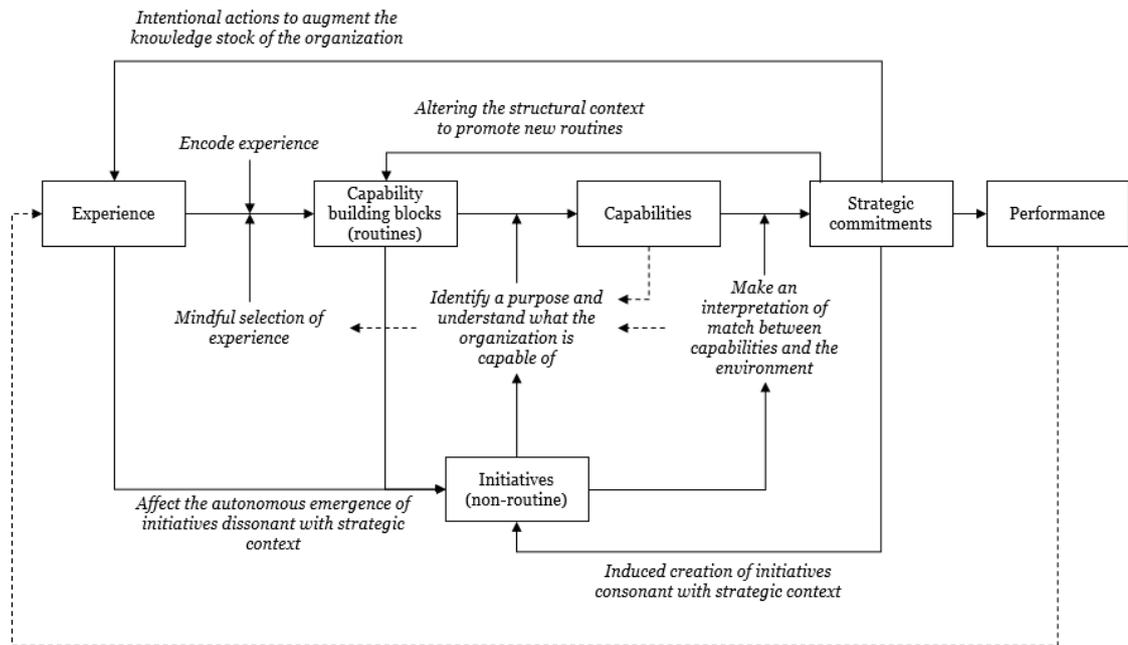
Figure 2.4. Integrated model of capability cognition and strategic initiatives.

In addition, existing organizational routines – which in effect are a part of an organization's structural context – direct individuals' attention towards certain issues and away from others. This naturally affects what kind of initiatives get defined and selected. Because organizational routines are agreed-upon ways of working, the more stabilized and rigid the routines are, the more difficult it is to mobilize resources behind an autonomous initiative. If a bottom-up initiative stems only from the existing experience and routine base of the organization, it would seem plausible to suggest that experience and routines affect the autonomous emergence of initiatives. Heterogeneous experience and routines would likely enable a higher variety of both routines and initiatives in contrast.

Since the strategic choices – or strategic commitments – by the managers do not only define the capability needs but also set the organization's strategic context, the commitments would also affect the induced initiative creation directly. The indirect influence by managers, i.e., the guided evolution proposed by Lovas and Ghoshal (2000), could in the context of Eggers and Kaplan's (2013) model be exercised through the intentional actions to augment the experience pool or to alter the organizational routines for example with an organizational restructuring. The influence on later-emerging initiatives would in this case be

indirect, because the change in experience pool and routines would likely yield also unexpected autonomous initiatives. Eventually, autonomous initiatives can also affect the structural and strategic context and the capability cognition: the ones that survive the intra-firm and extra-firm selection can become retroactively rationalized as a part of the strategic context (Burgelman, 1983). As such, autonomous initiatives are an important source of strategic variation that enables strategic flexibility and corporate renewal over time (Burgelman, 1983; Mirabeau & Maguire, 2014).

Second, initiatives would appear to be a natural source of purposes for new capabilities. New purposes arise as the result of the matching process, in which managers interpret the opportunities and capabilities and try to fit them together. An initiative almost by nature entails a more or less specific idea of such a match. They are non-routine activities, and their goal is the creation of a new business, a new capability, or new capacity (Bower, 2005). For instance, internal corporate ventures (ICV) are initiatives that aim to create new viable businesses to the firm. In these cases, the link between initiatives and capability creation is obvious: when pursuing a new environmental opportunity with an initiative, the matching process needs to be revised, and new purposes arise for capabilities.

A capability initiative would not necessarily be launched to respond only new opportunities, but also to respond to an identified mismatch between existing and needed capabilities in the case of an existing opportunity. In this case, the perceived capability mismatch would inhibit the firm from fully capturing the opportunity. Similarly, a capacity initiative would respond to an identified capacity shortage having similar consequences to a capability gap.

Furthermore, there is evidence that initiatives may lead to capability creation indirectly. In their study of internal corporate ventures (ICV), Keil et al. (2009) found that capabilities were developed in the venturing process even when the initiatives themselves did not achieve the business goals that were set to them. Still, these ventures were not necessarily considered failures because of the perceived indirect benefits provided by the nascent, new capabilities. Alike capability building blocks, the resulting capabilities were often transformed and

redeployed in other, new ventures which would not have been possible without these capabilities. (Keil et al., 2009)

Third, initiative definition and selection occur at all levels of management (Bower & Gilbert, 2005). Therefore, also the capability cognition is likely to happen similarly. At lower levels, it can be more about individual and team capabilities, and at the business-unit- or firm-level about organizational capabilities.

The fourth common denominator between the models is coping with uncertainty. According to Burgelman (1983, p. 238), strategic context determination process is activated when the corporate management realizes that "the current strategy is no longer entirely adequate but does not know how it should be changed until, through the selection of autonomous initiatives from below, it is apparent which new businesses can become part of the business portfolio". Similarly, routines may be developed and stored "without knowledge of their value nor their eventual development" as a sort of a real options strategy (Eggers & Kaplan, 2013, p. 301).

Finally, the generation of new capability building blocks can be intentionally fostered by the top management through deliberate changes in the firm's structural context. As part of guiding the evolution towards a certain direction, organizational changes can increase the variation in the organizational processes, as people need to collaborate with new people and possibly in new ways (Lovas & Ghoshal, 2000). The managerial actions to change the organizational structure do not necessarily increase the variation within existing routines, but rather set the requirement to create new ones. For instance, when pursuing market opportunities that lie beyond the capabilities of a single organizational unit or responding to industry convergence, the top management may wish to develop strategic flexibility by recombining resources from separate business units or even by integrating entire units (Raynor, 2005).

3 RESEARCH APPROACH AND METHODS

The objective of the study was to gain understanding about what kind of challenges digitization sets to managing strategic initiatives and organizational capabilities in manufacturing firms. Because of the interpreted theoretical gaps in the intersection of strategy process and capability cognition literature, I used a multiple case study research design to explore and build grounded theory based on the findings (Eisenhardt, 1989). In order to ensure the scholarly rigor of the study, I selected the Gioia method as the analytical approach. Gioia method provides good means to articulate the grounded theory and present the inductive research process (Gioia, Corley, & Hamilton, 2013). The method combines inductive, first-order open codes and more theory-driven second-order codes into a rigorous data structure (Gioia et al., 2013; Nag, Corley, & Gioia, 2007). Therefore, the followed reasoning logic was not exclusively inductive but also abductive (Mantere & Ketokivi, 2013).

In this chapter, I describe first the research context, and then the data collection procedures before presenting my data analysis process as well as the resulted data structure.

3.1 Research context

The research context was three Finnish manufacturing firms – pseudonyms Tammer, Newland and Bothnia – and their digitization initiatives, especially the ones related to the industrial internet. All the firms were among the global leaders in their respective industrial goods and services industries. The markets of each firm were relatively stable: the equipment markets were cyclical but quite mature, with the high capital intensiveness and need for a strong engineering expertise, global footprint, and good reputation as entry barriers to new players. Because of this, industrial internet alone was not expected to change the industries overnight.

In Finland's scale, they were large-size stock-listed, export-oriented firms: in 2014, each firm generated single-digit billion euros in annual revenues, and the number of employees was in the range of 10 000–20 000 people. Although every firm had also notable service sales (the share of service sales ranging from approximately 25–40 % of annual net sales), traditional equipment

manufacturing and sales formed the largest share of the business volume. Based on their own words and investor presentations, all the firms were seeking to grow their service businesses to bring additional growth and stability against the cyclicality. However, the challenge in moving to services was related to 'converting' not just the own organizations but also the customers to them. As put by one of the interviewees, the sizes of service deals were "peanuts" in comparison to the equipment delivery projects, and the customers expected to receive the services free of charge.

As is common to mature markets, the competitive landscape for each firm was characterized with intensive price competition. However, none of the case firms was trying to distinguish from the competition primarily with lower costs, but rather with superior quality and value of equipment and services. Over their long histories, each firm had built high-class engineering capabilities, which also formed the roots for digitization. The technical solutions and related offerings had evolved from improving component- or machine-level performance to higher-, more systemic-level optimization of sub-processes or even entire end-to-end processes over the entire equipment lifecycle. Advanced digital and mobile communication technologies were seen as the enabler for developing more granular services and products to diversified customer needs, while simultaneously improving the delivery efficiency.

3.2 Data collection procedures

In total, there were 28 interviews with 8 or 9 interviews from each case firm. Altogether 23 individuals from corporate, middle, and operating management were interviewed (see table 3.1). Three interviews were held with one interviewee, and two with another interviewee. The interviewees represented corporate and middle managers with business responsibility (e.g. CEO, Presidents of business areas, Vice Presidents of business units or lines) as well as top, middle and operating managers who were closely involved in the digitization initiatives. In order to validate findings and to form a more holistic view of the entire organization's attitude towards the initiatives, we interviewed also some middle and operating managers who were not directly involved in the digitization initiatives but whose areas of responsibility were adjacent to and partly interdependent with them.

Table 3.1. *Interviewees by management level.*

Management level	Title and area of responsibility
Corporate management	Chief Executive Officer
	Chief Digital Officer
	Chief Information Officer
	Senior Vice President, strategy
	President, business area
	President, business area
Middle management	Senior Vice President, business unit
	Vice President, division
	Vice President, business line
	Vice President, business line
Operating management	Director, services
	Director, business unit
	Director, business unit
	Director, research
	Director, product development
	Director, software development
	General Manager, business unit
	General Manager, product development
	General Manager, information management
	General Manager, business/service development
	Program Manager
	Product/Project Manager
	Team Leader, technology support

An interview guide (see appendix) was created based on preliminary interviews, existing literature, and research team discussions. Nevertheless, the interview guide was not followed slavishly, rather, the purpose was to keep the interviews only semi-structured if possible and let the interviewees express their thoughts in their own words as much as possible. Follow-up questions were then used to specify the answers in greater detail. The interview guide as such was not modified between interviews. Rather, interview questions were selected,

modified, or left out depending on their relevance to each interviewee, the discussed topic, and the natural flow of the interview.

The interviews were held mainly face-to-face with each interviewee, except for one interview where two interviewees were interviewed in the same session. The interviews were recorded and the recordings were transcribed by a transcription service. The ready transcripts were checked and corrected by the interviewer before uploading them to the qualitative analysis software file. Three video conference interviews where exceptions: during them, interview memos were written by the interviewer post-interview due to poor connections and sound quality that prevented recording. In these cases, the interview memos were sent to the interviewees for possible corrections and additions before uploading them to the analysis software.

3.3 Data analysis

Collected interview data was analyzed using a qualitative research software, Atlas.TI. Following the Gioia method, checked interview transcripts were first analyzed using open coding, i.e., the codes were created and named based on the data and without any specific theoretical framework in mind (Gioia et al., 2013). A short comment describing the quotation's content or simply repeating an interesting sentence by the interviewee was added every time a new piece of text was labeled with it. After open-coding six interviews representing different case firms, I selected Tammer as the lead case, and next open-coded all the nine Tammer interview transcripts.

In the axial coding stage, three thematic codes were selected to describe how the sequencing of opportunity and capability identification would be expected to happen in the matching process. I formed altogether 18 thematic codes based on both data and literature on resource allocation process and capability cognition following the Gioia method. According to Gioia et al. (2013, p. 20), the objective of forming thematic codes is to identify "concepts that might help - - describe and explain the phenomena" that are being observed. Next, I formed a network view of the thematic and open codes to determine connections and associations. In the process, overlapping open codes were merged together and unclear code names were rephrased to better describe the content.
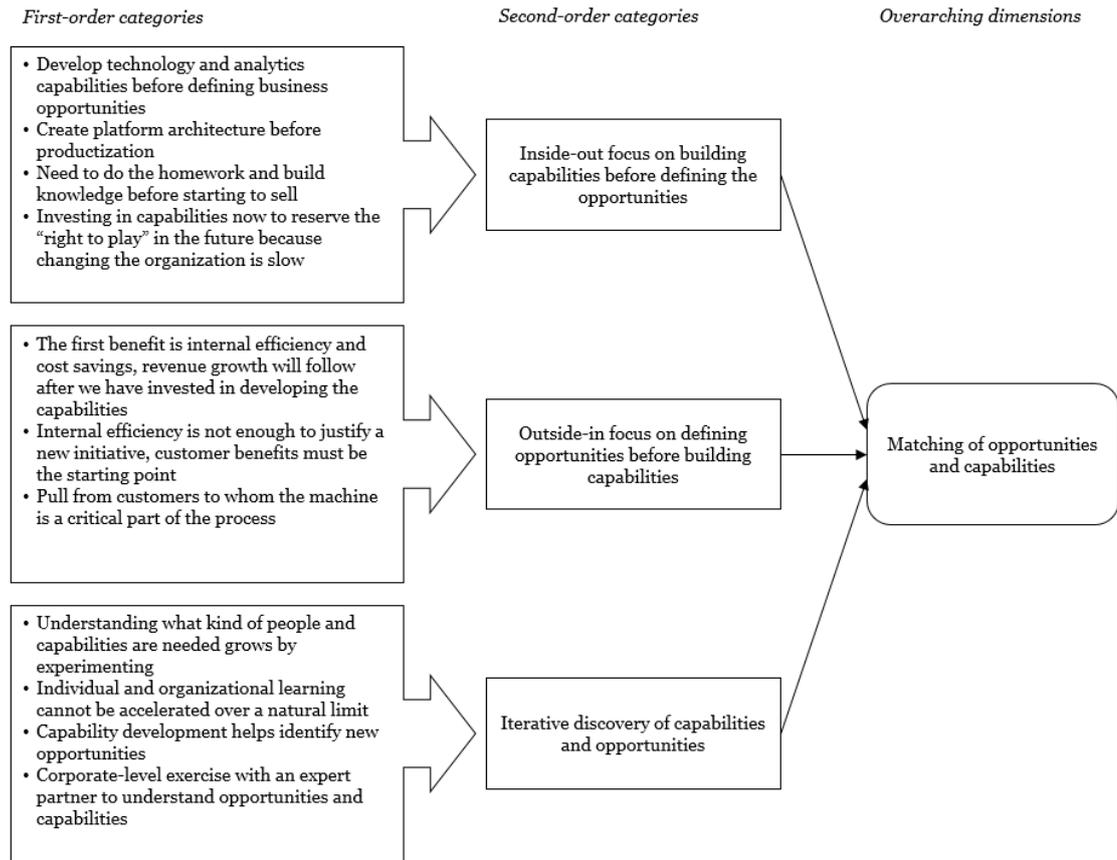
First-order categories | Second-order categories | Overarching dimensions

- Develop technology and analytics capabilities before defining business opportunities
- Create platform architecture before productization
- Need to do the homework and build knowledge before starting to sell
- Investing in capabilities now to reserve the "right to play" in the future because changing the organization is slow

→ Inside-out focus on building capabilities before defining the opportunities

- The first benefit is internal efficiency and cost savings, revenue growth will follow after we have invested in developing the capabilities
- Internal efficiency is not enough to justify a new initiative, customer benefits must be the starting point
- Pull from customers to whom the machine is a critical part of the process

→ Outside-in focus on defining opportunities before building capabilities

- Understanding what kind of people and capabilities are needed grows by experimenting
- Individual and organizational learning cannot be accelerated over a natural limit
- Capability development helps identify new opportunities
- Corporate-level exercise with an expert partner to understand opportunities and capabilities

→ Iterative discovery of capabilities and opportunities

→ Matching of opportunities and capabilities

Figure 3.1. *Data structure, part I.*

In the third stage of the analysis, I examined the code network for possible overarching patterns and novelty of findings (Gioia et al., 2013). This examination was a reflexive, dialogical process between existing literature and data, the aim being to find the explanation between them (Mantere & Ketokivi, 2013). During this process, I coded also the remaining interviews from Newland and Bothnia, applying both new open codes and existing ones created originally for Kalmar. The resulting 337 open codes were allocated to the thematic codes which were also revised and redefined, reducing the final number from 18 to 9.

Finally, I identified three overarching themes – 'matching of opportunities and capabilities', 'definition and selection of initiatives', and 'interaction with the external environment' – based on the thematic codes. The final data structure showing the overarching dimensions, second-order categories and examples of the first-order categories is presented in figures 3.1 and 3.2.
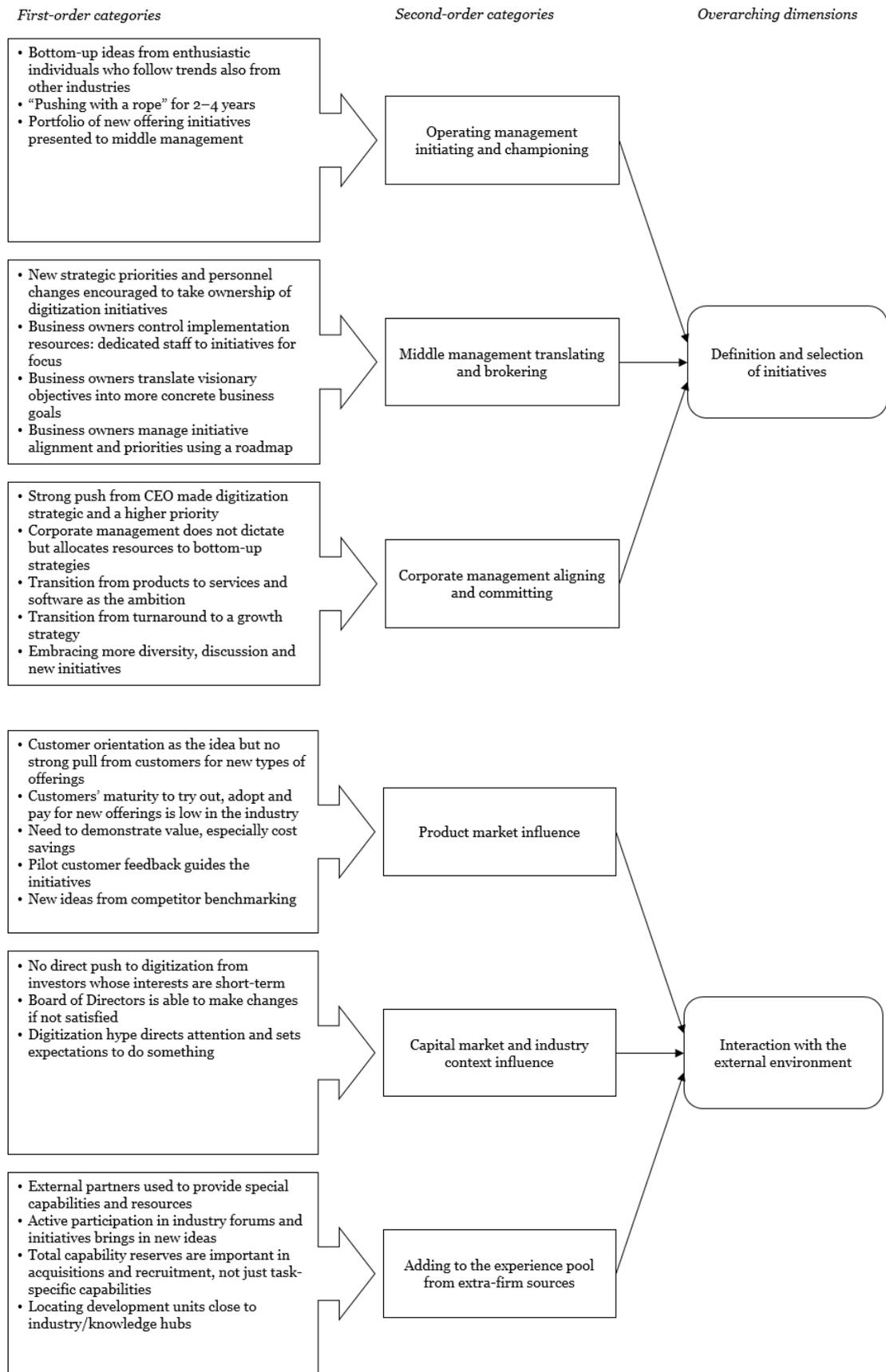
- Bottom-up ideas from enthusiastic individuals who follow trends also from other industries
- "Pushing with a rope" for 2–4 years
- Portfolio of new offering initiatives presented to middle management

→ Operating management initiating and championing

- New strategic priorities and personnel changes encouraged to take ownership of digitization initiatives
- Business owners control implementation resources: dedicated staff to initiatives for focus
- Business owners translate visionary objectives into more concrete business goals
- Business owners manage initiative alignment and priorities using a roadmap

→ Middle management translating and brokering

→ Definition and selection of initiatives

- Strong push from CEO made digitization strategic and a higher priority
- Corporate management does not dictate but allocates resources to bottom-up strategies
- Transition from products to services and software as the ambition
- Transition from turnaround to a growth strategy
- Embracing more diversity, discussion and new initiatives

→ Corporate management aligning and committing

- Customer orientation as the idea but no strong pull from customers for new types of offerings
- Customers' maturity to try out, adopt and pay for new offerings is low in the industry
- Need to demonstrate value, especially cost savings
- Pilot customer feedback guides the initiatives
- New ideas from competitor benchmarking

→ Product market influence

- No direct push to digitization from investors whose interests are short-term
- Board of Directors is able to make changes if not satisfied
- Digitization hype directs attention and sets expectations to do something

→ Capital market and industry context influence

→ Interaction with the external environment

- External partners used to provide special capabilities and resources
- Active participation in industry forums and initiatives brings in new ideas
- Total capability reserves are important in acquisitions and recruitment, not just task-specific capabilities
- Locating development units close to industry/knowledge hubs

→ Adding to the experience pool from extra-firm sources

Figure 3.2. Data structure, part II.

4 FINDINGS

Out of the completed data structures, I considered the theme 'matching of opportunities and capabilities' to entail the most scientific and managerial novelty. In this chapter, I first elaborate the three thematic codes that were interpreted to belong under the matching. The first section (4.1) presents how managerial commitment to industrial internet initiatives was manifested in the case firms. In the following sections (4.2 and 4.3), I discuss more specifically how the matching of opportunities and capabilities was externalized. In the last two sections, I synthesize my abductive findings into two propositions (4.4 and 4.5).

4.1 Managerial commitment in digitization initiatives

Managerial cognition about the opportunities and needed capabilities has been found to guide the organization to build those capabilities (Eggers & Kaplan, 2009; Laamanen & Wallin, 2009). Organizational orientation, the "organization-level corollary for attention" and constituting of the firm's capabilities related to a certain industry, can accelerate or decelerate this effect (Eggers & Kaplan, 2009, p. 463).

There were significant differences in the management approaches between the case firms. In Tammer, the prevailing management approach was to a great extent a bottom-up process. According to the resource allocation process literature, this approach is typical especially in stable conditions: initiatives are defined and selected first by the operating and middle-level managers, and the top managers influence the resulting strategy rather by either rationalizing the passed-through initiatives retroactively or guiding the strategy evolution toward a certain direction by making changes to the firm's strategic and structural context (Bower, 1970; Burgelman, 1983; Lovas & Ghoshal, 2000; Sull, 2005a). This can be both effective and efficient: when the definition and selection of initiatives are delegated and decentralized throughout the organization, the organization's performance is less dependent on the bounded rationality of only few top managers, and there can be more sensitivity and faster responsiveness to customer needs (Sull, 2005b).

In Tammer, the corporate management set the strategic direction and business goals to the business areas, which then crafted their respective strategies and

investment proposals rather autonomously from the bottom up. The corporate management then managed the strategies and proposals akin to a portfolio, making the high-level resource allocation decisions and ensuring the mutual alignment between the business areas. Overall, the corporate management's role in strategy making seemed to be rather limited.

"We haven't started from building a corporate digitization strategy that would then somehow affect the business areas, but the business areas need to have [digitization] as a strong part of their own business area strategies. - - [In the corporate management] we've been trying consciously not to organize this so that this wouldn't become one of those topics that 'okay, now the corporation started to coordinate this and let's make an enormous roadmap and terrible bureaucracy', and so on. Because of that we've been trying consciously to keep it so that there would be freedom to experiment and do, and the corporation's role would rather be to support and encourage the initiatives." –Chief Information Officer, Tammer

The downside of the bottom-up process is that when there are changes in the firm's environment, the initiatives that it generates may not address the new challenges and opportunities adequately (Christensen & Bower, 1996; Kuemmerle, 2005; Sull, 2005a). Although some researchers have claimed that the autonomous bottom-up strategizing can be the key for corporate renewal and long-term success (Mirabeau & Maguire, 2014), rapidly increasing uncertainty can transform the matching process into a politically-motivated contest of competing cognitive frames, i.e., individual interpretations about what should be done (Kaplan, 2008). In these situations, the top managers can decide to influence the strategy process directly by making interventions (Doz, 2005; Eisenmann & Bower, 2000; Raynor, 2005; Sull, 2005a).

In contrast to Tammer, where the digitization initiatives were managed mainly as any other development projects, both Newland and Bothnia had top-down cascading strategies for digitization with stronger and more direct top management influence. In Newland, the CEO had been promoting digitization for years and a top management team member was responsible for the corporation's overall digitization strategy, which entailed multiple programs and sub-projects.

"[As an answer to the question of who is in charge of running the digitization strategy:] – That's myself. - - We have some projects under that, mainly on the development side. So when we're launching out and rolling out new initiatives, there are sub-projects for each one of those." – Chief Digital Officer, Newland

Although the original idea for building remote monitoring and data analytics capabilities came from a customer segment with a clear need, Newland's top management had committed to building and applying those capabilities also in the larger customer segment, which seemed to be satisfied even with the more standardized equipment and services. The top management's perseverance was seen crucial to the continued investments in capability building.

"So really from the top management there has been lots of support and actually, this would not never have happened if [the CEO] couldn't have said that 'we will start doing this, make sure this happens'. So he was and the whole, the upper layer of the company was very much supporting this." –Program Manager, digitization initiatives, Newland

Also in Bothnia, the CEO was actively promoting the digitization, but the most vocal champion of it was one of the business area presidents. The reasons for this were that most of the strategic digitization initiatives were ideated and implemented in the respective business area for which the president was overall responsible, but also the president's personal interest and enthusiasm toward digitization. In the interview, Bothnia's CEO emphasized the importance of having "visionary people" who could promote new ideas become reality.

"It's like any business. People is, the business is people. People who make things happen. - - The guy who's head of [disguised business area], he's a visionary on that side. - - he's totally sold on to this. He's very much into that." –CEO, Bothnia

Visionary people alone are not enough for initiative implementation if their cognitive frames do not win the competing frames and the change-resisting inertia of the prevailing ones (Kaplan & Henderson, 2005). The structural context and its performance measurement systems also affect what individuals are incentivized to do (Burgelman, 1983; Kaplan & Henderson, 2005). In Newland's case, the top management's commitment to digitization helped dissolve some managers' doubts regarding the business benefits.

"When you start developing this kind of thing, of course, although we have good backup from the CEO level that, for sure there are other levels of organizations in our, in the company so, some could argue that okay, I don't see the business value of this development, why should we continue et cetera. But it's the same thing nowadays when people talk about industrial internet because there are not so many, good examples of how this business value has realized." – Program manager, digitization initiatives, Newland

Tammer's first big data initiative provides an example of the opposite outcome. The initiative was – quite exceptionally – driven as a corporate-level initiative which had received the top management approval for resourcing. For instance, certain experts had been hired from the outside of Tammer to bring in new personal capabilities. However, the initiative stalled before the implementation due to the middle managers' reluctance to commit to it. The middle managers, who were in charge of the continuous business performance of the units, were concerned about the envisioned benefits which they did not consider to be specified concretely enough. As a result, they were unwilling to invest the resources – and their personal reputation – in an initiative that appeared to be risky.

"It was well-funded and the people [had] even been recruited to initiative but no connection to everyday business or the people who were running the everyday business." –President, business area, Tammer

"The ideas have been, let's not say weak, but some of the ideas have not been thought thoroughly through from the business perspective." –Vice President, business line, Tammer

Interestingly, even though Tammer's top management had considered the initiative to be important and gave it a lot of their attention, they were not eventually committed enough to force the initiative through the middle management's resistance. Another interpretation is that the top managers were more committed to the performance goals they had set to the business areas and lines than to the single initiative. This finding indicates that it is important to make a distinction between managerial attention and managerial commitment when discussing managerial cognition. According to Kraatz and Zajac (2001), resources as such can be interpreted as commitments. Investing in acquiring resources and allocating existing resources to certain uses instead of others are, in effect, outcomes of true managerial commitments. The existing resource commitments can cause change-resisting inertia, because the decision to reallocate resources to a new initiative simultaneously implies a change in managerial commitment – the existing resource commitments tend to defend themselves (Kraatz & Zajac, 2001).

The example from Tammer also indicates that the top management attention alone may not mobilize organizational action, if the middle managers have

control over important implementation resources but lack commitment, and the top management is not willing to make the change happen with a top-down intervention. This finding could explain possible 'anomalies', where the top management attention to a phenomenon is high but organizational action is not mobilized, contrary to the suggestions by Eggers and Kaplan (2009) and Laamanen and Wallin (2009).

The data suggests also that an organization's prior experience does not affect only what kind of routines and capabilities are available (Eggers & Kaplan, 2013), but also the way how matching is done in the organization. In Bothnia, the past success stories appeared to bolster the managers' confidence that being an early adopter of new technologies was essential to the firm's survival and would pay off eventually.

"So you have to be on the leading edge on this part and the one who's not adopting this, they are going to be losers, because the way you interact with your customer is going to be totally different in the coming years. This is a survival game and you have to be on the leading edge to it. - - Where Bothnia suddenly is on the front side, while competition start developing those things, recently coming up with new, while we have many, many years of experience from this from power plants and from other businesses. When the customer is seeing that is that okay the Bothnia, has adopted this long, long before anyone else." –CEO, Bothnia

When digitization and the building of more systematic data collection and analytics capabilities were brought back to Tammer's strategic agenda two years after the big data initiative, the top management abstained from making strong direct interventions but rather settled for changing the firm's strategic context, aligning the previously dissonant bottom-up digitization initiatives with it (Mirabeau & Maguire, 2014). Although the top management paid more attention to these initiatives e.g. by following closely the digitization roadmap of a certain business area, they did not seem to feel any need to break the bottom-up process and abandon the high-level portfolio management approach.

"The methods and the processes are the same as in any other project but in the monitoring there indeed is that difference that the progress of this [digitization roadmap] is followed up at the business area level and the corporate level. That is the difference. The method is the same but who is monitoring it, that goes all the way up." Vice President, business line, Tammer

Table 4.1. *Manifestation of managerial commitment to industrial internet in the case firms.*

Managerial commitment	Tammer	Newland	Bothnia
Manifestation of top management commitment to industrial internet	• Setting digitization as a key strategic theme for the bottom-up strategy making • Top management team member promoting digitization initiatives within the organization (no business responsibility) • Corporate-level fund for promising initiatives that have missed the annual budgeting cycle	• Setting explicit, quantified objectives for building remote monitoring capabilities and overcoming internal doubts regarding business potential • Incorporating industrial internet as part of the firm's public vision statement • Top management team member in charge of the top-down oriented digitization strategies	• Vocally expressed perceptions of threats and opportunity potential resulting in a great sense of urgency to build industrial internet opportunities and capabilities • Strong confidence that being an early adopter of new technologies leads to success • Top management team member heading a business area as the primary digitization champion
Manifestation of middle management commitment to industrial internet	Before top management commitment: • Low interest in championing initiatives and investing resources After top management commitment: • Taking business owner role in initiatives, helping define business cases, linking initiatives to business goals, granting implementation resources • Expecting great but yet uncertain business benefits from the integrated data	• Industrial internet offerings are included in the business unit managers' area of responsibility, forming part of the performance measurement	• Conviction that internal efficiency improvement can no longer be the sole benefit from initiatives but they need to add value to customers • Sense of urgency to switch from 'waterfall' development project management to a more agile and iterative development methods

Managerial commitment	Tammer	Newland	Bothnia
Manifestation of operating management commitment to industrial internet	Before top management commitment: • "Pushing with a rope" to get approval for the industrial internet initiatives After top management commitment • Project management responsibility over	• Strong confidence in the firm's top management and digitization vision • Specific manager roles where digitization is a big part of the responsibility e.g. in research, product development, and program management • Business managers and data analysts collaborate to improve the performance of daily operations	• Specific manager roles where digitization is a big part of the responsibility especially in a new venture unit: unit management, product development

Overall, the manifestation of managerial commitment to digitization and industrial internet initiatives in the three case firms is summarized in table 4.1. Examples of how the commitment was manifested is categorized separately for the levels of top, middle, and operating management.

4.2 Inside-out focus on building capabilities before defining opportunities

Inside-out focus refers to the sequence in which managers focus first on building "potentially useful capabilities", and only then engage in the process of matching the capabilities to identified opportunities (Eggers & Kaplan, 2013, p. 321). Eggers and Kaplan (2013) acknowledge that a pure inside-out approach is in reality an oversimplification but suggest that in big incumbent firms the approach probably contains more inside-out than outside-in.

Inside-out approach was applied in all the case firms to a degree that varied depending on the stage of development each firm was in. In general, there were two main reasons for going with the inside-out approach. On one hand, each firm was lacking an explicit, across-the-board pull for solutions requiring digitization from the customer side. Even if the customers were interested in new ways to reduce their costs, not many were keen on sharing their operative data or participating in co-development. On the other hand, the managers' perception – particularly at the top management level – that digitization was something important to embark on enabled and necessitated investing in capability building anyways.

"No-one is asking for this. - - They are used to doing certain things, which they have always done. So your job is to surprise them, with things that make lives much easier to them." –CEO, Bothnia

"So we started adding, sensoring and monitoring capabilities as a more of a standard, in our equipment. Even though the customer wouldn't necessarily require them." –Chief Digital Officer, Newland

"The customers are actually in a very passive role right now. They have let us collect and utilize data. They are waiting and seeing what is to come, they haven't joined the development yet and

they don't really even have the desire to join. And some customers don't even want to give the data." –Vice President, business line, Tammer

A common feature across many interviews was the trust or expectation that the right opportunities would become revealed over the course of capability building. Because capability building was understood essentially as a learning process, the respondents believed that the increased knowledge about the potential of technical, human, and organizational capabilities would enable them as organizations to understand which opportunities were feasible and had the most potential.

"There we have a huge work before the data is in the format that can be used for providing digital services, if it's spare parts or if it's remote[ly] helping the customer, finding the problems or whatever. - - But I think that this is the homework we need to do really to be able to provide these digital services." –President, business area, Tammer

"There are different types of approaches, a little bit different kind of business models that actually are enabled very much by this kind of technology. When we are able to monitor the equipment, continuously, we know what's happening, how the customer is using those, of course that leads to, quite obvious thinking, that we could actually sell this, whole product and services package a little bit differently, as Rolls-Royce for example has done for a long time already selling hours, operating hours instead of motors. - - Of course if we look at the, our - - high-volume products, then you can think what's the value of this remote connection and so forth but of course for us it gives a lot of information about the product. - - But that's only internal benefits. For the customer of course we have been, what we have done is we developed these, portals where all this data. - - This is, I think very convenient for the customers to see everything in one location, one portal. You have visibility to all equipment so this kind of solutions are valuable. But still, how much money they're willing to invest on that is a question mark." –Program Manager, digitization initiatives, Newland

The most salient area in which each of the case firms had ongoing initiatives – albeit in different stages – was the development of the capability to monitor and collect performance and condition data of the installed equipment on the field and make reasonable and actionable analyses of it in large scale. The approach to achieve this was also fundamentally similar: consolidation of information, human resources, and initiatives with the anticipation that the combinations could yield new value-creating opportunities. All the firms were working on to consolidate their existing corporate IT systems (e.g. ERP and CRM) as well as the new data platforms for the collected equipment data in order to have centralized and

harmonized data storages. Also, the various development initiatives that were aiming to the realization of new human or organizational capabilities were to a large extent consolidated in all the firms.

The consolidation styles varied between the case firms. In Tammer, digitization initiative implementation was not centralized into any special venture unit but was carried out in the business lines. Nonetheless, one business area and especially one of its business lines were the de facto spearhead units for digitization.

"Then, additionally, [this business line] is a sort of a specialty for us. A specialty in the sense that we have the [other] machine product lines and then [this] product line, which arches over all the other product lines. And at the same time spreads across other divisions as well. We need to consider [this area of operations] from the entire business area's point of view. We need to try to integrate and align the initiatives that are done also in other units of this business area to [this area of operations]. [This area of operations] is the spearhead and the investment for the future of this business area." –Vice President, business line, Tammer

At the business-area-level, the digitization initiatives, both external and internal, were prioritized and aligned by the middle and top managers with a specific digitization roadmap. There was also a business area support function which was ideating and scanning the organization for new customer-oriented solution ideas, and facilitated idea reviews to business area managers. However, this function had no resources to implement the initiatives itself, and the function's task was by definition to focus on externally directed initiatives, not internally-oriented ones. Among the middle managers, it was considered equally important to digitize the internal processes and harmonize the IT infrastructure as to launch initiatives pursuing new opportunities. At the level of technical capabilities, Tammer's objective was to create a flexible and robust data platform which would integrate data from different types of machines, thus creating a more complete understanding of the customers' processes.

"We are working on to build a data management and collection platform that would enable us to collect data from different sources and convert it into an easily analyzable format." –Director, research team, Tammer

"And in big data, there's one ambitious challenge for us: as [this business area] is after all the only business in the world that has access to data and in-house understanding from all the possible physical equipment to operating systems [used by the customer segment]. - - No other

firm has it. We have the whole chain, from the very grassroots-level [machines] to the high-level systems. The utilization of that, in my opinion, is the big goal. And there we will eventually find the business opportunities." –Vice President, business line, Tammer

In Newland, there was no special unit dedicated only to digitization initiatives either. Instead, there were top-down cascading digitization strategies and programs that were headed by a top management team member, reached across all the business areas, and encompassed both internally and externally oriented initiatives, such as the harmonization of the firm's internal IT systems and new customer-oriented initiatives. Still, the early-stage research and development work needed for novel digitization initiatives was done centrally in the separated research and development units which served the entire range of Newland's business lines, but all the R&D work was not exclusively related to just digitization. For historical reasons, Newland's data analytics resources – basically skilled data scientists – were organizationally part of the corporate research unit although their daily work was already to a large extent support to the ongoing businesses. Some respondents considered that the consolidation path with the analytics capability was almost finished and anticipated that the resources might be decentralized in the near future.

"It's a good approach to really start from something where you, have a selected team for doing different cases so they start to learn and also we see what are really the opportunities that we have with the data that we have, and what we are also lacking data for example, or where we are lacking in those links between machines and services and spare parts. So I think we have a good approach. This will work probably, for this year maybe next year but then we have to really consider this, should we have those people in the business lines." –Program Manager, digitization initiatives, Newland

Alike in Tammer, also in Bothnia one business area was clearly the spearhead unit for building the digitization capabilities. As a key difference, Bothnia had established a new unit within the business line into which the various development initiatives and staff were consolidated. Besides avoiding overlap of initiatives and poor alignment among them, the consolidation was also in Bothnia expected to spur new innovative ideas.

"So, first of all, we are of course listening to our customers and, trying to get feedback from them. But also trying to be innovative and trying to think about solutions which the customer don't even know that he needs. And trying to really think out of the box. This is a real drive in

the new organization that we now have that we are looking to be innovative and we are looking to develop new, solutions which, preferably nobody else has in the marketplace. - - We had several products but they were developed in several different parts of the company. And we had, projects ongoing but they were not coordinated. There were this digitalization and, the need for more services in this area made it evident that we need to have a dedicated team or organization to do these things. - - We need to streamline that and we need to work together so that it is one solution because, God forbid, we can't have many different solutions in the same area." –General Manager, venture unit, Bothnia

In addition, Newland and Bothnia were pursuing to consolidate the functionalities of the numerous old customer-facing systems into single interfaces, 'one-stop-shop' customer portals. This was already a clear step towards searching opportunities with the established capabilities but still without certainty of direct, explicit business benefits. Both firms believed that the single interface would improve customer experience, because all the old functionalities and information – extended with lots of new – were provided via a more modern, device-independent portal, but the portals as such were not expected to generate new revenue besides possibly more active spare part sales.

"Yeah, naturally, we always had, let's say quite a long time we've had different kinds of portals for us, for example, selling spare parts or whatever. But, now it's more or less like this whole idea of [the portal] is to bring it all together, like all the relevant information for the customers. And, build a good customer experience so to say, so that we don't have this like scattered around systems where customers tend to get lost, but we have only one place where you log in, you get all the relevant info from there and there you go, basically. - - It's only like, they want to have one place where they go and get everything from there. So, they want it to be simple so that we want to lower their, let's say the bar to do business with us in a digital way as low as possible so that it's like something that you could do every day." –General Manager, industrial internet and service development, Newland

"For example, these online services that customer is able to see, all relevant information about their assets and alike. It's available for them in a portal." –Director, venture unit, Bothnia

"So you have this portal for everything that is related to Bothnia. So when we do this will help the customers to say that, it's easy to work with you. That's the important thing. The second thing is it really offloads, our organization, in this part." –CEO, Bothnia

On the contrary, Tammer was not yet planning to create similar portals but wanted to focus on building the substance knowledge and capabilities first.

"We can build the interfaces, fancy looking interfaces and make a lot of fuss and noise in the marketplace but if there is no substance behind the interface it doesn't take us very far." – President, business area, Tammer

Although the approaches to inside-out capability building resembled each other in all the firms, the degree of specificity to which the capabilities were defined as well as the perception of what it would take to build them, however, differed across the case firms. For instance, Newland had already established a remote monitoring capability and had also the data analytics capability in-house. Because the firm had taken steps to 'boost' the capability building by adding sensors and connectivity as a standard already since 2010, there had been a lot of data for the data analysts to work on with. As a result, a lot of the data analysts' daily work was supporting business lines in requests and not only innovating possible uses. Here, the inside-out-built capabilities were indeed used to capture new opportunities.

"But in a way we have resources for this and of course how we are doing is that we, together with our business we specify the analytics case studies or so forth. We are discussing with the business what could be the most valuable thing to do with this data that we're able to gather. Then we specify the projects and then our guys are working together with the business so that, we get to the results as required. This is something we are doing, now. - - Now these [analysts] are in the research organization but of course they are supporting directly the business." – Program Manager, digitization initiatives, Newland

In Bothnia, various remote monitoring technologies had been in place since the early 2000s and the firm also had a rather long history with building the data analytics capability. The data had been analyzed with old employees without specific data analysis training until 2010, when Bothnia hired its first actual data scientists from the outside of the firm. However, their lack of understanding about the engineering and performance of the equipment led first into challenges, as they were not able to evaluate whether their analysis results were truly valid, not to mention to create proactively recommendations to equipment engineering and maintenance.

"So, the impossible mix of good business and engine knowledge combined with IT knowledge, software development knowledge… There are not that many of those in the marketplace." – General Manager, venture unit, Bothnia

"But we said, we realized that, to make different kind of a sense out of this information, we need some different kind of a competence. That's why this handful of these [mathematicians] were hired. They really didn't know anything about our technology or our equipment as such." – Director, venture unit, Bothnia

Because such talent was found to be rare or inexistent, Bothnia had decided to solve the problem by setting up an in-house training program which trained a new breed of data analysts out of recently recruited university graduates. Moreover, the general approach at Bothnia appeared to be that the capability building, and opportunity identification, can always be boosted if the status quo is not satisfactory.

In Tammer, which had started the building the analytics capability as the last one of the firms, the degree of specificity in capability definition was the lowest. Tammer's managers considered that they were taking their first steps in the process of learning to understand the needed capabilities, let alone the opportunities. Alike in the two other firms, Tammer's managers also thought that 'hybrid' human talent was needed but the firm itself was in the stage of figuring out how to develop or acquire it. In contrast to especially Bothnia, the managerial perception was that the learning process would take its time and could not be accelerated beyond a certain limit.

"We want to understand this ourselves. It just takes its time to build the understanding. Parallelizing may work to a certain point but it doesn't help beyond that, because it's not enough that only the five people working directly with the initiative understand it. Also the next level and even the level after that need to understand it well enough. It just takes a certain time to get it done." –Vice President, business line, Tammer

4.3 Outside-in focus on defining opportunities before building capabilities

Outside-in focus is the opposite approach to inside-out. In outside-in approach, managers focus first on searching potential opportunities which are then matched with existing capabilities or by building new ones, in case a capability gap is perceived. Again, outside-in approach is also an idealization of an extreme case and thus unlikely to be found as such from real-life cases. (Eggers & Kaplan, 2013) Still, Eggers and Kaplan (2013) suggest that entrepreneurs' approaches may be closer to outside-in than inside-out sequencing.

Even though the matching in the case firms had happened predominantly inside-out, this focus would not have been possible without defining the opportunities at least at some level before that. Hence, while the actual ongoing development projects were mainly focused on capability building without certainty about the exact future opportunities, at least a vision about the business benefits existed in all the cases. Most commonly referred benefits were cost savings through more efficient processes, distinguishing from existing competitors with better quality and speed, and providing value-added services based on the expertise gained from analyzing data. However, the more concrete business models, offerings, and for example pricing decisions were still very much undefined, because a strong customer demand did not seem to exist for the new services types yet.

"This goes in three waves. In the first wave, we will benefit ourselves by understanding better and knowing how to make things more efficiently. Then, in the second wave, we need to increase our costs when we build the analysis capability and the business on top of it, which means that we will invest in people and devices and systems and ways of working. And the third wave is when it will start to generate business benefit, that is, top line. The first stage will decrease costs and the second stage will increase costs, and the third one will bring more revenues. - - 2 + 2 + 2 [years], that is my own rough estimate of how long each wave will take." –Vice President, business line, Tammer

Still, especially business case proposals – defined more or less specifically – were reported as an important initiative selection criteria in all the firms. In Tammer's case, the data platform initiative was clearly done inside-out. In the current stage, a team of research employees were solving the technical solutions for data collection, transfer, and storage, and analytics capability building was also on the list before the realization of the so far unspecified new services. However, even in this case, a broad description of the business benefits had been a critical factor for the initiative to proceed into implementation. The roots of the platform initiative had been in the prior big data initiative which never proceeded into execution because the envisioned opportunities were considered too abstractly defined for Tammer's needs. As a result, the initiative was never prioritized high enough against the initiatives with more concrete opportunity definitions, such as Tammer's large project deliveries for which the customer demand, opportunity, was explicit.

"It was a kind of a theoretical top management initiative, an island, a group effort I would say that the line organization never adopted as being important. So it was a kind of internal communication thing and it started a bit to live its own life." –President, business area, Tammer

"The biggest reason was that the vision, the nice picture of what it could be was painted but we didn't understand what kind of tricks and steps would have been needed in the implementation in the case of our organization and scale. The references that were used were big corporations like Dell and often from consumer business world. Those references were not exactly right if you think about our volumes and needs and that a machine like ours is a bit different." –Director, research team, Tammer

When the idea was picked up again and redefined as the platform initiative as a result of top-down change in the firm's strategic context, the assigned business owner helped make a business case proposal for the initiative and helped secure the implementation resources. A well-prepared business case proposal was mandatory for any initiative to get approval in Tammer, because the initiative flow and resource allocation process were mainly bottom-up, with only very seldom direct top-down interventions by the top management. Nevertheless, the business case for the platform did not need to be a meticulously quantified forecast, but rather a description of what kind of new opportunities the platform could open put on timeline.

"Every initiative where I put money to must have a business analysis behind it, a description of the business case: 'if we do this, what could it mean?' Not a single initiative will be launched where I don't see the benefit for the business. - - There's no general time limit that the initiative would have to pay itself back in a year, the payback can be in two years or three or five years. It just needs to be there. - - The business case can't of course be a detailed, accurate forecast if we expect it to sell something in two years from now. But for instance in an initiative like the platform development must describe what services it will enable. The services it will enable, then the gains from those services – all that must be thought about and described." –Vice President, business line, Tammer

The planned business cases were also not necessarily rigidly held on to if the perceptions changed. For instance, the platform project was launched with an outside-in opportunity in mind, but the development order was quickly reversed to inside-out as the middle management perceived that Tammer did not yet possess the capabilities to sell and provide the ideated service.

"First we had a certain service business as a priority. I don't mean a service like equipment maintenance but service business built around an IT system – that we thought would be the first

step. But we've moved that to a later stage because that is actually the fifth step, and the four other steps we've been missing. That's why I postponed it, so that we won't yet start thinking about and selling this, optimization and analytics, when we haven't got the building blocks with which to do it. Now the starting point is rather, well, the four steps and what we can do already now with our existing capabilities." –Vice President, business line, Tammer

All in all, although some pilot customer feedback and requirement lists were used in the platform research work, Tammer's approach did not, at least in this stage, include co-development with the customers.

In Newland, the whole discovery and establishment of digitization as a strategic theme was originally outside-in. The starting point had been the acknowledgement that, for certain customers, the equipment provided or serviced by Newland were a critical part of their business processes. Because the downtime cost of these pieces of equipment was very high, Newland interpreted that this customer need required higher responsiveness and higher level of the expertise from Newland's maintenance services.

"But when you really go into more demanding application areas - - or when you are getting more and more concerned about the uptime or the safety of the operation itself. Then we go into areas where you can improve the performance of the equipment quite a bit, with the inbuilt intelligence in the [machine]. And when you look at the top segment of the equipment, then that is something that can provide you with additional competitive advantage. In those application areas where customers are more concerned about the safety, or the high uptime of the equipment." –Chief Digital Officer, Newland

Moreover, remote monitoring, data analytics, and more easily accessible, integrated customer and product databases were interpreted as capabilities that would enable Newland capture the opportunity, while simultaneously reducing the cost by increasing Newland's own internal efficiency. Similar thinking was behind the customer portal initiative: responsiveness and accuracy become even higher when customers can actually serve themselves and place for instance spare part orders directly. However, as such the portal did not increase Newland's revenues since there was no extra charge for it – rather, the differentiating and possibly locking-in effects, added sales, as well the internal cost savings formed the opportunity.

The dilemma at Newland was that the opportunities were more visible in the segment of customers with the high uptime need. However, these customers formed only a minority of Newland's total customer base: for the largest segment, the specific equipment sold or serviced by Newland was less critical for running the operations, which correlated directly with a lower demand for more advanced services or products. In this segment, Newland's approach had been heavily inside-out focused, driven by the vision and perception of importance of the top management. Although Newland had been trying to picture the opportunity as e.g. improved safety and productivity for these customers, the opportunity as such did not seem to have realized yet. As a consequence, Newland appeared to be redefining the opportunity instead as higher internal efficiency, converting the new information into knowledge in new product development, evidently resulting in competitive advantages for the firm.

"So all these things that we are able to create with the added sensory with the added, intelligence onto the [machine], only address to a certain small segment of our customers. Then there's the wide segment of general - - customers or customers that are using [machines] in not so critical areas, where all the same benefits apply but the equipment itself is not that critical of a piece of equipment in the customer's process. So it makes it a bit more challenging to start than, selling the value of these additional features and functionalities to customers. But where you clearly see that value does exist, is in the capabilities of maintaining and supporting the crane." –Chief Digital Officer, Newland

Bothnia's steps with remote monitoring and data platform development resembled those of Newland. Also in Bothnia's case, the first input came from the customer business. However, the business opportunity was perhaps less explicitly stated than in Newland's case: Bothnia understood that their customers would benefit from faster, better and more accurate maintenance service as well as new ways to optimize their operations, although at least some of them hesitated the allowing the remote data collection and analysis.

"In [our customer] industry, it boils down to, in the cost saving era as we have, it matters optimizing everything you're doing. - - For us, when we do our service part we have to connect ourselves to that and say that, for us it's important to know that if a [machine] is going to be serviced, something wrong with [a certain component] and so we have to find out that at the right time so - - we can be there with the right spare part and knowing exactly what to do. - - The challenge we've had in this area is, maybe not doing it because we've done it for many years but, the more difficult is to get our customers to adopt to this, meaning that they should, let us

monitor their [equipment] and then buy the services that we are doing. It's a very conservative business that we are in, meaning that they feel that 'why should someone else look at our..., we can do it ourselves while we are operating'." –CEO, Bothnia

Furthermore, Bothnia seemed to be taking steps toward a higher level of customer-centricity, taking deliberately steps from inside-out to more outside-in matching of opportunities and capabilities. The interviewees emphasized that for the new initiatives, internal efficiency improvement alone was no longer enough to qualify as a selection criterion. Instead, any new initiative that was about receive resources needed to demonstrate a business case estimate of how the initiative would add value to the customer. The reason for this development was that over the past 10–15 years, Bothnia had developed over a hundred applications for different purposes, including both internal efficiency improvement and new customer value-adding features. Bothnia had acknowledged that many of the applications had not performed as well as the original business case proposals had implied. In addition, the development and maintenance of a non-harmonized set of applications was considered too costly.

"If you take all the business cases during the past ten fifteen years when we have started some application, we should be making money like bandits. If we really calculate that how much we… We don't have that much cost what we should have saved." –Director, venture unit, Bothnia

In addition, Bothnia was also building an online portal which would form a single interface for the customers. It was a central part of Bothnia's overall program for creating mass-customized services and solutions. The service model change as a whole and the portal development work were very much outside-in: for instance, the platform building was preceded by an extensive customer survey, in which the customers were asked to prioritize the most important services to them. Based on this information, Bothnia focused its efforts on building especially those capabilities that were needed to deliver or improve the top 3–5 needs. The mass-customized service model and portal included certain basic services with the normal charge, on top of which customers could acquire further add-on services according to their needs.

"What we want to achieve is flexibility. So based on our customers' demand on a service level so we want to create flexibility there. So if a customer wants basic services so they can get that. That is called core services. So it's a free-of-charge service level to all customers. Or if they want

to buy certain type of more advanced services then we have created these advanced services. So it's a little bit like flying tourist class or business class on airplane." –Director, business area development, Bothnia

Furthermore, out of all the three firms, Bothnia was the most active in co-creating new solutions together with their customers. Although Newland and Tammer were also carrying out their initiatives first with pilot customers, in Bothnia the interaction and iterations with the customers seemed to be the most advanced. It was for instance using mock-up versions of the services in the early stage of customer engagement to test which features were valuable and which were not, hence validating quickly the ideated opportunities and capability needs

"When we do a new development, we want to do a proof of concept together with the customer as soon as possible, at most in couple of months so that when we come to the market, we know that this is actually what the customer wants. - - When we have a new service in mind we will make a mockup or a demo version. Then we will take a customer and show him this mockup and let him interact with it, see how it works, ask for their suggestions. And then see how we can improve the concept. We will do it with several customers and then we will take it to development. If they don't like it, we don't develop it. It is better to fail quickly." –General Manager, venture unit product development, Bothnia

Overall, the approach was following to a great extent the lean startup method (Ries, 2011). The finding from Bothnia also gives slight support to Eggers and Kaplan's (2013) suggestion that more entrepreneurial firms would be more likely to use outside-in sequence in the matching process, although it is evident that all the three case firms were represented strong incumbent industry players.

4.4 Iterative definition and refinement of opportunities and capabilities

Dividing the sequence of the matching process into a dichotomy between inside-out and outside-in is theoretically convenient but may not be accurate in reality (Eggers & Kaplan, 2013). Eggers and Kaplan (2013) suggest that opportunity and capability discovery and development could happen through experimentation, e.g. smaller and reversible commitments. Similar ideas have been presented for example Brown and Eisenhardt (1997, p. 1), who found that successful, continuously changing firms use "a wide variety of low-cost probes into the future", and Ries (2011), who suggested that successful startups with marginal

resources identify and develop opportunities and capabilities through rapid iterations.

The findings of this study also suggest that the sequencing is in reality more ambiguous. Sequencing seemed to take turns between inside-out and outside-in iteratively. The definition efforts focused on the opportunities or the capabilities depending on whichever part was more uncertain. For example in Tammer, focusing almost exclusively on capability building became possible only after the too visionary opportunities were reassessed and put into a format of a business case proposal which still was rather directional plan than a forecast.

Besides that, all the firms were trying to promote experimentation and become more agile in the matching. Bothnia was in some areas the most advanced firm, co-creating new services with the customers by building early mock-up versions of new service concepts for early validation of potential business opportunities and capability requirements. The experimentation-based approach had not been one of Bothnia's existing capabilities, but one that had been built specifically for the service development. Bothnia's traditional product development had been very different due to the equipment's large size and technical complexity: because of the much higher cost of prototyping, these projects had been more strictly defined from the start.

Newland was also launching its new services by first piloting them with certain lead customers, but in Newland's case the customers' readiness to participate in co-development appeared to vary across the customer segment, with the small, 'advanced' customer segment being more open to co-operation than the large customer segment coping with more standardized services and equipment. In Tammer, the customers seemed to be the least involved in initiatives that were still in the research and development stage, but the requirements and specification templates from some lead customers formed the basis for capability development there as well. On the other hand, Tammer's in-house software development applied agile development methods and took benchmarks from the software industry, not from the software development departments of peer industrial companies. Overall, Tammer was deliberately trying to change the

company culture to promote more experimentation and expressing and listening to diverse opinions more openly.

As a difference between the firms, the speed and length of the iterations varied greatly. The intervals and duration seemed to depend at least on the managers' sense of urgency which was partly driven by threat perceptions, managerial commitment, and availability of customers who were interested in participating the co-development. Both attributes could be linked to the overall stage in which the respective firm was with the capability building and opportunity refinement.

In Tammer, the capability building in research did not seem to be rushed: the managerial perception was that it was foremost a learning process which would just take its time. This initiative was still in the early research stage and market pull for having that capability in place was so far weak: in the case of all the firms, the customer industries were described as highly cost-sensitive, implying demonstrating at least some results was necessary for spurring market demand to emerge.

In Bothnia, on the other hand, the iterations were rapid and done together with customers. In comparison to Tammer, Bothnia was in a further stage in the refinement and establishment of capabilities and opportunities: it had already working technical solutions for data collection as well as in-house capability to analyze the data with which it was able to demonstrate results to otherwise doubtful customers. Importantly, the interviewed top managers expressed a great sense of urgency to accelerate the iterations. The talks about "survival game" and the "need to stay on the leading edge" explained why they were not satisfied with serving only the explicitly stated customer demand, but wanted to innovate also solutions for which no demand necessarily existed yet. Top management commitment was described as the decisive prerequisite for following the accelerated pace:

Table 4.2. *Opportunity and capability development stages of the cases firms.*

Development stage	Tammer	Newland	Bothnia
Early stage: Identification of a generic opportunity and a capability need (primarily outside-in)	• Bottom-up benchmarking of solutions from other industries • Top-down requirement to investigate the threats, opportunities and capability needs to respond to digitization	• Identification of a need to improve responsiveness and quality of maintenance services and collecting more data as a response • Top-down strategic objective to build capabilities	• Identification of a need to improve responsiveness and quality of equipment and service performance – creating reports from daily data as a response • Top-down sense of urgency to stay on the leading edge in both opportunity discovery and capability building
Learning stage: Pushing to build technical, human, and organizational capabilities to refine the opportunity (primarily inside-out)	• Focus on building first the platform technology to collect, transfer and store data, then creating the capability to analyze it • Business opportunities expected to emerge and become specified in the process	• Investments in building remote monitoring technology and data analytics capability • Probing possible opportunities by sharing collected data with customers via integrated portal	• Investing in remote monitoring technology and big data analytics capability • Decreasing cost of communications technology paving the way for bidirectional continuous monitoring and performance optimization
Advanced stage: Continuous iterative interpretation and matching of opportunities and capabilities	• –	• Data analysts working in close collaboration with business managers	• Extensive customer co-creation of services with rapid validation and development of offerings and capabilities

"I think it is important that the high level of management is committed to agile ways of working. We are used to traditional waterfall-based approach where we have a tight project plan, hard business case, people who don't like to embrace change, but the good thing that the decisions to pursue agile development has come from the top, and now it is important that when we are implementing it, everybody understand what it actually means. There is quite a lot of benefits. The whole company needs to become agile as a way to deal with uncertainty. - - What we are doing now, we could have done it earlier but it was not our strategy." –General Manager, product development in venture unit, Bothnia

Based on these findings, the first proposition is stated as follows:

> **Proposition 1.** Opportunities and capabilities are refined and matched together in an iterative process, where the sequence of matching alternates between outside-in and inside-out.

Furthermore, the length and speed of iterations can vary depending at least on the stage of development and on how managers perceive and balance the urgency and 'natural time requirement' for learning. Based on the limited data from the three case firms, it also appears that the speed of iterations can accelerate over time as both opportunities and capabilities become validated and refined to a greater level of detail. Table 4.2 describes the broad development stages in the firms.

4.5 Effect of managerial commitment on the pattern of the matching

The prior literature on managerial cognition has shown that the managerial attention, especially in the top management level, affects what opportunities are perceived the most attractive and which capabilities are needed. Furthermore, the managerial attention guides the organization to build the needed capabilities if the organization does not yet possess them. (Eggers & Kaplan, 2009; Laamanen & Wallin, 2009) Eggers and Kaplan (2013) have suggested that the opportunities and capabilities are interpreted and fit together in a matching process. However, the sequence of the matching process, i.e., which does the organization focus on defining first, the opportunities or the capabilities, has not been fully understood.

Based on the data, it seems that the level of managerial commitment has a decisive effect on the pattern of the matching process. First of all, in Tammer, the initiatives were defined and selected mainly in a bottom-up process, where the business areas were rather autonomous and the corporate management exercised

its power by making high-level resource allocation decisions. As a result of the decentralized definition and selection, managerial commitment was built upwards step by step. For an initiative to pass through the intra-firm selection, it needed to be based on a solid argumentation. Business case calculations and presentations were a mandatory selection criterion and the prioritization tool for managers at any level. This kind of a process favored initiatives with clearly stated business opportunities and capability requirements. For digitization initiatives, which were novel to both Tammer and its customers, demonstrating the benefits concretely in advance was challenging, and, as an outcome, the early digitization initiatives were not prioritized above more 'proximate' initiatives. Because the top management relied more on influencing the bottom-up process indirectly by modifying the strategic and structural contexts instead of making interventions, the commitment to launching uncertain digitization initiatives remained low. Therefore, the low managerial commitment to any specific type of initiatives, such as digitization, favored initiatives where the opportunities were more certain.

Newland and Bothnia, on the contrary, had much more top-down oriented digitization strategies instead of the bottom-up definition and selection of initiatives. Both firms had started building new digitization capabilities and experimenting with new types of services earlier than Tammer, and although the opportunities and capabilities were defined on a more detailed level, the capability building and especially the work to convert the new opportunities into quantified business benefits was still in progress. In Newland and Bothnia, the strong top management commitment had been the critical enabler for the digitization initiatives where the opportunities were more uncertain. Starting from the CEOs, there was a strong conviction in both firms that the investments in building digitization capabilities would eventually pay back in the form of new opportunities, which at the time of investment decision could have been only on the level of a vision. The top management commitment mobilized organizational action despite the uncertainty by giving a clear direction. For instance in Newland, an explicit, quantified and measurable target was set for the capability building in a situation where setting sales or cost saving targets were not yet reasonable. Finally, also in Tammer the launch of digitization initiatives became

possible after the top management made the decision to make digitization a strategic priority for the firm, thus enabling initiatives focusing first on capability building. In sum, the strong managerial commitment in all the firms made it possible to start building digitization capabilities before the opportunities were concretely defined.

On the grounds of these findings showing the impact of managerial commitment on the matching process, I present the following proposition:

> **Proposition 2.** The pattern of the matching process depends on managerial commitment. In a high-commitment regime, capabilities are built before all opportunities are clear. In a low-commitment regime, capability building follows the clarification of opportunities.

The managerial commitment reinforces the inside-out search of opportunities based on capabilities that either already exist or are built before the discovery of the opportunities. Consequently, higher managerial commitment reduces the likelihood of outside-in-directed assembly of capabilities based on identified opportunities. Subsequent matches result in outcomes that may be related to for example the operative, financial, or strategic performance of the organization.

5 DISCUSSION

The findings of this research extend the understanding about how an organization's strategy process and managerial cognitions of capabilities and opportunities affect and shape each other as the organization responds to a technological discontinuity. A discontinuity, like the industrial internet in case of the manufacturing firms, can have such a broad definition that defining which opportunities and capabilities are the right ones is not self-evident. In order to reduce the uncertainty, organizations engage in a matching process where the opportunities and capabilities are refined.

My findings suggest that the pattern of the matching process is iterative in nature and that the managerial commitment has an influence on it. The two propositions and their mutual interconnection are presented schematically in figure 5.1. Proposition 1 (P1) suggests that the sequence of matching takes turns over time between inside-out search of opportunities based on existing capabilities and outside-in assembly of capabilities based on identified opportunities. The uncertainty brought about by the technological discontinuity is gradually resolved over the iterations as the definitions of opportunities and capabilities are refined.

Proposition 2 (P2) states that the managerial commitment affects which matching pattern – inside-out search or outside-in assembly – prevails at a certain time period. When the managerial commitment to pursue certain opportunities or capabilities is low, it is likely that the opportunities need to become more clearly visible before investing resources and time in capability building takes place. Based on the interview data, the low commitment towards a new area like the industrial internet is caused by the uncertainty or, rather, abstractness of the envisioned opportunities. If the managers have other options on the table with more concretely specified opportunities and capability needs, those options will likely be prioritized higher in the resource allocation. In this kind of a regime, the opportunities need to be refined and specified better before investing in capability building becomes possible. On the other hand, when the managerial commitment is high, the organization can being to invest time and other resources in capability building even before all the opportunities are clear.

The high commitment from especially the top management can ward off possible competing cognitive frames and show direction to the organization, thus resolving uncertainty.

Finally, the opportunity-capability matches result in outcomes which are considered more or less successful, affecting the managerial commitment and forming a recursive loop back to the matching process.
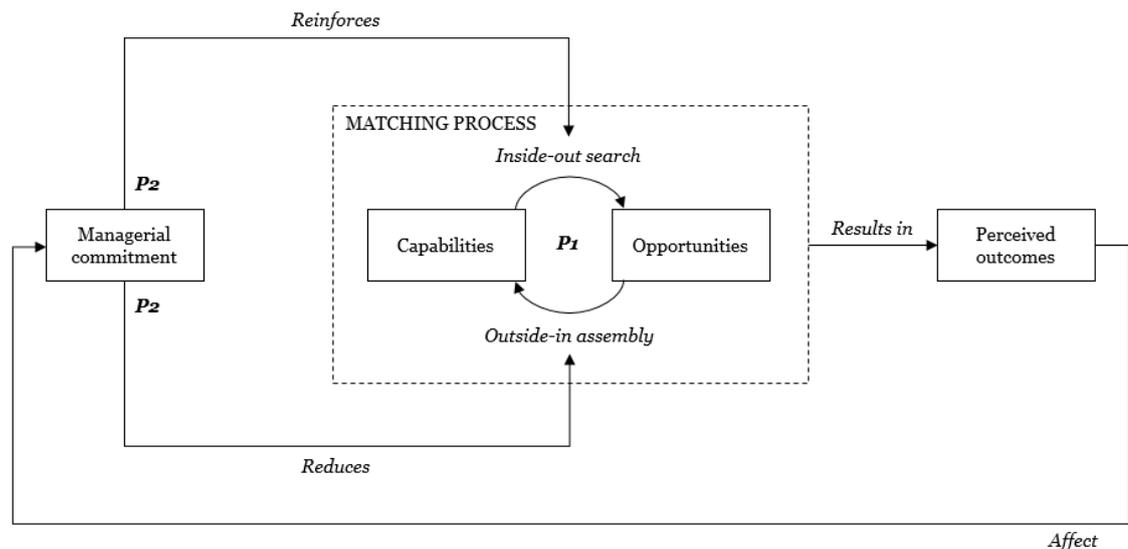

Figure 5.1. *The influence of managerial commitment on the iterative matching process.*

5.1 Implications to the resource allocation process theory

The idea of iterative resource allocation to initiatives as the core of strategy making is the prevalent idea in the resource allocation process theory (e.g. Bower, 1970; Burgelman, 1983; Noda & Bower, 1996). The findings of my thesis are aligned with the theory, but also extend it by highlighting more the role of managerial cognition to the process.

In general, a large extent of the resource allocation process literature appears to presume that strategy making is mostly bottom-up (e.g. Bower & Gilbert, 2005; Burgelman, 1983). According to my findings, the managerial cognition has a significant effect on whether an organization's strategy making relies on the bottom-up process or is characterized by top-down interventions. My data suggests that top managers who rely on a portfolio management approach may

commit less to individual initiatives and rather let the *intra-firm selection environment* (as coined by Burgelman (2005)) take care of sorting out the best initiatives. Rather, these top managers can opt for influencing the definition and selection of new bottom-up initiatives indirectly, for instance by altering the strategic context of the firm. In Tammer, the corporate management set the strategic themes and performance targets to the business areas, which however composed their strategy proposals autonomously and bottom-up.

In contrast, high top management commitment to pursue certain opportunities or capabilities can lead to a top management intervention and deviation from the bottom-up process, if the process does not generate satisfactory initiatives (e.g. Eisenmann & Bower, 2000; Raynor, 2005). In both Newland and Bothnia, the industrial internet initiatives were spearhead initiatives in broader digitization programs or strategies that were coordinated and managed more directly by the top management. Indirect means – changes in the strategic and also the structural context of the firm – were also used to demonstrate the commitment.

Differences in the managerial threat and opportunity perceptions as well as the sense of urgency to take action could explain the difference in the strategy making patterns. If the technological discontinuity is not considered immediately disruptive but rather something that starts to have bigger implications only after some years, the managers can be comfortable with moving the organization slowly towards the new paradigm more discreetly through embedding new concepts to the organization's strategic context. In Tammer, a recurring view among middle and operating managers was that there was not that much novelty in the industrial internet as such. Rather, it was seen as a logical continuation of the prior automation technology solutions. More radical implications to the business were expected eventually, but the perception was that there would not be any groundbreaking innovations coming out in the industry in the next 4–5 years. In the top management, the perception was also that no radical change would happen overnight, but that it was important to start moving already now because the organization was so slow to change:

"Probably whatever we do now, since we are not… by nature, we are not the fastest company in the world, we are very traditional, whatever we do now we are probably too slow anyway so it's very difficult to over-invest or overreact." –President, business area, Tammer

In Newland and Bothnia, the perceptions about the discontinuity were different. Newland had been investing in building capabilities for years and digitization had been vocally incorporated in the official strategy before peer companies: Newland wanted to be a shaper in the industry, advancing the emergence of the discontinuity. A top-down strategy fit this logic well. In Bothnia, the dominant impression was that unless they were the leaders, they would not survive against the competition. Due to this threat perception, Bothnia wanted to be attentive to customer needs but also to surpass them by innovating unforeseen offerings proactively. Also here, an actively managed top-down strategy was considered the best.

From the theoretical perspective, the superiority of either pattern of strategy making is not universal but situational. Bottom-up definition and selection of initiatives can be a good approach for organizational renewal if the change indeed is not too radical. The decentralized, autonomous initiative definition takes advantage of the different individual perceptions within the organization, thus increasing the sensitivity to such subtle changes in the environment which might be easily overlooked by the top management alone (Mirabeau & Maguire, 2014). However, if the discontinuity is truly disruptive and requires a rapid reconfiguration of the organization's resources and capabilities, the top managers are in the best position to direct the changes: because they typically have rich connections outside the firm and are informed about all the business units' resources and capabilities, they should be the most knowledgeable about what radical actions are required by the radical changes (Raynor, 2005). Strong commitment by the top management to their interpreted match helps also resolve the uncertainty caused by potential competing cognitive frames (Kaplan, 2008).

In conclusion, the applicability of either bottom-up or top-down strategy making depends on whether an organization's prevailing managerial cognition about the nature of discontinuity is accurate or not.

5.2 Implications to the managerial cognition theory

In their paper about capability cognition, Eggers and Kaplan (2013) called out for more research on how the matching of capabilities and opportunities actually happens in firms. My findings suggest that strategic initiatives act as an

important vehicle for the matching, because initiatives entail an idea of both the benefits it would yield and the capabilities and resources which would be needed to realize those benefits. In other words, initiatives encompass new opportunity-capability matches. Hence, when aggregated to the scale of the entire organization, the implemented initiatives do not only constitute the realized strategy (Mintzberg, 1978), but also form the organization-level interpretation of the opportunity-capability matches.

In my framework, the role of perceived outcomes is important. According to Noda and Bower (1996), resources are allocated iteratively to initiatives that are *perceived* as successful: the success of an initiative is not measured objectively, but it is always relative to the expectations and aspirations. Therefore, two initiatives that generate similar early results may be set off to completely different development trajectories, if for one the performance is above the early expectations and for the other the same performance is deemed disappointing. The examples from the case firms reinforce this interpretation. In Newland, the early success with the remote monitoring systems in one customer segment appeared to have reinforced the top managers' commitment to continue investments in building the capabilities further despite some doubts about the business potential. In contrast in Tammer, the first big data proposals were obviously not perceived as good enough in contrast to other initiatives with better business case analyses, resulting in lukewarm commitment from the middle managers.

Eggers and Kaplan (2013, p. 317) also presented the idea that experimentation could be one way in which managers evaluate potential matches, "either through adopting potentially reversible courses of action or testing possible matches in beta or pilot form". Based on the data, experimentation through pilot testing of for instance new service concepts was indeed one important way in which the firms carried out (or planned to carry out) the matching. Furthermore, the alterations between inside-out and outside-in may accelerate over the course of iterative refinement of opportunities and capabilities. In Tammer which was still very much in the early stage of defining opportunities and building capabilities for the industrial internet, the technological research for data platform was planned to take months before involving the customer in the work. In Bothnia,

which had proceeded to a stage where it was co-creating new service concepts together with their customers with the help of mock-ups, separating the iterations were so rapid that the validation of opportunities and needed capabilities was practically simultaneous.

Finally, Eggers and Kaplan (2013) also hypothesized that incumbent firms would be more prone to use the inside-out approach while entrepreneurial firms would opt for the outside-in. Although all of the three case firms definitely belonged to the incumbent category in their respective industries, I found modest support to the suggestion. In the beginning when the upcoming potential discontinuity is first identified, it seems that inside-out approach and even technology push are needed to build some understanding about what can be done with the new technology and to establish a reputation as a knowledgeable player. A logical explanation could be that in relatively conservative and cost-sensitive business-to-business markets, the reputational risk of approaching customers with premature new innovations could be too high to bear, especially when the customers are not accustomed to and do not themselves possess the capabilities for co-creation. The vendor's capabilities and expertise need to be first on such a level that concrete results can be demonstrated with e.g. prior reference cases or pilot exercises. As both vendor and customer become more convinced about the specific opportunity over the iterative refinement, it becomes easier for both parties to commit to more entrepreneurial co-creation methods. The above-mentioned instances from Tammer and Bothnia exemplify this logic.

5.3 Implications to managers and other practitioners

The findings of my thesis have two main implications to managers and one for the public or industry institutions organized for knowledge sharing across firms. First, when facing a technological discontinuity, especially the top managers need to evaluate the speed and radicalness of the upcoming change, and then align the organization's strategy process with it. In this process, top managers need to be aware of the benefits and disadvantages of both bottom-up and top-down strategy processes in different situations.

If the change is expected to be rapid and radical, a top-down intervention may be needed, because the bottom-up process may lower levels of the organization it is

more difficult to produce initiatives that would propose realignment of the organizational resources. Middle and operating managers' personal risks and myopia to the opportunities, threats, and capabilities at hand in their own business units may effectively inhibit the generation of initiatives proposing a reconfiguration of the organization's goals, capabilities, resources, and structures.

On the other hand, if the discontinuity is less radical but happens instead in stages, the bottom-up strategy process may be a valid way to produce the right responses. The generation and disclosure of more autonomously-ideated, previously unthought-of initiatives can be fostered by increasing the variation of experience, skills, and working styles in the organization. A fast way to increase variation is to assign new managers with new perceptions in key positions, also from the outside of the firm and even the entire industry. At the same time, the top management should acknowledge that the greater variety of ideas can also lead to a greater number of competing interpretations of which opportunities and capabilities the organization should pursue. To resolve the change-resisting inertia and uncertainty, the bottom-up strategy process can be influenced indirectly to generate a certain kind of initiatives by altering the strategic and the structural context of the firm, or more directly by demonstrating a strong commitment to a certain direction.

The second managerial implication is associated with how managers can become aware of the possible discontinuity and the related opportunities and capabilities in the first place. Based on the data, the firms that were the most advanced in defining and developing the specific opportunities and capabilities had interpreted commercial potential first in services, not equipment manufacturing and sales per se which after all was the original area of business of all the firms. The explanation could be that the services are more relationship-based whereas equipment sales has traditionally been transaction-based. Closer relationships provide more touchpoints between customer and vendor which enables faster feedback in both directions but also understanding better the context and conditions of the customer's business. Furthermore, in services it can be easier to experiment with new offerings than in the traditional manufacturing. Creating early mock-up versions of a service concept and testing it directly with real

customers is relatively simple in comparison to the technological research and development of industrial machines. The high complexity and cost of the equipment – not to mention the possibly very large size of it – can make it very difficult and expensive to build demo versions for testing, although the advancement of digital simulation and 3D design and printing technologies can reduce the cost of experimentation as well. Nevertheless, due to the iterative nature of refining opportunities and capabilities, finding the optimal and commercially viable match can take multiple iterations. Finding ways to experiment early can help the organization get on the move to the right direction, but the experimentation can also give valuable information about the real nature of the technological discontinuity as a whole.

The third practical implication concerns the institutions close to an industry where a technological discontinuity is expected to happen or on the way. Industry forums and institutions need to stay alert about the role they play in the knowledge sharing across industries and firms, because in small country like Finland, hypes can become exaggerated. Because the number of potential, interested participants in the industry forums is limited, a few topics may dominate the discussion at a time. As warned by Kahneman (2011), the risk of availability bias can distort the attention and commitment of managers towards certain phenomena and away from others. Therefore, industry forums and panels should recognize this threat and foster enough variation in the list of topics and participants to promote beneficial cross-pollination of new ideas.

6 CONCLUSIONS

In this chapter, I present first the key findings of my research and continue to an overall evaluation of my study and its limitations. I also suggest topics for further research before ending with my concluding remarks.

6.1 Summary of the key findings

Technological discontinuities bring about uncertainty about which opportunities and capabilities organizations should pursue. Based on my study, defining – and refining – the opportunities and needed capabilities, as well as their mutual matching, is iterative in nature. The sequence of matching alternates between outside-in assembly of capabilities based on identified opportunities and inside-out search of opportunities based on existing capabilities. The speed of iterations may accelerate over the course of refining the opportunities and capabilities, from slow cycles in the early research stage to a point where inside-out and outside-in eventually merge together, e.g. in co-creation with customer.

Managerial commitment affects the pattern of the matching. Strong managerial commitment to certain opportunities and capabilities can resolve the uncertainty intrinsic to the discontinuity, enabling the organization to engage in resolute capability building before all opportunities that can be achieved with the new capabilities are clear. In contrast, when the managerial commitment to a specific direction is low, the opportunities need to be defined first to allow investing scarce resources in building capabilities.

Importantly, it is crucial for the managers to assess the speed and radicalness of the identified technological discontinuity, and align the organization's pattern of strategy making according to it. A bottom-up strategy process can be applicable if the change happens more slowly and in stages, whereas a top-down strategy may be needed if the discontinuity necessitates more rapid and drastic responses. When assessing the nature of the discontinuity, the managers should try to avoid falling to the trap of availability bias, i.e., focusing only on the most hyped phenomena. Ensuring a great-enough variety of views and voices both within the firm and in the industry forums can help avoid the bias.

6.2 Evaluation of the study and limitations

In an abductive study like this thesis, the findings are drawn both inductively from qualitative data but also deductively from prior literature in an iterative manner. Because the qualitative data is anyways interpreted subjectively and the theoretical examination must be eventually narrowed down to certain literature, it is eventually the researcher's subjective evaluation and decision to conclude when the research is 'ready'. However, the number of interviewees and interviews in each company seemed to be enough to reach the saturation point in the frame set by the chosen theoretical frameworks and personal interpretation. Over the course of the interviews, the same names started to become suggested when asked about further possible interviewees, and the topics brought forth in the answers either started to saturate or clearly deviated from the research focus. Furthermore, hypotheses and findings that emerged over the course of the research were discussed with the rest of the research team and especially with the instructor. Based on these discussions and further data analysis, the final findings were confirmed and refined. Although a longer observation period and for instance an access to follow managers' work documents could have yielded a richer, more detailed data, I consider the overall quality of my research desirable for a Master's Thesis.

Nonetheless, my thesis naturally has also limitations. First of all, the data was collected in only three case firms, meaning that one must be careful in drawing generalizations. The case firms were relatively large incumbent manufacturers with business-to-business operations in a global scale. Depending on industry and the size of the company, the implications of a technological discontinuity and the patterns of matching opportunities and capabilities can be very different. For instance, each firm was operating in a rather mature market, where the barriers of entry were relatively high because of the high capital intensity. At the same time, in the scale of large software giants which would have the necessary capital, the markets were likely too small and growing too modestly to be attractive. A similar setting may not prevail in other industries, implying that the findings of this thesis need to be applied carefully.

On the other hand, the implications may also be different for emergent players trying to outcompete incumbents. The case firms were originated from a small

European country with a long tradition in engineering complex technologies. New entrants from for instance emerging Asian economies do not share similar history, reputation and customer relationships, but compete with different means from the beginning. Furthermore, the managers' potential interpretations of discontinuities, opportunities, and capabilities as well as the sense of urgency can be very different for managers stationed in a small Nordic country compared to areas with higher economic activity.

6.3 Future research

Since the data of this research were collected from a limited set of firms, future research could try to investigate whether the findings and propositions can be generalized beyond large Finnish manufacturing firms dealing with a technological discontinuity. If methodologically applicable, a survey of a large number of firms could extend our understanding of the topic.

Regarding specifically the proposition 1, future research could examine closer which factors actually affect the speed of iterations between inside-out and outside-in in the matching process. Based on this study, the managerial commitment and sense of urgency play a role in accelerating or decelerating the process, but a closer look at for example the role of specific customers and other industry-specific characteristics could yield important findings.

Regarding the proposition 2, it would be interesting to know more about the changes in managerial commitments. Do the changes in commitment lead to changes in how individual initiatives are promoted and managed, or to more fundamental changes in the organizations' strategy processes? Because the managerial opportunity-capability interpretations and sense of urgency varied across the firms, a follow-up study with the same firms later could focus on finding out if the perceptions of the nature of discontinuity, as well as the ways to deal with it, remained the same or were changed. In addition, the follow-up study could try to assess the results objectively and, if possible, form more prescriptive recommendations for best practices.

6.4 Concluding remarks

In the context of large manufacturing firms, concepts such as digitization and industrial internet may appear to some managers as hyped fads without that

much novelty, while others feel a great urgency to capture the envisioned new opportunities. Therefore, the managerial cognitions about the nature of a technological discontinuity can also have a stronger effect on the organizational strategy process than possibly thought. For an organization wishing to cope with and also benefit from a discontinuity, it is important that the managerial interpretation of the change is accurate and that the strategy process is aligned for a proper response.

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APPENDIX

1. Interview guide questions used in the interviews

- What kind of initiatives have you going on regarding digitalization, including both product and process-related use of IT?
    - [For each initiative, ask very briefly]:
    - When did the initiative start?
    - What is the main purpose of the initiative, in the sense that it is aiming for example mainly at the efficiency of internal operations, creation of customer value, or neither?
    - What was the motivation behind that?
- If possible, could you tell in your own words the story of the most important initiatives from their inception to the current state?
    - How were these initiatives started?
        - What was the deciding factor in the go/no-go decision?
        - How easily / or quickly has the decision been made (duration: from idea to decision)?
    - Have they been top-down or bottom-up?
    - What was the initial motivation behind them?
- Where did the idea come from?
    - From an external source or from someone in the company?
    - Do you follow what other players are doing in the same/some other industry regarding digitalization?
- How is the initiative organized?
    - Separate unit?
    - Separate project?
    - Staffing / resources allocated?
    - Who's in charge? Is there a high-level sponsor for the initiative?
    - Could you elaborate on the roles of operating managers, the top management and the middle managers in between the two in these initiatives?
    - What has been the role of externals, such as the suppliers of the digital technologies, or consultants?
    - If you compare the current organization to the organization before the initiative, has something changed?
    - How are initiatives communicated / reported on throughout the organization?
    - What are the goals and specific targets for initiative?
        - [Follow-up:] Are there specific KPIs to track these targets?
- What has been your own role in the initiative?
- Have you identified some competences that are needed to make the initiative successful?
    - Do you have these competences?
    - How have you developed or acquired these competences?
    - If not, what are the obstacles in obtaining them?
- How are your customers reacting to these initiatives?
    - If the initiative is already visible to the customers, how have they reacted?
        - [Possible clarification:] Is the reception positive, negative or neutral?
- How are the initiatives perceived inside the organization?
- What kind of challenges are there with these initiatives?
    - How are the challenges being managed?
    - What, in your opinion, has been essential for this initiative to be successful?
- Have there been any further ideas or proposals for digitalization initiatives which haven't proceeded to implementation?
    - What are the stories of these initiatives?
    - From where did these ideas originate?
    - Where did the initiatives stop? Why?
    - Who could tell us more about the digitalization initiatives that are on-going?
    - Who are the key people working on with them?

- o   What about the scrapped initiatives?
- We have talked about the firm's strategy and initiatives; to wrap up the interview I have a few questions about culture. We often hear discussion about the Finnish companies being too technology oriented and not customer oriented enough. How do you see your corporate culture in this regard?
  - o   Do you have a strong customer orientation or efficiency orientation?
  - o   Can you share a story that many people at your company would know about somebody acting exceptionally well, according to the company values?
  - o   Could you tell, which professional group(s) in the company is/are generally considered as very distinguished, the ones that have the biggest role to play in the future success of the company?
  - o   How do the digitalization initiatives correspond to the company's overall customer orientation/efficiency orientation?
  - o   Do you have an internal goal to be more customer oriented?
    - ▪   [If yes:] Do you think the digitalization projects are helping or hindering that goal, or are they rather neutral?