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Enacting Sensing Capabilities in Small and Medium-Sized Enterprises

Qualitative case study on microfoundations of sensing capability

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ABSTRACT:

Organizations are continuously expected to be able to respond to more dynamic and uncertain environments, where the ability to detect and interpret early change signals has become more crucial for maintaining competitiveness. Within the dynamic capability framework sensing has been identified to be a crucial mechanism for identifying opportunities and threats. Existing literature has mainly conceptualized sensing as an abstract firm-level capability, providing limited understanding of how sensing is enacted in practice. Prior studies have also highlighted the importance of microfoundations, but the focus has often been on wider dynamic capabilities framework and the process of signal identification, interpretation and translation into actions remains insufficient. The current research particularly lacks the examination of how sensing unfolds at the micro-level under uncertainty and how it is connected to decision making. This study addresses the gap through a qualitative single-case study in an SME operating in the Finnish construction industry. The empirical data consists of semi-structured interviews from both operational and managerial-level employees, enabling a wide examination of signal emergence and microfoundations of sensing related processes. The data is analyzed utilizing the Gioia methodology, allowing the identification of patterns in how signals are noticed, interpreted, escalated and acted upon. The findings show that sensing does not operate as a stable organizational capability but as a fragmented and emergent process shaped by individual actions, interaction and organizational structures. Signals primarily emerge from interaction with customers and external actors within the value chain, instead of formalized systems. Sensing is characterized by multiple layers of filtering including selective interpretation, social validation and decisions to amplify or dismiss. As a result, only certain signals become organizationally visible. The findings also reveal a weak coupling between sensing and action. While signlas are constantly noticed, interpreted and discussed, the translation into sufficient and timely actions is not systematic. The transition into decisions is shaped by uncertainty, availability of information, prior experiences and organizational constraints, often resulting in delayed or reactive responses. The study contributes to the dynamic capabilities and microfoundations literature by conceptualizing sensing as a multi-layered, context dependent process, instead of a stable firm-level capability. This highlights the importance of filtering mechanisms in sensing and challenges the assumption of linear relationship between sensing and action. The suggestion provided for

improved sensing in SMEs is not the sourcing of additional information, but more effective interpretation, sharing and action based on signals.

KEYWORDS: Dynamic capabilities, sensing capability, microfoundations, microfoundations of sensing capability, environmental uncertainty, SMEs

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SME = Small and Medium-sized Enterprise

1 Introduction

In today's volatile business environment, companies face increasing uncertainty driven by rapid changes in their external environment. These changes challenge companies' abilities to make strategic decisions based on weak and frequently changing market signals. It is important to distinguish the unpredictability and amount of environmental change, as market dynamism can be restricted to changes that are difficult to predict (Dess and Beard, 1984, p. 56). Another crucial factor affecting the information processing requirements is environment complexity, which can be described through the heterogeneity of the organization´s activities (Dess and Beard, 1984, pp. 56-57). Heterogeneity determines how many different factors managers need to consider in their information processing, thus increasing uncertainty. Environmental dynamism and complexity increase the difficulty of strategic decision-making and companies need to interpret changing and ambiguous signals (Dess and Beard, 1984). The ability to detect and act on unpredictable shifts in the external market environment, to recognize threats and opportunities has become a critical element of competitive advantage (Teece, 2007, pp. 1319–1324). Strategic management research conceptualizes this adaptive capacity through the dynamic capabilities framework, which explains how firms sense opportunities and threats, seize opportunities, and transform their resource base as a response to environmental changes (Teece, 2007, pp. 1319–1322).

As business environments have become increasingly uncertain, research has shown increasing attention to companies´ abilities to detect, interpret and evaluate emerging signals. Studies emphasize that firms capable of dynamic sensing can better anticipate market shifts and thus adapt their strategy to gain sustainable competitiveness (Teece, 2007, pp. 1319–1324; Day, 1994, pp. 43–45; Kump et al., 2019, pp. 1152–1154). In prior studies, sensing is also linked to processes of environmental scanning, allocation of attention, and recognition of opportunities (Ocasio, 1997, pp. 189–191; Zahra et al., 2006, pp. 918–920). Prior studies establish sensing as a foundational factor of strategic adaptation, especially under conditions of uncertainty.

However, despite extensive research on dynamic capabilities and recognition of sensing capability's importance, sensing capability remains theoretically rather abstract and underexplored. Sensing capability is often represented based on the outcomes of adaptation, while the underlying processes and actors enabling these capabilities receive less attention, thus the framework has been described as a "black box" (Pavlou & El Sawy, 2011, pp. 239–241). Sensing is often treated as an organization-level attribute, while attention to performable actions in practice remains limited. This suggests that the examination of the microfoundations of dynamic capabilities is needed (Felin & Foss, 2005, pp. 441–444; Helfat & Peteraf, 2015, pp. 833–835).

While prior studies have emphasized the importance of microfoundations, empirical research has paid limited attention to how sensing capability is enacted through microfoundational mechanisms, including individual actions, interaction processes and organizational structures. In particular, small and medium-sized enterprises (SMEs) provide a relatively underexplored yet relevant context regarding sensing, decision making in such companies often relies on a small number of key actors, making micro-level mechanisms particularly visible. Although organizational structures, processes and practices significantly impact how sensing unfolds, existing research remains rather limited in how microfoundations shape sensing capability within such contexts.

The purpose of this study is to address this research gap by answering the following research question: How do small and medium-sized enterprises engage in sensing environmental change under conditions of uncertainty? The study adopts microfoundations as a theoretical lens to examine how sensing capability emerges through the interplay of individual actions, interaction processes and organizational structures. Through this lens sensing is examined as a firm-level capability emerging from activities such as noticing, evaluating, sharing and acting based on environmental signals across organizational levels.

To address this research question, the study adopts a qualitative research design based on semi-structured interviews. The focus is on key actors associated with decision

making in SMEs, as their actions and roles are central in how sensing activities are enacted under uncertainty. Additional interviews with operational employees are included to further understand how decision-makers receive information from lower levels. This approach enables an in-depth exploration of sensing practices that would be difficult to capture through quantitative measures. The research follows an abductive approach, moving systematically between empirical data and theory to refine conceptual understanding (Dubois & Gadde, 2002, pp. 554–555).

The contributions of this study are threefold. First, the study extends the dynamic capabilities literature by providing empirical insights into the microfoundations of sensing capability, addressing prior critiques that highlight the abstract nature of sensing and dynamic capabilities (Pavlou & El Sawy, 2011, pp. 241–243; Teece, 2007, pp. 1322–1324). By examining sensing activities across organizational levels, including both managerial and operational actors, the study responds to the need for more fine-grained understanding on how sensing is enacted under conditions of uncertainty. Second, the study contributes to the microfoundations literature by examining how the interplay between individual actions, interaction processes and organizational structures shape sensing within a specific organizational context (Felin & Foss, 2005, pp. 441–444; Helfat & Peteraf, 2015, pp. 833–836). Third, the study offers managerial implications by identifying practices that support strategic awareness and adaptation in small and medium-sized enterprises operating under uncertainty (Kump et al., 2019, pp. 1155–1156).

The remainder of the thesis is structured as follows. Chapter 2 reviews the relevant theoretical literature and develops the theoretical framework guiding the study. Chapter 3 outlines the research methodology, including the research design, data collection, and data analysis procedures. Chapter 4 presents the empirical findings of the study. Chapter 5 discusses the findings in relation to prior literature, presents the theoretical and managerial contributions, and addresses the limitations of the study and suggestions for future research.

2 Theoretical background

This chapter discusses the theoretical streams selected for the research. The research draws on several relevant theoretical perspectives that inform the analysis and research of sensing capabilities in SMEs from a microfoundational perspective. The main theoretical stream and foundation is provided by dynamic capabilities literature with a focus on sensing capability. The subsequent subchapters discuss the microfoundations of sensing. In the final subchapther 2.3, a theoretical framework is presented to guide the analysis of the study.

2.1 Sensing capability in SMEs

2.1.1 Dynamic capabilities

The dynamic capabilities framework originates from the work of Teece, Pisano, and Shuen (1997), who argue that in environments affected by rapid technological change and market uncertainty, sustained competitive advantage cannot be achieved solely through static resource ownership. Firms must develop capabilities to reconfigure, integrate, and build internal and external competencies in response to changes in external conditions. Dynamic capabilities operate at a higher level than operational capabilities, determining how firms adapt, renew, and transform their resource base over time (Teece, 2016, p. 204). The framework builds on and extends the resource-based view (RBV), which explains competitive advantage through the ownership of valuable, rare, inimitable, and non-substitutable resources (Barney, 1991, pp. 105-106). Priem and Butler (2001, p. 28) argue that the underlying problem with RBV is that valuable and rare resources can be the source of competitive advantage, while competitive advantage is defined by value and rarity, which are the same criteria used to define the resources, thus creating circular reasoning. While RBV approaches competitive advantage through valuable firm resources (Barney, 1991; Peteraf, 1993), it is relatively static by nature which has led scholars to extend the framework by introducing the importance of being capable of purposefully modifying, recombining, and reconfiguring resources, as the environment is rarely stable.

Within the dynamic capabilities framework, capabilities are commonly conceptualized to include sensing, seizing and transforming, which together determine how firms identify opportunities and respond to environmental change. Among these, sensing represents the initial phase of adaptation focusing on identifying and interpreting the external environment.

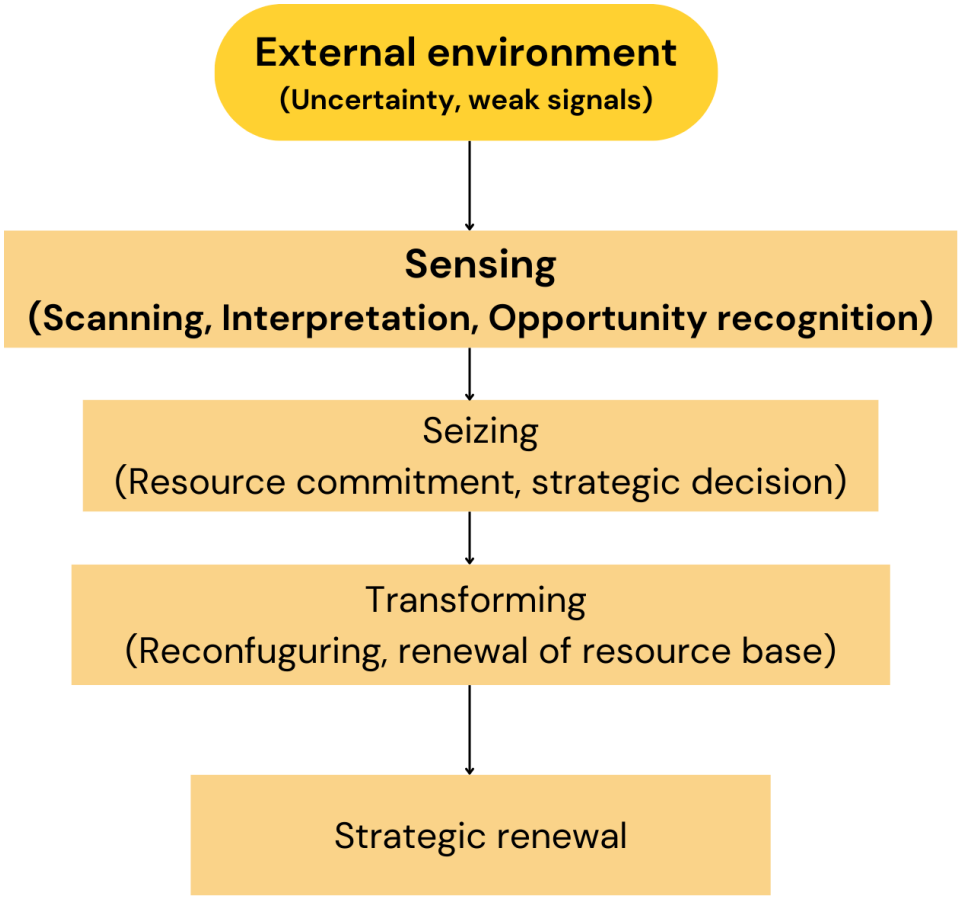

Figure 1. Dynamic capabilities process with analytical focus on sensing (developed by the author based on Teece, 2007).

2.1.2 Sensing capability

Sensing capability can be understood as the set of actions in the initial phase of adaptation through which firms scan, search, learn and interpret developments and

changes in technology, environment, markets and competitive landscapes including the existence of unmet customer needs (Teece, 2016, p. 212; Teece, 2018, pp. 41-45). In this sense, sensing acts as a gatekeeper in strategic adaptation, as inaccurate or biased sensing can lead to the pursuit of inappropriate opportunities or overlooking emerging threats (Teece, 2007; Helfat & Martin, 2015).

How sensing is performed is affected by organizational structure, available assets, and decision-making arrangements. A clear distinction between sensing and subsequent strategic actions is essential for analytical clarity. Sensing refers to identification, interpretation, and shaping of potential opportunities, while later stages involve committing resources to exploit them (Teece, 2007, pp. 1324–1326).

The challenges of sensing capability are amplified by the nature of environmental signals which are often weak and incomplete. Weak signals refer changes where the nature, impact and possible responses are unclear, such as the early stages of technological shifts (Ansoff, 1975, p. 23). These weak signals require interpretation as their strategic implications remain ambiguous. If weak signals are interpreted too late or remain unnoticed, they may lead to strategic surprises and discontinuities in the business environment (Ansoff, 1975, pp. 22-23). Figure 2 illustrates how different interpretations of emerging signals can lead to differing outcomes in terms of opportunities and threats.

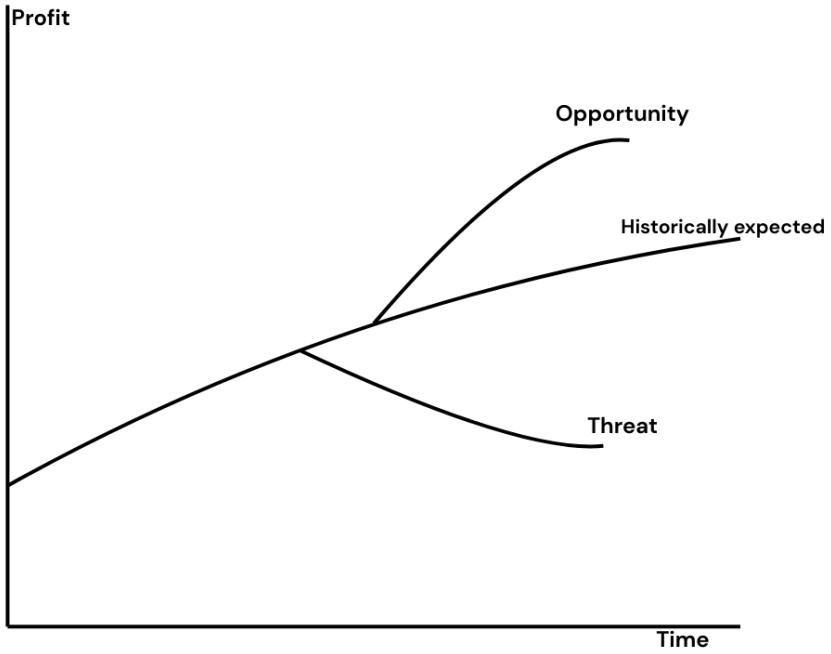

Figure 2. Strategic discontinuities and the impact of threats and opportunities (adapted from Ansoff, 1975).

Environmental information does not automatically translate into action, as organizations need to interpret signals and assign meaning to them. Daft and Weick (1984, p. 286) describe this as a process of scanning, interpretation and learning. After scanning information from external developments, competition, market conditions and technological changes, interpretations translate this information into meaning with cognitive processes and discussion with members of the organization. Lastly learning refers to the actions taken based on these interpretations (Daft & Weick, 1984, pp. 285-287). In the context of sensing capability, it emphasizes that sensing is not limited to collecting data but involves the construction of meaning from environmental signals.

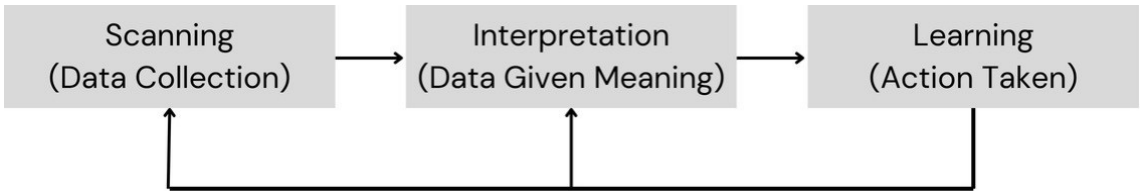

Figure 3. Organizational scanning, interpretation and learning process (adapted from Daft & Weick, 1984).

Entrepreneurship literature highlights that opportunities cannot be just discovered, but they are actively developed through actions (Ardichvili et al., 2003, p. 106). Sensing is associated with being a link between dynamic capabilities and the entrepreneurial process of opportunity recognition and evaluation, thus being at the intersection of strategy and entrepreneurship (Teece, 2016, p. 212; Ardichvili et al., 2003, p. 109). As Teece (2018, p. 48) highlights, that corporate entrepreneurship involves the same re-combination of resources as contemplated by the dynamic capability framework.

The processes, positions, paths framework further highlights that sensing capability cannot be reduced to static assets and resource positions, but instead emerges through organizational and managerial processes enacted over time. However, sensing is primarily enacted through the ongoing processes of search, interpretation and evaluation (Teece, 2007, pp. 1322–1323). These processes are embedded in routines and practices however, they remain dependent on the individual actors who enact them and their interactions (Barney & Felin, 2013, p. 140).

Prior research highlights conceptual challenges in dynamic capabilities literature including the mixing of higher-order dynamic capabilities and routine operational activities as well as concerns regarding theoretical foundations and definitional clarity (Teece, 2014, pp. 328-331; Helfat & Winter, 2011, pp. 1243-1244; Arend & Bromiley, 2009, pp. 75-76). The ambiguity of capabilities is especially relevant for sensing, which can easily be confused with routine activities of environmental scanning and market analysis.

Operational or ordinary capabilities refer to established routines which allow firms to perform their current plans and activities, whereas dynamic capabilities are concerned with adaptation and strategic change (Teece, 2016, p. 204; Helfat & Winter, 2011, pp. 1243-1244). While activities such as scanning, competitor monitoring and data analysis support sensing, they do not constitute sensing capability unless they contribute to identifying and interpreting strategically relevant changes. Eisenhardt and Martin (2000) argue that dynamic capabilities are well-known organizational strategic processes, such as product development and alliancing, rather than rare and idiosyncratic firm-level attributes.

As Teece (2007) describes sensing as involving identification and interpretation of opportunities and threats that may not be fully observable. Compared to routine data collection, sensing requires judgement, interpretation, attention allocation, and the ability to create meaningful patterns from displaced information. This distinction between ordinary and dynamic capabilities becomes crucial in an uncertain context. Ordinary capabilities for environmental scanning often rely on rather stable indicators, while sensing capability operates with weak and ambiguous signals which are open to multiple interpretations. The strategic relevance of a signal might not be clear, thus it requires the framing and evaluation of decision-makers in relation to the firm´s current and desired future positioning. This clear differentiation clarifies why sensing as a dynamic capability cannot be described by standardized scanning and monitoring mechanisms. These mechanisms can support sensing capability, but the enactment of sensing depends on how managers interpret and create meaning for the information gathered from these mechanisms.

By separating sensing from operational capabilities, the study aims to reinforce the focus on interpretive and cognitive processes rather than routine data collection and analysis activities. By doing so, the study strengthens the conceptual clarity and precision of sensing capability and its microfoundational enactment.

2.1.3 Sensing in SMEs

The development and enactment of dynamic capabilities are often affected by the organizational context, which can act both as an enabler and a constraint. SMEs often operate with a unique context differing from those of larger companies. Compared to larger organizations, SMEs are typically less structured, with decision-making concentrated among a limited number of actors. This increases the importance of individual-level actions and judgement, as sensing relies more on everyday managerial activities rather than specialized analytical processes.

In many SMEs´ strategic decision-making mandate is held by founders, owners or a small team of top management. As Peñarroya-Farrel, Vaziri, Rivera and Miralles (2025) highlight, that strategic technology and innovation related decisions in SMEs are often concentrated among general managers, rather than specialized departments. SMEs often operate with a structure where the board and top management overlap, including the same people at all levels (Brunninge et al., 2007, p. 296). Furthermore, strategic leadership is often concentrated toward only one person (Brunninge et al., 2007, p. 304). This context intertwines sensing capability close to the microfoundational aspects affecting the individuals in charge. This also creates a risk of developing fewer innovations if key decision makers rely on vertical communication and fail to delegate and include members on staff (Saraiva et al., 2024, p. 17980). In closely held firms decisions regarding strategy are often developed by owner-managers, which can create unwillingness to change the strategic decision, due to their personal commitment and investments in the company (Brunninge et al., 2007, p. 297).

As mentioned, SMEs often operate with structural informality. Communication is often direct and less constrained by hierarchy, enabling rapid information exchange. Saraiva, Ferreira and Alves (2024) argue that entrepreneurial strategic posture, dynamic and decentralized style of management and control over objectives are factors associated with the success of SMEs, all of which can be associated with structural informality.

Even though information flow may be rapid, informal structures may lack systematic mechanisms to challenge dominant interpretations and opinions and limit a wider range of perspectives. Structural informality thus may enable agility but also create cognitive blind spots.

In addition to structural simplicity SMEs´ sensing related processes are often limited by resource constraints. Inherent resource limitations and lack of capacity to respond in dynamic environments may represent a great risk for SME survival (Saraiva et al., 2024, p. 17977). In the context of sensing, limited availability of financial, analytical and human resources may limit crucial contributors for sensing capability such as specialized strategy units, environmental scanning systems and learning resources. Thus, sensing is less likely to be formalized and more dependent on everyday practices and and individual-level actions.

Taken together, SMEs present a structurally distinctive environment to examine sensing, where microfoundations can become particularly visible. It is important to note that even though these characteristics are common for many SMEs, SMEs are a heterogeneous group and can vary significantly in their structure, decision-making process and resource related constraints.

The primary analytical focus will remain on microfoundations of sensing, however, organizational arrangements and context influences how sensing unfolds in practice. By focusing on sensing in SMEs at a microfoundational level, the study responds to calls for greater conceptual precision regarding how sensing is enacted in practice.

2.2 Microfoundations of sensing capability

Pavlou and El Sawy (2011) critique the dynamic capabilities framework as a “black box”, meaning that the outcomes of capabilities can be observable, yet the mechanisms and underlying processes remain insufficiently specified and immeasurable. Microfoundations conceptualize organizational phenomena such as capabilities as emerging from the joint interplay of individual actors, interaction processes and organizational structures, rather than as abstract organizational attributes (Felin et al., 2012; Felin et al., 2015). Microfoundations research centers around the causal mechanism which constitute to individual-level actions and interactions emergence into collective organizational outcomes (Felin et al., 2015, pp. 576–578). The ultimate goal of the microfoundational perspective is to understand how micro-level actions and interactions create relationships to macro-level outcomes (Rabetino et al., 2025, p. 707). This perspective is important because explanations on an aggregate-level may obscure and therefore require attention to individual-level factors (Felin et al., 2012, pp. 1353-1354). Therefore, the microfoundational perspective serves as a lens through which dynamic capabilities can be examined by specifying the underlying mechanisms through which those capabilities are formed, maintained and modified.

The challenge is to explain how individual-level actions become stable collective capabilities. As Felin et al., (2015) describes that capabilities do not emerge through isolated decisions but from recurring patterned interactions which become embedded over time. These actions are shaped by the organizational structures, which influence communication channels, hierarchy and decision-making arrangements, and by interactions through which information is shared and collective interpretations formed.

Hence sensing is not a fixed organizational attribute, but is continuously enacted through individual actions, their interactions and the structural context in which these occur. This approach to sensing capability allows the study to focus of practical mechanisms of sensing rather than abstract descriptions. Organizational structures and design enable or constrain individual actions and interactions, while the behavior and

interactions of micro-level actors give rise to the emergent organizational outcomes (Rabetino et al., 2025, p. 707). Emergence refers to the process through which lower-level actions and interactions transform into higher level entities (Felin et al., 2015, p. 605).

2.2.1 Individual-level microfoundations

In the context of sensing capability, microfoundational perspective treats the enactments of sensing as dependent on how individuals identify, interpret and act on environmental signals, within a broader system of interactions and organizational structures. Rather than focusing on abstract traits, the individual-level emphasizes actions, behaviors and decision making of individuals (Felin et al., 2012; Felin et al., 2015).

As in uncertain environments information is often weak, scattered and ambiguous environments (Dess and Beard, 1984, pp. 52-56), sensing requires the indivual´s ability to filter weak information, recognize patterns and connect scattered pieces of data into more coherent synthesis. Prior research acknowledges that what people notice tends to be linked to what they already know, indicating that prior knowledge triggers recognition of value in new information (Ardichvili et al., 2003, p. 114). In addition cognitive frames guide attention and influence how signals are perceived as threats or opportunities (Kaplan, 2008, pp. 673–675). Similarly prior experience hinder can adaptation due to existing dominant beliefs (Tripsas & Gavetti, 2000, pp. 1157–1158). These cognitive frames shape not only interpretation but also which strategic alternatives are considered, thus researchers have devoted more focus on the cognition of managers and the interpretive processes they engage in (Eggers & Kaplan, 2013, p. 296).

Individual-level sensing is in addition selective. Individuals are exposed to large amounts of information, but only a fraction receives focused attention. Attention-based perspectives highlight that what is noticed is dependent on the attention allocation and focus, which is determined by both individual focus and organizational

conditions and priorities (Ocasio, 1997, pp. 189–190). This indicates that sensing is not a neutral detection process but it is influenced by prior knowledge, expectations and situational priorities. This results into different individuals interpreting the same signals differently, which leads to variation in the evaluation of environmental signals. Individual attitudes, motivations, abilities, emotions and cognition are crucial in shaping behavior and interactions, and influencing sensemaking and decision-making (Rabetino et al., 2025, p. 707). In addition to attention and interpretation, opportunity evaluation and action taken is often affected by simple rules or heuristics developed by individuals. These heuristics work as cognitive shortcuts to help navigate in situations where information is limited and incomplete (Bingham & Eisenhardt, 2011, p. 1440).

Importantly individual-level sensing does not take place in isolation. Organizational structures and communication channels shape what information reaches individuals (Ocasio, 1997, pp. 190–192). Individual-level actions are shaped by broader structural conditions and the organizational context in which they operate in (Rabetino et al., 2025, p. 707).

2.2.2 Interaction-level microfoundations

In addition to the individual-level actions, sensing capability often emerges through interactions between individuals. Individual-level actions provide the basis for interaction, where interpretations are shaped and refined through communication between actors. Interactions in microfoundations represent the mechanisms through which individual-level actions and behaviours aggregate into collective organizational outcomes (Felin et al., 2012), in the context of sensing this shapes how information is interpreted and acted upon within the organization. Thus, interaction processes are often instagated by managers, who connect stakeholders and promote communication (Rabetino et al., 2025, pp. 718-719).

Prior literature suggests that individuals involved with sensing often struggle with how to balance interpretations of past, present and future (Kaplan & Orlikowski, 2013, p.

966). Kaplan and Orlikowski (2013, p. 973), thus argue that interpretation involves connecting past experiences, present developments and anticipated future outcomes. These temporal considerations are reflected in interactions, where individuals adjust their interpretations based on feedback and views of others. These interactive processes can be argued to be increasingly important as an environment becomes uncertain, where signals are weak, ambiguous and open to multiple interpretations (Dess & Beard, 1984, pp. 52–56). Recurring patterns of action can help organize and guide variation in individual interpretations by providing a frame for action (Feldman & Pentland, 2003, p. 101).

Interaction does not merely aggregate individual views but actively shapes them, as interpretations are revised through discussion. Thus shared understanding can also be somewhat ambiguous. Interpretations may remain partially diverse while producing coordinated actions (Feldman & Pentland, 2003, p. 104). However interactions may also reinforce dominant views if a certain actor holds greater influence and limits the range of alternatives.

From a microfoundational perspective, interaction processes are crucial in linking individual actions into an organizational sensing capability. This aligns with the view that patterns of actions are continuously enacted and modified through interactions, rather than being static. Such patterns consists of the understanding of action and the actual actions taken by individuals, which are iteratively related (Feldman & Pentland, 2003, pp. 101–102). Actors do not only refine interpretations through interactions but also enact and adapt the patterns of actions allowing routines to evolve over time (Feldman & Pentland, 2003, p. 94). Repeated interaction may contribute to the emergence of stable patterns of action and organizational routines over time (Felin et al., 2012).

This indicates that sensing cannot be reduced to either individual-level actions or organizational routines alone as it emerges through a continuous interplay between individuals and their interactions. Through this interplay weak signals are collectively interpreted, evaluated and transformed into actionable understandings.

2.2.3 Structural and process-level microfoundations

In addition to individual actors and interactions sensing capability is shaped by the structural context in which those actors operate in. These contextual factors act as both enabling and constraining factors for individual and collective action and simultaneously establish the context for interactions (Felin et al., 2012, p. 1364). Thus organizations can be understood as systems of coordinated action among individuals and groups with different information, interest, knowledge and preferences (Puranam et al., 2014, p. 163), all of which contribute to how sensing occurs.

Structural factors such as hierarchy, communication channels and organizational roles all shape how information is distributed and the different pathways through which signals travel. Organizational design elements and structures shape how individuals and teams interact in innovation processes (Rabetino et al., 2025, p. 720). From an organizational design perspective these structures shape how coordination is achieved. Organizations must make sure that actors have access to information needed to execute their tasks and align their actions properly (Puranam et al., 2014, p. 165).

While structures shape the distribution of information and roles, sensing activities are enacted through individual actions and interactions over time. These patterns of action develop over time through learning, accumulated experience and more deliberate actions such as articulation and codification (Zollo & Winter, 2002, p. 345). Organizing can be viewed as a problem-solving process through which organizations tackle challenges of integration and coordination of effort alignment (Puranam et al., 2014, pp. 164-165).

Activities such as sensemaking, knowledge sharing, learning and coordination are crucial interaction processes in innovation activities (Rabetino et al., 2025, p. 721). These patterns are continuously refined and reproduced through individuals and their interactions. This highlights how patterns of action both emerge from and shape micro-

level activities. This repetition-based learning shows how routines develop and become stable patterns of behavior (Zollo & Winter, 2002, pp. 341-342). Simultaneously, these patterns influence which signals are prioritized, how they are interpreted and which of them lead into action.

From a microfoundational perspective the role of structure is not to explain a capability but to explain how it enables or constraints the mechanisms through which sensing emerges. These structural factors influence how attention is directed, what and how information is shared, how interpretations are validated and ultimately how decisions are formed. Organizational elements provide the context in which individual and interaction-level microfoundations operate in.

Thus sensing capability should be understood as emerging from individual actions, interactions and their alignment with the structural context within the firm. Rather than being an abstract property of the organization, sensing capability is the outcome of how these elements are configured and enacted in practice.

2.2.4 Integration: from micro to macro

The aggregation from micro to macro does not occur as a simple sum of individual actions. Instead research emphasizes the need to explain the mechanism through which actions at different levels are connected, rather than relying on simple aggregation (Felin et al., 2015, p. 600). Firm-level outcomes emerge through repeated interactions between individuals. Individual observations and interpretations are shared, stabilized and embedded within organizational practices. In this view interactions are crucial as collective outcomes ultimately emerge from the interactions rather than isolated individual actions (Felin et al., 2015, pp. 580-605). This allows micro-level activities to rise into relatively stable capabilities at the firm-level. It is important to understand that similar macro-level outcomes may be possible to reach with multiple micro-level

configurations, thus sensing capability can be enacted differently between firms, while producing similar adaptive capacity on a macro-level.

This perspective maintains the separations between the levels while simultaneously linking them. Individual-level actions provide the base for sensing, interactions enable the validation and refinement of interpretations and the structural conditions shape how these activities are coordinated and sustained. Macro-level constructs are not treated as static entities but rather as outcomes which are continuously shaped and refined through micro-level actions and interactions (Felin et al., 2015, pp. 576-578).

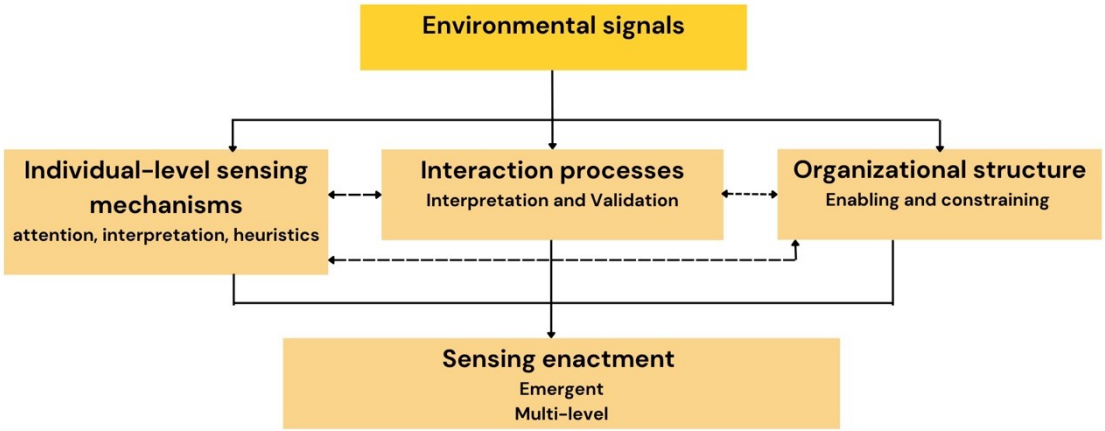

Figure 4. Microfoundational process of sensing enactment (developed by the author based on Teece, 2007; Felin et al., 2012; Felin et al., 2015; Ocasio, 1997).

2.3 Theoretical Framework

Despite the extensive research on dynamic capabilities, the enactment of sensing remains insufficiently specified at the micro-level, especially in an SME context with concentrated decision-making, resource constraints and relatively informal structures.

The previous discussion established sensing capability as emerging from individual actions, interaction processes and organizational structures. Weak and ambiguous signals require interpretation, making the interplay between individual actions, interaction processes and organizational structures central in how sensing is enacted, particularly in SMEs where decision-making is concentrated and formal structures limited.

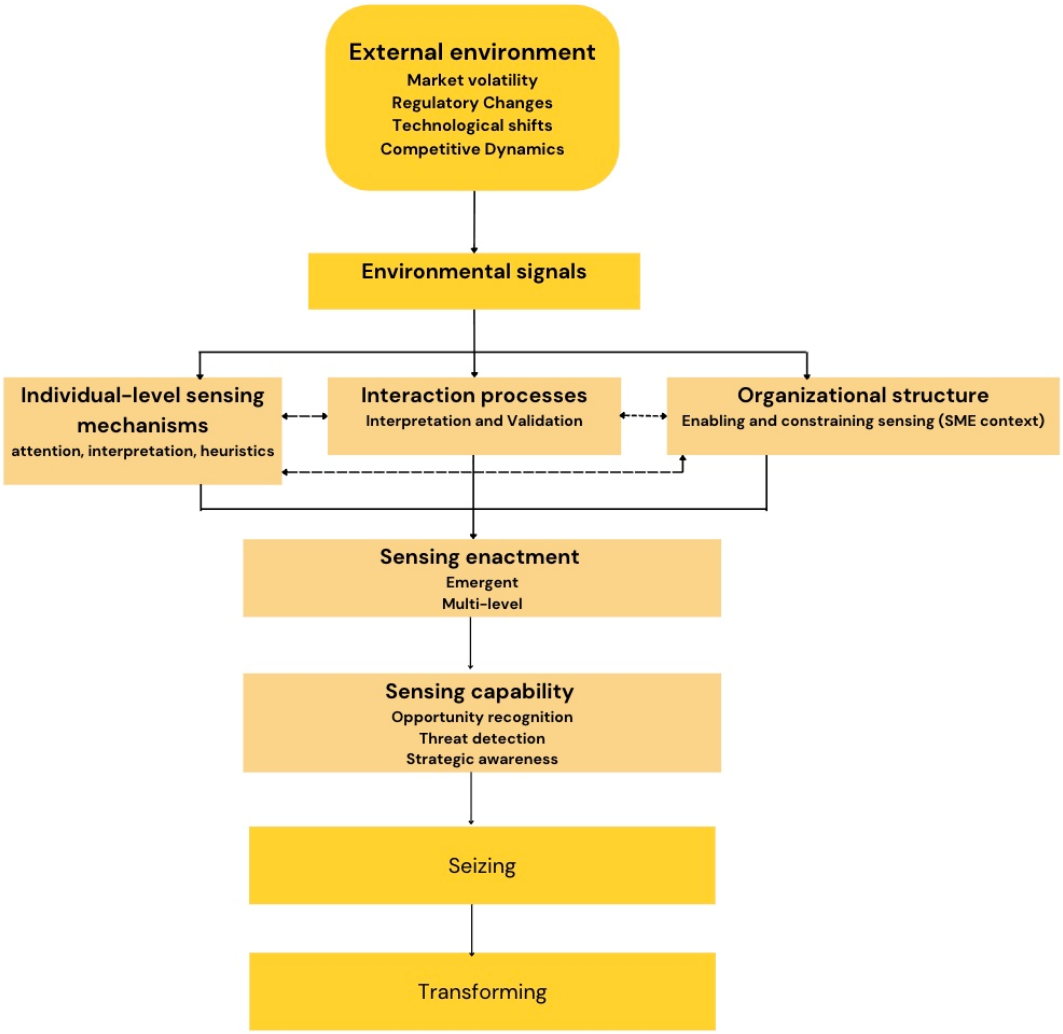

Figure 5. Integrated theoretical framework of sensing capability in SMEs (developed by the author based on dynamic capabilities, microfoundations, and SME literature).

Based on this synthesis, the theoretical framework conceptualizes sensing capability as a multi-layered phenomenon emerging from the interplay between individual actions, interaction and organizational structures. The framework proposes that environmental changes create weak signals which are noticed, interpreted and developed through individual actions, interaction processes and organizational structures before they inform strategic action. These actions are shaped and refined through interaction processes where interpretations are shared, evaluated and adjusted. Individual actions, interactions and organizational structures together form the microfoundations through which sensing capability is enacted. These activities are further shaped by organizational structures characteristic to SMEs, which shape how information flows, how interpretations are formed and decisions made.

This framework guides the empirical analysis of how sensing capability emerges through microfoundational mechanisms in SMEs under conditions of uncertainty.

3 Methodology

This chapter discusses the methodological approach in subchapter 3.1 and the case company of the study in subchapter 3.2. These aim to provide a comprehensive understanding and reasoning behind the chosen case company and how it fits the chosen research methodology. The aim is to validate the previously presented research question. Subchapter 3.3 discusses the data collection and methods, and data analysis is provided in subchapter 3.4. The quality and reliability of the data are discussed in subchapter 3.5.

3.1 Methodological approach

This study aims to examine how SMEs engage in sensing capability from a microfoundational perspective by using qualitative data as its primary data source. Consequently, qualitative single-case study is well suited to this research, enabling in-depth examination of dynamics within a particular setting (Eisenhardt, 1989; Gibbert et al., 2008; Eriksson & Kovalainen, 2008). Sensing is context-dependent, thus the study adopts an abductive research approach. This allows movement between empirical observations and theory, allowing for theoretical refinement and being open to insights from primary data (Dubois & Gadde, 2002, pp. 554–555). Qualitative methods are suitable for examining how strategic practices unfold in real organizational contexts (Eriksson & Kovalainen, 2008; Rouleau, 2005; Weick et al., 2005). A single-case study enables in-depth understanding of a complex organizational process, by examining microfoundational mechanisms through which sensing is enacted in practice.

The delimitations and assumptions of this study concern the selection of the case company, decision-makers interviewed and potential researcher bias. While sensing practices may vary between different organizational contexts and decision-makers, the microfoundational factors of individual actions and interactions are expected to shape how sensing is enacted across the examined SME. Examining sensing in all organizational contexts would exceed the scope of a Master´s thesis. Therefore the study focuses on developing an understanding of how sensing capability emerges within the

selected SME. To ensure a manageable and analytically executable research design, the study is narrowed to SMEs operating within the construction industry. The findings are not intended to be generalized across different company contexts, but to provide analytical insights that may be transferable to similar SME settings.

3.2 Case company

The case company is an SME operating within the construction industry in Finland. Due to confidentiality reasons neither the company nor the interviewees are disclosed. The selected SME operates within an industry characterized by regulatory changes, financial volatility and sustainability-related pressures. To sustain competitiveness and growth, the environmental dynamics require constant interpretation and strategic adjustment from key decision-makers. The case company operates in a context where decision-making authority is concentrated to a limited number of key actors. This structural character makes the company particularly suitable for examining microfoundations of sensing capability. According to prior research many SMEs rely more on experience-based judgement in strategic decision-making compared to more formalized organizations (Saraiva et al., 2024, p. 17980). The company operates in the Finnish market where regulatory, sustainability related and financial developments increasingly shape the competitive environment for construction companies. Therefore the examination of how key decision-makers interpret and act on these developments offers a relevant perspective to study sensing capability in SMEs. In addition to sustainability and regulatory changes, the industry context is under technological transition, which strengthens the relevance of studying sensing under uncertainty. In addition, the company operates with a structure involving subsidiaries which may influence the information flow and social aspects of sensing.

3.3 Data collection

In line with Gioia et al. (2013), the study employs cases and research questions that are well defined, and utilizes multiple data sources. Case studies usually combine data collection methods such as interviews, observation and archival data (Eisenhardt, 1989, p.

534). The primary source of data is interviews with key decision-makers within the case company. The interviewees were selected based on their decision-making authority and their involvement in strategic decision-making within the company. In addition operational personnel are included to provide insights into how signals emerge from day-to-day operations and how they reach managerial decision-makers.

Semi-structured interviews with open questions allow flexibility regarding the themes discussed (Eriksson & Kovalainen, 2008). All top-management interviews followed the same interview structure, while a different structure was applied for the operational employees. Interviews were held in Finnish as it is the native language of the interviewees. Interviews took place on Microsoft Teams calls. Permission to record was requested from all interviewees.

Company related material were used to support contextual understanding during the interview process.

3.4 Data analysis

The data analysis followed the Gioia methodology. First-order concepts were identified by reading the interview transcripts. Interviewee responses where coded into first-order concepts to identify emerging second-order themes. After theoretical sufficient consistency emerged, second-order themes were developed. The identified themes were reflected against the theoretical framework (section 2.3) to see whether new concepts would be identified and the framework should be refined. Finally aggregate dimensions were formulated by combining the gained theoretical insights following the Gioia methodology data structure (Gioia et al., 2013). Data structurization is presented in Appendix 5.

All of the interviews where transcribed using an automatic transcription tool and later corrected manually with the help of audio recordings to ensure accuracy. Observations made during the interviews were confirmed with the interviewees. After the

finalization of the thesis interviewee recordings, transcriptions and the notes of the researcher were destroyed.

Secondary data sources such as company press releases, were used to gain understanding during the interview process from the case company and the industry they operate in. This was done to gain a comprehensive understanding of the phenomenon from multiple perspectives (Farquhar, 2012). The secondary data utilization allowed the researcher to engage in conversation during the interviews from the perspective of the industry and the context of the case company, as well as when analyzing the primary data.

3.5 Assessment of the quality of the data

The quality and strength of a case study is presented through internal and external validity and construct validity (Saunders et al., 2019). Internal validity is improved within the study by constructing the theoretical framework variables from several prior studies both recent and fundamental. The external validity of the study is arguable, referring to the opportunity to generalize the study. The study´s practical implications may not be transferable to other organizations. The external validity of the study is influenced by several context factors: case company, industry, country, interviewees experiences and knowledge and the transition phase of construction industry affected by digitalization, business model innovation and macroeconomic factors. To increase the external validity the study adopts analytical generalizability (Gibbert et al., 2008), while trying to develop theory on managerial sensing enactment in SMEs. To increase the construct validity of the study a clear path of evidence is provided to understand the process from research question to findings.

To increase the reliability of the research and minimize participant errors, the interviewees received the interview key themes prior to the interviews (Appendix 3). The interviews followed a planned structure (Appendices 1 & 2). The key themes were also discussed briefly before the start of each interview to ensure consistency. This

increases transparency and minimizes error if the study is replicated by another researcher. A clear list of data sources is presented in the study to add reliability as suggested by Gibbert et al. (2008). The interviewees also received a consent form which indicated clearly that both the interviewees and the case company remain anonymous and the material is treated as confidential. This lowers the threshold to participate, while increasing the transparency and honesty of the interviews.

According to Flick (2018), In addition to the importance of privacy, it is essential to ensure that the data used is of high quality. This is done by utilizing subject specific academic research which have been recently published or which are fundamental regarding the current paradigm of dynamic capabilities or consensus regarding sensing enactment. This is done in order to ensure that the theoretical framework and theories guiding the study are in line with the current consensus and latest findings regarding the topic. Relevant academic research challenging the dominant views are also presented to illustrate the problematic nature of the topic.

4 Findings

This chapter presents the empirical findings of the study, illustrating how sensing capability is enacted within the case company. The findings are structured in line with the theoretical framework.

4.1 Fragmented and emergent market sensing

The findings suggest that sensing starts with the noticing of weak signals, which typically emerge through everyday interactions and observations rather than structured systems. The findings highlight that signals are not systematically collected or monitored, but they emerge organically through everyday activities, especially from customer facing roles and interactions with customers. However, the drivers of these signals emerging from customers are mentioned to be observed more systematically at the top management level. The process and sources of noticing weak signals also differ between role and seniority within the company.

At the operational level interviewees describe that the noticing of signals are embedded in routine customer facing interactions and sales work. One interviewee described how signals typically emerge from informal encounters rather than deliberate scanning.

“Not really in a regular way, but they (signals) keep coming up ... for example from discussing with customers...But it is difficult to determine the amount.” Interviewee 1

This indicates that at the operational level the employees experience signals as irregular and difficult to quantify. Rather than being clearly observable and measurable identifiable events, they emerge as fragmented pieces of information. Because of the fragmentation and ambiguity of the signals their recognition depends on the individual´s ability to connect isolated pieces of information into patterns. This suggests that some signals may remain unnoticed or dismissed due to low perceived relevance, which can limit the organization´s ability to notice early change signals in their environment.

Across roles and experience levels customers and competitors were consistently identified as primary sources for signals. As Interviewee 1 noted:

"In principle they (signals) become from customers or competitors... often it can be for instance some customer describing a situation." Interviewee 1

This indicates that noticing signals relies heavily on externally oriented activities, therefore highlighting the importance of boundary spanning roles in noticing changes in the operating environment.

At the operational level noticed signals may not be recognized as initially meaningful as they emerge from isolated observations. These can later be identified as parts of a broader pattern. Interviewee 1 described encountering unexpected competitive action.

"For example a slightly different kind of company.. not necessary even operating with same areas as us had made offers for same as us" Interviewee 1

Weak signals may appear at the operational level as ambiguous and difficult to interpret as they may not fit the expectations of the market.

Among management, sensing is described as more systematic, continuous and deliberate, yet it remains largely informal. Interviewee 2 highlighted that monitoring is continuous.

"The signals are constant... and we are constantly thinking about future developments.. The scope is constantly looking for positive signals from the economy" Interviewee 2

Even though the orientation towards noticing signals is more proactive the process remains informal and dependent on individual attention. However, this showcases that sensing enactment at the decision-making level is a constant focus point.

The types of signals noticed was highly linked to the experience level and the seniority of the role. As an employee gains experience the noticing of signals shifts into more strategically relevant areas such as new business models, financing and other factors often considered more relevant regarding strategic decision-making while more inexperienced employees face mostly operational signals. This indicates a distinction between different organizational roles in sensing activities. Operational sensing is linked to the day-to-day activities, sensing at higher organizational levels is more proactive, forward-looking in anticipating market developments. However the practices across different organizational levels remain informal and largely dependent on individual actions, which indicates a lack of a structured mechanism to capture and integrate signals across different levels.

Enactment of sensing at the top management level emphasized the importance of communication and connections with other decision-makers in the industry. This seems to be enhanced by the nature of the value chain within the construction industry where there are several companies and stakeholders involved within larger projects, thus information and connections to different actors within the industry are crucial as the signals often emerge from these conversations. While previously mentioned operational insights emerge from the customer playing field, this should be enhanced with a strong presence of key decision-makers as their knowledge and experiences drive better results regarding signal detection.

“For example (CEO´s) experience operating in the industry and connections to several property managing agents and construction consultants and that type of persons who make those decisions... of course we get tips from there what should be done in what manner... we move a lot within the field and actively see a lot of people and discuss...

ultimately the ideas arise from the field" Interviewee 5

The reliance of individual exposure and connections also introduces variability in what is noticed by the organization. What is noticed is highly affected by the level of the employee and their personal relations and interaction context they are part of within the industry, thus exposing individuals to different types of signals. This can result in biased or only partial representations of the external changes.

Overall, noticing signals appears as continuous but unstructured system. What is noticed is dependent on individual exposure and interaction. Signals emerge mostly from everyday activities with customers at the operational level and are characterized by ambiguity, fragmentation and lack of clear boundaries. This unstructured way enables sensing but makes it difficult to coordinate at the organizational level. However, at the senior level sensing becomes more deliberate, but the structure remains nonexisting. This suggest that signal sourcing is dependent on individual exposure and experience, while the dynamic and uncertain market shapes the frequency and what signals emerge.

4.2 Individual-level interpretation of signals

After noticing a signal the findings show that the interpretation is strongly shaped by individual-level experience, judgement and prior knowledge. The most influential factors affecting interpretation are identified to be experience and intuition at the individual-level. Across roles and experience levels individuals at some point have to rely on accumulated knowledge and subjective judgement. This is likely a result of the lack of formal analytical processes. The findings indicate that interpretation at the individual-level appears to function as a filtering mechanism within the process of sensing. Noticed signals go through the evaluation of individual actors who evaluate their relevance and determine which signals undergo further development through interaction and which are ignored or shared. Indicating that interpretation does not only shape

understanding but also influences which signals become organizationally visible. This indicates that interpretation is strongly shaped by the cognition and prior experiences of individuals, introducing biases and variation in how signals are evaluated and escalated within the organization.

At the management level, prior experience and industry knowledge was repeatedly emphasized as key mechanisms for interpreting ambiguous signals. One interviewee described the interpretation process of a signal that was later acted upon as follows:

"I had previously been in a somewhat similar situation...where we solved the situation with this digital development where we then improved the service and now I right away started to think that we also need a technological solution" Interviewee 2

"The experience helped... for me it was quite easy to understand that wait a moment this is an opportunity" Interviewee 2

This suggests that interpretation even at the management level does not rely on pure analytics but pattern recognition which are developed through experience, indicating that every signal is not evaluated individually from scratch but framed and compared based on previous encounters with similar situations.
Similarly to experience, intuition was mentioned at the management level more than on the operational level. Intuition can be seen as a complementary level for experience. This was highlighted by interviewees as initial interpretations often emerge quickly before deliberate analysis.

"Intuition often tells that there is something here, but after that the more precise thinking process begins" Interviewee 2

This suggests that the initial interpretation process often begins with rapid intuition-

driven assessment, which is later refined through interaction, discussion and consideration.

The interpretation at the operational level was found to be more subjective. This is essential because individual interpretation at the operational level was identified to act as a filter for which signals noticed at the operational level reaches the decision-makers. This relies heavily on individual perception of meaning as one respondent described:

"If it is found meaningful enough then one tells it... It is kind of the responsibility of the observer." Interviewee 1

Indicating that operational level interpretation acts as a gatekeeper for signal escalation. Signals which move upward within the organization are selectively filtered and chosen based on individual judgement, thus creating a dependency on the personal threshold of relevance, which changes between individuals. Initial interpretation is decentralized and highly dependent on individual judgement. Different actors with different experience and level of knowledge may therefore interpret similar signals in different ways, leading to variation in what information is escalated further in the organization.

The seniority of the employee was also identified to influence the threshold of escalation towards top management. Of the three operational employees the junior expressed that he has to be extremely sure that his matter is relevant, the one with a bit more experience expressed some form of uncertainty before escalation and the most senior one expressed that he can call the CEO with no hesitation. Also while the senior goes directly towards the top-management with his observations, the junior employees often discuss together and with their supervisors before escalation, indicating that when a signal is noticed at a lower level in the company it has to go through more

interpretative filtering before it reaches decision-makers, which may increase the risk of signals being lost. The variation in escalation thresholds creates asymmetry to the sensing process. Signals which originate from entry-level operational employees are likely to be delayed, filtered through multiple lenses or lost at the source with no escalation at all, thus increasing the risk of information loss. More experienced employees can bypass the filtering system thus more directly affecting and contributing to organizational decision-making and sensing.

Even though interpretations based on intuition, industry knowledge and prior experiences were identified as sources of competitive advantage, they also create biases. In some cases signals were interpreted through assumptions based on previous market developments. For example one operational interviewee described how expectation of market recovery may have influenced decision-making.

“Often the market has recovered (In similar situations)... so we may have been too relying on that.” Interviewee 3

This showcases that cognitive mechanisms based on prior experiences enable rapid and efficient interpretation, but they can also lead to underestimation of changes within the environment due to systematic biases. When external signals are interpreted through existing frames there is a tendency to align them with prior events and expectations. As a result, signals which do not fit the existing assumptions can be underestimated or dismissed based on a non-relevant frame, which may lead to certain signals being underestimated or dismissed.

Overall, the data suggests that individual-level interpretation plays a crucial role in shaping how signals are filtered and escalated. Through interpretation signals are filtered, framed and selectively escalated, making it highly affected by individual judgement. Experience and intuition enables fast interpretations under uncertainty, but they create bias and variability in what signals are noticed, shared and acted upon.

Initial interpretations are often formed individually but they rarely remain unchanged within the sensing process. Initial interpretations serve as the preliminary assessments which undergo further refining, challenging and reinforcement through social interactions.

4.3 Interaction-based development of interpretations

After the initial interpretation phase, the findings indicate that the signals do not remain at the individual level, but are ultimately developed through social interaction and validation within the organization. The data indicates that interaction processes play an important role in determining how signals are understood and which signals gain further organizational attention and not only as a process of sharing interpretations. Signals are ultimately validated, challenged or dismissed indicating that collective understanding appears to emerge through interaction rather than aggregated from individual views or interpretations. This highlights that interpretation is collectively constructed through interaction.

When collective interpretation occurs at the operational level before the signal goes through management´s evaluation, it is primarily driven by informal discussions rather than structural processes. Interviewees described how they typically share and interpret signals:

“Probably mostly informal discussions... normal conversations and meetings, but not a clear channel” Interviewee 1

“I first ask AI it then tells me what opportunities there is and what it sees as challenges. Based on that I go it through with others involved with the topic, so that has developed in to a way of doing this for myself....I can become aware of multiple models and alternatives and based on the form some form of a thought what could be the new thing..... Often like this, also often directly discussion... In a way I like to know what I talk about” Interviewee 3

These highlight that there is no standardized way for collective interpretation but understanding emerges from ongoing dialogue between individuals, which is affected by their previous understanding and background work. The “ways of doing things” as described by Interviewee 3, affects the conversations and discussion leading to collective interpretation, thus individual habits and cognition can be seen to be a major influence in this step.

In addition, the operational employees consistently mention that signals are discussed with those whom they perceive relevant regarding that specific information, thus suggesting that the approach is also context-dependent. This can be observed for example from what Interviewee 1 describes as follows:

“If something comes up, then I discuss with those who are affected by it and we go it through” Interviewee 1

This indicates that the interpretation process is socially situated and selective rather than organization-wide. This also supports the previous statement of Interviewee 1 arguing that the one who notices a signal carries the responsibility for it. Furthermore this highlights that the social factor of interaction processes is highly selective. Signals are processed through a selected content-fixed group rather than organizationally, meaning that the development relies on who is perceived as needed to be included in the discussion. Resulting in some signals gaining momentum and some remaining peripheral from the broader organization.

The organizational structure of the case company further reinforces the informal way of interaction and sensing. The flat hierarchy of the company enables direct communication across levels and units, thus making it easy to share observations without formal escalation.

“There is not a stiff hierarchy.. one can be quite directly in contact” Interviewee 1

“One could use a trend term like lean, meaning that we are lightly structured and one can take a call to the CEO or Board or Head of Sales..” Interviewee 3

This allows rapid exchange of information and indicates that interpretation processes are not systematically coordinated.

Again at the management level where strategic decision-making occurs, the process of interaction-based interpretation is more explicit but remains somewhat discussion- and context-based. Decision-makers describe how decisions are formed through social interaction:

“We engage in a lot of debating within the management team before we make decisions and quite much sparring with the board aswell... But there is not an established model or process to how it goes, so we discuss a lot but.. a little bit like case by case basis” Interviewee 2

Indicating that shared understanding among the key decision-makers is made through iterative discussion rather than formal analytical processes. The influence of individuals within these discussions is likely not evenly distributed. Individuals with stronger experience and expertise in a specific area may have a stronger impact on how certain signals are processed. Meaning that interpretation outcomes are highly linked to the individuals involved in interaction and not merely the content.

When relying on informal interaction variability is introduced. When structured mechanisms are non-existing effectiveness and quality of interaction-based interpretation is highly dependent on who is involved in the discussions and how actively signals and information are shared. This results in an informal process where some signals gain more attention and are developed further while others remain localized and fade out. In

addition, this increases the importance of cognitive diversity within the decision-makers, which was also highlighted by Interviewee 2:

"I have a feeling that we have a good amount of different perspectives available... very different type of people and different roles and different backgrounds... We can think about things diversely." Interviewee 2

This highlights the importance of deliberately structuring the board of directors and the management board in a way which is cognitively diverse and encourages debate, different perspectives and different knowledge areas, making up for the lack of formalized structure in the interpretation process. While cognitive diversity is identified to be a positive contributor to interaction-based interpretation, it is only effective if the participants are active and take part in open discussion. Without deliberate inclusion of participants there is a risk that dominant perspectives guide the discussions and force existing assumptions.

The interaction processes act as a bridge between individual interpretation and organizational responses. Overall the findings suggest that interaction-processes are a critical factor but remains relatively informal in the case company. Interpretations and meaning is constructed through interactions and negotiation. This enables flexibility and effectiveness, however it creates inconsistency in how signals are collectively understood and escalated across the organization.

4.4 Structural and process-related sensing process

The data suggests that sensing activities are closely linked to organizational context, which is identified to be shaped by structure, communication and the distribution of roles. Rather than being an isolated independent capability sensing is embedded in and emerges from these contextual conditions, which enable and constrain how signals are noticed, interpreted and shared through individual and interaction-level mechanisms.

One of the most consistently found enabling factor is the flat hierarchy of the case company which was highlighted especially on the operational level. Interviewees described how a low hierarchy enables direct interaction across different levels within the organization.

"We are in quite close collaboration with the top management daily, so if there is a need it (Information) reaches them quite quickly" Interviewee 4

This creates a foundation for rapid interaction and information sharing, and makes it easier for the ones who notice signals to share their observations without the burden of formal escalation. This also supports the access to multiple different perspectives allowing cognitive diversity from the beginning. In this sense the structure supports responsiveness and accessibility. However the lack of formal structure creates ambiguity in how different individuals communicate and interpret signals. This suggests a paradox within the organizational context of the case company, where the same factors are associated with information flow and responsiveness also create barriers in the same actions. Without formal structures signals remain dependent on individual-level actions and initiative which can cause delays and breaks in information flow despite the structure creating the ease of communication

The interviewees consistently mentioned the absence of formal communication channels regarding market-related signals noticed.

"More those conversations when passing by, so just those informal conversations, not an actual formal channel, or at least I haven't used any formal channels ever" Interviewee4

The findings also highlight the challenges related to complexity among different business units. The presence of multiple business units and different roles across the units

limits how signals move through interaction processes across the organization. As interviewees explained:

"We have multiple different businesses and different type of customers. So no one is directly involved with every employee and every business unit in their everyday even though the company is small... The more the organization should share thoughts and signals... the challenge is if those signals reach the decision-makers" Interviewee 2

This is a result of strategic decisions to grow through acquisitions mentioned by the key decision-makers. The fragmented structure may result in signals remaining localized within specific parts of the organization, without reaching the relevant decision-makers. The fragmented structure of the company makes it difficult to form a coherent organizational understanding of the external environment, because signals may remain at specific units or roles preventing them from reaching broader strategic discussion. This creates a risk for a layer of local sensing within the company.

In addition delays in information flow were identified as a recurring issue, which can seem contradicting to the ease of communication enabled by the flat hierarchy. Interviewees identified situations where information has not reached relevant actors in a timely manner, thus hindering the response time and weakening the effectiveness of sensing. A delayed flow of signals to the decision-makers appear to hinder the organization´s ability to respond. Suggesting that even if a signal passes the individual filtering and is shared, breakdowns in interaction and information flow can disrupt the sensing process.

"Maybe more in our own operations there has been some need for improvements which has not reached management in timely manner, therefore it has been difficult to react" Interviewee 3

However, the information breakdowns due to the organizational structure were also often more operational and key decision-makers believe that information flow regarding strategically relevant signals is fluent. Interviewees suggested that ownership involvement supports the information flow of strategic related issues.

"We have quite big twenty shareholders here who actually a big part of the management are also involved in this" Interviewee 5

"We have a lot of shareholders involved.. I would say those who are key actors and majority of out management... so for sure everyone has their own interest regarding that information flows and we know where we are." Interviewee 6

Within the specific case company it was also emphasized that their evaluation often also involves internal resource evaluation as they have consolidated several operational units. One interviewee described that internal capabilities have acted as signals to provide new and innovative solutions to the markets as decision-makers of all units have engaged in discussions of their consolidated capabilities. Thus the organizational context and growth phase of the company also acts as a source for signals emerging through interaction among decision-makers.

"Of course we monitored that market and current incumbent competitors and what they do and we noticed that there is for sure a place for our capabilities... It emerged from discussion with the whole shareholder team (key members from consolidated companies) and we where thinking what should we do together" Interviewee 6

Overall, the findings suggest that the organizational context both enables and constrains the integration of signals from different parts of the organization. Signals are gathered in multiple locations with localized processes, due to a lack of a systematic process to consolidate them into an organizational understanding. The organizational context has a dual role in shaping sensing. Flat hierarchy and informal structure enable

fast interaction and access to decision-makers, while the lack of structure creates inconsistencies and breakdowns in information flow. In the case company sensing emerges from and is constrained by the structural and processual conditions of the organization.

4.5 Divergent response patterns following sensing

The findings suggest that weak signals are frequently noticed, interpreted and discussed within the case company, however the transition from sensing processes to action often remains inconsistent. Signals do not automatically lead to strategic action, but certain barriers at individual, interaction and organizational levels were identified which may cause ineffectiveness in strategic decisions. The operational and managerial levels were identified to be highly interactive and relying on one another. Managerial actions can both enhance and hinder the benefits gained from signals noticed at the operational level. The link between sensing and action is obscure and dependent on several intervening factors.

At the operational level signals often lead to interaction and discussion but rarely into concrete actions, which is normal due to signals being more operational than strategically relevant. One interviewee described how observations are shared and discussed but do not lead into action.

“we have had various conversation, but then has there been anything done? maybe not” Interviewee 1

This shows that while sensing occurs it does not always lead to decision-making or implementation. One important factor appears to be the several barriers emerging from individual-level interpretation and evaluation of those who receive the signal and whether they perceive it as strategically relevant.

At the management level delays in responses were explicitly noticed. Interviewees from both management and operational levels acknowledged situations where relevant signals in the environment were noticed but actions were taken too late or an opportunity was missed. This highlights that there have been gaps between recognizing and acting based on a signal, which can lead to a missed opportunity or the realization of a threat, thus resulting in losing competitive advantage. The reason for delayed or passed decisions was identified to be uncertainty and the ambiguity of signals. It was also highlighted that often this has been the right course of action, as a lot of signals are noticed but only a few of them are relevant when they become clearer. Uncertainty leads to more cautious decision-making and postponed decisions. Key decision-maker interviewees highlighted that if interaction processes do not provide a clear consensus they have to look for or wait for more information in order to make a decision.

"There has been some cases where some business opportunities has gone by because we have not believed that something is good business or some things would have demand. We have later believed in them and competitors have kind of already taken that business in control for example regionally. Generally patience and consideration has been for the good but sometimes we have considered for too long" Interviewee 2

As mentioned this reduces risk and the case company has identified this as a way of reducing incorrect decisions, however it also increases the risk of delayed response especially in dynamic environments and markets like the one in which the case company operates in. Uncertainty acts as a weakening factor between sensing and action, because signals are ambiguous and decision-makers avoid risk and gather more information. This cautious approach can result in missed opportunities particularly in the environment of the case company.

In addition a limiting factor that was brought up by the key decision makers was the deliberate strategy of the organization. The organization selectively chooses signals based on perceived clarity, consensus and alignment with existing strategies. This creates a coherent strategic execution but personal commitment to the deliberate strategy risks overlooking emerging strategies.

"We are opportunists in that sense... if we notice that there is an opening somewhere, we tend to act on it quite readily... But at the same time I´d say that maybe the way we operate and our strategy is here... I would want to say that it (strategy) is locked for some time" Interviewee 6

A key distinction between operational and strategic responses appears to be the level of proactiveness. At the operational level responses often remain reactive. Actions are taken only after signals become fully visible rather than in the early stages of the signals, suggesting that early-stage sensing is not always fully utilized.

The reflection on a reaction was also described as difficult due to the retrospective nature of the reflection of decisions.

"We have reacted when we have noticed, it is easy to retrospectively say whether it was late or not" Interviewee 1

Responses were also identified as too vague at some instances. Signals were noticed and perceived as strategically relevant, but actions remained insufficient. At the managerial level it was identified that uncertainty and lack of consensus strengthens the risk of vague or delayed response, while strong intuition and experience-based interpretation of an opportunity increases the likelihood of proactive strategic action. Similarly experience from a beneficial delayed response may increase the likelihood of a delayed response. As one interviewee describes their reaction to a change in the

competitive landscape:

"We had reacted but in my opinion not as radically as we needed... why this type of reaction was made, Our top management has a lot of experience from this field... normally these type of market conditions have been managed by (moderate response)" Interviewee 3

These operational level insights often build up into the managerial level decision-making, thus making them relevant in the context of organizational sensing process. The company has successfully made several actions based on weak signals, where the action was rationalized based on the following structure Signal, Individual-level interpretation, heuristics, interaction-based validation, problem analysis, opportunity and business analysis, execution. This describes a process through which signals may develop into strategic action. The transition from sensing to action is influenced by cognitive, social and organizational factors. The multi-layered process introduces inconsistencies, delays and ultimately a gap between sensing and action.

"Based on conversations and actions with customers we got signals that these things should be in better condition... I have previously been in a similar situation... where we solved it with digital development... I started to think that this should also have a digital solution... we started to draw out the problems and think what kind of a solution technology could provide and what it would mean for the business and the customer service... this was in 2023 and in 2024 we already had concrete development regarding the issue" Interviewee 2

Overall, the findings suggest that sensing capability does not always ensure strategic action or ensure its timing or effectiveness. The transition from sensing to action is often shaped by uncertainty, risk considerations, organizational constraints and subjective experiences. This can result in delayed responses to noticed signals or into responses which are limited or reactive. However every signal should not be acted upon

and it is difficult to determine the correct amount of caution as the interviewee mentioned. This suggests that sensing capability is ineffective and useless without the existence of working decision-making and execution, thus making sensing capability´s results also dependent on seizing and transforming.

4.6 Summary of key findings

The findings suggest that sensing capability within the case company is not a structured organizational process, but a multi-layered emergent phenomenon which is unevenly distributed and shaped by individual actions, interaction processes and organizational structures.

Firstly sensing is often triggered by boundary-spanning roles primarily in customer-facing activities when individuals capture weak signals from fragmented and ambiguous observations. It is Important to note that this is not tied to a specific role as customers and competitors were consistently mentioned as the source of these signals across roles. The signals are not captured systematically but they emerge in everyday interactions, making noticing or early signals highly dependent on individual exposure rather than an organizational system.

Secondly the interpretation process often begins with individual evaluation of the relevance of the signal. This creates the first barrier to what is then escalated into interaction-based interpretation. Individuals have different ways of engaging in individual interpretation which is affected by prior experiences, heuristics and knowledge. As a result signals are interpreted in a fragmented manner which results in variation of interpretation. The interpretation of the signals that reach or are captured at the management level are often selectively framed based on past experiences, which can both enhance and distort strategic understanding.

Thirdly sensing is inherently interaction-based. Despite the signal or the actor,

interaction processes and collective interpretation were the prominent way of evaluating. Signals chosen for further development are developed through informal discussion and interaction-based evaluation where information and perspectives are negotiated rather than handled purely analytically. The lack of structure results in variability in how signals are shared, interpreted and validated within the organization with variation existing between roles.

Fourth, the organizational context acts both as an enabler and constraint shaping individual and interaction-level processes of sensing capability. Flat hierarchy and easy communication enables rapid information exchange and accessibility of relevant actors, however the lack of formal structures and the existence of organizational fragmentation lead to inconsistency and breakdowns in information flow. Signals do not systematically reach the decision-makers.

Finally a critical gap lies between sensing and action. A key finding is the weak and inconsistent link between sensing and action. Signals are frequently noticed but the transition into timely and effective action is obscure. The prominent barriers to decision-making are uncertainty and ambiguity, leading to more reactive rather than proactive responses. In some cases this can lead to loss of opportunities, insufficient responses and lastly to loss of competitive advantage.

These together create a dynamic loop of sensing. The signals which go into further development and lead to actionable decision, delayed decisions, captured opportunities, realized threats or missed opportunities shape the future individual-level interpretations and interaction processes. The learning loop is especially relevant for a company such as the case company where decisions often rely on past experiences, industry knowledge and intuition as all of them are affected by the learning loop.

Overall, the findings suggest that sensing capability is not a standalone or isolated capability but rather an emergent capability shaped by individual-level filtering,

interaction-based validation and organizational structure. Together creating the foundation for how effectively a company can act based on weak signals.

Based on the findings, the research question " How do SMEs engage in sensing environmental change under conditions of uncertainty?" can be answered as follows Sensing in SMEs emerges as a distributed, constant process. SMEs engage with the external environment through individuals across organizational levels, receiving signals from customers, the macro environment, operational-level input and interaction. Rather than formalized roles or strategic analytical tools, sensing is enacted in everyday organizational activities in which signals emerge, are filtered and interpreted based on prior experience, attentional focus and knowledge areas.
Operational employees play a role in sensing as initial contact points for many signals related to customers and competitors. Signals at the operational level become strategically relevant when they are interpreted and validated across organizational levels, indicating that sensing is not solely a top-down process but an interactive process where bottom-up inputs are selectively raised and shaped through individual and interaction-level processes.

Uncertainty shapes sensing processes to be interpretive rather than formal. Enactment occurs through continuous interpretation of signals and future developments. The process is enhanced through cognitively diverse interaction aiming to challenge, refine and validate interpretations. In SMEs the structure is informal which guides sensing enactment. Interaction often occurs informally, which enables rapid interpretations and decisions, however this was identified as increasing the risk of bias due to dominant cognitive frames. Sensing reflects an interplay between individual actions, interaction-based validation and contextual constraints, supporting the view of sensing capability as an emergent process rooted in ongoing activities across the organization.

The multifaceted enactment of sensing is also dynamic. Findings suggest that

successful adaptation, delayed responses and deliberate non-actions all resulted in a learning loop, thus shaping future interpretation and interaction processes of sensing. Therefore the enactment of sensing is inherently dynamic when it comes to interpretation and interpretation processes.

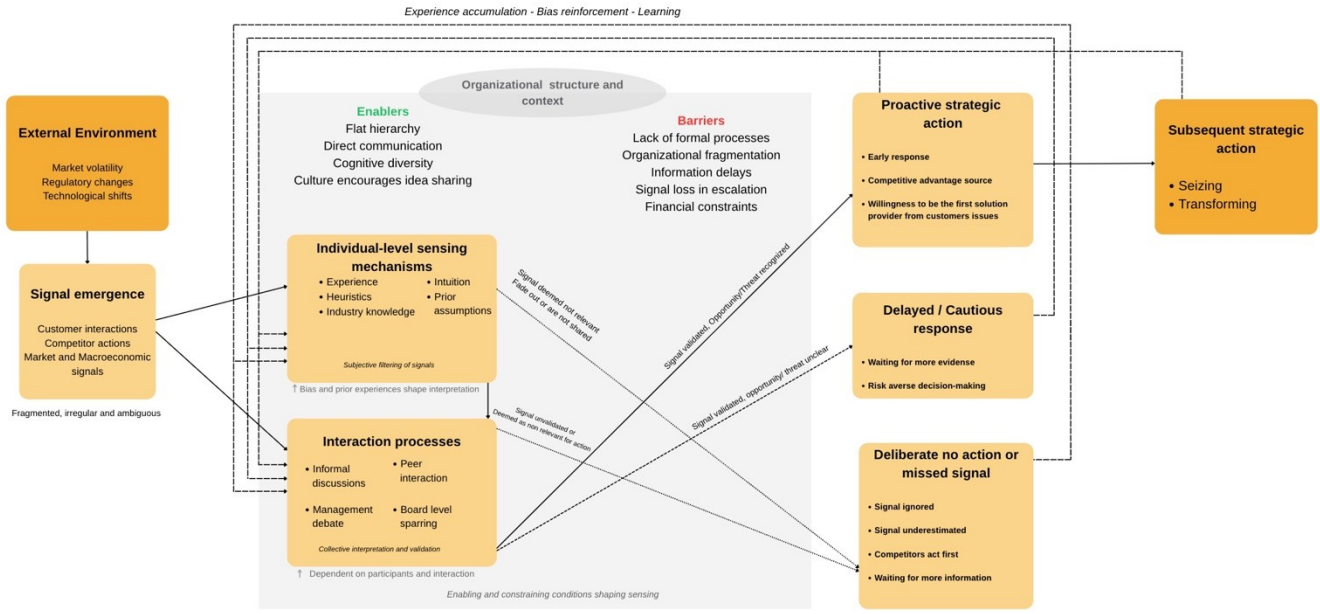

Figure 6. Refined theoretical framework

5 Discussion

5.1 Theoretical contribution

This study contributes to the dynamic capability and microfoundations literature with a clear focus on sensing capability by providing a more detailed and empirically grounded understanding of how sensing emerges in SMEs. Prior research has established sensing as a crucial part of dynamic capabilities (Teece, 2007; Teece, 2018), however it has remained abstract and uneffectively specified at micro level. This study addresses the gap by identifying concrete mechanisms through which sensing emerges in practice.

The study contributes to addressing the "black box" of dynamic capabilities, by specifying the underlying microfoundational mechanisms of sensing capability across individual, interactional and structural levels. Rather than treating sensing as an abstract organization-level attribute the study identifies sensing as a multi-level filtering process that consists of individual-level evaluation, selective escalation and interaction-based validation. These mechanisms describe how sensing emerges across levels, shifting the conceptualization of sensing into a dynamic and multi-level process instead of a static capability of signal detection and evaluation. This aligns with prior work emphasizing the need to better operationalize and unpack the underlying mechanisms of dynamic capabilities (Pavlou & El Sawy, 2011). It is important note that sensing as a microfoundational process emerges through interplay of individual actions, interaction processes and organizational structures together forming the multi-level iterative process.

This extends prior literature on microfoundations (Felin & Foss, 2005; Helfat & Peteraf, 2015) by highlighting that sensing is not only rooted in individual-level actions but in addition is affected by whether individual interpretations become socially validated and organizationally visible. This implies that sensing is not merely about identification and interpretation of opportunities (Teece, 2007), but about which signals survive the individual, interactional and structural filtering mechanisms. This study highlights the role of sensing as a filtering process of selection, shaping and reduction and is less

dependent on signal availability. This additionally extends the microfoundational perspectives which emphasize individual cognition and managerial cognition as key drivers for capabilities (Helfat & Peteraf, 2015), by showcasing that the interpretations emerging from individual actions must become developed through interaction processes and organizational structures in order to influence organizational sensing outcomes.

Second, the study challenges the assumption that sensing as a dynamic capability is a coherent firm-level attribute. The study suggests that sensing is highly fragmented, unevenly distributed and primarily dependent on individual exposure and initiative. Signals originate mainly from boundary-spanning roles with a focus on customer-facing activities, however the escalation of signals vary heavily across individuals. This suggests that sensing should be conceptualized as an emergent and distributed process, rather than a coherent organizational capability. This challenges the assumption that dynamic capabilities operate as organizational-level processes (Teece, 2007), by introducing the unevenly distributed nature of sensing.

Thirdly, the study the study further extends the prior research on interaction-level microfoundations by showing how informal and selective interaction processes shape sensing outcomes. The findings indicate that theses processes are not systematically organized in SMEs but occur through adhoc interactions. This results in interpretation processes being selective and context-dependent, thus some signals are further amplified while others fade out. The study thus extends the literature by highlighting the selective nature of interaction-based evaluation process.

Fourth, the study demonstrates a weak coupling between sensing and action (seizing), within the dynamic capabilities framework. Prior research highlights sensing as an enabler for seizing and transforming, however the findings suggest a crucial gap between signal interpretation and timely or effective action. Uncertainty, ambiguity and risk considerations act as key constraints on action which often delays decision-making, thus resulting in reactive and not proactive responses. This suggests that sensing is not

sufficient on its own for enabling seizing but its effectiveness is closely tied to decision-making processes and organizational conditions. This finding indicates that it is important to challenge the linear progression of sensing, seizing and transforming.

Lastly, the study highlights structural characteristics of SMEs. The study contributes to the SME literature by showing that characteristics such as flat hierarchy, direct communication and concentrated decision-making act simultaneously as enablers and constraints for sensing and its outcomes. These features enable rapid information sharing, but they also create inconsistencies and gaps in how signals are processed, escalated and interpreted. Organizational context serves a dual role highlighting that sensing capability cannot be understood independently of structural conditions through which it is enacted. The study reveals a structural paradox within sensing in SMEs, where the same factors enable rapid sensing simultaneously create inconsistencies and breakdowns in information flow.

Overall, the study provides a more coherent empirical grounding for specifically sensing capability, while prior studies have focused mainly on dynamic capabilities as a whole. By solely focusing on sensing within these contexts the study provides a clearer and robust understanding of sensing within SMEs. Sensing capability is reconceptualized as a multi-level, emergent and context-dependent process, rather than a stable organization-level attribute (Teece, 2007). This clarifies how sensing operates under conditions of uncertainty.

5.2 Managerial implications

The findings suggest that sensing in SMEs does not fail due to lack of information but due to the filtering and interpretation of information, which determine the action. This provides several relevant managerial implications. Managers in SMEs should concentrate on how signals are filtered within the organization, including clarifying what type of signals are relevant, how they should be shared and how interpretation takes place within the organization.

First managers should acknowledge that sensing is highly dependent on individual initiative across the organization, particularly when signals originate from the operational level. Employees in customer-facing roles may act as primary sources for weak signals, yet mechanisms for capturing these signals remain limited. This introduces a risk that relevant information remains localized or is lost entirely. To avoid this managers should introduce lightweight but consistent practices assigned to signal sharing, this can be done through regular structured discussions or reporting routines. The goal of these activities is not to overly formalize sensing, but reduce randomness in how signals are escalated. Frequent check-ups also makes it easier to prevent information overload and discard irrelevant signals. The main reason for these practices assigned for signal sharing is to reduce the reliance on individuals to find time and space to share signals. It is important to note that these activities should remain lightweight as excessive formalization in SMEs may reduce the flexibility which acts as an enabler for sensing.

Secondly the findings and prior research highlight the importance of cognitive diversity. Interpretation and sensing as a whole are heavily affected by prior experiences, knowledge, thus homogeneous management teams reinforce existing cognitive frames and biases and may cause the overlooking of opportunities. Firms should from the beginning be constantly aware of the cognitive diversity and actively ensure diversity in backgrounds, perspectives and expertise within management and the board. If a firm fails to do so, informal interaction processes creates the risk for bias and path-dependence, due to selective attention created by existing mental models.

Thirdly, managers should be aware of their own biases emerging from their experience and intuition. While these allow rapid interpretation, they can easily lead to over-reliance on past patterns and underestimation of future change. To avoid negative bias managers should engage in deliberate reflection practices, where their assumptions are challenged and alternative interpretations are demonstrated. These reflective activities should also include the critical thinking of where ones intuition and

interpretations arise from, and what is the actual cause of a prior success or failure, which drives these underlying assumptions. Without these reflective practices there is a risk of reinforcing existing strategic trajectories without enabling adaptation.

Fourth, the study highlights the critical gap between sensing and action. In some cases when relevant signals are noticed they remain unacted upon or responded with delayed response due to uncertainty and risk avoidance. While caution is also identified as a necessary and a positive factor, excessively done it increases the risk of missed opportunities. Managers should therefore clarify criteria for decision-making under uncertainty, guiding when to act based on incomplete information. This can include thresholds and simple rules which guide action and reduce reliance on ad hoc judgement. It should also be recognized that the initial action based on a weak signals does not mean full commitment. Early exploration can reduce the risk of delayed response without significantly increasing risks.

Fifth, in SMEs the organizational context should be evaluated as a critical factor influencing sensing. Flat hierarchies may encourage rapid communication, however the lack of formal processes may risk inconsistency in information flow. Informality should be balanced with structural minimalism. Otherwise fragmentation can cause the loss of utilizing organization´s full sensing potential.

Overall the managerial implications to improve sensing capability do not require complex systems as the implications remain microfoundational. This study highlights awareness and deliberate management of cognitive, interaction-level and structural mechanisms. Without addressing these underlying factors, investments in more structured data or analytical tools and processes may remain limited in in their improving effect for sensing effectiveness.

5.3 Limitations and future research

Despite the contributions of this study it has several limitations which have to be acknowledged.

First, the study is based on a single case study within one SME operating in the Finnish construction industry, which limits the generalizability of the findings. While the study is aimed at being analytical rather than statistical, the specific industry context, which is characterized by project-based operations, market volatility and regulatory factors may influence the findings of how sensing is emerges. Future research should examine different industry contexts to explore the transferability of the findings. In addition the emergent nature of sensing creates sensitivity to the company context, thus the findings may not be generalizable to organizations of different structure.

Secondly the study relies primarily on interview data with a relatively small number of interviews. This introduces the potential for biases and subjective interpretations. When discussing past decisions interviewees may rationalize them retrospectively or overemphasize certain parts of the sensing process. Even though multiple perspectives were included, future research could benefit from observational or longitudinal data to give a better understanding of how sensing unfolds in real time. Future research should include real-time process tracking by observation, particularly regarding the filtering processes which were inferred from the data in this study.

Third, the study focuses on microfoundations of sensing, placing less emphasiz of formalized processes in comparison to individual and interaction mechanisms. This is consistent with the microfoundational approach, however it limits the ability to examine formal systems, tools and routines which may affect sensing. Future research could examine the intersection of formal structures and micro-level processes, especially for SMEs which are transitioning towards more structured processes.

Fourth, the study identifies the crucial gap between sensing, decision-making and

action, but it does not include seizing and transforming phases. This limits the ability to fully understand sensing outcomes in practice and how they translate into strategic change. Future studies should implement a more integrated approach to studying sensing and how it interacts with decision-making and execution.

Fifth, the findings highlight the cognitive biases and heuristics but they remain somewhat reasoned than directly measured. This could be assessed in the future by implementing more cognitive or behavioral methods to capture how interpretations are formed and how biases influence decision-making.

Finally, the study remains limited in the number of participants included. As a company grows the mechanisms identified in this study may become insufficient or evolved over time. Future research could benefit from examining how sensing capability evolves as a company scales focusing on whether formal structures enhance or hinder sensing, as they were identified to be both enablers and constraints.

Overall, the study provides a detailed and contextually grounded conceptualization of sensing in SMEs, however further research is needed to test and refine the findings of this study across different contexts and methodological approaches. Future research could benefit from empirically testing the multi-level sensing process and examining how filtering mechanisms operate in different organizational contexts.

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Appendices

Appendix 1. Semi-structured interview questions for decision-makers

Background and Role

1. Could you describe briefly your role in the company, and involvement in strategic decision making?
2. How would you describe the decision-making structure in your company?

Environmental signals

3. What kind of changes have you observed recently in your operating environment?
4. Where does these changes typically emerge from? (customers, competitors, regulation, technology, networks...)
5. Can you describe a situation where you noticed a weak or early signal of change, before it was clearly visible in the industry?
6. How did you initially react to that signal?

Interpretation and managerial cognition

7. How do you determine if a signal is strategically relevant?
8. How do you evaluate if a change is an opportunity or a threat?
9. What factors influence your interpretation of environmental signals? (Prior experiences, intuition, data, discussions, industry knowledge...)
10. How do your prior experience and industrial knowledge affect your interpretation

Attention and strategic judgement

11. What kind of issues and changes typically capture your first attention when monitoring the external environment

12. How do you prioritize which issues or changes require further attention
13. Do you rely on rules of thumb or experience based principles when evaluating potential opportunities or threats

Sensemaking and social validation

14. Do you discuss your interpretations before making strategic decisions?
15. How is a shared understanding about important changes usually formed within your company?
16. Have your or does your initial interpretation change based on these conversations?

Organisational Context

17. How does the size and structure of the company influence how changes are noticed and interpreted?

Reflective question

18. Can you describe a situation where your company recognized an important change too late, if so why do you think it was not recognized earlier and what did you learn from it?

Appendix 2. Semi-structured interview questions for operational personnel

Role and work context

1. Could you briefly describe your role in the company and daily responsibilities
2. How often in your work do you encounter information about changes in markets, competitors or customers?

Observing environmental changes

3. What kind of change have you recently observed in your work environment?
4. Where do these changes typically appear first? (for example customers, competitors, suppliers, regulation etc)
5. Can you recall a situation where you encountered a change or a signal before it was widely discussed within the company?

Communication of signals

6. When you notice a change or something unusual in your work, what do you typically do?
7. How are such observations typically communicated within the company?
8. Are there formal or informal ways of sharing this type of information?

Interaction with management

9. Do you typically discuss these observations with management or supervisors?
10. Can you describe a situation where you noticed something and it led to a discussion or a decision in the company?
11. How does the management typically react when employees bring up new information or signals?

Information flow

12. How does information regarding customers, market and competitors typically move in the company?
13. Do you recognize a situation where important information does not reach the decision-makers?

Organizational context

14. Do you feel that the employees are encouraged to share observations about changes in the market?
15. How easy it is to present new ideas to the management?

Reflective question

16. Do you recall a situation where a change in the environment was recognized too late? What do you think that caused that?

Appendix 3. Interview key themes

The concepts below represent the key themes guiding the interview. Key theoretical concepts of sensing capability, microfoundations and sensemaking may be interpreted in different ways, thus the descriptions below aim to ensure shared understanding between the interviewee and the interviewer.

Sensing capability

In this study sensing capability refers to the firms ability to detect, interpret and evaluate changes in its external environment. This includes identifying emerging opportunities and threats under conditions of uncertainty.

Sensing cannot be described by passive environment scanning, but active interpretation and shaping of perceived challenges and opportunities. Sensing precedes strategic action and shapes the foundation for upcoming decisions and commitments (Teece, 2007).

Sensing is particularly relevant in uncertain environments, where market signals are weak, ambiguous and rapidly changing.

Microfoundations of Sensing

The microfoundational perspective in the study aims to emphasize that organizational capabilities are partially of fully driven by individual-level actions, cognition and interactions (Felin & Foss, 2005).

In the context of this study, sensing is examined through individual perception of environmental signals, attention allocation, interpretive framing and managerial judgement. Although sensing capability is an attribute of the firm it is ultimately enacted by individual decision-makers influenced by factors created by a specific organisational context.

Managerial cognition

Managerial cognition ferers to the individual-level cognitive process managers go through in order to interpret and evaluate environmental signals (Helfat & Peteraf, 2015).

In the context of this study managerial cognition is examined through attention, perception, framing and judgement. This allows the study to discuss what is noticed, how these signals are recognized, how signals are interpreted to be opportunities or threats and how decisions are formed under uncertainty.

The environmental signals are often ambiguous and weak, meaning that interpretation often relies on prior experience, industry knowledge and cognitive schemas.

Sensemaking

Sensemaking is the process through which individuals create meaning from ambiguous or uncertain situations (Weick et al., 2005). In the context of this study sensemaking highlights that environmental changes does not automatically carry meaning, managers actively engage in interpretation and that meaning if often a result of discussion and social interactions.

Sensemaking therefore closely links into how sensing capability is enacted in practice, especially under conditions of uncertainty.

Organisational Context in SMEs

The context of SMEs provide an distinctive structural context for examining sensing capability. SMEs typically have less structure, centralized decision-making, informal channels of communication and limited analytical capabilities or resources.

In these settings sensing activities often link closely to cognition and judgement on individual-level. The study does not treat organisational structures as a separate level of analysis, but as a contextual condition.

Environmental Uncertainty

In the study environmental uncertainty refers to situations where future developments are difficult to predict, information is ambiguous or incomplete and changes can emerge through weak signals or rapid shifts.

Environmental uncertainty increases the need and importance of accurate interpretation, attention allocation and managerial judgement in decision-making.

Appendix 4. Interview overview

	Interviewee	Role	Interview duration
Top Management	2	CEO	45min 10sec
	5	CCO	49min 41sec
Middle Management	6	HR & Administration Manager	47min 53sec
	3	Sales Manager	38min 46sec
Operational	1	Sales	28min 56sec
	4	Sales Junior	41min 7sec

Appendix 5. Data Structurization