BUSINESS MODEL INNOVATION: THE ROLE OF THE TOP MANAGEMENT'S COMPOSITION, COGNITION, AND KNOWLEDGE SOURCING STRATEGY

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ABSTRACT

The overall purpose of this dissertation is to investigate business model innovation (BMI) in established firms, and to determine what role a firm's top management team (TMT) plays in facilitating such efforts. As business environments become more volatile, TMTs' ability to identify and implement BMIs becomes a source of competitive advantage. Notably, not all TMTs are equally well equipped to handle this responsibility. While an increasing number of studies point toward the important roles of cognitive and behavioral factors in the initiation and implementation of BMI, more empirically-driven research is required to understand the influence of TMTs' composition, cognition, and knowledge sourcing. To address these gaps, this dissertation contributes three empirical papers. The first paper is a case study that illustrates how features of organizational design steer the allocation of attention among top managers toward (or away from) BMI efforts. By linking organizational design theory with an attention-based view of the firm, the study identifies how organizational design influences the TMT's attentional perspective and attentional engagement towards BMI. The second paper investigates what compositional characteristics of the TMT are most conducive to BMI. Based on combined survey and registry data, and drawing on upper echelons theory, this paper shows how TMT composition (in terms of the diverse characteristics of members) is associated with the scope of the firm's BMI efforts. The third paper draws on complexity, open innovation, and organizational learning theories to provide empirical insight into the forms of external knowledge sourcing that increase the TMT's propensity for BMI. The study shows that the diversity and intensity of such knowledge sourcing are associated with the scope and novelty of a firm's BMI efforts. In sum, the findings of the three papers contribute new empirically-driven insights on the role of the TMT in BMI. Further, they highlight how firms may use organizational design, team composition, and

external knowledge sourcing to influence the TMT's propensity to initiate and implement different types of BMIs.

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INTRODUCTION

Why are some firms better at innovating their existing business model (BM) than others? There are several anecdotal accounts of firms that have struggled to innovate their BM, only to find themselves being surpassed by competitors that have exploited new opportunities more effectively. Examples of this include how Toys R Us failed in their multi-channel transition, which resulted in them being surpassed by Amazon, and how Nokia was surpassed by Apple and several other competitors after failing to recognize how internet connectivity increased the value of data and software in mobile phones. Research has also started to address this phenomenon of BM innovation (BMI). While it has been found that BMI is important to maintain the competitive position of firms over time (Deshler and Smith, 2011; McGrath, 2010; Zott and Amit, 2017), it is also the case that firms struggle in their efforts toward such innovation (Hacklin et al., 2018; Osiyevskyy and Dewald, 2015a; Teece, 2007).

In these struggles, the dominant coalition within a firm plays a key role. As BMI is a strategic issue that requires top management action, the top management team (TMT) has a central task in securing the necessary BM changes as new threats or opportunities appear (Foss and Stieglitz, 2015; Leih et al., 2015; Teece, 2010). Hence, a firm's efforts toward BMI must be seen in the context of how well the TMT is equipped to handle this responsibility. Currently, the BMI literature provides limited insight into why some TMTs are better equipped to handle BMI (Foss and Saebi, 2018), and consequently how to help TMTs handle this responsibility.

After entering academia following a long career in business, the difficulties associated with identifying and implementing BMI are not new to me. During my years as a consultant and senior manager, I had several opportunities to observe how BMI and the challenging role of the TMT play out in practice. First, I observed that, even in the face of big shifts in the external

environment, some TMTs failed to recognize the need for BM change. I observed this situation when the consumer adoption of internet services took off at the turn of the millennium, where a newspaper I worked for completely disregarded the transition to online distribution. About 10 years later, I saw a similar reaction when an insurance provider missed the transition to smart mobile devices as the main channel for digital services. In an effort to understand this phenomenon in more detail, I have found that established theories point to the issue of TMT attention. This attention is found to be a scarce resource that is often consumed by day-to-day operations, with no attentional capacity allocated to strategic actions such as BMI (Frankenberger and Sauer, 2019; Laamanen et al., 2018; Ocasio et al., 2018). The question arises how firms can ensure that the TMT allocates enough attention to the environmental shifts that warrant BMI. This points to a research gap in the BMI literature regarding how firms can steer the attention of top managers toward (or away from) BMI (e.g., Frankenberger and Sauer, 2019; Laszczuk and Mayer, 2020). Hence, I investigated how features of organizational design influenced the allocation of top managers' attention toward BMI. This was achieved through an in-depth, longitudinal case study of a Norwegian retail bank.

Second, I noticed that when the TMT composition of a firm in which I worked changed, the firm also seemed to be conducting more BMI. Again, this sparked my curiosity. Although there are findings in the TMT literature that point to how TMT composition affects performance in firms (e.g., Boeker, 1997; Carpenter and Fredrickson, 2001; Lyngsie and Foss, 2017), I started to speculate how this could be applied to BMI. For example, can TMT composition affect a firm's BMI initiatives and, if so, in what way? There is currently limited BMI research that targets what member characteristics within the TMT are beneficial for BMI efforts (e.g., Al Humaidan and Sabatier, 2017; Diller et al., 2020; Guo et al., 2013; Narayan et al., 2020). Hence,

I investigated the influence of TMT composition on BMI. This was achieved through a large-N study of Norwegian firms.

Third, I witnessed an increasing trend toward the use of more open ways of innovation in incumbent firms, such as partnering with accelerator environments, industry clusters, and research institutions. It has been argued that this trend mostly benefits product, service, and process innovation, prompting me to wonder about the effect it may have on BMI. Could it be that different uses of such external sources lead to different forms of BMI? Hence, my aspiration transformed into contributing to the current BMI literature with new insights into how access to external knowledge may help the TMT identify a possible BMI and overcome the associated constraints (Ethiraj and Levinthal, 2004; Levinthal, 1997; Nickerson and Zenger, 2004). By utilizing theories on open innovation, organizational learning, and complex systems, I investigated the influence of external knowledge sourcing on firms' BMI efforts through a large-N study of Norwegian firms.

The remainder of this introductory part of the dissertation is organized as follows. First, I provide an overview of the theoretical backdrop. Here, I start with the current state of research on BM and BMI before moving on to develop research questions and connect TMTs and BMI to related research fields (such as the attention-based view, upper echelon theory, and open innovation). Second, I present the method-related topics regarding the research design, data collection, and data concerns. Third, I provide an overview of the three papers in the dissertation, including aggregated descriptions of how they shed light on the research questions. Lastly, I conclude with a discussion of how my research findings contribute to a cumulative argument in relation to the role of the TMT in BMI.

THEORETICAL FRAMEWORK

The Concepts of BM and BMI

The fact that BMs have been studied for a long time without a clear definition of the concept has caused a multitude of interpretations to be utilized (Zott et al., 2011). In more recent studies, as found by Foss and Saebi (2017), most definitions of BMs are close to the definition proposed by Teece (2010, p. 172) as the "design or architecture of the value creation, delivery, and capture mechanisms" of a firm. The BM concept provides researchers with a comprehensive tool for describing the core logic of how a firm is organized to create, deliver, and capture value. It answers the following questions: who are the customers, what do they want, and how can the firm be organized to provide value and make a profit (Teece, 2010)?

Building on the above definition, Foss and Saebi (2017) found that a BM can be described along the following four dimensions: the value proposition, the target segments it addresses, the structure of the value chain required for realizing the relevant value proposition, and the mechanisms of value capture that the firm deploys. The value proposition defines what the firm offers to its customers. A value proposition can be transactional, focusing on selling a product or service to a large customer group (such as a grocery store). It can also be relational by tailoring solutions to each customer (for example, consultancy companies), and in platform models (such as eBay), the value proposition facilitates exchange between buyers and sellers. The target segments refer to who the firm's target customers are. Hence, it details which ones are relevant for the business and which ones are not. Examples of such target segments are the mass market and niche market customers. The value delivery determines how the firm communicates with and reaches out to its customers in delivering its value propositions. Firms can deliver value through their own activities or through partners' activities; hence, value delivery can also be direct (such

as sales forces and web sales) or indirect (such as partner stores and wholesalers). Value capture defines how a firm monetizes the value proposition. Examples of revenue models that monetize the value include selling products (such as H&M selling clothes), usage fees (such as hotels charging per number of nights), subscription fees (such as gym membership), and freemium models (such as Skype).

While the earlier literature mainly refers to the BM concept as a tool for enterprise classification or as an antecedent of heterogeneity in firm performance, it has more recently been considered a new source of innovation (Teece, 2010; Zott et al., 2011). Much of the motivation for this focus on innovation originates in the adoption of internet technologies that spurred previously unseen value propositions and ways of value capture at the turn of the millennium. This challenged the fitness of many traditional BMs (Demil and Lecocq, 2010; McGrath, 2010), and provided us with numerous examples of how firms may fail to reinvent themselves when the need arises (such as Borders, Tower Records, and Sony). Business environments in the last couple of decades have become characterized by even more discontinuities, technological disruptions, global competition, and complexity (e.g., Berends et al., 2016; Doz and Kosonen 2010; Schneider et al., 2017). Consequently, having the capability to look beyond familiar ways of doing business and find suitable paths for BMI remains as important as ever (Chesbrough, 2007; Egfjord and Sund, 2020; Teece, 2010).

As the innovation of existing BMs is an essential tool for firms seeking to maintain (or improve) their competitive fitness (Cucculelli and Bettinelli, 2015; Doz and Kosonen 2010; Massa and Tucci, 2014; Zott and Amit, 2007), BMI has emerged as a new unit of analysis that "complements the traditional subjects of process, product, and organizational innovation" (Zott et al., 2011, p. 1032). This has given rise to a new field in the research literature on BMI (for comprehensive reviews, see Andreini and Bettinelli, 2017; Foss and Saebi, 2017). While BMI

literature also touches upon the development of innovative BMs in new ventures, this dissertation expands on BMI research that addresses established firms with existing BMs. Here, BMI is defined as "designed, novel, nontrivial changes to the key elements of a firm's business model and/or the architecture linking these elements" (Foss and Saebi, 2017, p. 2). In my efforts to piece together the existing knowledge in this area, it was important to gain a deeper understanding of what makes BMI so challenging. One source of such challenges is that, unlike product, service, or process innovations, most firms do not have structures and resources in place to handle BMI (Chesbrough, 2010). Moreover, a BMI can take forms that affect the complex interactions between BM components, fundamentally altering many areas of the existing BM simultaneously (such as value creation, delivery, and capture) (Foss and Saebi, 2017). This inevitably challenges existing knowledge inventories, interests, and entitlements and, together with the lack of established structures and resources, places managers in situations that severely limit their ability to make decisions on a purely rational basis.

In the following, I will first introduce BMI as a means of innovating a complex system. This helps illustrate the various forms that BMI can take and the challenges these entail for the firm. Second, I elaborate on the argument of boundedly rational top managers, and how this points to research gaps in the BMI literature that are important to address in the current dissertation.

BMI as Innovating a Complex System

BMs in established firms vary in complexity based on the extent of the interdependencies between the components of value creation, delivery, and appropriation mechanisms (Ennen and Richter, 2010; Rivkin, 2000; Siggelkow, 2001). Interdependencies between components are negligible in a highly decomposable system, whereas interdependencies between components are

numerous and complex in a non-decomposable system (Simon, 1962). According to Foss and Saebi, "innovating a BM where the value creation, delivery, and appropriation mechanisms are tightly interdependent implies architectural change; conversely, a more loosely coupled business model will entail less architectural change, but potentially more modular change" (2017, p. 216). Moreover, both modular and architectural change can result in a BM that is new to the firm but already exists within the industry, or in a BM that introduces something completely new. Hence, BMI can be differentiated with regard to both the scope of change (modular versus architectural) and the degree of novelty (known versus new to industry), as shown in Figure 1 (Foss and Stieglitz, 2015; Foss and Saebi, 2017). Further explanations and examples of the four different types of BMI are provided in Article 1.

Novelty	Scope		
		Modular	***Architectural***
	New to firm	Evolutionary BMI	Adaptive BMI
	New to industry	Focused BMI	Complex BMI

Figure 1: BMI Typology (Source: Foss and Saebi, 2017, p. 217)

Building on the view of BMs as complex systems in which the degree of interdependency between existing BM components affects the complexity of the model, we can connect it to previous research on organizational-level adaptation and population-level selection (Levinthal, 1997). This literature provides a valuable perspective that helps clarify both the importance of and the challenges with the different types of BMI. Levinthal (1997) repurposed the original NK model (Kauffman, 1993) by replacing the complex systems of nature's lifeforms with the complex systems of organizations. In addition, he introduced the concept of fitness landscapes

into management research. The topology of this fitness landscape depends on the complexity of the complementarities between organizational attributes (the complexity of the system under study). Zero complementarities indicate that each organizational attribute provides value independent of other attributes. As visualized in Figure 2, this can cause a smooth fitness landscape with only one equilibrium. By contrast, a high level of complementarities means that the contribution from each attribute is dependent on the state of many other attributes, creating a complex and rugged fitness landscape with several low and high-scoring equilibria, as visualized in Figure 2.

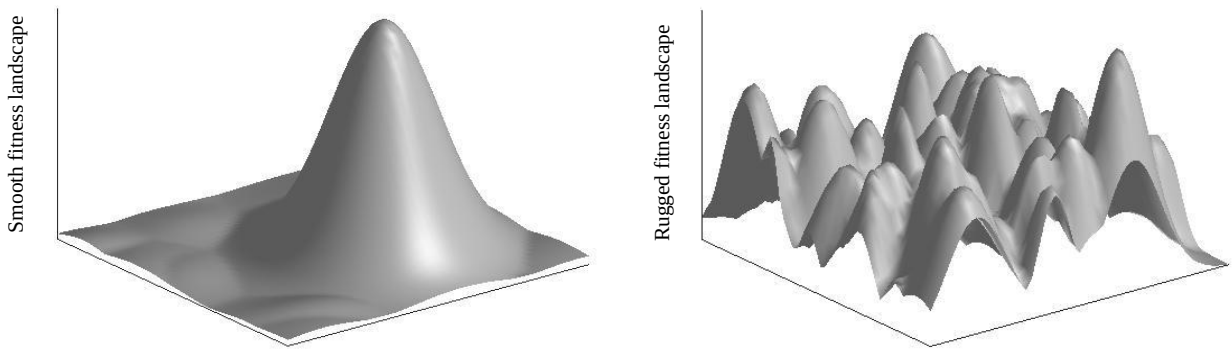

Figure 2: Stylized Smooth and Rugged Fitness Landscapes

Although Levinthal's original repurposing of the NK model based its complex system on "organizational forms," I find (alongside Foss and Saebi, 2017) that the arguments link well to that of BMs. Connecting the two fields of NK models and BMs, the attributes of the BM as a complex system are represented by the components of value creation, delivery, and appropriation mechanisms, in addition to the complexity of their interdependencies. Every possible BM variant accessible to a firm can then be located within a smooth or rugged fitness landscape, depending on the level of interdependencies.

Building on the perspective of a BM fitness landscape, BMI involves changing a firm's position within the landscape through either small steps (modular BMI) or larger leaps (architectural BMI). As the fitness landscape is typically rugged and comprises local optima and a variety of more distant peaks (i.e., there are some interdependencies between BM components), these local optima can potentially obscure the best-performing and more distant BM variants. This complicates the search for new possibilities, making it difficult for decision makers to make leaps that go beyond mere local search and adaptation (Baumann and Siggelkow, 2013; Gavetti and Levinthal, 2000; Siggelkow and Levinthal, 2005). Modular innovations should then be less challenging than architectural innovations. This is because the former involves altering a BM component in isolation (i.e., a small step in the fitness landscape towards local optima), whereas the latter involves changing several components simultaneously (i.e., larger leaps in the fitness landscape). For example, modular BMI may involve an incumbent firm targeting a new customer segment while keeping its BM architecture and other elements intact, whereas architectural BMI may involve a firm changing its business model from a traditional pipeline to a two-sided platform. Moreover, BMI that targets a BM known to industry (among the local and known forms of the fitness landscape) should be less challenging than one that targets a BM that is new to the industry (beyond the known forms of the fitness landscape). An example of this would be targeting a new customer segment that other competitors are already serving compared to targeting a customer segment not previously served by the industry.

BMI Under Conditions of Bounded Rationality

Envisioning and navigating to a distant or unfamiliar position within the fitness landscape requires decision makers to overcome the constraints that hold a firm to its existing BM (Ethiraj and Levinthal, 2004; Levinthal, 1997; Nickerson and Zenger, 2004; Sund et al., 2016). By

investigating how firms overcome the constraints of BMI, this dissertation places the TMT at center stage. The reason for this ex-ante priority of the TMT level of analysis is twofold. First, as BMI is a strategic issue that fundamentally affects how firms create, deliver, and/or capture value, the responsibility for such action ultimately falls on the TMT (Foss and Stieglitz, 2015; Teece, 2010). Second, although centrally placed in the organization, not all TMTs are equally good at sensing the need for and mobilizing toward BMI (Foss and Saebi, 2018).

Extant research has pointed to cognition and behavioral factors among the TMT as playing a key part in firms' efforts toward BMI (Bogers et al., 2015; Foss and Stieglitz, 2015; Foss and Saebi, 2018; Sund et al., 2021a). As complete BM designs are rarely documented in firms, they often exist only as cognitive representations in the minds of the firm's decision makers (Aspara et al., 2013; Baden-Fuller and Mangematin, 2013; Bjorkdahl and Holmén, 2013; Doz and Kosonen, 2010). The complexity of BMs, the ruggedness of the competitive landscape, and the vast volume of internal and external stimuli all serve to severely limit the extent to which BMI decisions can be made by the TMT based on rational economic optimization of all available alternatives. Hence, and contrasting with a strictly rational perspective, the behavioral theory of the firm (Cyert and March, 1963; March and Simon, 1958) sees a firm's decision makers as boundedly rational. This implies that their decisions are heavily influenced by the nature of the stimuli received, their cognitive base and values, and their attention allocation (Hambrick and Mason, 1984; Ocasio, 1997). In this perspective, a TMT's behavior pertaining to complex decisions, such as BMI, is shaped by both structural and cognitive influences (Ocasio, 1997; Simon, 1947). Structural influences steer what stimuli are available and attended to by the TMT, whereas the cognitive influences of TMT members steer how those stimuli are processed and what factors (such as ex-ante knowledge, assumptions, and values) are brought into the situation.

Assuming top managers as boundedly rational, the question then becomes what structural and cognitive characteristics increase the propensity for BMI.

Current Research Gaps

As BMI is a recent concept, the volume of research that connects this concept to behavioral factors is limited. To obtain a current overview of the field, I searched the EBSCO Business Source Premier database for relevant articles. The first part of the search was conducted in October 2020 and was limited to English language, peer-reviewed articles in academic journals. I searched for the terms "business model" and "innovation" so that the terms did not have to be used directly in sequence. I also included alternative concepts to "innovation" used in the literature, such as "reinvention," "renewal," "transformation," "evolution," and "dynamics" (Foss and Saebi, 2017). Furthermore, to limit the search to topics closely related to the behavioral elements of BMI, the articles also had to include terms representing a behavioral or cognitive topic (namely, "cognition", or "cognitive", or "behavior"). This resulted in 101 results from the database (in titles, abstracts, or keywords). In addition, search terms were included representing the key decision makers and their composition (namely, "top management", or "senior management", or "manager"); terms representing the use of external knowledge (namely, "knowledge search", "knowledge sourcing, "open innovation"); or terms representing the allocation of managerial attention (namely, "attention allocation", "attention-based", "attention pattern"). This resulted in 79 additional hits in the database (in titles, abstracts, or keywords). Furthermore, an additional 10 articles were included based on a supplemental search in Google Scholar for relevant articles. Moreover, in June 2021, an updated search identified 9 additional articles that had been published in the period after October 2020.

After removing articles that did not essentially address the behavior of top levels of management in connection with BMI (in established firms), 45 relevant articles remained. These articles were then grouped according to topic and research method. Table 1 illustrates the resulting main streams of research, together with examples of the articles contributing to each stream. Streams 1–3 are closely connected to topics of organizational and cognitive characteristics, while streams 4–5 are more focused on topics of organizational structures and activities. None of these streams appears to be widely researched, even though interest has increased over the last decade. For instance, although stream 2 has the most empirical contributions, the numbers are still low. The cumulative development of knowledge within the streams is further limited by varying definitions and ways of operationalization (such as for the BMI concept) across studies. The current dissertation thus contributes to areas that can benefit from further empirically-driven research. Furthermore, these areas are closely connected to the main topic of the dissertation, namely, how firms can help the TMT handle its responsibility towards BMI. Specifically, I focus on the TMT's allocation of attention (stream 1), composition of diverse team members (stream 3), and access to external knowledge sources (stream 5).

Table 1: Main Streams of Research

Main research focus	Method	Examples
1.Attention influencing BMI	Single/multiple case studies	Frankenberger and Sauer, 2019; Laszczuk and Mayer, 2020
2.Cognitive framing and processing that influence BMI (e.g., perceiving opportunity vs. threat, dealing with uncertainty and biases, cognitive representation of BMs)	Conceptual	Baden-Fuller and Mangematin, 2013; Freiha, 2020; Martins et al., 2015; Tikkanen et al., 2005; Täuscher and Abdelkafi, 2017
	Single/multiple case studies	Aspara et al., 2011, 2013; Egfjord and Sund, 2020; Moreau, 2013; Roessler et al., 2019; Schneckenberg et al., 2017, 2019
	Survey data / Data samples	Dewald and Bowen, 2010; Fuentes-Henríquez and Del Sol, 2012; Osiyevskyy and Dewald, 2015a, 2015b, 2018; Saebi et al., 2017
3.Individual and team characteristics influencing BMI (e.g., human capital, social capital, external vs. internal focus)	Single/multiple case studies, Survey	Guo et al., 2013; Al Humaidan and Sabatier, 2017; Diller et al., 2020; Narayan et al., 2020.
4.Overcoming inertia regarding current BM (e.g., experimentation, trial-and-error learning, organizational learning)	Conceptual, Case examples	Chesbrough, 2007, 2010; Groskovs and Ulhøi, 2019; McGrath, 2010
	Single/multiple case studies	Achtenhagen et al., 2013; Andries et al., 2013; Cavalcante, 2014; Doz and Kosonen, 2010; Laudien and Daxböck, 2017; Sosna et al., 2010
5.Knowledge search influencing BMI (e.g., external sourcing, boundary-spanning cooperation, open innovation)	Single/multiple case studies, Case examples	Chesbrough and Schwartz 2007; Jagoda et al., 2012; Micheli et al., 2020
	Survey data / Data samples	Denicolai, 2014; Hock-Doepgen et al., 2021; Huang, et al., 2013; Snihur and Wiklund, 2019; von Delft et al., 2019; Yan et al., 2020; Yu et al., 2020; Yu et al., 2021

TMT's allocation of attention. Recent studies imply that TMT attention could play an important role in BMI (e.g., Frankenberger and Sauer, 2019; Laszczuk and Mayer, 2020, in Table

1). Frankenberger and Sauer (2019) pointed to how targets of attention (such as end user and business methods) and intensity of attention (such as effort and persistence) are associated with the development of certain BM designs. Moreover, Laszczuk and Mayer (2020) illustrated how specific forms of attention (such as selective and engaged) lead to BMI.

The attention of decision makers is a central component in theories of organizational behavior and is closely linked to the view of managers as boundedly rational (March and Simon, 1958; Simon, 1947). With decision makers' attention (e.g., top managers' attention) being a scarce resource (Laamanen et al., 2018; Pashler, 1999), their ability to rationally consider all action alternatives and their consequences is limited (Augier and March, 2008; Cho and Hambrick, 2006; March, 1996; Ocasio, 1997). Linking this to my earlier argument about the complexity of alternatives and consequences in BMIs, these innovations constitute a particularly salient challenge on TMT attention. Hence, when it comes to BMI, shortcomings may be due (at least in part) to trade-offs in managerial attention allocation (Levinthal and March, 1993; Ocasio et al., 2018; Shepherd et al., 2017).

As BMI is important to maintain or improve firms' competitive fitness (Cucculelli and Bettinelli, 2015; Doz and Kosonen 2010; Massa and Tucci, 2014; Zott and Amit, 2007), allocating enough of the TMT's attentional capacity to BMI also becomes important. The idea that a firm can steer the attention allocation of its decision makers toward certain aspects of the firm's situation was also part of the early theories of organizational behavior (March and Simon, 1958; Simon, 1947). Such steering of attention was further developed in Ocasio's (1997) theoretical work on the attention-based view (ABV) of the firm. A central argument of the ABV is that attention is structured so that organizations can regulate the focus of managerial attention through various structural elements (namely, attention structures) (Ocasio, 1997). However, since their conceptualization, these structural elements in the ABV literature have received limited

focus in empirical research (cf. Ocasio et al., 2018). As the steering of TMT attention may show itself as a central component in increasing the propensity for BMI in firms, I find that there is a need for more knowledge in this area. I argue that much of what the ABV terms "attention structures" is, in essence, what research describes as organizational design (based on definitions according to Foss et al., 2013; Burton et al., 2015; Burton and Obel, 2018). This argument is supported by previous theoretical work that proposes that attention structures can include such elements as channels for operation and governance (e.g., formal decision-making meetings, budget and financial performance procedures, and ad hoc decision-making procedures), communication practices and channels, and team compositions (Ocasio and Joseph, 2005; Ocasio et al., 2018). Moreover, some studies have targeted the relationship between organizational design and BMI (e.g., Bock et al., 2012; Bocken and Geradts, 2019; Foss and Saebi, 2015; Leih et al., 2015; Sund et al., 2021b; Teece, 2018), although they have not gone into detail on how this is contingent on factors such as TMT attention. Hence, by linking the ABV with research on organizational design, I open new ways to empirically investigate the allocation of TMT attention towards BMI.

RQ1: How can firms use features of organizational design to foster TMT attention towards BMI?

By addressing this research question, my dissertation can provide new insights about the BMI process in firms and, thus, serve as an important step toward understanding the role of organizational design and TMT attention. Through this, the dissertation can also show how the ABV provides an important explanatory mechanism when investigating BMI. Moreover, the dissertation can contribute to the ABV literature with new empirically-based insights within the under-researched area of attention structures. Beyond its academic contribution, new insights into this field of TMT attention can also benefit practice. The new insight can here inform managers

on how to purposefully employ the controllable features of organizational design to support their efforts to balance attention between current business and new BMI opportunities.

TMT's composition and diversity. To date, only a few studies have provided empirical evidence of the effects of top management's individual- or team-level characteristics on BMI outcomes (Al Humaidan and Sabatier, 2017; Diller et al., 2020; Guo et al., 2013; Narayan et al., 2020, in Table 1). Guo et al. (2013) and Diller et al. (2020) investigated the influence of a single top manager's characteristics (namely, CEO or owner), whereas Al Humaidan and Sabatier (2017) and Narayan et al. (2020) explored the influence of team characteristics (orientation and diversity).

Motivated by the central role of TMTs in BMI, and in line with recent developments in literature (cf. Narayan et al., 2020), I find that an attractive way to expand on the current insights is to draw on the upper echelons theory (Hambrick and Mason, 1984; Hambrick, 2007) and research on group diversity (Faems and Subramanian, 2013; Shemla and Wegge, 2019; Williams and O'Reilly, 1998). These research areas can help connect the composition of the TMT to team-level processes and organizational outcomes such as BMI (Hambrick, 2007). The upper echelons theory is founded in a view of managers as boundedly rational (Cyert and March, 1963; March and Simon, 1958) and has a strong focus on the TMT as the level of analysis when studying organizational behavior (Bantel and Jackson, 1989; Hambrick and Mason, 1984). Moreover, group diversity research has found that diverse teams are more sensitive to the environment, more innovative, and more open to change (e.g., Carpenter et al., 2004; Keck, 1997; West and Anderson, 1996). However, diverse teams have also been shown to be more prone to conflicts, which hinders information sharing and cooperation (Cronin and Weingart, 2007; McNeil and Thompson, 1971; O'Reilly et al., 1993; Pfeffer, 1981; Smith et al., 1994). Hence, by continuing

to build on these insights while investigating various forms of TMT diversity, I find that I can uncover more about their positive and negative influences on BMI outcomes.

Given how different BMI initiatives may be regarding scope (modular versus architectural) (Foss and Saebi, 2017), I also argue that the various forms of TMT diversity can matter differently for different types of BMI. Following an increase in BMI scope, there is also an increase in the complexity (and ambiguity) of search, decision making, and implementation (Baumann and Siggelkow, 2013; Foss and Saebi, 2015; Gavetti and Levinthal, 2000). With such a heightened level of complexity, the entire TMT needs to become more involved, and this creates room for individual TMT members to "inject a great deal of themselves" into the process and outcome (Finkelstein et al., 2009, p. 43). Followingly, as the scope of BMI widens, the impact of TMT members' cognitive characteristics should also shift. By taking advantage of this insight, and by connecting upper echelon and team diversity research to that of BMI, I aim to build more knowledge on the role of TMT diversity in explaining firms' propensity for different types of BMI (according to scope).

RQ2: What compositions of the TMT in terms of member diversity benefit different types of BMI?

By addressing this research question, my dissertation can provide new empirically based insights that contribute to the theoretical advancement of the TMT and BMI disciplines. Despite a substantial number of studies targeting TMT composition, there are still significant knowledge gaps regarding how diversity in TMTs influences various forms of firm performance (Harrison and Klein, 2007; Homberg and Bui, 2013; Menz, 2012; Nielsen, 2010; Schubert and Tavassoli, 2020). Here the dissertation can contribute with a study that departs from the norm of one-dimensional innovation-performance measures (e.g., a binary innovation outcome variable) by drawing on BMIs where the scope of innovation vary between cases. This provides a more fine-

grained view of what TMT compositions matter for different types of innovations (modular – architectural BMI). Through this, the study can also contribute insights that consider the level of TMT involvement in shaping innovation outcomes (cf. Finkelstein et al., 2009; Foss and Stieglitz, 2015). For practitioners, the new understanding drawn from this study can help guide CEOs in composing TMTs that are suited to the dynamics of the environment and the ambitions for more complex (architectural) BMI. The importance of such new and practical insights is also made clear from studies that point to how more architectural BMI is required as firms experience increasingly unstable environmental conditions (Saebi, 2015; Saebi et al., 2017).

TMT's external knowledge sourcing. There is emerging evidence regarding how external knowledge sourcing may benefit BMI efforts (e.g., Chesbrough and Schwartz, 2007; Snihur and Wiklund, 2019; Yu et al., 2020; Yu et al., 2021, in Table 1). Although most of the empirical evidence is still fragmented and non-systematic, there is a recent cumulative development regarding how different search strategies lead to different forms of BMI. Three new studies (Snihur and Wiklund, 2019; Yu et al., 2020; Yu et al., 2021) have now helped illustrate how broad and deep external search is beneficial for BMI.

Taking this a step further, I can provide additional insight into the BMI literature by applying a more fine-grained conceptualization of BMI along the dimensions of scope and novelty (see Figure 1). The challenges associated with the different forms of BMI can then be linked to how a firm searches across the BM fitness landscape (as described earlier). In established industries, most incumbent firms are clustered together in the landscape through a few dominant BM forms (Gavetti and Levinthal, 2000). Local search in this part of the landscape, wherein managers search for "solutions in the neighborhood of its current expertise or knowledge" (Rosenkopf and Nerkar, 2001, p. 288), typically involves modular and non-novel BMIs (i.e, local adaptation inn the landscape). In contrast to this, a distant-looking search, where

managers search for solutions requiring knowledge far removed from the current knowledge inventory (Levinthal, 1997), typically involves BMIs that are novel and architectural (i.e., long jumps in the landscape).

The argued link between knowledge search and BMI provides an opportunity to study how different search activities in firms can change the propensity for different types of BMI. By also drawing on the open innovation (OI) literature (Chesbrough, 2003), I can differentiate the search for (i.e., sourcing of) external knowledge according to the *breadth* of the search (number of different external knowledge sources) and the *depth* of the search (intensity with which the external sources are used) (Laursen and Salter, 2006). A broad external search provides the firm with a pool of dispersed knowledge sources, which increases its chances of identifying new knowledge combinations that can be applied in BMI (Cohen and Levinthal, 1990; Laursen and Salter, 2006). A deep external search intensifies interactions with external knowledge partners, creating favorable learning environments through elements such as trust and a common language (Fey and Birkinshaw, 2005; Oerlemans and Knoben 2010; Saviotti, 1998). This learning environment of close interaction also increases the chances of assimilating more tacit types of knowledge (Bierly et al., 2009; Hansen, 1999; Oerlemans and Knoben, 2010).

Notably, the potential influences of external knowledge searches are also dependent on a firm's absorptive capacity, defined as the ability to identify, assimilate, and exploit knowledge gained from external sources (Cohen and Levinthal, 1990). Hence, by taking advantage of this insight on absorptive capacity, together with the abovementioned insight on broad and deep search, I seek to build more understanding regarding what types of external knowledge sourcing (search breadth/depth combinations) are associated with different types of BMI (according to scope and novelty).

RQ3: What forms of external knowledge sourcing in terms of breadth and depth benefit different types of BMI?

By addressing this research question, my dissertation can contribute to the BMI literature with new empirically-based insights on what external knowledge search activities increase the propensity for BMI that goes beyond incremental efforts (i.e., BMI of higher novelty and scope). Moreover, by linking research on NK models, OI, and BMI, the dissertation provides a valuable new perspective on interpreting this association. Through this, it can also provide more insights regarding the role of firms' absorptive capacity when reaching out to the more unfamiliar areas of knowledge. Furthermore, my dissertation can contribute to the field of OI research (that targets the use of external knowledge in innovation efforts), by addressing the association between inbound flows of knowledge (Chesbrough, 2003) and forms of innovations that vary in terms of their interdependencies, such as BMI. For practitioners, this new insight can help managers recognize the characteristics of their own knowledge sourcing activities, help them evaluate how this matches their ambitions for BMI, and guide them in identifying what changes might be necessary to improve such a match.

METHODOLOGICAL CHOICES

In the following section, I will account for the general research context of the dissertation and its considerations relative to each individual study's methods. As the individual papers also include details of the methods used, the focus here will be on overall considerations and aggregated aspects of the respective studies.

Research Context

The point of departure for my dissertation was my experience as a manager at Sbanken ASA, who, together with the Norwegian Research Council, agreed to fund my doctoral project

through the Industrial PhD program. Notably, apart from the expectation that my research should contribute to both theory and practice, according to the proposition for the project, the funding partners did not steer the focus of my studies. Through being the academic partner in my doctoral project, NHH has also provided me with access to the Centre for Service Innovation (CSI) and the Centre for Strategy, Organisation, and Performance (STOP). These centers have granted me access to supervisors, knowledge, and data sources that have been essential for my research.

Research Design Consideration

The research design of each study provided me with an appropriate framework to guide the research efforts (Frankfort-Nachmias and Nachmias, 1996). The designs were chosen based on the nature of the individual research question. Table 2 provides an overview of how the research questions match the research designs.

Table 2: Research Design and Data Collection

Article	**Research design**	**Data collection**
Article 1 (RQ1) *"Steering Managerial Attention"*	Qualitative - case study	Primary case data collected from 2012 to 2017.
Article 2 (RQ2) *"Architectural or Modular?"*	Quantitative - cross sectional large-N study	Secondary survey data from 2014, together with accounting and registry data from 1992 to 2016.
Article 3 (RQ3) *"Searching Wide and Deep"*	Quantitative - cross sectional large-N study	Secondary survey data from 2014, together with accounting data from 1992 to 2016.

I employed both qualitative and quantitative methods in my dissertation. The use of mixed methods in exploring and explaining a phenomenon within a complex reality is in line

with the critical realism stance within the "philosophy of science" (Archer et al., 2013; Guba and Lincoln, 1994). According to this perspective, the two methodologies are considered complementary in the search for new knowledge within a field with limited extant knowledge (Guba and Lincoln, 1994; Jick, 1979). Here, qualitative methods are applicable where the maturity of our understanding of the phenomenon is low (RQ1), and quantitative methods become more applicable as fields are further developed so that the testing of preliminary hypotheses is a valuable exercise (RQs 2 and 3).

Qualitative Research Design

For research question RQ1, I linked the ABV with research on organizational design to conceptualize and empirically investigate the role of organizational design in shaping the TMT's attention towards BMI. A qualitative case design is most suited for several reasons. First, Ocasio's concept of structured attention is currently hard to operationalize in an empirical, quantitative setting. By contrast, an in-depth case study enabled me to illustrate this concept using detailed data from a real-life setting. Second, a case study provided an opportunity to exploit extensive data access. Third, "the essence of a case study, the central tendency among all types of case study, is that it tries to illuminate a decision or set of decisions: why they were taken, how they were implemented, and with what result" (Schramm, 1971, p. 6). Hence, this is a design that can provide me with a holistic and real-world perspective on the TMT's attention allocation and BMI decisions. Further, the design deals with situations where there are many variables of interest, and where prior theories (such as organizational design and ABV) can help in guiding data collection (Yin, 2014). Thus, by relying on a single longitudinal illustrative case design, I gained a necessary and unique level of insight into the complexity of real-world attention allocation and decision processes regarding BMI (Siggelkow, 2001, 2007).

The choice of firm for my case study fell on a Norwegian retail bank, a choice that was motivated by the level of access provided by the firm and how it matched the requirements of the research question (theoretical sampling). Answering the research question required a case where I could document the TMT's attention to BMI efforts under the influence of various environmental conditions and under various organizational design setups. As the bank satisfied both conditions, the case data enabled me to illustrate a set of conceptual arguments that addressed the research question and contributed to the current knowledge within the fields of BMI and ABV. The final narrative for the case was formed through an iterative process in which an expanding part of the dataset was processed and analyzed, iterating until we had a clear grasp of how the data related to the constructs involved (Eisenhardt, 1989; Langley, 1999).

Data sources. The case data were drawn from sources such as interviews and several forms of archival documents (both internal and external in origin). From these sources, I limited data collection to between 2012 and 2017, as this provided the best research access and most relevant data in the context of the research question. For the semi-structured interviews (all conducted during the last part of the specified period), I utilized purposeful sampling (Lincoln and Guba, 1985) and targeted the TMT as well as a variety of other positions within the firm. In this way, the sample of interviewees included the necessary decision makers and those who had the best insight into the relevant topics.

Method and data concerns. The trustworthiness of the findings in the case study was evaluated using the criteria of credibility, transferability, dependability, and confirmability (Lincoln and Guba, 1985). Credibility relates to whether the documented relationships and inferences in the study provide a reasonable account of reality. Establishing such credibility requires the researcher to employ methods and techniques that ensure correct understanding and analysis. In this case study, triangulation of data from different sources was conducted using both

interviews and archival data. In addition, feedback on both raw data and the research results were received from key participants in the case firm in several instances during the analysis, as well as feedback on the analyses and research results from colleagues at NHH and other academic institutions. Transferability relates to the extent to which the findings of the study can also be applied to other settings or situations. For others to evaluate whether the findings might be applicable in other situations, I provided information about the organizational and industry context, the period of data collection, and the kind of data collected. Dependability relates to whether others can follow how the researcher has arrived at conclusions and be able to reproduce the study if desired. While a qualitative study can be difficult to repeat exactly, I have strived to offer a transparent account of the process and the data so that it may be repeated by others. Notably, I have not retained any raw case data, as they are accessible only through approved access at the case firm. Confirmability relates to the research being conducted in "good faith" and not overly biased in terms of my own views. I have addressed this by positioning the study in terms of established theories, following well-established methods, and by being transparent in presenting findings and conclusions. Moreover, the findings and conclusions have been discussed by other research participants throughout the study. Notably, I worked in the banking sector for several years before conducting this case study. The findings of the case study challenged my previous views in several areas and led me to perceive earlier actions in a different light. These are realizations that I admit openly, and hope they are seen as indications that I can evaluate my own work with a critical perspective.

Quantitative Research Design

For research questions RQ2 and RQ3, I found quantitative studies to be most suitable. There is already a significant volume of empirical studies that have operationalized the concepts

of TMT diversity (RQ2) and knowledge search activities (RQ3) in their respective fields. Although such applications are limited in BMI research (see Table 1), the extant empirical work has provided me with sufficient insight to build hypotheses in connection with BMI. Hence, research designs were chosen that allowed for testing of these hypotheses, providing answers to the research questions (RQ2 and RQ3), and enabling a better understanding of associations with BMI. Experimental designs with random assignment of treatment and control groups may be ideal for establishing causality; however, I considered these to be beyond what is practically possible, as organizations would be unwilling to sign up for such random treatment assignments. A large-N longitudinal design would be preferable, as it could collect data from firms over two or more periods, enabling me to statistically demonstrate causality. While desirable, this design was not feasible within the cost and timeframe of this dissertation. Moreover, a relevant and unexploited survey dataset from 2014 was already available. When connected with existing accounting and registry data, this dataset would provide ample opportunity to perform cross-sectional analysis and provide adequate answers to RQ2 and RQ3. Hence, this was the design chosen for both quantitative studies.

Data sources. Articles 2 and 3 are based on three quantitative sources of data. First, these articles utilized a secondary dataset collected by CSI through a survey in 2014. This survey was conducted using an online questionnaire sent to the CEOs and HR managers of 4000 Norwegian firms in the fall of 2014. These firms had to have an employee base greater than 30, as it was assumed that companies smaller than 30 were unlikely to have a BM that might be subject to change. Furthermore, the online questionnaire was designed as a double-respondent study in which separate questionnaires were sent to the CEO and HR managers of the same companies. There were 286 responses from CEOs and 325 responses from HR managers (only CEO responses were used as a source in this dissertation). The questionnaires were prepared in

English, translated into Norwegian, and then translated back into English to ensure accuracy. Based on a pre-test with three academic colleagues and a pilot with five managers at Norwegian firms, the researchers revised some of the items to ensure the face validity and meaningfulness of the measures in the research context of Norway. The survey process and data collection were subsequently handled by the Kantar AS agency. Second, Articles 2 and 3 utilized a secondary dataset collected by the Centre for Applied Research (SNF) at NHH in 2018, covering a comprehensive set of official accounting data from firms registered in Norway. This data was delivered to SNF from the Brønnøysund Register Centre (a governmental administrative agency) through Bisnode Norge AS and in cooperation with Menon Business Economics AS. Third, the articles utilized a secondary dataset collected by STOP in 2017. This data was collected with a transfer of registry data from Statistics Norway (SSB) and consisted of several tables with detailed records of persons and firms registered in Norway. The data originated from official registries that were administered by SSB based on their governmental mandate. At NHH, the data was anonymized and stored in their Human Capital database, which resided on a dedicated server with restricted access. To support studies such as this, that apply multiple sources of data, the Human Capital database included interconnected and anonymized copies of all the above-mentioned data sources.

Development of measures. While most of the measures used in Articles 2 and 3 are based on already established and tested measures from extant research, this is not the case for BMI as a dependent variable. For both quantitative studies, the dependent variables represent the type of BMI undertaken by the firms (see Figure 1) and were drawn from 11 survey items in the 2014 CSI survey (see the Appendix in Articles 2 and 3 for details). The items were based on the four main components of a BM: target market, value proposition, value capture, and value delivery (Foss and Saebi, 2017, 2018). Each item was mapped to determine whether components had been

subjected to change during the three years prior to the survey, and whether these changes were already known to the industry ("new to firm, known to industry") or new to the industry ("new to firm, new to industry"). Thus, it was possible to separate different forms of BMI according to scope (modular, architectural) and novelty (known to industry, new to industry), something that has not previously been conducted in large-N surveys. Notably, it was not possible to track how the changes occurred during the three-year period with this data. Hence, all changes were treated as occurring at the same time in the analysis. Although this is a simplification of reality, it is difficult to avoid in large-N studies of firms' innovation efforts and should have limited impact, as a BMI typically will take several years from conceptualization to implementation (Chesbrough, 2007). A potential future improvement of such a measure could still include a shorter mapping period (1 or 2 years instead of 3).

Based on the above survey items, the dependent variables of Articles 2 and 3 are measured somewhat differently. This difference is then in accordance with the differences in research questions. The theoretical argument of Article 2 relates to the single BMI dimension of scope. Hence, the study's measurement of the dependent variable was based on all changed items (i.e., scope), regardless of the changes being known to industry or new to industry (i.e., regardless of novelty). By contrast, the theoretical argument of Article 3 relates to the BMI dimensions of both scope and novelty. Hence, the study's measurement of the BMI variables considered survey data on both scope and novelty. The resulting research design included one dependent variable that represented all the changed items that were known to industry (scope of non-novel BMI), and another dependent variable that represented all the changed items that were new to industry (scope of novel BMI). Notably, the sum of changed items represented in these two variables was then equal to the sum represented in the variable of BMI scope in Article 2.

Method and data concerns. For the chosen quantitative research designs in Article 2 and 3, there are validity concerns that must be addressed. These include internal and external validity, statistical conclusion validity, and construct validity (Cook and Campbell, 1979). Internal validity relates to how well the study establishes the focal causal relationship. With a high degree of internal validity, the reader can conclude that there is strong evidence of causality. To make such claims, my data would have to satisfy the requirements of covariation, cause preceding the effect in time, and no plausible alternative explanations (Frankfort-Nachmias and Nachmias, 1996). As the collected data limited the studies to cross-sectional analysis, I could identify relationships (covariation) and control for alternative explanations. However, I could not conclusively demonstrate that the investigated predictors preceded the BMI efforts. Consequently, my claims about the connections between predictors and BMI were based on comprehensive theoretical arguments and reliable covariations between variables. External validity relates to the generalizability of the findings, meaning to what extent they may also be applicable to other populations, contexts, and time periods (for example). Given that the survey data included random sampling, it should improve the generalizability of my findings. Moreover, the data also included firms from a variety of industries and of many sizes and ages, which should further improve the external validity. Conversely, the data were limited to Norwegian firms; hence, it may be argued that the generalizability of the findings is somewhat constrained regarding economies and cultures that are significantly different from Norway. Statistical conclusion validity relates to the ability to make conclusions about focal relationships based on statistical evidence. The sampling, statistical tests, and measurement procedures are all important factors for establishing such conclusion validity in studies. For Article 2 and 3, the samples were found to be of adequate size and quality. However, there may still be a non-response bias in such samples. Such a bias would indicate that firms that responded to the survey were systematically

different from those that did not respond, creating an issue with the representativeness of the sample. During the studies, tests for non-response bias were performed without indicating any significant differences. Moreover, for each of the two studies, several statistical tests were conducted to establish the validity of the conclusions. The measurements were based on both multi-item measurement scales in surveys and population registry data. Except for the dependent variable (BMI), the scales were collected from established research, which also contributed to the validity of the results. Construct validity relates to the measures being valid representations of the constructs in question. Threats to such validity may be found in weaknesses in construct explication, reactivity in self-reporting, common method, and operationalization bias, among others. All measures utilized in Articles 2 and 3 are well grounded in the established literature, and most have also been operationalized and tested in previous research. Article 3 also employed factor analysis to ensure construct validity and both Article 2 and 3 presented Cronbach's alpha scores to provide further insight into the validity of the measures. There may still be issues connected to the self-reporting of CEOs in the survey. Most notably, there could be systematic responses according to what CEOs see as socially desirable. However, several procedural elements were introduced in the survey to reduce the risk of such biases influencing the results. Another issue with the validity of the measurement may originate from the retrospective nature of the survey, creating a challenge for CEOs to have a clear memory of the period in question. As the survey was conducted close to the mapped period, this issue was hopefully minimized. Moreover, it is unlikely that such errors will be distributed systematically across the responses.

Research Ethics

In the process of conducting my research, I have been guided by ethical principles related to the confidentiality of those participating, data use, and data storage. In the case study, archival

data and interview transcripts were stored only within the system of the case firm. In this system, all files were handled according to the policies set by the firm, with no special allowances made for this project. Hence, no application was made to the Norwegian Centre for Research Data (NSD). When accessing and using the data for analysis, and later for the purposes of authoring Article 1, I attempted to keep information about the participating parties confidential to the greatest possible extent. Hence, no names or titles were connected to any specific contributions or texts stored outside the case firm's system. Moreover, the name of the case firm was not stated in the resulting documentation of this work.

In the quantitative studies, much of the data were of a particularly sensitive nature and the dataset was anonymized by SSB in advance of me having research access. The data was used and stored according to the rules set by NSD, SSB, and NHH and can only be accessed by a small group of named researchers. There is some data overlap between what was utilized in Article 2 and 3, since they both use the same survey observations. The overlap applies to the survey data used to measure the dependent variables, and to the official accounting data that were used as control variables. While such data overlap can weaken the unique contribution of a paper in certain circumstances, my argument is that this should not be the case here. This argument is based on aspects concerning each paper's targeted research question, use of theoretical arguments, use of data and variables, and theoretical and practical contributions (Colquitt, 2013; Kirkman and Chen, 2011). First, the two studies have both unique and clearly defined research questions. Article 2 was designed to address the influence of TMT composition on the scope of BMI, while Article 3 was designed to address the influence of external knowledge sourcing on the combined BMI dimensions of scope and novelty. Second, although BMI theory featured in both articles, most of the theoretical arguments are unique to each study. Article 2 builds on upper echelon and team diversity theories (Hambrick and Mason, 1984; Hambrick, 2007; Shemla

and Wegge, 2019; Williams and O'Reilly, 1998), while Article 3 builds on NK models and OI theories (Chesbrough, 2003; Laursen and Salter, 2006; Levinthal, 1997). Third, as this dissertation and my general field of research concern BMI as an outcome, there was some overlap in the dependent variables and how they were measured (as described earlier). However, given the salient differences between the dependent variables (which included both design differences and the use of additional data), independent variables, theories, and research questions, I considered this to be an acceptable overlap. Given their role in the analysis, I also do not consider the overlap in control variables to be an issue in this context. Fourth, and related to the argument about differences in research question, the contributions to the literature and practice are also unique to each paper. Consequently, I found that regardless of the limited data overlap, the contribution of the dissertation becomes stronger by having two articles that quantitatively address different aspects of the link between TMT and BMI.

PRESENTATION OF ARTICLES

Article 1

Steering Managerial Attention Toward Business Model Innovation: The Role of Organizational Design

The purpose of this first article is to investigate TMT's attention towards sensing the need for and initiating BMI. The motivation for this focus emanates from the argument that firms often have inadequate BM responses to the challenges they face in the external environment, and that this is due to trade-offs in managerial attention allocation. More specifically, we argue that the processes of scanning the external environment and interpreting changes require a forward-looking attentional perspective, defined as top-down cognitive schemas that "generate heightened awareness and focus over time to relevant stimuli and responses" (Ocasio, 2011, p. 1288).

Moreover, we argue that the process of searching for new BMs requires considerable attentional engagement, defined as the "intentional, sustained allocation of cognitive resources to guide problem solving, planning, sensemaking, and decision making" (Ocasio, 2011, p. 1288). By building on the ABV's attention structures and by linking research on BMI, managerial attention, and organizational design, we seek to reveal more about the association between organizational design features and the type of BMI implemented by firms.

The study draws on an illustrative, in-depth, longitudinal case study. Our findings from the case firm demonstrates how a firm's ability to innovate its BM is at least in part a function of management attention, and how organizational design not only shapes attention allocation towards BMI, but also the scope and novelty of the BMI initiatives. Based on these findings, we highlight how certain organizational design features are more conducive to novel (new to industry) and architectural BMI, while others limit managerial attention to non-novel (known to industry) and modular BMI. The study contributes to the BMI literature with increased insight into the interplay between organizational design, managerial attention, and BMI. Moreover, the study offers a conceptualization and operationalization of attentional perspective and attentional engagement that will serve as a benefit for future empirical inquiries based on the ABV.

Article 2

Architectural or Modular? How Top Management Composition Affects the Scope of Business Model Innovation

The purpose of this second article is to empirically investigate how a firm's TMT composition, in terms of diversity in cognitive characteristics, is associated with the propensity for different types of BMI according to scope. The study builds on the argument that not all TMTs have a composition equally well suited to the demands of more complex forms of BMI (architectural BMI). A TMT may struggle to recognize opportunities outside the dominant

business logic (Coombs and Hull, 1998; Osiyevskyy and Dewald, 2015a; Prahalad and Bettis, 1986; Roessler et al., 2019) and find it difficult to collectively work through the diverging interests that arise from a highly complex change such as architectural BMI (Foss and Saebi, 2015). On a more detailed level, we argue that TMT compositions that are beneficial for architectural BMI should foster information diversity and reduce cooperation issues from power diversity and intergroup bias (caused by social categorization). Moreover, by linking BMI research, upper echelon theory, and the literature on team diversity, we hypothesize that an increase in power differences and intergroup bias should negatively moderate a positive association between information diversity and BMI scope.

This empirical study draws on three separate data sources: (i) an online survey among CEOs of firms in Norway, mapping their BMIs over a three-year period; (ii) national population registry data; and (iii) official accounting data from Norwegian firms. The research design relies on observable individual characteristics from the population registries as proxies for the top managers' cognitive characteristics. Such observable characteristics include gender, ethnicity/immigration history, education, and work experience. Based on these data, we find evidence of information diversity within the TMT to be beneficial for architectural BMI, whereas power diversity and intergroup bias is detrimental to architectural BMI. Conversely, and contradicting our hypothesis, our findings do not show any moderating effect. The study contributes to the BMI literature by linking micro-level cognitive factors among top managers to the initiation and implementation of BMIs through team diversity measures. Moreover, it contributes to the TMT literature by introducing BMI as a new unit of analysis that allows for a dimensionalization of innovation outcomes that considers the scope of change.

Article 3

Searching Wide and Deep: The Link Between External Knowledge Search and Business Model Innovation

The purpose of the third article is to empirically investigate how the use of external knowledge sourcing can aid top managers in their search for an attractive BMI. In a complex and rugged fitness landscape, the best BM solution is often not visible to the TMT, as the optimal design may not be in proximity to any current or familiar model (Foss and Saebi, 2018; Foss and Stieglitz, 2015). A deliberate and far-reaching search in the space of possible BMs is required to identify the most attractive BMI (Levinthal and March, 1993). Therefore, we empirically investigate how the breadth and depth of external knowledge searches are associated with BMI efforts. The study builds on the argument that managers need to establish search channels outside the boundaries of the organization to enhance their exposure to the knowledge, ideas, and perspectives needed for BMI. Such use of external knowledge is a central tenet in the OI literature (Bogers et al., 2018), and by linking OI research to that of BMI and NK models, we are able to argue how the breadth and depth of a firm's external knowledge sourcing activity are associated with the scope and novelty of the firm's BMI. The hypotheses for the study state that a broader knowledge search is connected to an increase in BMI scope, while a deeper knowledge search is connected to a higher degree of BMI novelty.

The study draws on two separate data sources: (i) an online survey among CEOs of firms in Norway, mapping their BMIs and OI efforts over a three-year period, and (ii) accounting data from Norwegian firms. Based on the data, we find that the broader the firm's search, the larger is the scope of its BMI. The deeper the firm's search, the more novel is the BMI. Consequently, the study contributes to the literature on BMI by providing new insights into the association between

external knowledge sourcing and BMI. Moreover, by linking research on NK models, OI, and BMI, we provide a valuable new perspective on interpreting this association.

DISCUSSION – CONTRIBUTIONS AND IMPLICATIONS

I started this introductory chapter with an argument about the central role of the TMT in securing BMIs as new threats or opportunities appear in the environment. Arguably, a firm's success in BMI must then be considered in the context of how well the TMT is equipped to handle this responsibility. As the current BMI literature provides limited insights into why some TMTs are better equipped to handle BMI than others (Foss and Saebi, 2018), this knowledge gap became the target of my dissertation.

In broad terms, the three articles constitute the main part of the dissertation and provide new clarity regarding the role of TMTs in BMI efforts. They demonstrate through new empirical insight the central place of TMTs in BMI processes, and find how firms may use organizational design (Article 1), team composition (Article 2), and external knowledge sourcing (Article 3) to better equip the TMT to deal with its responsibilities (see illustration in Figure 3). Moreover, by combining insights from all three studies (and building on the BMI typology of Figure 1) the findings point to what equips the TMT for modular and non-novel BMI versus what equips the team for more novel and architectural BMI.

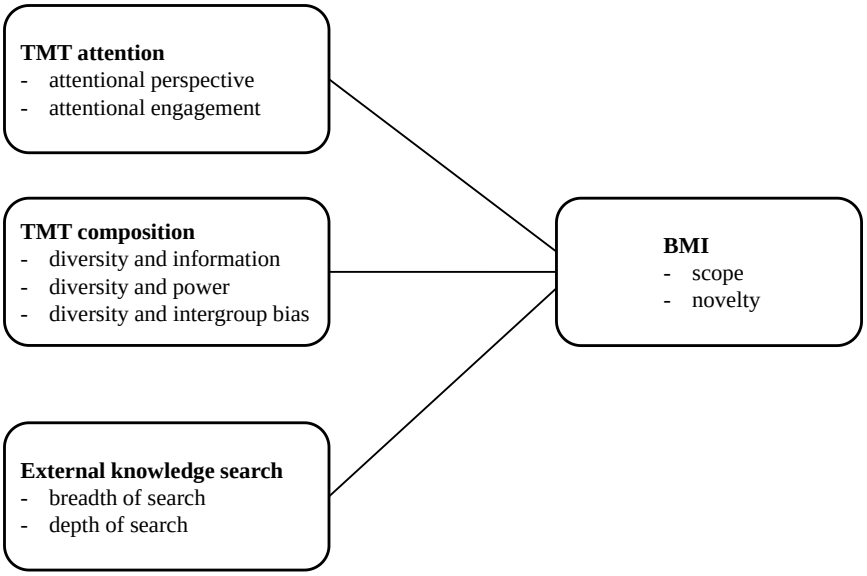

Figure 3: Aggregated Research Framework

The starting point of the dissertation's empirical work centered on TMT attention. Extant research has pointed to the importance of organizational-level attention when it comes to strategic action (March and Simon, 1958; Ocasio, 1997; Simon, 1947). A key argument in this literature is that to explain a firm's handling of strategic action is to explain how the firm steers the attention of key decision makers. However, this literature currently provides us with little empirically backed insight to help answer the question of how to better equip the TMT for BMI. Therefore, my goal is to contribute new insight into this topic by conceptualizing and illustrating how organizational design can be used to equip TMTs with the attention suitable for different types of BMI (Article 1). My conceptualization of TMTs' situated attention through organizational design is based on a novel use of the ABV and its attention structures (Ocasio, 1997). Such attention structures have, to a limited degree, been operationalized in extant research, with subsequently little empirical evidence on their manifestation in firms and the influences they have on firms' decision makers. My hope is that this dissertation will inspire more researchers to operationalize such structures (e.g., through organizational design) and make further headway in studies on the

ABV. Moreover, as my conceptual argument is based on a novel utilization of the concepts of attentional perspective and attentional engagement (Ocasio, 2011), it highlights an important separation of attentional requirements according to the different stages of sensing and seizing BMI opportunities. Thus, the dissertation's conceptualization and operationalization of these concepts provide scholars with a novel process perspective of TMT attention towards BMI.

Based on the abovementioned conceptualization and operationalization regarding TMT attention, the case study of Article 1 identified features of organizational design that steered managerial attention towards BMI. The case illustrated how some features steer attention towards novel and architectural BMI while other features steer attention towards non-novel and modular forms of BMI. For me, it was surprising to see how potent these organizational design features were in changing the attention of top managers. This was even more unexpected, considering how changes appeared within relatively short timeframes after the TMT was subjected to various design features. Based on my own managerial experience, I speculate that most managers are probably not aware of how much these features affect them. If this experience is representative, it speaks even more to the importance of gathering more knowledge on such a phenomenon. Notably, some of the results regarding TMT attention also have relevant links to topics targeted by the other two empirical studies of the dissertation. The first of these results relates to the influence of TMT composition, an influence that was further investigated in Article 2. The second result relates to the influence of external knowledge and perspectives on the TMT, which was further investigated in article 3.

In the second study of the dissertation (Article 2), I started to target literature that dealt with team composition and the upper echelon theory (Hambrick and Mason, 1984). Based on this theory, the composition of TMTs should matter for strategic initiatives such as BMI. However, while the literature in this field has developed over some time, it has been fraught with

inconsistent results, which are often argued to spring from research design weaknesses (Homberg and Bui, 2013; Nielsen, 2010). By investigating the role of TMT composition in BMI, this dissertation contributes to this debate by addressing two sources of such weaknesses. First, it addresses how different forms of team diversity impact firm outcomes differently. Hence, the association with BMI is studied using the three categories of information diversity, power diversity, and social categorization (Harrison and Klein, 2007). Second, it addresses how the role of the TMT (and, thus, the role of team composition) can differ according to different firm outcomes. For this purpose, the study used a measure of firm outcome (i.e., BMI scope) that could be linked to various levels of TMT involvement (Foss and Stieglitz, 2015).

Through the abovementioned design features, and by utilizing detailed registry data for the TMT members' micro-level characteristics, the second study contributed valuable new insights on the association between TMT compositions and BMI scope. The study uncovered that the TMT composition best suited to implement architectural BMIs should include members who are diverse in the informational background and perspective they represent. Moreover, the members should be homogenous with respect to tenures to limit issues of power diversity and intergroup bias (the latter is based on social categorization among members). Beyond the insight this brings to BMI research, it also acts as an important illustration of how different forms of TMT diversity can have different influences on firm outcomes (information diversity versus power diversity and social categorization). Moreover, it also shows the value of utilizing a firm outcome that helps clarify the different roles the TMT can take in the process. My hope is that these insights will be beneficial to future efforts within research on TMTs and their influence on firm performance.

Articles 1 and 2 both touch upon the benefits of connecting to diverse perspectives in the TMT, whereas the third study of my dissertation (Article 3) provides empirical evidence on the

dedicated use of external sources to provide such perspectives. By drawing on both OI theory and NK models, I found that it is possible to demonstrate how different external knowledge search activities can be associated with BMIs of various scope and novelty. This new and valuable perspective on the influence of knowledge sourcing is supported by a view of BMs as complex systems (Foss and Saebi, 2017), which, together with the NK model literature (Levinthal, 1997), help place BMs and BMIs within the realm of fitness landscapes. Arguably, moves across this landscape in the form of different types of BMI can then be connected to different requirements for knowledge search. By building on this argument, my dissertation shows how broad searches (a high number of different external sources) widen managers' field of vision for identifying sets of BM choices that mutually reinforce each other (i.e., architectural BMI) and how deep exposure to particular knowledge sources (an intense use of external sources) is linked to novel knowledge combinations (i.e., novel BMI). This combination of search breadth, search depth, and BMI dimensionalized according to scope and novelty, provides us with valuable new insights into the influence of external knowledge sourcing on BMI. Moreover, it provides a unique contribution to the BMI literature in that it is the first empirical study to fully utilize the typology of Foss and Saebi (2017) (Figure 1).

By considering the findings on external knowledge sourcing (Article 3) in combination with the dissertation's findings on TMT attention and composition (Article 1 and 2), further insights can be drawn. First, for external knowledge sourcing to benefit the TMT's effort toward BMI, the team needs to be part of the knowledge exchange. Notably, in my study of attention, I found the TMT's part in the detailed (bottom-up) processing of new information to be important when searching for new BMIs. While the easily codified knowledge gained from low-intensity knowledge searches can be transferred to the TMT by indirect means (e.g., through other internal resources), it works differently for novel knowledge combinations. Such insights originate from

prolonged and deep external connections and cannot be absorbed by the TMT in the same indirect way. Consequently, the TMT members need to participate directly and actively in such connections to gain the required level of novel understanding. Second, the information diversity argued to benefit the BMIs of a larger scope in Article 2 can be considered aligned with the argument for a wide knowledge search in Article 3. In both studies, such diversity in information was (to some degree) found to be positively associated with the scope of BMI.

Across all three studies, I find that while each study has a separate research focus, they connect well on several aspects that strengthen a common argument about the role of the TMT in BMI. This aligns closely with the current need for more knowledge and places my dissertation as an important contribution to the development of the BMI literature. As an additional benefit (and as argued earlier), I find that the dissertation makes valuable contributions to the related research fields of TMT (Article 1, 2, 3), ABV (Article 1), and OI (Article 3).

Managerial Implications

Although this dissertation mainly targets an academic audience, it is also influenced by the needs of practitioners navigating firms through changing and sometimes disruptive business landscapes. Accordingly, my dissertation addresses the context of established firms, where BMI may be a key source of renewed performance. Through the empirical contributions of all three studies, there are now new and practical insights that point to how such firms may address the challenges of moving beyond mere incremental innovations, increasing the propensity for BMIs of greater scope and novelty. The overarching insight that managers should recognize is that the TMT, and the manageable structures surrounding it, do have an impact on a firm's BMI effort. Therefore, managers should take a proactive stance regarding these TMT-related aspects to change their success with BMI.

In what follows, I provide a practical interpretation of the research implications through a set of recommendations that are structured according to the two repeating phases of i) gaining new knowledge, and ii) search and experimentation, as presented in Figure 4. While some of these recommendations fall exclusively within the responsibility of the CEO or board of directors (e.g., TMT member composition), most are of a nature that are best dealt with by the TMT as a collective (e.g., external knowledge sourcing). Moreover, the two phases are repeating because firms that engage in a distant search for possible BM solutions need to be able to iterate between gaining new knowledge and applying the knowledge through BM search and experimentation.

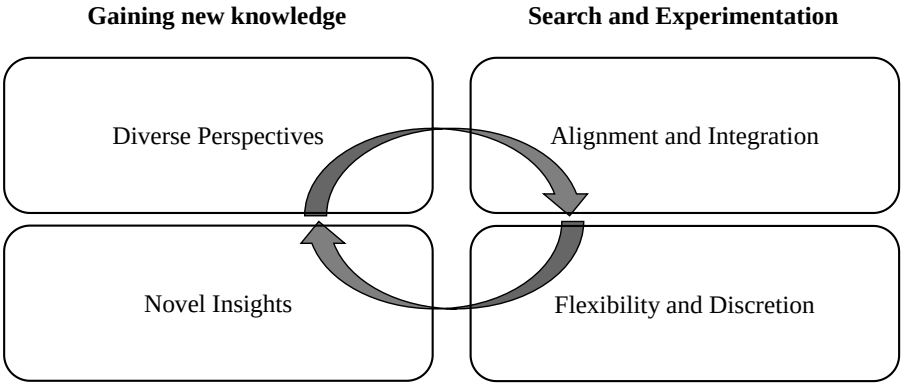

Figure 4: TMT Framework Facilitating Architectural and Novel BMI

Diverse perspectives. To identify and interpret new and unfamiliar information, the firm needs a TMT that has access to a diverse set of perspectives. Scanning the environment for signals that warrant a change in the existing BM can be overwhelming, and a TMT with members who think "too much alike" may misinterpret or entirely miss such signals. Thus, composing a TMT with members who are diverse in relation to core demographics and educational specialization invokes access to a variety of information and perspectives that can benefit the BMI efforts. Moreover, internal experts and external knowledge partners who participate in the

TMT's deliberations regarding BMI also constitute valuable contributions to securing such diverse perspectives.

Novel insights. To gain the deep and novel insights necessary for more novel BMI efforts, a search for knowledge far removed from the current knowledge inventory is often required. Hence, the firm should establish close collaborations with a few selected external knowledge sources (i.e., integration of these external sources in the innovation process through arrangements such as strategic alliances and partnerships). For the TMT to convert this flow of knowledge into new practical insight within the team, it should be made a direct part of those collaborations. While establishing access to such external sources is a critical step, there might also be a need to further motivate the TMT to search for and use the new knowledge. This motivation can result from a clearer dedication of resources, tolerance for high-risk initiatives, and focus on long-term over short-term performance targets.

Alignment and Integration. To handle the uncertainty associated with a search for a more novel and architectural BMI, the firm needs decision makers who are highly aligned and integrated. Regarding the first point, the firm should have TMT members that are aligned in a common understanding about the BMI efforts (namely, mutual understanding about the current situation and repertoire of actions). This alignment should also be extended to include key external stakeholders, such as owners and alliance partners. The level of alignment among these actors might be strengthened through extensive within-TMT knowledge dissemination, cross-departmental collaboration in innovation efforts, and a TMT composition that is oriented towards external stakeholders. Regarding the second point about integration, a TMT composition that is more homogenous with respect to tenures (tenure in job market, tenure in organization) can secure members who communicate more effectively and cooperate better when facing new challenges. Such favorable conditions for communication and cooperation are suited to prevent

power struggles, conflicts, and entitlements that are likely to surface when more diversely tenured teams are being challenged. Hence, a homogenous tenured TMT with a strong external orientation should be best suited to handle the uncertainty of novel and architectural BMI.

Flexibility and Discretion. To handle the unpredictability associated with a search or experimentation involving novel and architectural BMI, the TMT needs a high level of flexibility (namely, the TMT's willingness and ability to consider and reiterate between different solutions). This flexibility can be strengthened by providing the TMT with flexible work and communication schedules, together with centralized discretion over the innovation process. One practical way to provide the TMT with more flexibility is to regularly remove the team from day-to-day operations, and place it in a setting where work schedules, reporting, and ways of communicating are sufficiently flexible so they can be adapted according to the need at hand. Moreover, unlike product, service, and process innovations, most firms do not have structures and resources in place to handle BMI. The handling of such innovations is often uncharted territory in firms, and hence the TMT should be provided with wide discretional powers to dictate the form and direction of BMI efforts as new needs arise.

Future Research and Limitations

Among the research designs of this dissertation, there are inherent limitations that should be remedied by future research efforts. While most of these are mentioned earlier in the section on methodological choices, some limitations may benefit from an extra mention here. First, a limitation that applies to both quantitative studies is connected to their use of cross-sectional data, which causes limitations in causal arguments. Future research using longitudinal designs may be valuable in clarifying the suggested causality of these findings. Second, a limitation that applies to all three studies relates to the generalizability of the findings. As all my studies are based on

empirical data from Norwegian firms, their generalizability can be challenged. Therefore, future research that includes more cross-national data will be valuable.

Beyond the research opportunities provided by the limitations of the current dissertation, there are still many valuable avenues to explore within the field of BMI research. For instance, I have taken only the initial steps in utilizing the potential of ABV, upper echelons theories, and NK models in BMI research. In future research, I wish to continue to build on these perspectives. I would like to investigate how the financial performance of firms and the performance aspirations of top managers interact in influencing BMI efforts. As managers' performance aspirations determine the boundary between what is considered success and failure, a firm's performance relative to these aspirations should act as a trigger for BMI search behavior. Second, I would like to expand this focus on performance feedback and target firms' digital performance. I would investigate whether firms that identify themselves as "digital leaders" within their industry are more or less likely to engage in BMI efforts. Moreover, I am also interested in investigating how the characteristics of the TMT matter in this context.

In sum, and as a final remark of these introductory chapters, the world of academic research has opened my eyes to new insights on BMI and my goal is to play a part in the development of the field in the years to come.

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ARTICLE 1

STEERING MANAGERIAL ATTENTION TOWARD BUSINESS MODEL INNOVATION: THE ROLE OF ORGANIZATIONAL DESIGN

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STEERING MANAGERIAL ATTENTION TOWARD BUSINESS MODEL INNOVATION: THE ROLE OF ORGANIZATIONAL DESIGN

ABSTRACT

The successful initiation of any business model innovation (BMI) requires, first, that top management pay attention to cues in the external environment that warrant a move away from the existing business model (i.e., attentional perspective) and, second, sustained search efforts to find a new high-performing business model (i.e., attentional engagement). However, top management attention is a scarce resource, and a firm's organizational design (i.e., the structuring, coordination, and motivation of work) influences what issues and solutions come to the attention of top management. Findings from an in-depth, longitudinal case study illustrate how organizational design shapes the allocation of managerial attention toward BMI and influences the scope and novelty of a firm's BMI initiatives. The paper contributes to both the BMI and attention-based literature by highlighting the interplay between organizational design, managerial attention, and BMI.

INTRODUCTION

Business models (BM), once conceived of, are not static. They change because of emerging threats and opportunities in the firm's external environment (Doz and Kosonen, 2010; Foss and Saebi, 2017; Saebi et al., 2017; Schneider et al., 2017). A firm's ability to innovate its existing BM is an important dynamic capability (Teece, 2007), which hinges on the ability to *sense* (i.e., scan the environment for cues that warrant a change in the firm's BM); *seize* (i.e., mobilize and commit resources to searching for a new BM); and *transform* (i.e., implement and refine the new BM) (Teece, 2010, 2018).

Business model innovation (BMI) is the responsibility of the top management team (TMT) (Foss and Stieglitz, 2015; Leih et al., 2015). However, not all firms and not all TMTs are equally good at sensing the need for BMI and mobilizing a search for new BMs. For instance, the TMT might misinterpret signals in the external environment. This can cause two types of errors: failing to identify an objective need for BMI, as well as identifying a need for BMI that is not there. Moreover, when searching for a new BM, some managers might strive for novel solutions, while others are more comfortable searching in the vicinity of existing solutions. Some abandon the search prematurely. As a result, the new BM may represent an inadequate response to the challenges that the firm faces in its external environment.

The inability to sense the need for BMI and search for a new BM may come from trade-offs in terms of the allocation of managerial attention. The attention of the TMT is a scarce resource (Augier and March, 2008; Cho and Hambrick, 2006; Grønhaug and Lines, 1995; Laamanen, 2019; Lavie, 1995), and most of this resource is already being utilized by the pressure of day-to-day operations (Laamanen et al., 2018). However, we argue that the processes of scanning the external environment and interpreting changes without bias are likely to require a forward-looking *attentional perspective*, defined as a top-down cognitive schema that "generate[s] heightened awareness and focus over time to relevant stimuli and responses" (Ocasio, 2011, p. 1288). Moreover, the process of searching for new BMs is likely to require considerable *attentional engagement*, defined as "the process of intentional, sustained allocation of cognitive resources to guide problem solving, planning, sensemaking, and decision making" (Ocasio, 2011, p. 1288).

The question of how firms can foster the forward-looking attentional perspective and attentional engagement that the TMT needs to sense and seize a BMI thus presents itself. In the current research literature, there is limited theorization and empirical evidence to help us answer

this question. Advocates of the attention-based view (ABV) maintain that organizations can purposefully regulate the "attention of organizational members across the activities, communications and interaction" through the firm's *attention structure* (Ocasio et al., 2017, p. 83). We propose that the latter is, to a large extent, determined by a firm's organizational design. Based on this idea, we argue that certain firms may, because of their organizational design, be more successful in steering the attentional perspective and attentional engagement of the TMT toward the initiation of BMI [1].

Linking research on ABV and managerial cognition, we seek to extend current theory and discover how the features of a firm's organizational design influence the TMT's attention and, accordingly, the type of BMI (in terms of scope and novelty of change) that the TMT opts for. To support our theorization, we draw on an illustrative, longitudinal case study of a mid-sized Norwegian retail bank. The retail banking industry in Norway has long been stagnant, but it has recently experienced major changes in environmental conditions because of the emergence of digital technologies (e.g., mobile device solutions, artificial intelligence, and big data analytics) and new industry regulations (e.g., PSD2 and GDPR). These, in turn, have enabled the entry of a new breed of competitors (e.g., fintechs and bigtechs). These changes threaten the long-term performance of traditional BMs, triggering the need for established players to pay increased attention to their environment and begin searching for relevant BMIs. During the period of our longitudinal study, the TMT of the case firm attended to several environmental changes that required a search for BMI. Moreover, the case firm underwent a period of noteworthy changes in its organizational design, allowing us to examine how the firm scanned the environment and engaged in searches for BMIs under different organizational designs.

Our case findings illustrate how organizational design influences TMT attention to both environmental changes and the search for BMI opportunities. Certain features of organizational

design are more conducive to steering the attention of the TMT toward searching for novel and architectural forms of BMI, while others limit managerial attention to searches close to the current BM. Thus, the findings support our conceptual argument that links organizational design, TMT attention, and BMI in established firms.

THEORETICAL FOUNDATION

The Role of Attention Allocation in BMI

According to the ABV, organizations can influence the decision-making process of managers by allocating and distributing various stimuli to channel the attention of the individual (Ocasio, 1997; Simon, 1947). Attention is defined as "the noticing, encoding, interpreting, and focusing of time and effort" across *issues* (e.g., opportunities and threats) and *answers* (e.g., products and procedures) (Ocasio, 1997, p. 189). In an organizational setting,

1. attention is *situated* in the sense that the objects of managerial attention depend on the characteristics of the particular context or situation they find themselves in;
2. attention is *structured* in that an organization's attention structures can regulate the situated attention by shaping (a) the valuation of issues and answers, (b) the distribution of decision-making activity into procedural and communication channels, and (c) the interests and identities of the involved managers (Ocasio, 1997; Simon, 1947).

A firm's *attention structures* (Ocasio, 1997) comprise both "softer internal aspects," such as culture and social relationships (Souitaris and Maestro, 2010), and "harder internal aspects," such as structural positions, goals, resources, and decision-making authority (Ocasio and Joseph, 2005; Ocasio et al., 2018). Our suggestion is that the latter is what research describes as organizational design (i.e., the division and integration of internal labor through structure and control) (e.g., Burns and Stalker, 1961; Burton and Obel, 2004; Galbraith, 1974; Miller and Dröge, 1986). We define organizational design as the structuring, coordination and motivation of

work (e.g., decision-making processes, the distribution of authority, and reward systems), as well as the setting of objectives and the allocation of resources (see Burton et al., 2015; Burton and Obel, 2018; Foss et al., 2013). Hence, at the center of our argument is an adapted version of Ocasio's temporal model of environmental stimuli, situated attention, and organizational moves (cf. Ocasio, 1997, p. 192), in which the situated attention of the TMT is structured by organizational design.

Since its conceptualization, there has been limited theoretical and empirical developments connected to Ocasio's concept of "attention structures," including how it affects firm outcomes, such as BMI. Examples of the influence on attention by "hard" attention structures can be found in Shepherd et al. (2017), in which allocating roles and responsibilities within the organization was found to direct managerial attention toward noticing incremental *versus* radical change in the external environment and thus prompted different strategic action. Kleinknecht et al. (2020) also highlighted the role of hierarchy and bureaucracy in directing the attention of management toward pressures for short-term results at the expense of the long term. Moreover, to date, studies rooted in the BMI literature have shown two relevant linkages. Some have identified organizational design as an important antecedent of BMI (e.g., Bock et al., 2012; Bocken and Geradts, 2019; Foss and Saebi, 2015; Leih et al., 2015; Sund et al., 2021; Teece, 2018). However, these studies did not specify how the link between organizational design and BMI is contingent on other factors (such as the allocation of TMT attention). Other studies have shown how allocating managerial attention provides an important explanatory mechanism when investigating the formation of new BM designs (e.g., Frankenberger and Sauer, 2019; Laszczuk and Mayer, 2020). These studies imply that TMT attention may play an important role in BMI, but they do not analyze the factors that influence this attention in depth.

Given the central role of the TMT in BMI efforts, we find it is important to connect the fields of organizational design with the ABV to understand how organizational design may be purposely used to influence the TMT during BMI processes. As different BMIs involve different attentional challenges for the TMT, we will, in the following text, first introduce the concept of BM as a complex system, which will help us illustrate the various forms that BMI can take. We then build on the concept of attention structures (Ocasio, 1997) and argue how a TMT's attentional perspective and attentional engagement (Ocasio, 2011) may influence that TMT's ability to sense and search for various forms of BMI.

Business Models as Complex Systems

From an activity system perspective, BMs consist of boundary-spanning linkages between interdependent activities that help the firm, in concert with its partners, create, deliver and capture value (e.g., Foss and Saebi, 2017, 2018; Frankenberger and Sauer, 2019; Snihur and Tarjizan, 2018; Teece, 2018; Zott and Amit, 2010, 2017). Innovating an existing BM entails "designed, novel, nontrivial changes to the key elements of a firm's business model and/or the architecture linking these elements" (Foss and Saebi, 2017, p. 216) [2]. As Foss and Saebi (2018) argued, BMs are comparable to "complex systems" (Fleming and Sorenson, 2001; Levinthal, 1997) in which several parts "interact in a nonsimple way" (Simon, 1962, p. 468). This implies that BMs entail varying degrees of interdependencies between efforts to create, deliver, and capture value (Lanzolla and Markides, 2020). In a highly modular system, one BM component can be altered (i.e., modular change) without needing to consider how that change affects other components. In a tightly interdependent system, altering one component typically requires considerations of how that change affects other components and/or how the components themselves are linked within the BM architecture (i.e., architectural change). Moreover, a change in an existing BM can be novel to the firm but already known in the industry. This can be the case when a firm changes its

BM so as to be on par with those of its competitors. In contrast, a firm can introduce a completely new BM to the industry.

In sum, we can then differentiate BMIs based on the scope of change (modular versus architectural) and the degree of novelty (new to the firm versus new to the industry) (Foss and Saebi, 2017; Foss and Stieglitz, 2015) (see Figure 1). As argued later, the various forms of BMI pose distinct challenges regarding the allocation of TMT attention.

Novelty	**Scope**		
		Modular	***Architectural***
	New to firm	Evolutionary BMI	Adaptive BMI
	New to industry	Focused BMI	Complex BMI

Figure 1: BMI Typology (Foss and Saebi, 2017)

In *evolutionary* and *focused* BMI, the innovation is contained in one element of the business model (i.e., modular change). For example, an incumbent firm targets a new customer segment while keeping its BM architecture and other elements intact. In terms of novelty, evolutionary BMI describes a change that is new to the firm but known in the industry, while focused BMI encompasses change that is new to the industry as well, e.g., targeting a customer segment ignored by competitors. In *adaptive* and *complex* BMI, the change is comprehensive and far-reaching since it affects the BM's architecture of interconnected activities and linkages (i.e., architectural change). For example, an incumbent firm changes its business model from a traditional pipeline to a two-sided platform. In adaptive BMI, this innovation is new to the firm, while in the case of complex BMI, the firm is the first to introduce this innovation to the industry.

As discussed below, innovating an existing BM is challenging for managers because it requires (i) sensing the need for a new BM and (ii) finding the optimal solution, in terms of which BMI to pursue in response to an emerging threat or opportunity, that is not readily evident.

Sensing the Need for BMI: The Role of Attentional Perspective

Managers must be able to detect opportunities and threats in the external environment that warrant changing the existing BM and then decide that a search for a new solution is worth pursuing (i.e., the ability to "sense" the need for BMI in response to relevant contingencies) (Loon et al., 2020; Robinson and Simmons, 2018; Sund, 2013; Teece 2010, 2018; Wilden et al., 2013). This requires allocating managerial attention to emerging trends in the external environment, as well as an internal assessment of how these trends affect the current BM ("Do we need to innovate the BM? If so, to what extent?"). We argue that this is akin to Ocasio's notion of *attentional perspective*, defined as top-down cognitive schemas that "generate heightened awareness and focus over time to relevant stimuli and responses" (Ocasio, 2011, p. 1288).

The high task demands of day-to-day operations often leads the TMT to rely on top-down (i.e., schema-driven) attentional processing when detecting opportunities and threats in the external environment (Laamanen et al., 2018; Shepherd et al., 2017). However, the top-down allocation of attention can result in an attentional perspective that is backward-looking among top managers, that is, one based on historical experiences, established industry structures, and institutional logics (Ocasio, 2011). This is likely to limit top managers' focus on (and interpretation of) environmental changes that are familiar and close to the current way of doing business. In contrast, an attentional perspective that is less experience based and more forward looking within the TMT increases top managers' ability to sense and interpret changes that are unfamiliar and far removed from the current way of doing business (discontinuous change). As

Shepherd et al. (2017) argued, the process of allocating attention can focus on sensing incremental change or discontinuous change in the external environment but not both. Hence, a lack of forward-looking attentional perspective among top managers can represent a barrier to sensing the disruptive environmental changes that warrant a change in the existing BM. The question of how firms can purposefully use features of organizational design to foster a more forward-looking attentional perspective, and thus secure management's ability to sense and react to more discontinuous environmental changes that require a BMI response, thus arises.

Searching for BMI: The Role of Attentional Engagement

Once an environmental change and the need to innovate the BM has been identified, the TMT must search for the best BMI solution. As this solution is typically "by no means given to the decision-maker but can only be approximated through a process of more or less deliberate search" (Foss and Stieglitz, 2015, p. 110), managers must be willing and motivated to engage in time- and cognitive-intensive search processes (Baumann and Siggelkow, 2013; Gavetti and Levinthal, 2000).

Two issues shape the attentional demands that make such a search challenging. First, the search for a new BM is often unpredictable, with unknown options and new information and knowledge requirements arising along the way (Li et al., 2013). As the new BM "cannot be fully anticipated in advance" (McGrath, 2010, p. 248), managers must cycle through an iterative learning process of exploration, discovery, and experimentation (Chesbrough, 2010; Gans et al., 2019; Sosna et al., 2010). Hence, top managers must be able to maintain their attention on the search over extended periods. Second, managers who "get stuck" on a rigid search path are more likely to miss or ignore valuable feedback loops from the external and internal environment (Osiyevskyy and Dewald, 2015). Such cognitive inertia results in an overreliance on known

mental models and limits the search to familiar grounds or already committed paths (Gans et al., 2019; Hodgkinson, 1997; Hodgkinson and Wright, 2002; Kim et al., 2016). In contrast, managers with high cognitive flexibility — the plasticity required to adjust to new information — are more able to identify "different problem elements and their discontinuities" and reflect "upon the connections between elements to untangle cause-and-effect relationships" (Laureiro-Martinez and Brusoni, 2018, p. 1033). Hence, top managers must be able to detach and reallocate attention to new information and alternatives as the search progresses.

Based on the above insights, we argue that these attentional demands imposed on top managers are akin to Ocasio's (2011, p. 1288) concept of *attentional engagement*, defined as the "process of intentional, sustained allocation of cognitive resources to guide problem solving, planning, sensemaking, and decision making." Attentional engagement includes both top-down and bottom-up (i.e., stimulus driven) processes of cognitive processing. It must motivate top managers to commit their knowledge to solving an identified problem, but they must also be open to making sense of the feedback from their environment (causes and consequences) in new ways and finding new or altered action alternatives (Ocasio, 2011). As attentional engagement can be differentially distributed between individuals, units, and levels in the organization, the diffusion of such engagement throughout the TMT and organization is important for new sensemaking to take hold and actions to occur (Ocasio and Joseph, 2008; Rerup, 2009).

Notably, a search for modular innovations, as compared to architectural innovations, should be less challenging for the attentional engagement of the TMT. The former involves attending to a single BM component in isolation, whereas the latter involves attending to change in several components simultaneously. Moreover, BMI that targets a BM known to the industry should be less challenging than one that targets a BM that is new to the industry. The former involves, to a large degree, known actions and predictable outcomes, whereas the latter involves

more unfamiliar action alternatives and unpredictable outcomes. Thus, the question of how firms can purposefully use features of organizational design to foster the attentional engagement needed for the TMT to also include novel and architectural BMIs in its search efforts arises.

Situated Attentional Perspective and Attentional Engagement towards BMI

By connecting the concepts of attentional perspective and attentional engagement to Ocasio's (1997) concept of situated attention, we provide the building blocks needed to link organizational design, TMT attention, and BMI. Arguably, both sensing environmental changes and searching for BMI opportunities are connected to a unique set of attentional requirements, and correspondingly both have their unique requirements in terms of attention structures (i.e., organizational design). First, based on our above argument regarding the role of attentional perspective in sensing the need for BMI, we can link a forward-looking attentional perspective to organizational design features that promote managers' awareness of their external environment (i.e., access to information and perspectives, as well as the extent to which the TMT notices and discusses changes relevant to BMI). Second, based on our arguments regarding the role of attentional engagement in more novel and architectural BMI searches, we can also link the needed attentional engagement to organizational design features that promote the bottom-up processing of new information (i.e., the TMT's willingness and ability to search for unfamiliar and distant solutions), flexibility in searching for a BMI solution (i.e., the TMT's willingness and ability to consider and reconsider various solutions), and the alignment behind search efforts (i.e., top managers' and key stakeholders' mutual understanding of the situation and their repertoire of actions).

While our conceptual argument joins the theoretical debate on situated TMT attention, by highlighting the role of organizational design in shaping attentional perspective and attentional

engagement, more empirical insights are needed to develop this further. Moreover, as mentioned above, in the extant literature there is a general lack of empirical evidence that targets the role of attention structures. In the following, drawing on a longitudinal in-depth case study, we address this gap by illustrating how features of organizational design shape TMT attention towards sensing environmental changes and searching for BMI opportunities in a real-world context.

METHODS

We draw on a longitudinal and illustrative case study of a Scandinavian retail-banking incumbent. This is a suitable methodological approach to support our conceptual contribution as it provides more clarity to the conceptual constructs, reveals more about the dynamics of the phenomena as they play out over time, and provides us with detailed examples of the proposed mechanisms (Siggelkow, 2007). Moreover, the Scandinavian retail banking market has been experiencing strong shifts in the environment over the last decade as new digital technologies emerged (e.g., mobile device solutions, artificial intelligence, and big data analytics), new industry regulations were put into force (e.g., PSD2 and GDPR), and a new breed of competitors entered the market (e.g., fintechs and bigtechs). As the authors had a unique level of access to the case firm, they were allowed an in-depth study of the research question (Yin, 2014) through following the changes in the firm's external environment, the features of organizational design that were in force, and the handling of BMI initiatives that took place during the longitudinal study (2012–2017).

Data Collection

Access to data was mainly secured through the first author's position as a business and organizational developer within the case firm. This provided the research team with a considerable advantage in identifying and accessing relevant sources. The case data were collected and analyzed by the first author, drawing extensively on archival data sources with the

support of retrospective interviews (see Table 1 for more details on the archival data). The range of data sources allowed the research team to triangulate findings and crosscheck information from the interviews with documents (Eisenhardt, 1989; Siggelkow, 2001; Yin, 2014). We limited the data collection relating to internal events to the period between 2012 and 2017, as this provided the best research access and most relevant data in the context of the firm's responses to environmental changes. From external sources, additional data from 2011 was also included. Conducting interviews and collecting documents were mainly arranged in advance, but some incidences of such were triggered by events or the analytical results of our ongoing efforts. For the interviews, we used purposeful sampling (Lincoln and Guba, 1985), and we targeted both the TMT and the mid-level management of the firm. In this way, the sample of interviewees included the key decision-makers, as well as those who had the best overall insight into the features of the firm's organizational design and innovation efforts (see Appendix A for details on the interviews). The interviews were mainly semi-structured and lasted for about one hour.

Table 1: Details of Archival Data

Data source	Comments on relevance	Number of documents	Number of pages
External trend analysis	Analysis documents from external sources targeting industry and environmental developments	60	3655
Publicly available documents and reporting	Publicly available documents and statements regarding firm performance, strategic direction, and goals (annual and quarterly reports, prospects, presentations, interviews)	39	1040
Strategic planning documents	Internal documents prepared as part of the firm's strategy context (presentations, analysis documents, decision documents, work notes, minutes)	48	963
Innovation documents	Internal documents prepared as part of the firm's innovation context (presentations, analysis documents, decision documents, progress reports, work notes, minutes)	231	2010
Aggregated reports from annual organizational surveys	Internal survey documents from surveys conducted annually over several years, targeting a broad range of aspects regarding the organizational environment	6	360
Steering documents	Internal documents including presentations, procedures, routines, mandates, performance indicators, performance evaluations, organizational structures, department descriptions, role descriptions, competency requirements, and personnel details	294	3211

Data Analysis and Interpretation

Our case analysis was an iterative process. First, we conducted a thorough examination and coding of the initial case data relating to incremental and disruptive change in the firm's external environment and the firm's handling of actions regarding BMI. This examination was based on high-level assumptions regarding the importance of TMT attention and organizational design in this context. Second, based on the initial examination, we utilized a deductive approach by building on the relevant theoretical constructs of attention, organizational design, and BMI and searched for data that represented the given constructs. The case data were coded using etic coding, that is, codes appropriate for the research field of interest (Belk et al., 2012). The first

author's position within the case firm and experience within the industry provided the research team with considerable insights when interpreting and coding the data. Moreover, another person outside the research team also reviewed key parts of the coding to instill further confidence in the process (Clark et al., 2010; Miles and Huberman, 1994). The final set of codes and coding structures emerged through an iterative process in which an expanding section of the dataset was processed and analyzed, with iteration continuing until we had a clear grasp of how these codes and structures related to the constructs involved. Third, we constructed a composite narrative and process flowchart for the case (Eisenhardt, 1989; Langley, 1999; Langley et al., 2013) before we integrated the findings, and through cross-case pattern analyses, we gained a better understanding of the events, how they were linked to one another, and what influenced them. In these analyses, the contributions of the entire research team ensured that the results were fair representations of the case data and not limited or biased by any individual experiences or views.

Changes in the external environment. Data on the relevant changes in the firm-environment were found using external industry analyses and coded according to their main point of origin and the time of impact. During the observed period for such external events (2011–2017), we identified ten instances of shifts in the environment that constituted a threat to or opportunity for the firm's existing BM. These included such examples as accelerated expectations regarding the availability of mobile services among consumers (2012), an increasing focus on the underserved small business market (2014), and a shift from closed to more open business platforms (2011). Appendix B provides an overview of the identified shifts in the business environment.

BMI needs and consequent search initiatives in the firm. In the case firm, environmental analyses and BMI search initiatives (i.e., a search decision and follow-through) were handled by the TMT in two separate and formalized contexts:

i. the context of *strategy and business plan revisions*, which was an annual strategic cycle (henceforth referred to as the "strategy context"), and
ii. the context of *development and innovation*, which covered the firm's continuous innovation efforts (henceforth referred to as the "innovation context").

Environmental analyses were typically found in documents connected to strategic plans and coded in relation to the relevant environmental changes and the main BM component affected (see Appendix C for details). Documented BMI search initiatives were coded in relation to the associated strategic plan and the main BM component affected (see Appendix D for details). The definition of BMI in Foss and Saebi (2017) guided the selection of initiatives. A consolidated view of the links between these coded findings, from environmental changes to the consequent internal analyses and, finally, to the detailed BMI search initiatives, is supplied in Appendix F. Furthermore, when categorizing the firm's BMI search initiatives, we built from the codes using the typology of Foss and Saebi (2017), as presented in Figure 1. Based on this typology, we linked each initiative to the relevant category according to their scope and novelty. See Appendix E for an overview of these coded findings.

The firm's organizational design. In line with Foss et al. (2013) and Burton and Obel (2018), we defined organizational design as the structuring, coordinating, and motivation of work, as well as the setting of objectives and the allocation of resources. We used these five definitional elements to categorize and aggregate our codes regarding organizational design (for detailed data, see Appendices G and H).

TMT attention. While attention is a concept at the individual level, our analysis focused on the features of organizational design and aggregated attention at the TMT level of analysis, as this was also the team level responsible for BMI efforts. The TMT refers to the CEO and the small group of executives reporting to the CEO. Based on our conceptual argument, the attention

of the TMT can be divided into attentional perspective (i.e., the "heightened awareness and focus over time to relevant stimuli and responses") and attentional engagement (i.e., the "process of intentional, sustained allocation of cognitive resources to guide problem solving, planning, sensemaking, and decision making") (Ocasio, 2011, p.1288). Hence, within the high-level concepts of attentional perspective and attentional engagement, we identified and aggregated our codes regarding TMT attention (detailed data are found in Appendices G and H).

ANALYSIS AND FINDINGS

In the following sections, we present the case narrative and the analyses of the interplay between the firm's organizational design and the TMT's attention toward sensing and searching for BMI. The case data reveal that twelve BMI searches were conducted as the environment of the case firm changed from 2012 to 2017. By grouping these initiatives according to the BMI typology from Foss and Saebi (2017), we find that the TMT, to a large degree, limited its BMI searches to alternatives close to the current way of doing business (evolutionary BMI) (see Figure 2). In contrast with this, a few search initiatives also took on more novel and architectural characteristics (including focused, adaptive, or complex BMI alternatives).

		Scope	
		Modular	***Architectural***
Novelty	***New to firm***	Evolutionary BMI B1.1, B1.2, B1.3, B1.4, B1.5, B4.2, B6.1, B10.1	Adaptive BMI B7.1
	New to industry	Focused BMI B4.1, B6.2	Complex BMI B2.1

Figure 2: BMI Search Initiatives According to Type (cf. Foss and Saebi, 2017)

Earlier we argued that firms can purposefully use the features of organizational design to foster a forward-looking attentional perspective and the attentional engagement needed for the TMT to include novel and architectural BMIs in its search. In the following sections, we address this argument in the context of the case firm. In this firm, the variation of BMI handling over time provides us with a valuable platform for analysis. First, we show how the events of environmental change and BMI search unfolded within the studied period. Here, we also identify several embedded cases (i.e., processes flows) of how the TMT attended to these events over time. Second, we describe the organizational design features that were found to influence the TMT during these processes. Finally, we connect the process and organizational design findings and provide our analysis of how organizational design features influenced the TMT's situated attentional perspective and attentional engagement.

THE EVENTS OF ENVIRONMENTAL CHANGE AND BMI SEARCH

We identified ten instances of changes in the external environment that had the potential to affect the firm's current BM. A process flowchart of those environmental changes, together with the internal events that represent how each change was attended to by the TMT, is provided in Figure 3 (see Appendix F for additional details). For the internal events, the flowchart includes details concerning the context of the events (strategy context and innovation context), the period when the TMT sensed the environmental change (documented acknowledgment of the TMT's attention to the change and its consequences), the period when the TMT engaged in a search for BMI (documented TMT engagement in a BMI search decision and follow-through), and what types of BMI this engagement involved (see also Figure 2).

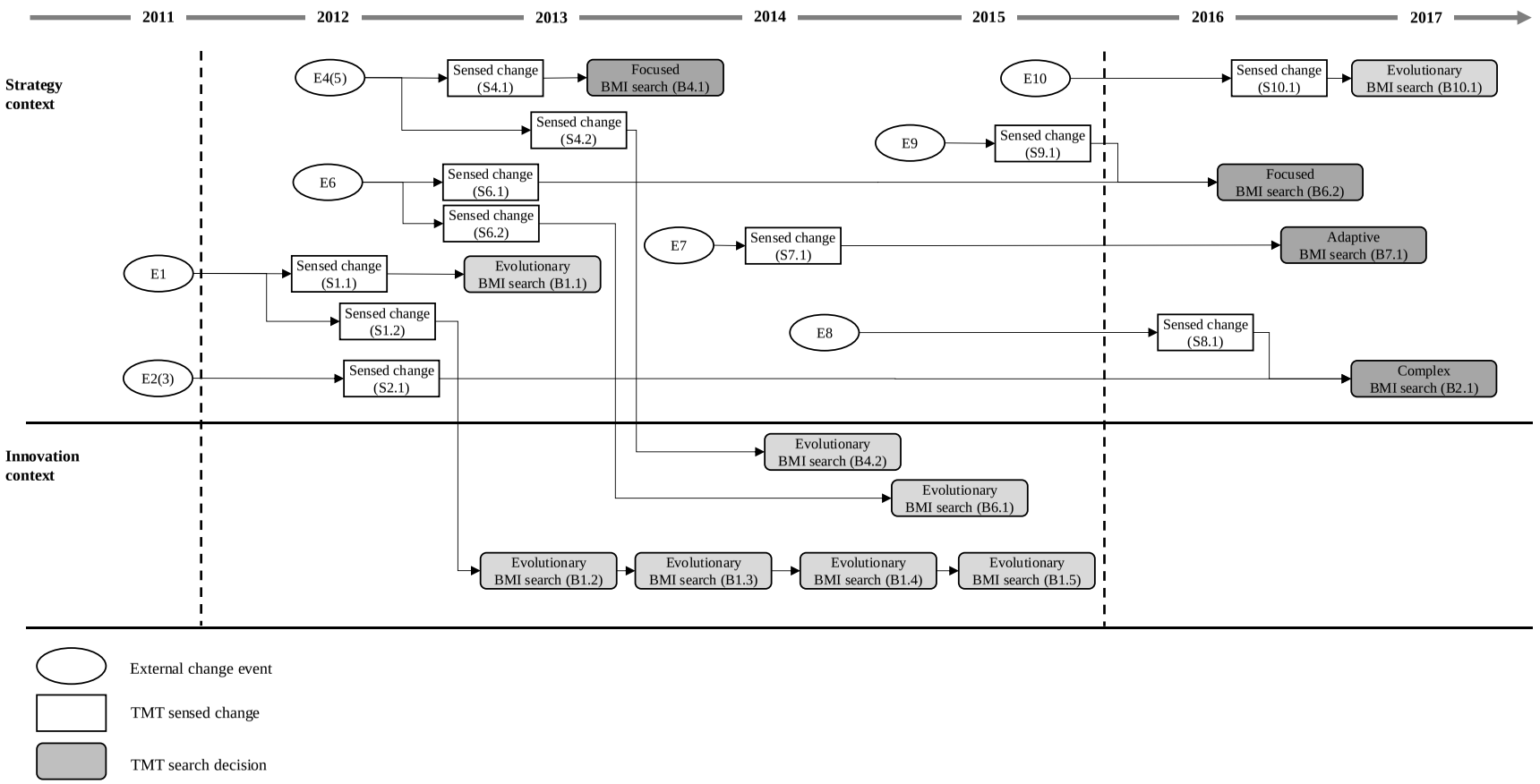

Figure 3: Flowchart of Events and their Linkages

The above visualization provides us with the first high-level patterns regarding how environmental changes and BMI searches were attended to differently in different situations. Here, we can point to differences in TMT attention within the strategy context as compared to the innovation context. Moreover, we find differences in how process events were attended to before versus after 2016. This latter point is particularly visible for the BMI search component of the processes. Notably, throughout the entire 2012–2017 period, the TMT sensed changes in the environment in a quite timely fashion, often before they were acted upon by other firms in the industry. For example, in 2012 and 2013, the TMT attended to the need to move bank services to mobile devices (based on E4) and move toward an open banking platform (based on E2). In contrast, the TMT's engagement in BMI search initiatives was often limited. Those searches that considered alternatives beyond evolutionary BMI often occurred a significant time after the need for BMI had been acknowledged and became more prominent in the 2016–2017 period (see B2.1, B6.2, and B7.1). For example, the above-mentioned need for an open banking platform was eventually followed by a complex BMI search initiative during the 2016–2017 period (B2.1).

When investigating the structural influences on TMT attention, the above patterns point to the importance of considering what features influenced the processes before versus after 2016. Relatedly, the case data also show that there were substantial changes in the organizational design features leading up to the 2016–2017 period. Hence, at an aggregated level, we find two organizational design setups influencing the TMT's attention during the studied period.

ORGANIZATIONAL DESIGN SETUPS

Our case data show that the abovementioned change in organizational design was driven by a high-level recognition that the firm was struggling to maintain its competitive position within an

increasingly innovative environment and that the organizational design had to be adjusted accordingly. The following extract is an illustration of this motivation:

> "*We needed to strengthen our focus on the customer and capacity for innovation, and through this, take back our challenger position in the market. We have therefore introduced key changes in management, organization, cooperation and coordination, and capacity"*
> *– Presentation document with a focus on the new organization, June 2016*

Consequently, during the studied period, there were two main setups of organizational design. The 2012–2015 period being recognized by characteristics such as decentralization, customer focus, and risk-aversion, while the 2016–2017 period being recognized by more centralization, financial focus, and latitude for risk.

The following text details the different setups and is structured according to the theoretical elements included in our definition of organizational design. An overview of the organizational design features included in the analysis is provided in Table 2. The overview of design features is not exhaustive, as it is limited to features of organizational design that were introduced or applied in a way that made connections to TMT attention within the targeted processes possible.

Table 2: Features of Organizational Design that Affect the TMT's Attention

Organizational design *main element*	**Organizational design** *2012 – 2015 features*		**Organizational design** *2016 – 2017 features*	
Structure	S1	Large TMT (ten members)	S2	Reduced TMT (seven members)
	S3	Long-tenured TMT composition	S4	Short-tenured TMT composition
	S5	TMT composition with predominantly internal (functional and operational) interests	S6	TMT composition with predominantly external (generalist) interests
Coordination	C1	Flexible strategy context with a strong external and long-term perspective, removing the TMT from daily operations	C1	Flexible strategy context with a strong external and long-term perspective, removing the TMT from daily operations
	C2	Strategy context with communication channels and regular work sessions involving extensive joint dissemination of information	C2	Strategy context with communication channels and regular work sessions involving extensive joint dissemination of information
	C3	Strategy context with communication channels and regular work sessions that hosted a broad involvement of internal specialists	C5	Strategy context with limited communication and work-sessions that hosted involvement of internal specialists
	C4	Strategy context decisions mainly in the form of guidance to search decisions made in the innovation context	C6	Strategy context frequently making detailed search decisions
	C7	Innovation context with a functional and short-term perspective	C7	Innovation context with a functional and short-term perspective
	C8	Innovation context with limited joint dissemination of information	C8	Innovation context with limited joint dissemination of information
	C9	Innovation context deciding detailed search initiatives	C9	Innovation context deciding detailed search initiatives
Motivation	M1	TMT compensation based on fixed salary with a small, short-term, performance-adjusted component	M2	TMT compensation with an increased long-term performance component
Objectives	O1	Priority placed on short-term financial goals in search decisions	O2	Increased priority placed on long-term financial goals in search decisions
	O3	Low latitude for risky search decisions	O4	Increased latitude for risky search decisions
Resources	R1	Low latitude for resource-intensive search decisions	R2	Increased latitude for resource-intensive search decisions

Structure. Until 2015, the group of key decision-makers defined as the TMT was a relatively large group of ten members, most with a long tenure at the firm (average of ten years).

In that period, the TMT was comprised mostly of functional specialists, who were close to every level of the organization and had hands-on experience with much of the day-to-day operations and development. From 2016 onward, the firm went through a notable change in stakeholders, governance, and organization. During that period, the size of the TMT was reduced to seven members, and many of the former members were replaced with new externally recruited candidates (see tenure details in Appendix A). These new members were more generalists (less functional in their profiles), and the new TMT became less involved in detailed day-to-day operations and development. These changes in the TMT also resulted in a TMT composition with more external interests as compared to the previous composition, which had mostly internal interests.

Coordination. In the case firm, the TMT processed and communicated about environmental developments and BMI efforts in two situational contexts, the strategy context and the innovation context. First, in the strategy context, except for a set of formal milestones during the year, the processes of analyses and decisions were very flexible. They could take many forms depending on the need at hand. The key guiding principles here included a general long-term perspective on firm performance, a strong orientation toward trends in the external environment, the broad involvement of the organization in analysis and recommendations, and placing key decision-makers in situations in which complex and novel issues and opportunities were in focus. The following extract from the strategy context is an illustration of some of these principles:

> "*The focus of today is to look five years into the future and what is needed for us to be successful in still being a challenger-bank in the market at that time"*
> *– Presentation document used in an off-site strategy context workshop, June 2014*

Outcomes of the strategy context, that were related to BMI, appeared mainly in the form of strategic plans that would subsequently function as a guide for processes and communications in the innovation context:

> "*The strategies and priorities, as they appear in the strategic plans, shall together constitute a key premise in all innovation efforts."*
> *– Innovation context mandate, March 2014*

Second, the innovation context was a continuous, formal, and structured process in which initiatives and deliverables included analyses, decisions, and search initiatives covering everything from operational improvements to BMI. Here, the key guiding principles included a strong function-oriented focus, a short-term perspective on performance within functional areas, the wide distribution of decision rights, and flexibility only within a given framework.

A notable change in the design and use of these contexts occurred at the start of the 2016–2017 period. From that point onward, more BMI search initiatives were being decided and initiated directly from the strategy context, replacing the normal process of using strategic plans to guide the innovation context (see also B2.1, B6.2, and B7.1 in Figure 3). The BMI searches initiated in the strategy context often took place through processes of limited organizational involvement. Instead, the TMT and board of directors placed themselves in more direct control of shaping innovation efforts, typically with significant support from external advisers. This new situation can be illustrated by the following statement:

> *"The top management engaged the external consultants, and they are the only ones with full insight into the search process. The choices and decisions are only partly documented, so the internal team is uncertain on how to proceed"*
> *- Decision maker in middle management*

Motivation, Objectives, and Resources. In the period from 2012 to 2015, the reward structure for top management was based mainly on a fixed salary with a small, annual, short-term performance-adjusted component (linked to overall firm performance). From 2016 onward, after a successful listing on the stock exchange, the portion of performance-based rewards among the TMT increased. There were larger salary adjustments based on short-term performance, and the long-term performance component was significantly increased through stock ownership on the

part of top managers (the TMT's stock ownership was valued at approximately 23 million NOK as per year end 2017, source: annual report 2017).

The firm's short-term performance goals were communicated through a formal scorecard that provided guidance to the entire organization. Most of these short-term performance indicators (KPIs) remained the same throughout the 2012–2017 period. They covered four target areas: financial and risk, operational efficiency, customer satisfaction and growth, and employees and culture. Among these, the customer-satisfaction goals have historically been promoted as the most important:

> *"Listening to what the customers need and providing them with the best possible service were the most important goals for us"*
> *- Decision maker in middle management*

However, in the 2016–2017 period, this priority was challenged as the expectations regarding financial and operational targets were raised, as illustrated by the following statement:

> *"The goals are now very focused on the economic bottom line, together with volume growth and product sales"*
> *- Decision maker in middle management*

Long-term performance goals were also present and communicated throughout the 2012–2017 period. However, those goals played a more prominent part in decision contexts during the 2016–2017 period. At the same time, those goals became more centered on long-term financial targets, and they were also accompanied by greater latitude for long-term, resource-intensive, and risky initiatives.

SITUATED ATTENTIONAL PERSPECTIVE AND ATTENTIONAL ENGAGEMENT

By comparing and contrasting findings across embedded process instances and time periods, we identified patterns of organizational design features having an influence on the TMT's attentional perspective (in sensing change) and attentional engagement (in searching for BMI). In the

following, we provide detailed descriptions of some typical process examples within each of the two time periods (2012–2015 and 2016–2017) and present the identified patterns regarding how organizational design was found to influence the TMT's attention.

The First Period – Two Typical Process Examples

Mobile payments (E4, S4.2, B4.2). From 2010 onward, the sale of smartphones in Norway has shown a strong growth tendency. In 2012, the share of the adult population that owned a smartphone had already reached 57%, and one year later, this share had increased to 73%. Alongside this development, consumer expectations regarding the availability and usability of digital services on such mobile devices were becoming more prominent. In 2012, these expectations began to appear in trend reports targeting the banking industry:

> *"While digital banking through desktop solutions is already something of everyday use, there is a growing number of those who are also seeking to use bank services on mobile devices"*
> *- Report from the industry organization for Norwegian banks, April 2012*

Toward the end of 2012, the growth in mobile-based banking began to impact payment services in the Nordic countries. In both Sweden and Denmark, new mobile-based payment services were released into the market with great success. These initiatives also spurred new digital platforms that showed great potential for further market disruption within those countries. Soon after these releases, various industry reports in Norway picked up on the development and went on to speculate about how this might impact the domestic market:

> *"Danske Bank's mobile payment service, Mobile Pay, has become very popular among their customers. Almost 300 000 customers have already downloaded the application on their mobile phone"*
> *- External trend analysis, July 2013*

> *"Mobile payment, and other associated forms of service digitalization, will open up mobile banking as the only channel for customer communication. Will a new breed of banks soon be able to take on the market in Norway? We think so"*

- External trend analysis, November 2013

These trends within the space of mobile payments were picked up on by the TMT in the strategy context. This occurred around the same time as the trends began to appear in industry analyses. Here, the business of mobile-based payments was recognized (sensed) by the TMT as both an emerging challenge and an attractive opportunity for the bank. Accordingly, this also found its way into the bank's strategic planning documents:

> *"The bank should adapt to this new trend of mobile banking to strengthen our competitive position, be ready for an increased rate of innovation, and face new digitally enabled challengers"*
> *- Planning document from the strategy context, September 2013*

During 2014, under the guidance of the strategic plan from the fall of 2013, this opportunity was dealt with by the TMT in the innovation context. Eventually, a BMI search decision was shaped through the involvement of several key specialists within the organization. This search initiative became centered on innovations in the channel dimension of the current BM (i.e., modular BMI):

> *"Conditioned on the initiative being conducted within current procedures and guidelines, and on that the actions of external stakeholders do not significantly change the foundation of this decision, the [initiative name] -efforts can go ahead"*
> *- Decision document in the innovation context, November 2014*

Moreover, the search initiative explored BM options in line with other business setups that had already appeared in the industry at the time (i.e., BMIs already known in the industry). Hence, the innovation search conducted by the TMT focused on evolutionary BMI alternatives (cf. the BMI typology in Figure 1).

Consumer credit (E1, S1.2, B1.2). Before 2012, the size of the Norwegian market for consumer credit services had been limited but growing. After a temporary slowdown during the financial crisis in 2008–2009, the market resumed its high-paced growth leading up to 2012:

> *"At the time when the finical crisis hit, the growth rates for consumer credit were high. After a drop during 2009 the growth rates have again been increasing in the last three years"*

- Report from the regulatory authority of Norway, November 2012

The trend reports that targeted this market pointed out that there was an increasing demand for the high-margin services that firms here provided but also that the rapid development of the market would prompt new changes and new business models going forward:

> *"The increased demand for car financing and consumer loans, and a continuing high use of debit and credit cards, resulted in a good year for the member companies in the private market. Interest margins are still at a high level, while defaults and losses are well under control"*
> *- Report from the industry organization, December 2011*

> *"With rapid changes and uncertainties on many fronts, be they economic, regulatory, or political, companies are now adopting new business models and value propositions"*
> *- Report from the industry organization, October 2012*

Within the strategy context, the TMT also recognized (sensed) these aspects of the market. The case firm was, at this point, heavily invested in other areas of financing (mainly mortgages), and the new market situation was seen as an attractive opportunity to diversify the business into new areas. Accordingly, this opportunity was included in strategic planning documents during the fall of 2012:

> *"In addition to our mortgage business, we need to put a stronger focus on the business of consumer credits to increase our profitability, reach new customer segments, and strengthen our relationship with the customers"*
> *- Planning document from the strategy context, December 2012*

Under the guidance of the strategic plan created in 2012, the opportunity was dealt with in the innovation context. After a few months, the TMT shaped the BMI search decision through a wide involvement of the organization. This search initiative became centered on the improvement of an existing value proposition (i.e., modular BMI) through a potential insurance add-on:

> *"This is an exploration of travel insurance as a possible add-on to our credit card offering. The goals are to achieve more card sales and more card usage"*
> *- Decision document in the innovation context, June 2013*

This search initiative targeted an existing but underdeveloped customer offering with new service characteristics that were in line with what several competitors already offered (i.e., a BMI already known in the industry). Hence, the TMT's search focused on evolutionary BMI alternatives (cf. the BMI typology in Figure 1). After 2013, the strategic guidance regarding consumer credit was repeated in both 2014 and 2015. Along the same lines as in 2013, this was handled by the TMT through three additional evolutionary BMI searches, which were all initiated in the innovation context.

The First Period – Organizational Design and Attentional Perspective

The role of coordination and structural features. Our findings show that top managers in the firm had a forward-looking attentional perspective on the external environment when the TMT was removed from their day-to-day operational tasks for a significant period. In the firm's strategy context, the TMT's attention was deliberately steered away from opportunities for further exploitation of the current model and toward a more forward-looking exploration of the business environment (Table 2: C1). These conditions were further strengthened when the separation from operations occurred not just in time but also in space. This included moving the TMT to remote premises for several days at the time for the purpose of exploring novel topics:

> "*We need the room to lift our gaze towards emerging possibilities for innovation and business development, without being hassled by day-to-day troubles. This is critical for our success in this area"*
> *- Decision maker in top management*

Moreover, when the TMT was exposed to a variety of perspectives and insights through the broad involvement of internal specialists, the attention paid to environmentally driven consequences increased. This impacted the attention of the TMT during the 2012–2015 period, when the team was dominated by members with internal (and mostly operationally oriented) interests (Table 2: S5). Ordinarily, the internal specialists (e.g., in technology and consumer

behavior) did not have a mandate to go beyond the current BM in their work, but when they were invited as key contributors to the environmental analysis, the TMT was able to benefit from their additional perspectives. The following quote is an illustration of these benefits:

> *"We have some internal specialists that are very competent, that keep themselves up to date on new developments in the external environment, that see the consequences, and have the ability to push us managers to see new possibilities"*
> *- Decision maker in top management*

Such internal involvement was facilitated by features that secured organization-wide and cross-level contributions to the strategy context (Table 2: C3).

The First Period – Organizational Design and Attentional Engagement

The role of structural features. The TMT's attentional engagement in BMI searches was found to be linked to the level of alignment with internal stakeholders. In the 2012–2015 period, the level of internal alignment was strong as organizational resources (specialists and middle managers) were extensively involved in both environmental analysis and search considerations, creating a "common cause" regarding BMI search initiatives:

> *"The insights mostly come from us anyway, so it is easy to get to work as soon as we get the go-ahead signal"*
> *- Internal technical specialist*

Such involvement was predominant when the TMT included more members, was closer to operations, and had strong internal interests (Table 2: S1, S3, S5). While these features created a common organizational engagement in BMI searches, they also limited the engagement to BMI searches that were mostly of an incremental nature.

The role of coordination features. Those BMI opportunities that were sensed by the TMT in the strategy context were included in strategic plans guiding the TMT's efforts in the innovation context. In the innovation context (Table 2: C7), we find that the TMT members' functional orientation (i.e., operational responsibilities) and short-term perspective were being

amplified. Hence, they were more prone to rely on established industry knowledge and ways of doing business (top-down cognitive processing). This context also lacked features that could ensure the joint dissemination of new insights and a common view regarding the need for a BMI search (Table 2: C8). Thus, the TMT members struggled to be aligned in their attentional engagement with BMI searches:

> *"When we meet, the focus is on the initiatives that are imperative for the success of each business area, each one of us representing our own area in the discussions on priority"*
> *- Decision maker in top management*

Moreover, the formal structures of this context created little room for flexibility in terms of how the TMT's attention was directed. This lack of flexibility favored predictable and incremental search initiatives over unpredictable and more novel or architectural BMI searches. The latter types of search requiring more room for flexibility and change. Accordingly, these coordination features influenced the TMT's attentional engagement such that it limited its BMI searches to mostly incremental forms.

The Second Period – Two Typical Process Examples

Small- and medium-sized business (E7, S7.1, B7.1). Early in 2014, the demand for better banking services in the small- and medium-sized business (SMB) market was beginning to become noticed in wider circles. This customer segment had long been underserved by incumbent banks, and in the new era of digital banking services, the needs and possibilities connected to these customers were neither fully understood nor exploited. The emerging situation can be illustrated in the following extract:

> *"SMBs feel poorly served by the financial services they are offered. More SMBs now wish to bank digitally, but the current digital services offered by banks are not aligned with the needs of SMBs, and this is weakening their relationship"*
> *- External trend analysis, February 2014*

This trend was picked up on by the TMT in the strategy context around the same time as it began to appear in these trend analyses. At that time, the case firm did not have any service offerings for the SMB segment. It did, however, have a strong offering of digital banking services to other segments. Given the SMB segment's interest in digital banking services and its low level of satisfaction with current banking connections, this trend was recognized (sensed) by the TMT as an emerging opportunity:

> *"This is a market segment that is dominated by traditional banks and is characterized by weak competition, high prices, and a low degree of innovation. An expansion into this segment could provide us with cost synergies based on our existing services, diversified sources of income, a more diversified financial balance, and a strong growth in deposits"*
> *- Internal analysis document in the strategy context, April 2014*

Followingly, this found its way into the bank's strategic planning documents, where it was described as an attractive opportunity with high potential impact on the current business. During the next couple of years, the SMB opportunity was regularly acknowledged by the TMT in the innovation context. However, the search decision eventually came in the fall of 2016, after renewed consideration by the TMT in the strategy context:

> *"The SMB customer segment is still poorly treated in the banking market, and there should be good opportunities for a new and customer-oriented banking concept"*
>
> *"In the time to come, we need to explore what the details of the offering could be, including definition of the value proposition, how to distribute and communicate with the customers, and finding potential partners that can be a supplement to our own services"*
>
> *- Decision document in the strategy context, October 2016*

Based on the documented details of the search efforts for a new SMB offering, such efforts involved BMIs that were architectural (i.e., involved several components of the BM) and non-novel in the market (i.e., already known in the banking industry). Hence, the search focused on adaptive BMI alternatives (cf. the BMI typology in Figure 1). The search was also a time-consuming effort on the part of the TMT. As the search progressed, it involved an increasing

number of internal resources that had to be aligned, and the search was still actively ongoing in the fall of 2017.

Open banking (E2, S2.1, B2.1). During 2011 and 2012, the first weak signals of a new and radical opportunity within the banking industry were documented, building on new information regarding regulations and consumer habits. The opportunity was characterized by banks opening their technological platforms to allow for more cooperation with third-party service providers and more transparency and service options to be made available to customers. The following extract illustrates how this was communicated in trend analyses at that time:

> *"Banking will necessarily become increasingly intertwined with customers' digital lives. New business models and means of interaction will be required in order to be successful in this changing business context. In most cases, it will prove more effective to work successfully with innovators from technology, telecommunications, and other non-traditional banking providers, than to go at it alone. Identifying partners to acquire or that can help deliver the vision becomes of critical importance"*
> *- External trend analysis, October 2011*

This trend was picked up on by the TMT in the strategy context after it began to appear in trend analyses. Here, the TMT recognized (sensed) that, in order to deliver on the future expectations of its customers and regulators, the pace and range of service innovations had to increase significantly. In strategic plans, this was framed as an emerging opportunity for the case firm:

> *"We will become the digital hub for everything connected to the customers' economy. We position ourselves to exploit new changes and opportunities by opening our platform for service providers outside traditional banking. Through such an open architecture, we can take a central role in simplifying customers' economic life by collecting everything they need in one place"*
> *- Planning document from the strategy context, September 2012*

During the next five years, this opportunity was regularly acknowledged but not acted upon by the TMT in the innovation context. In each year, the opportunity was repeated in the strategic plans that guided this innovation context, eventually taking on the label of "open banking." However, the search decision eventually came in the spring of 2017, after renewed consideration

on the part of the TMT in the strategy context. This also followed a renewed recognition (sensing) on the part of the TMT, regarding how the current business setup for in-house innovation was unable to handle the rapidly accelerating pace of innovation and development in the market:

> *"We must become better fit for purpose. We are expanding to an open platform to benefit from an evolving payment landscape and leverage regulatory opportunities through open APIs. We are also embracing open banking by integrating third party features and data" - Decision document in the strategy context, June 2017*

Based on the documented details on the search efforts for an "open banking" setup, these efforts involved BMIs that were both architectural (i.e., involved several components of the BM) and novel (i.e., not already known in the banking industry). Hence, the search focused on complex BMI alternatives (cf. the BMI typology in Figure 1). The search was still actively ongoing in the fall of 2017.

The Second Period – Organizational Design and Attentional Perspective

The role of coordination and structural features. The environmental trends that indicated emerging opportunities within SMBs and open banking were recognized (sensed) by the TMT during the first (2012–2015) period. As described above, here, a predominant internally focused TMT was able to adopt a forward-looking attentional perspective on the environment within the strategy context. In this context, the attentional perspective of the TMT was influenced by being moved away from daily operations and drawing on a wide range of internal specialists.

In contrast with this, in the second period (2016–2017), we find a TMT composition with more external interests (Table 2: S6). By including more members with a predominantly outward-looking perspective, the TMT increased its use of external knowledge sources (e.g., strategy consultants and start-up communities). This can be illustrated by the following statement by a member of the new TMT:

> *"We need to utilize more external knowledge in our efforts to follow the environmental developments and to innovate. Previous efforts have shown it to be inadequate and expensive to rely on internal knowledge"*
> *- Decision maker in top management*

Hence, the team maintained a forward-looking attentional perspective on environmental changes and their potential implications for BMI and did so without using internal specialists to the same extent as before.

The Second Period – Organizational Design and Attentional Engagement

The role of structural features. As described above, the structural features that promoted an internal alignment in the 2012–2015 period limited the TMT's attentional engagement to more incremental innovations. This incremental focus on the current business can be illustrated by the following statement regarding the SMB opportunity:

> *"How can we prioritize our effort towards a new customer segment when we still have not optimized the offering to our current customers?"*
> *- Decision maker in top management*

During 2016 and 2017, a new TMT composition strengthened the alignment with external stakeholders (including the board of directors) (Table 2: S1 vs S2, S3 vs S4, S5 vs S6) and weakened the internal alignment. Our findings show that the TMT's level of attentional engagement in BMI search benefitted from the close involvement of external stakeholders and knowledge sources. The following extract illustrates this influence on the part of the SMB opportunity:

> *"Before, the firm's resources were firmly dedicated to the current business, and we lacked the capacity and knowledge for such a small business initiative. Now, the backing for such exploration is stronger"*
> *- Decision maker in top management*

In sum, the increase in external alignment helped influence the TMT's attentional engagement such that it included BMI searches of a more novel and architectural nature.

The role of coordination features. In 2016 and 2017, the firm increased the level of discretion given to the TMT. This allowed more centralized decision-making, which also increased the TMT's flexibility regarding BMI search efforts (Table 2: C6). This development can be illustrated by the following statement from a member of the new TMT:

> *"We are in a situation where we need to make faster decisions, with less organizational involvement"*
> *- Decision maker in top management*

These centralized processes were anchored within the strategy context of the firm. The design of regular work-sessions and communication channels within the strategy context ensured an extensive innovation dialogue within the TMT and the joint dissemination of new insights (Table 2: C2). Through these features, the firm achieved limited heterogeneity in terms of top managers' attention to identified opportunities, BMI search considerations, and the repertoire of available actions. When such common attention was established, top managers could work through the recurring issues caused by their diverging operational interests and form a common attentional engagement in BMI search activities. The following quote is an illustration of this:

> *"By dealing with new situations and information together, when we are separated from everything else, it is easier for us to find common ground in how we make sense of it. It is also easier to develop and maintain a common understanding regarding what our possibilities are and what we should do next"*
> *- Decision maker in top management*

The strategy context was also very flexible (Table 2: C1). Through the flexible coordination features of this context (e.g., highly adaptable work and communication schedules), it became possible for the TMT to switch their attention to new tasks and search steps as soon as new (and often unexpected) information and intermediate search-results arose. This reduced the risk of top managers overlooking or rejecting potentially relevant issues and answers as the search progressed, even in situations of high uncertainty. The abovementioned features of

coordination hence contributed to the attentional engagement of the TMT such that it included more novel and architectural BMI searches.

The role of motivation, objectives, and resources. In 2016 and 2017, a new set of goals and reward schemes within the TMT led to a change in attention, from short-term to long-term business targets (Table 2: O1 vs O2, M1 vs M2). Moreover, new objectives regarding risk-taking and resource budgets (Table 2: O3 vs O4 and R1 vs R2) provided top managers with more tolerance regarding risk levels and resource usage. In this way, the TMT was given ample opportunity for action that included uncertain and resource-intensive initiatives. The following statement is an illustration of this influence on the TMT:

> "*There should now be possibilities for plans and initiatives that involve business opportunities far removed from the current business, as long as we can show that we are taking the right risks"*
> *- Decision maker in top management*

As the search for BMI solutions is time consuming, uncertain, and resource intensive, these new features helped managers let go of their incremental development focus on the current business (top-down cognitive processing) and increase their attentional engagement in more novel and architectural BMI searches.

DISCUSSION

Our findings indicate that top management's attention toward BMI is, at least in part, a function of the firm's organizational design features. While other factors may play a role in this regard (e.g., TMT pro-activeness), we focus specifically on the features of organizational design that are more conducive to turning the TMT's attention toward sensing and searching for various types of BMI. By linking these findings to attention-based theory and our conceptual argument related to the concepts of attentional perspective and attentional engagement, we illustrate how this helps explain the case firm's initiatives toward BMI.

Organizational Design and Forward-Looking Attentional Perspective

Earlier, we posed the question of how firms can purposefully use features of organizational design to foster a more forward-looking attentional perspective in the TMT. Our case findings highlight three features of organizational design that influenced TMT attention in this way. First, we found such influences on the part of the analysis and decision-making context in which the TMT members were placed (i.e., features of coordination), thereby removing them from operations in terms of time and space. Second, we found that the TMT was also able to benefit from internal specialists' perspectives in terms of strengthening its own attentional perspective on future developments and trends (i.e., features of coordination). Third, we showed how a forward-looking attentional perspective could be achieved through a team composition that connected the TMT with external sources of knowledge (i.e., features of structure).

Organizational Design and Attentional Engagement

Earlier we posed the question of how firms can purposefully use features of organizational design to foster an attentional engagement that also supports novel and architectural BMI search. Our case findings highlight several features of organizational design that influenced TMT attention in this way. First, we found that attentional engagement was strengthened by providing the TMT with more room for the bottom-up processing of information in BMI searches. Such processing was encouraged by i) long-term perspectives, ii) openness to risky and uncertain initiatives, and iii) openness to resource-intensive efforts (i.e., features of objectives, motivation, and resources). Second, we found that an attentional engagement that included novel and architectural BMI searches was promoted by providing the TMT with greater flexibility in terms of BMI searches. Such flexibility was encouraged by i) analysis, communication, and decision contexts that were adaptable according to new needs and insights and ii) a high level of TMT

discretion for centralized decision-making (i.e., features of coordination). Third, we found that an attentional engagement that included novel and architectural BMI searches was promoted by providing the TMT with greater alignment within the team and with external stakeholders. Such an alignment was strengthened by i) a TMT composition based on external interests and ii) extensive within-team knowledge dissemination (i.e., features of structure and coordination).

Consequences of Unevenly Distributed Attentional Engagement

While the above findings point to how organizational design features during the 2016–2017 period provided the TMT with a stronger attentional engagement in BMI, the diffusion of this engagement to the rest of the organization was lacking. Therefore, there was a growing difference between the attentional engagement found in the TMT and that found in the remainder of the organization. This stands in contrast to the situation prior to 2016, when the alignment, in terms of attentional engagement, was stronger across all levels of the organization. This cross-level alignment made it easier for organizational resources to make sense of new BMI searches and make valuable contributions. Ultimately, the organizational design setup of 2016–2017 strengthened the attentional engagement on the part of the TMT in BMI searches but left the remainder of the organization increasingly confused and struggling to make valuable contributions. Accordingly, while the new organizational design features constituted a success in terms of strengthening the TMT's attention to more radical BMI searches, they also brought about additional organizational challenges that we believe impacted later process stages (i.e., the transformation stage). However, as this study is limited to the sensing and seizing stages of the process [1], it falls to future studies to explore this point further.

CONCLUSIONS

The successful initiation of any BMI requires top management's attention toward sensing cues in the external environment that warrant a change in the existing BM (i.e., forward-looking attentional perspective), as well as sustained search efforts to identify a new high-performing BM (i.e., attentional engagement). As a firm's organizational design (i.e., the structuring, coordination, and motivation of work; setting of objectives; and allocation of resources) is here argued to regulate managers' situated attention, we raised the question and provided an illustration of how features of organizational design can foster the forward-looking attentional perspective and attentional engagement that top management requires to sense changes in the external environment and act upon them via BMI searches.

Contributions to the BMI Literature

Research has highlighted the important role of managerial cognition as a filter between managers' interpretations of exogenous change and a firm's BMI response (e.g., Aspara et al. 2013; Frankenberger and Sauer, 2019; Martins et al., 2015; Osiyevskyy and Dewald, 2015; Tikkanen et al., 2005). Indeed, as our study illustrates, a firm's ability to innovate its BM is, at least in part, a function of management's attention to and understanding of the need for change (i.e., scanning the environment for emerging threats and opportunities) and whether (and to what extent) those trends suggest a change in the current business model. In line with recent studies, we show how the ABV provides an important explanatory mechanism for investigating the initiation and formation of BMI (Frankenberger and Sauer, 2019; Laszczuk and Mayer, 2020).

Our study serves as an important step toward understanding the role of organizational design in influencing the TMT's attention to BM problems and the search for the most attractive BMI. To notice discontinuous changes in the external environment that may constitute a BM

problem, the TMT requires a forward-looking attentional perspective. Moreover, by viewing BMs as complex systems, we gain a deeper understanding of the cognitive challenges that firms face when searching for new BM alternatives and the strains this may place on the allocation of TMT attention. In particular, we find that the attentional engagement of a TMT plays a key role in shaping the scope and novelty of a firm's BMI search. Our study thus contributes to a better understanding of the interplay between organizational design, managerial attention, and BMI.

Contributions to the ABV Literature

Our study contributes with new insight on how features of organizational design underlie what Ocasio (1997) termed "attention structure" and are likely to affect the allocation of TMT attention. Furthermore, our study highlights the roles of attentional perspective and attentional engagement in the TMT's sensing of and search for BMI. While more research is still needed in this area, our study offers a first step toward conceptualizing and operationalizing these concepts. We find that a good indicator of TMTs' attentional perspective is the managers' awareness of their external environment (i.e., the extent to which the TMT noticed and discussed changes relevant to BMI). Indicators of TMTs' attentional engagement in BMI search include the bottom-up processing of new information (i.e., a TMT's willingness and ability to search for unfamiliar and distant solutions), the level of flexibility in terms of searching for a BMI solution (i.e., a TMT's willingness and ability to consider and reconsider different solutions), and the level of alignment behind search efforts (i.e., top managers' and key stakeholders' mutual understanding of the situation and repertoire of actions). Scholars can build on these indicators to proxy the concepts of attentional engagement and perspective for future empirical inquiry. In sum, we contribute to the ABV literature with empirically supported arguments regarding how organizational design structures the TMT's situated attentional perspective and attentional engagement toward BMI.

Managerial Implications

In increasingly dynamic environments, continuously innovating the firm's BM is a key managerial task. Failing to do so may cause the firm to lose its competitive advantage, resulting in prolonged declines in revenues and profit. However, the attention of top managers is a scarce resource, and most attentional capacity is already consumed by the pressure of day-to-day operations. Thus, firms should purposefully employ features of organizational design that support the TMT in scanning the external environment and motivate the TMT to search beyond familiar BM forms.

Our study of an incumbent retail bank provides managers with various examples of how firms (not just in retail banking) may purposefully use features of organizational design to help steer TMT attention in this way. Such features of organizational design can include the distribution of top management roles and positions (e.g., the functional backgrounds and interests of TMT members), the distribution of decision-making and involvement within the firm, and the firm's formulation of business goals and reward mechanism, as well as the authority and discretion accorded to the TMT. Moreover, our study sheds light on the challenges to attention that many TMTs face under dynamic conditions. This includes the increased need for ambidexterity in management teams, where the focus on the external must be balanced with an internal focus that maintains the motivation and capabilities of the wider organization. Overall, our findings should lend themselves easily to practical interpretation as they point to detailed features of organizational design that managers know and can control.

Limitations and Future Research

While we base our empirical contributions on a longitudinal illustrative case study, it is reasonable to discuss the generalizability of case study findings. We argue that this study has several features that suggest such analytical generalizability (Yin, 2014). First, our findings are in line with our conceptual argument, which, in turn, is built on previous studies rooted in the BMI literature and the ABV. Second, BMs and features of organizational design are concepts that are present in all firms, even if their actual materialization differs. Thus, the current case is not so unique that its lessons cannot be transferred. Neither do we assume that the managers subjected to the features of organizational design in the case firm had cognitive processes that fundamentally differ from those of other managers in other firms.

Still, there are limitations and shortcomings regarding our study. While we had unique access to managers and archival data at the case firm, and received feedback on the research results from key actors in the case firm during the analysis, we may have missed relevant data. For example, the nature of the archival data did not allow us to capture details in informal (undocumented) dialogues taking place among managers. This can lead to a potential bias in our study as only the most salient issues, events, and solutions are documented. Furthermore, we limited our analysis of features of organizational design to five definitional elements (structure, coordination, motivation, goals, and resources). Studies adopting a wider definition of organizational design may shed light on features that we have overlooked. In addition, capturing the attentional perspective and attentional engagement of managers (e.g., what managers pay attention to, for how long, and how intensively) would require in-depth cognitive and psychological inquiries. Instead, we relied on data from documents and interviews covering such

elements as TMT discussions, dialogues, and meetings to provide us with insights regarding the allocation of attention at the team level.

As we address the emerging literature on the intersection between organizational design, cognition, and BMI, we encourage future research in this field. Such research should address the above-mentioned shortcomings but also expand to include more quantitative analyses. Much of what has been explored here through qualitative data should be verified using quantitative data through large-N studies. Our conceptualization and process study serve as a steppingstone on the path to empirically investigate the relationships between features of organizational design and BMI. Combining data sources such as official accounting data and national population registries with firm-level surveys, future research can effectively analyze the relationships between firms' features of organizational design and BMI efforts. One promising research avenue is to connect to the upper echelon theory (Hambrick and Mason, 1984) and examine how certain TMT compositions (e.g., based on internal or external profiles and risk preferences) and levels of TMT discretion (e.g., the centralization of decisions and the availability of resources) can affect firms' propensity to engage in novel and architectural BMI. Another promising research avenue is to investigate how firms' goal-setting affects TMTs' willingness to search for more distant BM forms (e.g., priority being placed on short-term over long-term goals, or performance as compared to prioritized goals). This would connect research on BMI to the behavioral theories of the firm (Cyert and March, 1963; Greve, 2003). In contrast, while the connection between organizational design and BMI might lend itself easily for large -N studies, managerial attention is more difficult to capture in this way. While we, in the current study, have had a unique level of access to the firm and its managers, we still have much to learn about the influence of organizational design on attention at the team and organizational levels (Ocasio, 2011). A research design centered on experiments can be a promising next step in investigating how the

attentional perspective and attentional engagement of management teams are affected by various features of organizational design. In sum, applying the ABV in the context of BMI should continue to be a fruitful avenue via which to advance research on the organizational antecedents of BMI.

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NOTES

[1] For the purposes of this paper, we disregard the final implementation of BM as an outcome because a multitude of factors are likely to influence this part of the process, e.g., Foss and Saebi (2017).

[2] The literature on BMI differentiates between situations where an existing business model is already in place, versus when a model is formed for the first time (Massa and Tucci, 2014). In the current study, we address research in the context of incumbent firms with existing business models, where this form of innovation may be a key source of renewed performance (Zott and Amit, 2007).

APPENDIX

A: Details of Interview Data

Interview #	Position / Role	Years in the firm	Date	Duration
1	TMT member 1 (CEO)	11	June 2017	1 hour
2	TMT member 2	17	June 2017	1 hour
3	TMT member 3	2	June 2017	1 hour
4	TMT member 4	2	June 2017	1 hour
5	TMT member 5	7	June 2017	1 hour
6			Oct 2017	0.5 hour
7	TMT member 6	2	June 2017	1 hour
8			Oct 2017	0.5 hour
9	TMT member 7	1	June 2017	1 hour
10	Middle manager 1	10	June 2017	1 hour
11			Oct 2017	0.5 hour
12	Middle manager 2	12	June 2017	1 hour
13	Middle manager 3	15	June 2017	1 hour
14	Middle manager 5	2	June 2017	1 hour
15	Middle manager 6	8	June 2017	1 hour
16	Middle manager 7	2	June 2017	1 hour
17	Middle manager 8	17	June 2017	1 hour
18			Oct 2017	0.5 hour
19	Subject specialist 1	7	June 2017	1 hour
20	Subject specialist 2	4	June 2017	1 hour
21	Subject specialist 3	5	Oct 2017	0.5 hour

B: Key environmental shifts

The case firm is situated in Norway, and thus exposed to the economic conditions of the country. From the years 2011 to 2017, the economy of Norway experienced a relatively steady and moderate growth, characterized by low levels of unemployment, low-interest rates and rapid growth in debt levels among the population. However, in the same period, the domestic and global retail banking market underwent significant structural changes due to new competition, government regulations, demography, and technological breakthroughs. Thus, the environment has shown a transition from a situation of regular and stable change to a situation characterized by environmental shifts as well as hyper-competition. While the Norwegian retail banking consists of a large number of retail banks situated across the country, it is a small number of full-service banks that dominate the market. In addition, many new entrants (fintechs as well as non-financial players) are disrupting parts of the market with innovative services and business models.

Through the collected case data, we identified ten instances of significant changes in the external environment that would require adaptations or innovations in the firm's business model. Each entry is placed in relation to the period where the shift first became identified in external trend-reports as getting notable traction (from external sources such as Cicero, PWC and McKinsey, together with industry organizations and official national statistics and reports). The environmental changes are also numbered according to the order they were identified (E1-10) and listed according to its origin in "consumer trends and expectations", or "business practices and regulations".

Consumer trends and expectations	**2011-2013**	**2014-2015**	**2016-2017**
E1 New demand for unsecure lending among consumers	**E1.1** Consumers use of unsecured credit and lending growing rapidly	**E1.2** Rapid growth of new players entering the market with highly digitalized solutions	
E4 Consumers require service providers to be available on mobile devices	**E4.1** Key turning point where consumer expectations regarding availability and usability of banking services on mobile devices reach a critical level. The fight for customer attention in digital channels intensifies considerably, particularly in regard to the young customer segment.	**E4.2** Strong increase in number of mobile payment-solutions in the market, including in the Norwegian payment market. Adoption among consumers in Norway escalating	
E6 Consumers taking responsibility for their long-term savings	**E6.1** Emerging need and interest for long term savings among consumers	**E6.2** A clear "jump" in knowledge and interest for long term (pension) savings among the population	**E6.3** Many new initiatives in savings being introduced into the market. The fight for customer attention intensifies considerably
E7 The underserved small businesses market getting more attention and demanding better banking services		**E7.1** Emerging demand for better banking services	**E7.2** Strong increase in investments towards digital services for small businesses, both among new and old players in this market.
E10 Consumers adopting entirely new ways of doing their day-to-day banking		**E10.1** Entirely new types of banking services being introduces in the Nordics by new players, but most still lacking customer-traction.	**E10.2** Incumbents increasing testing of new types of banking services in Norway

Business practices and regulation	**2011-2013**	**2014-2015**	**2016-2017**
E2 Banks seeking more open approaches to innovation and development	**E2.1** Emerging interest in open forms of innovation		**E2.2** Shifts towards use of alliances, cooperation and sharing of data when producing new services within banking. The term "open banking" is established throughout the national industry
E3 New regulation disrupting traditional business in industry	**E3.1** More credit regulations, more costly access to capital. **E3.2** Initial process regarding new regulation within payments that opens the banking-industry for new and increased competition.	**E3.3** A roadmap for new payment regulation in Europe is formalized.	**E3.4** More regulations within credit and marketing being introduced. **E3.5** Process regarding new regulation within consumer protection.
E5 Investment focus among incumbents	**E5.1** "Brick and mortar" banks accelerating branch closures and increasing their efforts into technological development and innovation. Cost efficiency and growth being a strong driver.		
E8 Accelerating pace of innovation and development		**E8.1** Rapidly accelerating pace of new services and solutions being introduced into the market as both new and old players are testing concepts and trying to differentiate themselves. New digital players are gaining notably in market share, as incumbents re-organize themselves to face the challenge.	**E8.2** Shift towards new suppliers of banking services (financial technology companies) being acquired by banking incumbents.
E9 Emerging technologies changing the way banks operate		**E9.1** Notable trend towards data intensive customer insight among banks and micro-segmentation of customer services.	**E9.2** Robotics and artificial intelligence technologies getting significant traction in the industry, both within process automation and customer advisory functions

C: Strategic plans for BMIs

In the table, each plan is placed in the time-period where they first become documented. While some of the plans also include detailed decisions (tagged as 'strategic decision') that are committing the organization to a particular BMI search initiative, most instances are in the form of a strategic guide for the organization (tagged as 'strategic guiding'). The latter signifying that it is up to the main development and innovation process to shape and initiate action. Each plan is also numbered and linked to the relevant (triggering) environmental shift from appendix B.

Primary area of change	Strategic planning 2012-2013	Strategic planning 2014-2015	Strategic planning 2016-2017
Offering new value propositions and targeting new customer segments	**S4.2** Plans for initiatives that target emerging opportunities driven by innovative technologies and consumer trends within payments (mobile payments). Relevant for environmental shift E4, E5 [strategic guiding] **S6.1** Plans for an initiative to develop a strengthened long-term savings concept, including new value propositions to customers and new ways of delivering services. Relevant for environmental shift E6 [strategic guiding] **S6.2** Plan for initiatives that target new concepts and value propositions for families. Relevant for environmental shifts E6 [strategic guiding]	**S6.1.1** Repetition and refinement of plans within the long-term savings concept [strategic guiding] **S7.1** Plans for an analysis-initiative to expand the customer base to also include small businesses. Relevant for environmental shift E7 [strategic guiding]	**S6.1.2** Repetition and refinement of plans within the long-term savings concept [strategic decision] **S10.1** Plans for initiatives to build an insurance offering as an "add on" to the core banking products. Relevant for environmental shift E10 [strategic decision] **S7.1.1** Repetition and refinement of plans to move from a pure retail focus and expand the customer base to also include small businesses [strategic decision]
Capturing value in a novel way	**S1.1** Plans for an initiative to diversify the funding portfolio, including certificates and covered bonds program. Relevant for environmental shifts E1, E3 [strategic decision]	**S1.2.1** Repetition and refinement of plans within the diversification of the lending portfolio [strategic guiding]	**S1.2.2** Repetition and refinement of plans within the diversification of the lending portfolio [strategic guiding]

Primary area of change	Strategic planning 2012-2013	Strategic planning 2014-2015	Strategic planning 2016-2017
	S1.2 Plans for initiatives to diversify the lending portfolio, including new products and services, ways of distribution, and pricing mechanisms. Relevant for environmental shift E1 [strategic guiding]		
Finding new ways of producing and distributing existing or new products and services to existing or new customer segments (new supply chain structure)	**S4.1** Plans for an initiative to shift the digital distribution platform, moving the primary customer device from desktops to mobile devices, and at the same time strengthening our mechanisms of customer communication Relevant for environmental shifts E4, E5 [strategic decision]	**S4.1.1** Repetition and refinement of plans within digital distribution platform [strategic decision] **S9.1** Plans for initiatives to significantly change and strengthen the way the firm handle customer relationships, including initiatives in data analytics, organizational structure, communication solutions and processes. Relevant for environmental shift E9 [strategic guiding]	**S4.1.2** Repetition and refinement of plans within digital distribution platform [strategic decision] **S9.1.1** Repetition and refinement of plans within strengthening customer relationship management [strategic decision] **S8.1** Plans for initiatives to strengthen the organization to handle the rapidly accelerating pace of innovation and development in the market. Relevant for environmental shifts E8 [strategic decision]
New business model architecture	**S2.1** Plans for an initiative to create an open banking platform, with the potential to link value offering, value capture and the supply chain in entirely new ways. Relevant for environmental shifts E2, E3 [strategic guiding]	**S2.1.1** Repetition and refinement of plans for the open banking platform [strategic guiding]	**S2.1.2** Repetition and refinement of plans for the open banking platform [strategic decision]

D: Key BMI search initiatives

Each entry in the table is numbered and marked with a link to the associated plan in appendix C. The table includes both searches that received a positive decision (tagged as 'go') and those that received a negative decision or non-action (tagged as 'no go'). As the table entries are based on documented events there is a majority of positive search decisions. Often, innovations lacking the necessary support would be dropped before being dealt with in any formal context.

Primary area of change	Search initiatives 2012-2013	Search initiatives 2014-2015	Search initiatives 2016-2017
Offering new value propositions and targeting new customer segments	**B1.2** Together with an external partner the firm initiated an initiative to combine insurance and credit card services in new ways in their customer offerings. Based on S1.2 [go] **B6.3** The firm made an effort to find a new value proposition for families, through a set of services and channels towards children and their parents. Based on S6.2 [no go]	**B1.3** Together with a partner the firm decided to explore combining insurance and car loan services in new ways in their customer offerings. Based on S1.2 [go] **B4.2** The firm started an initiative to be part of a Norwegian effort for offering mobile payments. Based on S4.2 [go] **B6.1** The firm started an initiative to explore new offerings within long term savings together with a partner. Based on S6.2 [go] **B7.2** The firm made an effort to expand the customer base to also include small businesses. Based on S7.1 [no go] **B1.6** The firm made an effort to find a partner solution with a large international loyalty scheme to create new value propositions and reach new customers. Based on S1.2 [no go]	**B10.1** The firm initiated an effort to explore insurance offering to be an add on to the core banking products. Based on S10.1 [go] **B6.2** The firm initiated a search process to introduce advanced robotics support for customers seeking economic advice and investment-support. This initiative also explored a partnership with a start-up company specializing in this field. Based on S6.1, S9.1 [go] **B7.1** The firm has started an initiative to explore a move from a pure retail focus and expand the customer base to also include small businesses. Based on S7.1 [go]
Capturing value in a novel way		**B1.4** The firm started a search initiative into consumer loans with risk-based pricing, giving different customers	

Primary area of change	Search initiatives 2012-2013	Search initiatives 2014-2015	Search initiatives 2016-2017
		different interest rates based on an automatic evaluation of the individual. Based on S1.2 [go] **B1.5** The firm started an initiative into custody account lending. Offering customers financing of share trades for a number of listed shares on Oslo Stock exchange. Based on S1.2 [go]	
Finding new ways of producing and distributing existing or new products and services to existing or new customer segments (new supply chain structure)	**B4.1** The firm sought a significant shift in the digital distribution platform, moving the primary customer device from desktops to mobile devices. Based on S4.1 [go] **B1.1** The firm initiated a search for new ways of securing funding for the mortgages loan portfolio. Based on S1.1 [go]		
New business model architecture			**B2.1** The firm started an initiative to explore a move towards a more open banking platform, with a concept that have the potential to link value offering, value capture and the supply chain in entirely new ways. Based on S2.1, S8.1 [go]

E: BMI search initiatives according to typology

BMI search initiatives from appendix D is here grouped according to the typology as presented in the main document. Hence, each initiative is connected to the relevant category according to details about their scope and novelty.

		Scope	
		Modular	***Architectural***
Novelty	***New to firm***	Evolutionary BMI B1.1, B1.2, B1.3, B1.4, B1.5, B4.2, B6.1, B10.1	Adaptive BMI B7.1
	New to industry	Focused BMI B4.1, B6.2	Complex BMI B2.1

F: Summary and time distributions of findings

An overview of environmental changes is provided in the table and flowchart below, together with key data on when and how the changes were dealt with by the case firm (see Appendices B-E for additional details). Each entry in the table has details on the origin of the environmental change (inside or outside the industry), the period when the change was identified in external reports, and the period when change-opportunities were acted upon (seized) by firms in the domestic industry. Moreover, and as found in internal case data, each entry has details about the period when the TMT sensed the change (documented awareness of the change and its

consequences), what period the TMT engaged in seizing the change-opportunities (documented BMI search initiative that was decided and followed through by the TMT), and what forms of BMI searches this involved (search details matched with the BMI typology as presented in the main document).

Environmental change	**Based on external sources**			**Based on internal sources**		
	Origin of change	Identified *year*	Seized by industry *year*	Sensed by TMT *year*	Seized by TMT *year*	Seized by TMT *BMI search*****
E1	Inside industry	2011-2013	2014-2015	2012-2013	2012-2013 2014-2015	B1.1,1.2 Evolutionary BMI B1.3,1.4,1.5 Evolutionary BMI
E2*	Outside industry	2011-2013	2016-2017	2012-2013	2016-2017	B2.1 Complex BMI
E3*	Inside industry	2011-2013	2014-2015	2012-2013	-	-
E4**	Outside industry	2011-2013	2014-2015	2012-2013	2012-2013 2014-2015	B4.1 Focused BMI B4.2 Evolutionary BMI
E5**	Inside industry	2011-2013	2016-2017	2012-2013	-	-
E6	Inside industry	2011-2013	2016-2017	2012-2013	2014-2015 2016-2017	B6.1 Evolutionary BMI B6.2 Focused BMI
E7	Inside industry	2014-2015	2016-2017	2014-2015	2016-2017	B7.1 Adaptive BMI
E8*	Outside industry	2014-2015	2014-2015	2016-2017	-	-
E9***	Outside industry	2014-2015	2016-2017	2014-2015	-	-
E10	Outside industry	2014-2015	2016-2017	2016-2017	2016-2017	B10.1 Evolutionary BMI

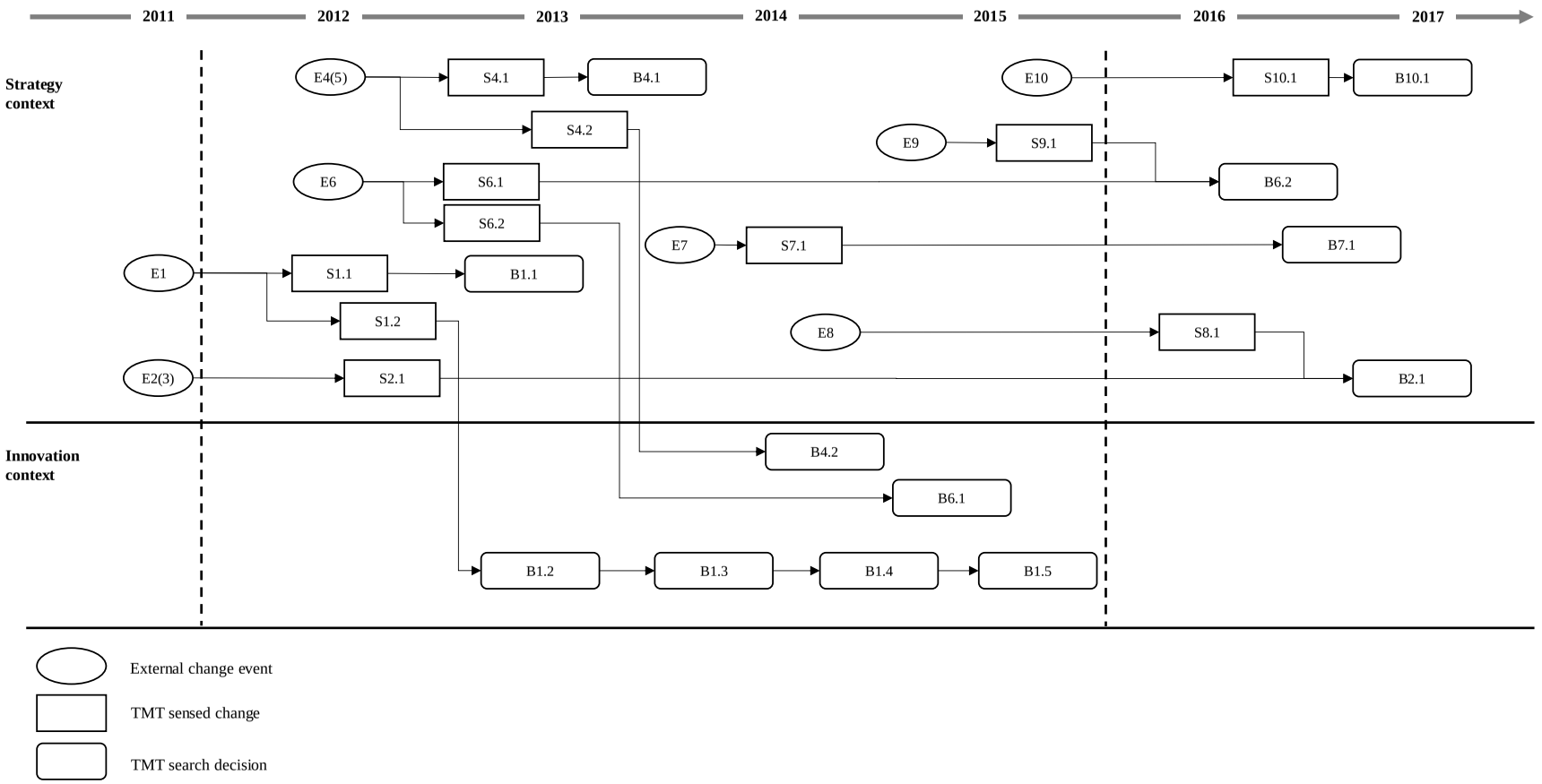
* E2, 3, and 8 were seized by the TMT through closely linked BMI search efforts (detailed only for E2).

** E4 and E5 were seized by the TMT through closely linked BMI search efforts (detailed only for E4)

*** E9 were seized by the TMT as part of the B6.2 search effort

**** Details about BMI search efforts are found in Appendices D-E

The flowchart below provides further details on the time distribution of the external change events, TMT sensing the change (documented awareness of the change and its consequences), and TMT search decisions (documented BMI search initiative).



G: Organizational design and TMT attention towards BMI

As presented in the main text, the attention of top managers is influenced by context- and period- specific organizational design features.

The table below provides additional data in this regard.

Organizational design features	TMT attention toward BMI
Coordination	BMIs have been relevant in two separate decision contexts in the firm, both involving the same set of decision makers. First, the strategy-context which is based on an annual cycle where key deliverables are strategy revisions, business plans and reviews, and targeted strategic initiatives. Except from a set of formal milestones during the year, this is a very flexible process that can take many forms and cover a wide variety of focus areas. Key guiding principles in the process include a general long-term perspective on firm performance, a strong orientation towards trends in the external environment, broad involvement of the organization in analysis and recommendations, and placing key decision makers in situations where complex and novel issues and opportunities are in focus. The following statements from the interviews illustrate some of the influences of this context: *"We need the room to lift our gaze towards emerging possibilities for innovation and business development without being hassled by day-to-day troubles. This is critical for our success in this area" - Decision maker in top management* *"By dealing with new situations and information together, when we are separated from everything else, it is easier for us to find common ground in how we make sense of it. It is also easier to develop and maintain a common understanding regarding what our possibilities are and what we should do next" - Decision maker in top management* Consequently, and as evident from the findings in appendix C and F, decision makers have in this context been able to attend to environmental trends in their initial stages. Decisions made in this context have mainly been shaped as guidelines for the innovation-context where the final search decisions are then made. Second, the innovation-context is a continuing process where initiatives and deliverables include analyses, decisions and implementations covering everything from operational improvements to groundbreaking innovations. Key guiding principles of the process include strong function-oriented focus, short term perspective on performance within functional areas, wide distribution of decision rights, and formal procedures. The influence of this context can be illustrated by the following statement: *"When we meet the focus is on the initiatives that are imperative for the success of each business area, each one of us representing our own area in the discussions on priority" - Decision maker in top management*

Organizational design features	TMT attention toward BMI
	In both the strategic and innovation context, different organizational levels (including top-management) have historically worked closely together on both operational issues and innovations, shaping recommendations and decisions together. In the 2012-2015 period, most of the attention towards issues and opportunities have typically emerged through such close and cross-level cooperation: *"We have some internal specialists that are very competent, that keep themselves up to date on new developments in the external environment, that see the consequences, and have the ability to push us managers to see new possibilities"* *- Decision maker in top management* *"The insights mostly come from us anyway, so it is easy to get to work as soon as we get the go-ahead signal"* *- Internal technical specialist* These contexts have not been held consistent throughout the period. Our study found evidence of an internal shift taking effect on the handling of environmental developments and BMIs during the 2016-17 period. See more of this under Structure.
Structure	Until 2016, the group of key decision makers defined as the top-management (and then key to BMI initiatives) was a relatively large group compared to organizational size. In this period, each manager in the TMT was close to every level of their organization and hands-on in much of the day-to-day operations and development. At the same time the board of directors held a formal distance and did not play any pro-active part in the development of strategic initiatives in the firm. The firm then went through a notable change in stakeholders, governance and organization. This had effects such as an increased level of focus on external expectations, a more pro-active board of directors, and increased levels of formality and hierarchy in the organization. The TMT was slimmed down in size, gained more managers with external identities, and became less involved in the detailed day-to-day operations and development. Most minor innovation-decisions and searches continued to originate from the innovation-context, but the changes opened for more strategic decisions being made in the strategy-context (replacing strategic guiding). The latter decisions often taking place through processes with more limited organizational contribution. Instead the TMT and board of directors were taking more direct control in shaping the innovation-efforts of the firm, often with significant support from external advisers. This is illustrated by the following statements from the interviews: *"We are in a situation where we need to make faster decisions, with less organizational involvement" - Decision maker in top management* *"We need to utilize more external knowledge in our efforts to follow the environmental developments and to innovate. Previous efforts have shown it to be inadequate and expensive to rely on internal knowledge" - Decision maker in top management*

Organizational design features	TMT attention toward BMI
	In this way our study also finds the strategy-context departing from the historical model of wide internal contribution, and decisions mostly in the form of guidelines. As the 2016-2017 structural changes have strengthened the focus of the TMT towards the external environment and BMI-opportunities, they have reduced the involvement of the broader internal organization. Thus, parts of the organization no longer have a clear part in shaping these kinds of innovation efforts: *"We do not know what is going on anymore. We end up getting the information from what is being said to the media" - Decision maker in middle management* In the collected data, we also find evidence of this change in the organizational cultural survey. The survey regularly targets the employees' view on the cultural elements they find most prominent in the current organization and the elements they wish could characterize the organization in the future. By studying the data, we see a new development taking hold between the last two surveys in the period (2015-survey and 2017-survey). Firm-level cultural elements identified with terms such as "teamwork" and "we achieve progress together" are losing significance, while new elements such as "confusion", "bureaucracy" and "hierarchy" are on the rise with a significant increase. While individual teams in the organization may still thrive internally, the result indicates an organization that finds the distance to and formality of decisions to be increasing. Another cultural element that has been losing significance for a longer period is "innovation". Even if the strategic decisions are directed towards more complex responses to the environment, this is not the same as the progress being truly innovative in the view of the broader organization. The interviews and survey results show an organizational that is increasingly finding the innovation effort of the firm lacking. Each decision maker is found to use their own perception-framework when interpreting which trends in the environment or what solutions are critical for the firm's development. From the interviews, we can extract information that show the presence of such diversity in interpretation among managers in the organization. In the following, we show an example of how the benefits of increased external contribution to the firm's development is interpreted differently. Some see the use or acquisition of external resources as a financial benefit: *"We need a significantly improved cost efficiency in our innovation/development, and so we need more knowledge on how to connect effectively to external partners" - Decision maker in the finance function* While others see it as a tool for increased access to knowledge: *"It will be important to work with external partners, as we together can establish formal cooperation regarding innovation-labs, prototyping, etc. We could also cooperate with academia regarding new knowledge" - Decision maker in the innovation function* Or, as an effective alternative to developing knowledge or capabilities internally:

Organizational design features	TMT attention toward BMI
	"Are we able to build the internal capability we need? It is a challenge when it comes to new fields of knowledge. We are not hungry enough and are too passive. New external resources have more energy and gets things going" - Decision maker in the processing and sales function Our findings show more of such different views between functions and hierarchical placements as managers are representing different roles and perspectives in the interviews. To a certain degree we expect that these perspectives over time will come to represent the interests and identities of the managers involved. Moreover, the structural changes have triggered the recruitment of several external candidates for top-management positions. As the previous top-management had a profile of longer-tenured employment, this change will also have contributed to shifting the interests and identities of the TMT.
Motivation, Objectives, Resources	The strategy-context mainly provides strategic guiding for the innovation-context as shown in appendix C. In addition, the firm's performance goals and scorecard provide guidance for the entire organization. The firm's scorecard structure and most key performance indicators (KPIs) have stayed the same through 2012-2017, covering the following four target-areas: financial and risk, operational efficiency, customer satisfaction and growth, employees and culture. The customer-satisfaction perspective has historically been perceived in the organization as the most important KPIs, as illustrated by: *"Listening to what the customers need and providing them with the best possible service, were the most important goals for us" - Decision maker in middle management* In the period 2016-2017 the weight of these KPIs has been challenged as there have been increasing expectations on financial and operational targets: *"The goals are now very focused on the economic bottom line, together with volume growth and product sales" - Decision maker in middle management* As these targets have guided the innovation-context they have not worked to challenge existing business models. As innovation opportunities become more tangible, focus has been directed towards achieving the targeted growth through optimization and minor adjustments of the established model. This occurred even if the strategic plans in the area (appendix C) opened for more ambitious initiatives. Consequently, decisions from the innovation-context where largely directed towards product-, service-, and process innovations, or in some cases evolutionary BMIs (see appendix D and E). In the period 2012-2015 the top-management's reward structure was mainly based on a fixed salary with a small performance adjusted component (linked to overall firm performance). From 2016, the portion of performance adjusted rewards among the TMT has been increased as a result of increased performance adjusted salary and significant stock ownership among the top managers.

Organizational design features	TMT attention toward BMI
	Through the interviews conducted in 2017 we find the management starting to see the importance of more far reaching BMIs. Even if the exact terminology of business models is not used the message still comes across, as the following example statements show: "*I think that the current strategy of having the best online-bank for everyday services will fail, the online bank will perish, and other channels will take its place" - Decision maker in middle management* *"Some of our core business will still remain, but changes will be coming at us with ever increasing speed" - Decision maker in top management* Towards the end of the period we also find more decisions for novel and architectural BMI initiatives. One of these initiatives represent a clear indication of the change when compared to the historical situation, namely the initiative for moving into service-offerings for small and medium sized businesses. This has over a period of several years been seen as a valuable opportunity, but still the firm has not chosen to engage in any dedicated search. When working towards securing further growth in earnings in 2014-2015, the decision to prioritize initiatives involving such unfamiliar customer segments became too difficult. Instead the answer was to continue to secure attention on the familiar, because: *"How can we prioritize our effort towards a new customer segment when we still have not optimized the offering to our current customers?" - Decision maker in top management* During 2017, the firm was again able to move forward with the small and medium sized business-initiative: *"Before, the firm's resources were firmly dedicated to the current business, and we lacked the capacity and knowledge for such a small business initiative. Now, the backing for such exploration is stronger." - Decision maker in top management* As the importance placed on different targets have changed it has had direct effect on the perceived guidelines among top-tiers of management. This can be illustrated by the following statement: *"There should now be possibilities for plans and initiatives that involve business opportunities far removed from the current business, as long as we can show that we are taking the right risks."* *- Decision maker in top management* At the same time, our findings showed that this new perspective had not reached all organizational levels and were increasingly causing confusion. The lack of common guidelines is evident from decisionmakers below top management, regarding the current strategic goals and the planned innovation efforts: *"The current strategy is unclear and we are now just doing what we always have done, there must be more clarity on what the new goals for the future are" - Decision maker in middle management*

Organizational design features	TMT attention toward BMI
	"The official strategy is to be more of what we already are, but there now seems to be changes and there is a need to make new goals clearer to the organization" - Decision maker in middle management Consequently, at the time of the interviews the decision makers of the organization were both imprinted with the value of change, but at the same time in a state of confusion regarding the argument behind recent strategic decisions and uncertainty regarding what changes would be the right ones.

H: Organizational design and organizational alignment

As presented in the main text, case findings provide us with insight into how design features affect the organizational alignment in the BMI search. The table below provides additional data in this regard.

Origin of decisions	Organizational alignment
Innovation-context (mainly in 2012-2015)	Here, the handover of knowledge and responsibility was simplified by the fact that an initiative had already been processed by a wide set of organizational resources. Consequently, the attention of key resources was already centered on the task at hand. With this as a platform, specific efforts towards handover are not seen as particularly demanding. The decision makers' hands-on focus also helped secure a transfer of attention towards the BMI search efforts.
Strategy-context (mainly in 2016-2017)	When centralized analysis and search are handled in the strategy context, handover to the organization was weaker and came later in the process. This is evident from progress-reports from the early stages of such search initiatives. In some of these initiatives more formal governance structures were established at an early stage, but these structures still struggled to secure the attention, resource commitment and goal alignment needed for a successful contribution. Consequently, the firm has experienced significant challenges in making the wider organization able to provide valuable contributions, as illustrated by the following statement: *"The top management engaged the external consultants, and they are the only ones with full insight into the search process. The choices and decisions are only partly documented so the internal team is uncertain on how to proceed" - Decision maker in middle management*

Origin of decisions	Organizational alignment
	Even if decision makers were still hands-on in the governance, their distance from the day-to-day process and deliverables created room for their attention to be diverted. In the later part of the 2012-2017 period, interviews together with formal progress reports show that these issues are growing. With an increasing number of BMI analysis and search decisions being centralized, together with an increasing distance between those that decide and those that must contribute to the search, issues of missing attentional alignment are also increasing.

ARTICLE 2

ARCHITECTURAL OR MODULAR? HOW TOP MANAGEMENT COMPOSITION AFFECTS THE SCOPE OF BUSINESS MODEL INNOVATION

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ARCHITECTURAL OR MODULAR? HOW TOP MANAGEMENT COMPOSITION AFFECTS THE SCOPE OF BUSINESS MODEL INNOVATION

ABSTRACT

Business model innovation (BMI) is a strategic issue that affects how firms create, deliver, and/or capture value, with the responsibility for such action ultimately falling on the top management team (TMT). However, not all TMTs are equally well equipped to initiate and implement BMI. Linking BMI research to upper echelons theory and the literature on team diversity, we investigate how a firm's TMT composition (in terms of member diversity) is associated with the decision to innovate their existing business model. More specifically, we explore how TMT diversity affects the scope of the chosen BMI (i.e., modular versus architectural innovation). Combining CEO-level survey data from 286 Norwegian firms with national registry and accounting data, we find that TMTs composed of different genders, ethnicities/immigration histories, and educational backgrounds are more likely to implement architectural BMI. Conversely, TMTs with large differences in tenure are more likely to implement modular BMI. In sum, these findings provide evidence on how TMT composition affects the scope of BMI in established firms.

INTRODUCTION

As the business landscape changes, established firms need to innovate their business model (BM) to remain competitive (Deshler and Smith, 2011; Ho et al., 2011; McGrath, 2010; Zott and Amit, 2017). Because BM innovation (BMI) is a strategic issue that fundamentally affects how firms create, deliver, and/or capture value, such actions are a key responsibility of the top management team (TMT) (Foss and Stieglitz, 2015; Teece, 2010). Notably, the scope of BMI can differ among

firms. For example, while most environmental changes may require the TMT to respond incrementally through modular BMI, environmental changes of a more profound and disruptive nature (such as new competitive threats) may require the TMT to innovate the BM more radically by changing several elements of the BM simultaneously (i.e., architectural change) (Foss and Saebi, 2017; Hacklin et al., 2018).

However, not all firms respond with architectural BMI when facing disruptive changes in their industry (Hacklin et al., 2018; Osiyevskyy and Dewald, 2015; Teece, 2007). One reason for this could be that architectural BMI is particularly challenging to the TMT because it involves altering the complex interactions between several BM elements simultaneously to attain the desired outcome (Foss and Saebi, 2018). As indicated in recent studies, microlevel cognitive characteristics among top management can affect the TMT's ability to interpret changes in the environment and search for new BM solutions (e.g., Frankenberger and Sauer, 2019; Laszczuk and Mayer, 2020; Schneckenberg et al., 2019; Täuscher and Abdelkafi, 2017). Thus, not all TMTs are equally well equipped (in terms of their member compositions) to initiate and/or implement architectural BMI. While a handful of studies have provided empirical evidence of the effects of TMT composition on BMI outcomes (e.g., Al Humaidan and Sabatier, 2017; Diller et al., 2020; Guo et al., 2013; Narayan et al., 2020), we seek to offer a more fine-grain view. We demonstrate how TMT composition (in terms of diversity) is associated with the decision to innovate a firm's existing BM, and how TMT diversity affects the scope of the chosen BMI (i.e., modular versus architectural innovation).

The relevant concern involves determining the key cognitive characteristics that make a TMT more inclined to envision and implement a BM that significantly departs from the existing one. Linking BMI research to upper echelons theory (Hambrick and Mason, 1984) and literature on team diversity (Williams and O'Reilly, 1998), we hypothesize that a TMT composition that

fosters information diversity (due to the task- and non-task-related characteristics of its members) and reduces power diversity and intergroup bias (due to diversity in the tenure characteristics of its members) benefits the initiation and implementation of architectural BMI.

Our study combines three data sources: (i) an online survey among the CEOs of 286 firms in Norway, mapping their BMIs over a three-year period; (ii) national population registry data that provide detailed information on the surveyed firms and the individuals that constitute the TMT of those firms; and (iii) accounting data from 1992 until 2016 that we use as control variables in our analysis. Because the individual psychological/cognitive variables of top managers are difficult to map in large-N empirical studies, we rely on observable individual characteristics as proxies (see Hambrick and Mason, 1984; Hambrick, 2007). These include characteristics such as gender and ethnicity/immigration history (Lisak et al., 2016; Richard et al., 2004), education (Schubert and Tavassoli, 2020; Smith et al., 1994), and tenure (Chi et al., 2009; Wagner et al., 1984). Our analysis supports the basic notion that the composition of the TMT with respect to diversity is associated with varying preferences for BMI scope. Specifically, we find that TMTs composed of different genders, ethnicities/immigration histories, and educational backgrounds are more likely to implement architectural BMI, while TMTs composed of members with high tenure diversity are more likely to implement modular BMI.

THEORY AND HYPOTHESES

The Role of the TMT in BMI

BMI in established firms refers to the process of innovating an existing BM through the "designed, novel, nontrivial changes to the key elements of a firm's business model and/or the architecture linking these elements" (Foss and Saebi, 2017, p. 2). BMI is significantly different from other forms of process, product, and service innovation, as it may result in fundamental

architectural changes in how the firm creates, delivers, and captures value (Amit and Zott, 2012). Moreover, the BM design of a firm is rarely explicitly documented and formalized. Rather, it mainly resides as cognitive structures in the minds of the firm's decision makers (Aspara et al., 2013; Bjorkdahl and Holmén, 2013; Baden-Fuller and Mangematin, 2013; Doz and Kosonen, 2010; Egfjord and Sund, 2020). Because BMI involves significant or "nontrivial" changes to these cognitive structures, the process of initiating and implementing a new BM is often cognitively taxing for the TMT (Frankenberger and Sauer, 2019; Malmström et al., 2015; Schneckenberg et al., 2019). Such challenges play a key role in BMI as the TMT needs to scan the business environment for signals that warrant a change in its existing BM, search for new BM solutions if such signals are received, and decide which BM needs to be implemented. Further, the TMT is required to manage and oversee the implementation process (Foss and Stieglitz, 2015; Roessler et al., 2019).

More detailed insights on the role and challenges of the TMT in BMI are found by considering how much of the BM is affected by the innovation. A BMI may involve change to a single BM element (e.g., the customer segment), or it may involve changes to several BM elements simultaneously (e.g., the customer segment, channel, and value proposition) (Amit and Zott, 2012; Demil and Lecocq, 2010; Frankenberger et al., 2013). Hence, the scope of BMI can range between modular change (altering one BM element in isolation) and architectural change (altering several BM elements simultaneously) (Foss and Saebi, 2017, 2018). By relying on a definition of BMI that includes a dimension of scope (cf. Foss and Saebi, 2017), different TMT roles and challenges can be linked to different types of BMI (i.e., modular versus architectural). Informed by a contingency perspective (Chakravarthy, 1982; Hrebiniak and Joyce, 1985), prior studies have found that more architectural BMI is required in response to significant shifts in the external environment (Saebi, 2015; Saebi et al., 2017). These shifts include new regulations

(Blind, 2012), the emergence of new technologies (Sabatier et al., 2012; Wirtz et al., 2010), sustainability concerns (Bocken and Geradts, 2019), and competitive threats (Keiningham et al., 2020). Considering the cognitive challenges top managers face in interpreting and responding to these kinds of environmental changes, the TMT may struggle to recognize opportunities outside the dominant business logic (Chesbrough, 2007; Coombs and Hull, 1998; Prahalad and Bettis, 1986). Moreover, to unravel the complexity involved in identifying and deciding on an architectural BMI, the TMT must collectively engage in information-rich and cognitively challenging search processes involving several parts of the BM (Baumann and Siggelkow, 2013; Foss and Saebi, 2015; Gavetti and Levinthal, 2000). Following an initial BMI decision, the TMT must take on a new role: in implementation. Given that modular BMI affects only a limited part of the business, the task of implementation can be delegated to a single manager or a group of subordinates. In this case, the TMT tends to adopt a "hands-off" approach, monitoring and sponsoring the BMI process after the initial decision has been made. In contrast, implementing architectural BMI places significantly greater demands on the TMT. These wide-ranging innovations affect large parts of the business, and the TMT is likely to be much more "hands-on" in everyday decision-making, maintaining coherence among business elements, moderating formal and informal arenas of communication, and managing conflicts (Foss and Stieglitz, 2015).

Thus, as the scope of BMI widens, the complexity and ambiguity of the search, decision making, and implementation increase, requiring the entire TMT to become more involved. This creates room for individual TMT members to "inject a great deal of themselves" into the decisions (Finkelstein et al., 2009, p.43), resulting in a greater impact of the TMT members' cognitive characteristics (i.e., their beliefs, knowledge, assumptions, and values) on the BMI process and outcome.

TMT Composition and Firm Outcomes

In the upper echelon literature (Hambrick and Mason, 1984; Hambrick, 2007), the central theme concerns how executives perceive situations and alternatives through individualized lenses shaped by their cognitive characteristics. Moreover, upper echelon theory connects the composition of such characteristics within the TMT to team processes and organizational outcomes such as innovation (Hambrick, 2007). In this way the theory builds on a wider field of literature that views managers as boundedly rational when interpreting situations and shaping firm outcomes (Cyert and March, 1963; March and Simon, 1958). The theory also expands on this wider literature by introducing a stronger focus on the TMT (i.e., the dominant coalition) as the level of analysis when considering firm outcomes (Bantel and Jackson, 1989; Priem, 1990). Observable individual characteristics are often used in this context as proxies for the TMT members' cognitive characteristics (Hambrick and Mason, 1984; Hambrick, 2007; March and Simon, 1958). These observables include age, gender, family ethnicity/immigration history, education, and work experience (D'Aveni, 1990; Hambrick et al., 1998; Jehn and Bezrukova, 2004; Lyngsie and Foss, 2017; Pitcher and Smith, 2001; Schubert and Tavassoli, 2020). The underlying assumption is that these observable characteristics covary (albeit imperfectly) with the cognitive characteristics (Bantel and Jackson, 1989) and so addresses the difficulty associated with measuring such psychological constructs directly in large-N studies (Smith et al., 1994).

Connected to the upper echelon theory's focus on TMT composition, there is also an underlying assumption that TMTs collectively shape strategic decisions within firms (Hambrick, 2007). Building on this assumption, extant research has, in explaining how teams perform, established as a central construct the proportion of different characteristics within the team (Finkelstein et al., 2009; Homberg and Bui, 2013; Priem, 1990). By drawing on both upper echelons theory and research on the effects of group diversity (Shemla and Wegge, 2019;

Williams and O'Reilly, 1998), in recent decades, studies have provided considerable evidence on how organizational outcomes depend (at least in part) on the composition of various cognitive characteristics in TMTs. This evidence has typically emerged through theoretical models where TMT diversity affects internal team processes, which in turn affect TMT decisions and ultimately firm outcomes (Hambrick et al., 2015*)*. Notably, TMT diversity has been linked to outcomes such as firms' innovative performance (Bantel and Jackson, 1989; Boone et al., 2019; Lyngsie and Foss, 2017; Schubert and Tavassoli, 2020), financial performance and growth (Certo et al., 2006; Eesley et al., 2014*;* Eisenhardt and Schoonhoven, 1990; Hambrick et al., 2015), strategic change and posture (Boeker, 1997; Carpenter and Fredrickson, 2001), and corporate sustainability (Henry et al., 2019).

However, despite the substantial number of empirical studies conducted in this field, the effects of TMT diversity on the performance and innovation of firms are inconclusive. The lack of cumulative insight is driven by many weak results and inconsistencies in studies targeting similar relationships (Harrison and Klein, 2007). Examples of such issues can be found in the study by Certo et al. (2006), where only partial support is found for the diversity hypotheses, and in the inconsistent results of Bantel and Jackson (1989) and Schubert and Tavassoli (2020) regarding diversity effects (for reviews targeting more of the TMT literature and related issues, see Harrison and Klein, 2007; Homberg and Bui, 2013; Menz, 2012; Nielsen, 2010; Schubert and Tavassoli, 2020).

To explain these weak and inconsistent results, scholars in social psychology often refer to the perspectives of *information/decision-making*, *power*, and *social categorization* in diversity studies (Harrison and Klein, 2007; van Knippenberg et al., 2004). For example, diverse educational backgrounds and genders can ensure information variety in teams, which enables the provision of the nonredundant, task-relevant information and perspectives that are needed in

making quality decisions (Eesley et al., 2014; Williams and O'Reilly, 1998). However, diversity among team members can also induce a level of conflict that prevents information sharing and progress. One driver of such conflicts arises from within-team diversity associated with different levels of institutionalized power (Drazin and Rao, 1999). Such diversity has been found to cause "internal competition, suppression of voice, reduced (quality of) communication, and interpersonal undermining" within teams (Harrison and Klein, 2007, p. 1201). Another driver of conflict can be found in intergroup biases caused by social categorization, where individuals use salient attributes to classify themselves and others into separate social categories. With such biases, individuals become more favorable to in-group members and more hostile to out-group members, hindering out-group information sharing and cooperation and thereby disrupting the team's problem-solving process (George and Chattopadhyay, 2009; van Knippenberg and Schippers, 2007). Accordingly, the perspectives of information/decision-making, power, and social categorization need to be considered when addressing the influences of TMT diversity.

Furthermore, findings also indicate that the way diversity affects TMT actions depends on the particular context, which involves the information needs of the TMT, the role the TMT is expected to play, and each member's interpretation of the saliency of individual differences given that role (Carpenter et al., 2004; Hambrick, 2007; Harrison and Klein, 2007; Schubert and Tavassoli, 2020). Not all types of strategic decisions and outcomes require the same level of information variety, and not all strategic decisions require the involvement of all the TMT members in equal measure, despite the assumption that TMTs collectively shape strategic decisions and firm outcomes. Hence, when investigating the effects of TMT diversity on BMI, it is necessary to consider the process or context in which the cognitive characteristics of the TMT members come into play (Finkelstein et al., 2009).

Hypotheses: Information Diversity, Power Diversity, Social Categorization, and BMI

Linking research on BMI (Foss and Saebi, 2018; Foss and Stieglitz, 2015) to TMT research perspectives concerning information/decision-making, power, and social categorization (Harrison and Klein, 2007; Williams and O'Reilly, 1998; van Knippenberg et al., 2004), we argue that the role of the TMT composition (in terms of member diversity) becomes more salient as the scope of the BMI increases. In line with Nickerson and Zenger (2004), we differentiate between the problem-formulation and the problem-solving stages of BMI.

While modular BMI affects one of the BM elements in isolation (e.g., the revenue model), architectural BMI involves altering the complex interactions between several BM elements simultaneously to attain the desired outcome (Foss and Saebi, 2018). Thus, successfully initiating and implementing architectural BMI is likely to depend on two criteria. In the problem-formulation stages of BMI, the TMT needs to search for alternative BM opportunities that may fundamentally differ from the existing BM. Here, ensuring a variety of information sources and perspectives among the TMT members is needed to make quality decisions (Ethiraj and Levinthal, 2004; Nickerson and Zenger, 2004). In the problem-solving stages of architectural BMI, the TMT takes "hands-on" control of designing the highly interdependent solution and implementation initiatives, placing increased pressure on the team to cooperate and align their interests (Foss and Stieglitz, 2015). Therefore, diversity-induced conflict within the TMT (e.g., power structures and social categorization that limit cooperation and alignment) could hinder the implementation of architectural BMI. In the following section, we hypothesize which types of TMT diversity are more likely to induce information variety and which are more likely to induce conflict, as well as their resulting effects on the scope of BMI.

The link between information diversity and BMI scope. Research has found that diverse teams tend to be more sensitive to the environment, more innovative, and more open to change

than more homogenous teams (e.g., Carpenter et al., 2004; Keck, 1997; West and Anderson, 1996). This tendency arises from the team's ability to draw on multiple information sources and perspectives (Bantel and Jackson, 1989; Jackson, 1992), their willingness to consider a variety of strategic alternatives, and their willingness to challenge the status quo and each other (Gladstein, 1984; Schweiger et al., 1989; Wiersema and Bantel, 1992). Such information diversity is important for architectural BMI as it imposes changes on several BM components, often involving a significant level of complementarity. The more prevalent these interactions are, the more demanding the search for a superior BM will be, because such a search involves understanding how and when BM components need to be changed simultaneously to obtain the desired outcome (Ennen and Richter, 2010; Foss and Saebi, 2017). Hence, to unravel the complexity of such opportunities for architectural BMI, TMTs must engage in information- and cognitive-intensive searches (Baumann and Siggelkow, 2013; Gavetti and Levinthal, 2000). Furthermore, the teams should have access to perspectives that, when interpreting information and addressing problems, are able to challenge the cognitive inertia that reinforces the status quo or restricts innovations to familiar ground (Gans et al., 2019; Hodgkinson and Wright, 2002).

Prior research points to task- and non-task-related characteristics that contribute to information diversity among managers—that is, characteristics that are either directly or indirectly linked to the information needs of the task at hand. Education is an example of an accessible and suitable task-related characteristic in BMI, representing the knowledge, skill, and cognitive frameworks of a group of managers (Finkelstein et al., 2009; Harrison and Klein, 2007; Østergaard et al., 2011; Schubert and Tavassoli, 2020; Shemla and Wegge, 2019). Educational diversity within the TMT captures its members' breadth of specialization and educational experience (education level). Diversity in area of educational specialization provides a proxy for breadth in functional perspectives and the available knowledge stocks within the TMT. When

managers come from a variety of knowledge areas (e.g., engineering, economics, communications) the potential for combining knowledge in new ways increases, stimulating the performance and innovativeness of the team (Carpenter and Fredrickson, 2001; Dahlin et al., 2005; Hambrick et al., 1996; Henry et al., 2019; Schubert and Tavassoli, 2020). Moreover, diversity in education level provides a proxy for different perspectives on addressing tasks in the TMT. Managers with advanced degrees are well trained in conducting fundamental analyses and research, while managers with undergraduate degrees typically take a more practical view of tasks, providing the TMT with a variety of approaches to tackling a given task or situation (Faems and Subramanian, 2013). Relatedly, such diversity is found to positively influence the TMTs ability to scan the business landscape for information and innovative solutions (Auh and Menguc, 2005) and has been argued to positively affect a firm's performance and innovativeness over time (Auh and Menguc, 2005; Faems and Subramanian, 2013; Simons et al., 1999; Smith et al., 1994).

Another way of ensuring information diversity in the TMT is by increasing diversity in non-task-related characteristics among its members. Such diversity may stem from members drawing on different pools of experience, different social ties, and different leadership styles. This has been found to affect behavior and the use of information when faced with new BM problems (Harrison and Klein, 2007; Lyngsie and Foss, 2017). The gender and ethnicity/immigration history of TMT members are two key demographic characteristics that have shown validity in representing individual psychological attributes in such settings (Hambrick et al., 1998; Richard et al., 2004). A composition of both male and female members provides the TMT with perspectives and leadership styles that promote the communication, cooperation, and knowledge sharing needed to recognize the value of new information and opportunities (Dwyer et al., 2003; Lyngsie and Foss, 2017). Moreover, diverse

ethnicities/immigration histories within the TMT provide the team with a diverse set of tacit norms and conventions, together with different perspectives on how to find and interpret new information (Boone et al., 2019; Carpenter et al., 2004; Dahlin et al., 2005). Thus, team diversity in terms of gender and ethnicity/immigration history has been found to have a positive (albeit multifaceted) relationship with team creativeness, innovativeness, and performance (Earley and Mosakowski, 2000; Kanter, 1977; Lyngsie and Foss, 2017; Richard et al., 2004).

Architectural BMIs are complex innovations that involve several areas of the BM and move the firm further away from the status quo: they impose greater demands on the TMT's ability to draw on a variety of perspectives and information sources, make sense of the consequences and opportunities in different parts of the BM, and envision new solutions. Thus, we argue that information diversity with respect to education level, area of specialization, gender, and ethnicity/immigration history will be positively associated with architectural BMI.

> **Hypothesis 1:** *An increase in TMT information diversity is positively associated with architectural BMI.*

The link between power diversity, social categorization and BMI scope. Individual members or sub-groups within a firm's TMT often differ in the amount of power they wield within the team and within the organization. High levels of diversity in such power levels can have detrimental effects on team performance through heightened internal competition, acts of defiance among team members, self-censorship, and a generally reduced flow of information (Harrison and Klein, 2007; Pitcher and Smith, 2001). These formal and informal levels of power among managers are typically attained during their work tenure and manifest in both formal and informal structures, such as social and political relationships (Drazin and Rao, 1999; Finkelstein et al., 2009; Hambrick and Fukutomi, 1991; Ocasio, 1994).

Looking beyond the individual level, the work tenure of TMT members also lay the foundation for social categorization, where members place themselves and others in groups (or cohorts) according to certain milestones in their careers. Relevant milestones for such grouping of members include their date of entry into the job market (or, relatedly, date of birth), current organization, and current position (Ely, 2004; Finkelstein et al., 2009; Williams and O'Reilly, 1998; Wagner et al., 1984). Accordingly, and in addition to similarities in influence and power, members with comparable tenures (within the same cohort) tend to have stronger social ties, more shared experiences, and similar communication patterns, perceptions, and values (Hambrick and Mason, 1984; McNeil and Thompson, 1971; Ryder, 1965; Wagner et al., 1984). Hence, such categorization increases the propensity for intergroup bias and for group members to cooperate in protecting their own interests when challenged (van Knippenberg et al., 2004).

Architectural BMI has a high propensity to challenge existing privileges, power structures, and coalitions of influence within the firm (Foss and Saebi, 2017; Heath et al., 1993), and thus it increases the saliency of the abovementioned diversity factors. Moreover, the closely linked problems of power diversity and intergroup bias–induced conflict become particularly relevant in situations where the TMT is "hands-on" in the implementation phase. This is because "successful implementation […] often depends on obtaining the involvement, cooperation, endorsement, or consent" of all the managers in the team (Nutt, 1989, p. 145). Accordingly, when team members disagree with a decision or cannot cooperate, implementation becomes problematic (Ancona and Caldwell, 1992; Hitt and Tyler, 1991; Nutt, 1989). These effects may materialize as problems in the actual implementation stage or as early as the problem-formulation stages, when top managers start to experience or anticipate such problems. In other words, the result of anticipated implementation problems may reduce the propensity to search for (or select) BMI options that would require team wide consent and collaboration.

Existing research has found that management teams experiencing an increase in tenure diversity have an elevated propensity for conflict beyond what they are able to effectively resolve themselves (Cronin and Weingart, 2007; McNeil and Thompson, 1971; O'Reilly et al., 1993; Pfeffer, 1981; Smith et al., 1994). Consequently, this form of diversity can either prevent or slow progress on strategic initiatives such as BMI (O'Reilly et al., 1993; Smith et al., 1994). In contrast, teams that are more homogeneous with respect to tenure have been found to communicate better, are more integrated and cohesive, and are able to handle conflicts and make progress on initiatives and changes more effectively (Roberts and O'Reilly, 1979; Wagner et al., 1984). Because of the challenges architectural BMI poses to the TMT, and because the different types of tenure ("in position," "in organization," and "in job market") have independent and additive effects on manager behavior (Finkelstein et al., 2009), we argue that tenure diversity will be negatively associated with the propensity to implement architectural BMI.

> **Hypothesis 2a:** *An increase in TMT diversity with respect to member tenure is negatively associated with architectural BMI.*

In TMTs with high levels of information and tenure diversity, we expect the latter to offset (or reduce) the initial benefits of information diversity. This means that while a TMT composed of members with different educational backgrounds, genders, and ethnicities/immigration histories is likely to benefit from multiple information sources and perspectives, the diversity in tenure among these members is likely to result in power diversity and intergroup bias–induced conflict. This in turn can lead to self-censorship and restricted information sharing among team members, hindering the effective initiation and implementation of architectural BMI.

> **Hypothesis 2b:** *An increase in TMT diversity with respect to member tenure will negatively moderate the relationship between information diversity and architectural BMI.*

We summarize our hypotheses regarding the effects of TMT diversity on the propensity for BMI in Figure 1.

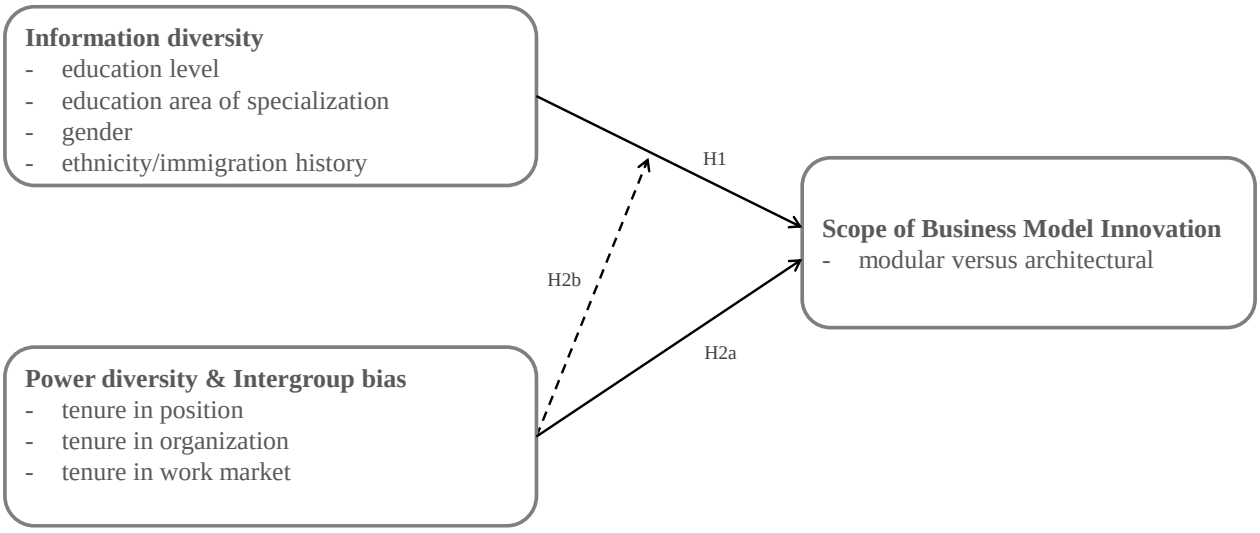


Figure 1: Conceptual Model

DATA AND METHODS

Sample and Data

The dataset used in our analysis was compiled by linking three separate data sources: First, survey data covering BMI was collected in 2014 by the Center for Service Innovation at the Norwegian School of Economics (NHH). This was conducted through an online questionnaire sent by e-mail to 4,000 CEOs of Norwegian firms in the fall of 2014. The firms targeted in the survey had to have 30 or more employees and included all major industries in the economy. The survey provided 286 responses yielding a response rate of 7.2%. In the current study, we relied on a sample of 233 respondents (5.8%) after excluding responses with missing answers or missing links to data from the two other sources. This is an admittedly low response rate, which is common for organizational research targeting CEOs as respondents (Baruch, 1999; Baruch and

Holtom, 2008). The large number of nonresponding firms raises questions of sample bias. To ensure the representativeness of the sample, we performed tests for non-response bias [1]. These tests did not indicate significant differences between early responding and late-responding firms with respect to any of the key variables used in our analysis (based on chi-square and t-statistics). We also performed tests on the industry sector, size, age, and profitability of responding firms against data on the total sample frame. Only firm age showed a significant difference, where our sample had a slight over-representation of older firms. Overall, we concluded that our sample was sufficiently representative.

Second, for TMT-data our study utilizes Norwegian registry data. The registry data is collected by the government and covers all Norwegian firms and employees. The registries contain detailed and yearly updated information on all employees of all firms, including variables such as birth date, gender, immigration history, education history, employment position, and employment history. Providing such data for public registries is legally mandated for all Norwegian firms.

The third data source is a database of accounting numbers covering all Norwegian firms over a time period from 1992 until 2016. Accounting data are mainly used as control variables in our analysis. To protect the anonymity of the firms (particularly the employees), the survey, registry, and accounting data were linked and then anonymized by the Norwegian statistical agency (Statistics Norway/SSB).

Variables

Independent variables. The top managers (i.e., the TMT) of each firm were identified through seven-digit job position codes provided in the registry data (STYRK-08 coding). These are fine-grain employment position codes, where top-management positions as a standard have codes that start with "1". In cases where the position codes provided inconclusive results,

additional data on firm ownership interests, compensation level, and previous work history were manually considered for each person. Ultimately, this resulted in a sample of 997 top managers distributed over the 233 firms used in the analysis.

The independent variables used in this study represent diversity in the TMT along seven different dimensions, all of which were captured from registry data. Gender was collected through a numerical code (male = 1, female = 2). Ethnicity/immigration history (shortened to Ethnicity in Table 1-3) was collected through data on family immigration status going back two generations. This was then converted into a variable, with "0" indicating no immigrant status or family history of immigration from outside Norway, "1" indicating immigrant status or family history from the Nordic countries, "2" indicating immigrant status or family history from other European countries, and "3" indicating immigrant status or family history involving countries outside Europe. Education level was collected from registry data cataloging the highest education degree attained, coded according to length of education (no education: "1" to Ph.D. level: "8"). Education specialization was also collected from the same source, with codes representing the associated type of specialization (0–8). For example, "4" represents Economics and Business Administration and "5" represents Sciences. Tenure in position was collected through yearly updated data on an individual's employment-positions, where the position-variable was calculated as the number of years an employee has been registered in the current position. Tenure in organization was collected through yearly updated data regarding which employer each employee works for. The tenure in organization-variable was calculated as the number of years since an individual was first registered as an employee with the focal firm. Tenure in job market was calculated based on age corrected for length of highest education degree attained.

The diversity score for each of the categorical variables (gender, ethnicity/immigration history, education level, and education specialization) was calculated using Blau's diversity index

(Blau, 1977): $(1 - \sum_{i=1}^{k} p_i^2)$, where p_i is the proportion of the group in the *i*th category. This index provides a continuous measure for the diversity in each case, with a high score indicating high team diversity. The diversity score for each of the continuous variables (tenure in position, tenure in organization, and tenure in the job market) was calculated using the coefficient of variation, defined as the standard deviation divided by the mean (Bantel and Jackson, 1989). The larger the coefficient of variation, the greater the diversity within the team.

Dependent variable. To operationalize BMs empirically, we refer to its underlying components: (i) the market segments it addresses, (ii) the value proposition it offers, (iii) the structure of the value chain, (iv) and the mechanisms of value capture (cf. Foss and Saebi, 2015; Saebi et al., 2017). In our case, the dependent variable represents the scope of BM-change performed in the firm (i.e., how much was changed simultaneously within these components). This variable was created from 11 survey items (see Appendix A for details). We recorded whether these 11 BM elements (as represented by the survey items) had been subjected to change during the three years leading up to the survey in 2014 ("yes", "no"). The survey responses for these items exhibit a relatively high degree of internal consistency (Cronbach's alpha coefficient = 0.74). The responses were subsequently translated into a composite variable measuring BMI scope according to the number of BM elements changed (0 to 11), where an increasing score represents BMIs of increasingly wider scope (Foss and Saebi, 2017).

To test the robustness of the results for power diversity and social categorization, an alternative dependent variable was included to capture innovation outcomes in our sample firms. This variable was drawn from two survey items (Cronbach's alpha coefficient = 0.61) based on the Eurostat Community Innovation Survey. This captured whether the firm had performed significant innovations in i) organizational structure and/or ii) management practices, processes,

and techniques in the three years prior to 2014 (see Appendix A for details). This variable was constructed as a binary variable ("yes" or "no").

Control variables. Several control variables were derived from the registry and accounting data sources. *Company Age*: Firm age is likely to affect the possible range of tenure diversity among the top managers. Moreover, older firms tend to be more inert with respect to strategic and organizational change (Boeker, 1997; Hannan and Freeman, 1989; Wagner et al., 1984). Thus, it is important to include firm age as a control to ensure that the observed relationship between TMT diversity and BMI is not an artifact of correlation with firm age. *Company Size*: The most common argument in the literature is that firms change more easily when they are small. As they grow larger, they become more bureaucratic and more inert (Boeker, 1997; Hannan and Freeman, 1989). However, there is also a counter-argument claiming that larger firms control more resources and are better able to bear the costs and risks associated with change (Haveman, 1993). Either way, it would appear prudent to include a size-variable to control for such effects. In the current analysis, firm size is based on the log number of employees. *TMT Size:* Diversity measures are well known to be positively correlated with the size of the group under study (Carpenter et al., 2004). Since our study focuses on TMT diversity, it is important to control for the independent effects of team size. In the current study, *TMT Size* was measured by a simple count of the number of top managers in each firm. *Performance:* Performance shortcoming is one of the clearest indicators of the environmental fitness of a BM, and low financial performance can create an extra motivation for change (Boeker, 1997; Haveman, 1993; March and Simon 1958). Therefore, it thus can serve as an important predictor of whether managers will initiate changes in the existing BM (Levinthal, 1997; Zajac and Kraatz, 1993). Given that managers are boundedly rational, performance aspirations determine the boundary between what they consider to be good or poor fitness (Lopes, 1987; Schneider, 1992).

Here, comparison to industry peers will be one of the strongest influences on manager aspiration level (Cyert and March, 1963; Greve, 1998, 2003; Iyer and Miller, 2008). Consequently, we employ industry adjusted return on assets (ROA) as a control variable. *Industry controls:* Industry growth, volatility, and capital intensity measures were included to control for changes in sector demand, the uncertainty associated with this demand, and cost driven path dependency. Both industry adjusted performance and industry controls were based on four-digit industry codes and data from the time-period covered in the survey. A test for non-independence of observations originating in industry associations was also performed (using two-digit industry codes) [2].

ANALYSIS AND RESULTS

Table 1 presents descriptive statistics and pairwise correlations between the variables used in our study. We can observe that the variable pair of "*tenure in position - tenure in company*" had a high correlation, which is unsurprising given what these variables represent. Nevertheless, variance inflation factor (VIF) analysis of these variables produced low scores and did not raise any "red flags". The other correlations were all within what might be expected based on the motivation for their inclusion in the analysis. Hence, we did not find multicollinearity to be an actionable concern and all our variables remained in the analysis.

Table 1: Descriptive Statistics and Pairwise Correlations

Variable	Mean	S.D	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) BMI	3.812	2.615	1.000														
(2) Company size	4.368	1.049	0.078	1.000													
(3) Company age	26.390	25.451	-0.087	0.075	1.000												
(4) Performance	0.042	0.130	-0.106	-0.069	-0.034	1.000											
(5) TMT size	4.143	1.842	0.030	0.581***	0.080	0.124*	1.000										
(6) Industry growth	0.009	0.632	-0.103	0.047	-0.233***	-0.024	-0.049	1.000									
(7) Industry volatility	0.111	1.570	-0.014	0.051	0.487***	-0.089	0.026	0.029	1.000								
(8) Industry capital intensity	0.524	3.459	-0.072	0.030	0.552***	-0.048	0.035	-0.104	0.910***	1.000							
(9) Gender - diversity	0.182	0.211	0.169***	0.045	0.096	0.012	0.118*	-0.183***	0.020	0.041	1.000						
(10) Ethnicity - diversity	0.111	0.182	0.174***	0.138**	0.006	0.041	0.172***	-0.044	-0.048	-0.026	0.098	1.000					
(11) Education level - diversity	0.470	0.217	0.019	0.078	0.044	0.186***	0.412***	-0.097	0.018	0.030	0.055	0.104	1.000				
(12) Education specialization - diversity	0.345	0.227	-0.020	0.194***	0.185***	0.101	0.410***	0.020	0.112*	0.103	0.080	0.107	0.409***	1.000			
(13) Tenure in position - diversity	0.620	0.481	0.202***	0.106	0.070	0.002	0.187***	-0.149**	0.028	0.033	0.196***	0.124*	0.181***	0.105	1.000		
(14) Tenure in company - diversity	0.526	0.418	0.079	0.188***	0.067	-0.009	0.203***	-0.169**	0.010	0.023	0.179***	0.093	0.241***	0.151**	0.760***	1.000	
(15) Total work tenure - diversity	0.148	0.089	-0.077	0.026	0.044	0.025	0.224***	-0.160**	-0.028	-0.001	0.158**	0.136**	0.398***	0.207***	0.235***	0.258***	1.000

* p < 0.1 ** p < 0.05 *** p < 0.01

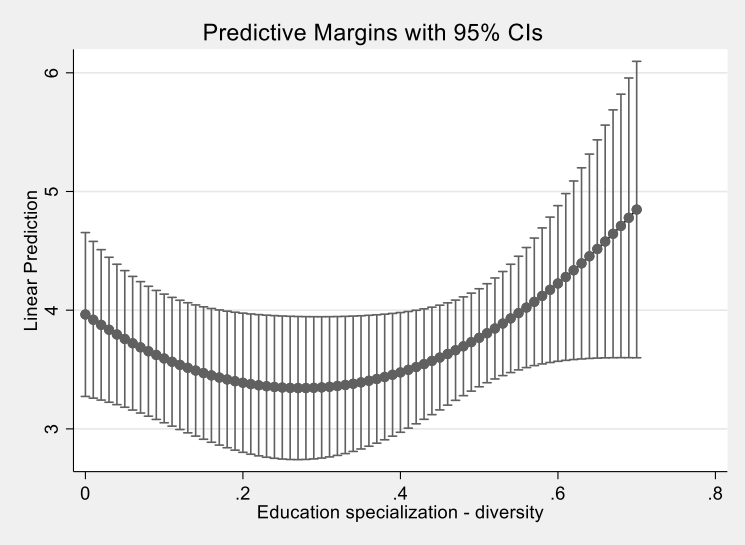
For our analysis, we performed multiple ordinary least-squares (OLS) regressions since our dependent variable was a representation of a continuous BMI scope level. The regression output is presented in Table 2. Variables were entered sequentially starting with control variables (Model 1), followed by adding our independent variables (Model 2 and 3) and the interaction terms (Model 4). The results in Model 1 demonstrate that all industry controls were significant, where *industry growth* and *industry capital intensity* both had a negative coefficient, and *industry volatility* had a positive coefficient. When adding the independent variables in Model 2, the controls for *performance and company age* also became negative predictors of *BMI scope*, although only weakly significant ($p < 0.1$). These results support the arguments for including them as controls in our model. Firms that performed poorly or were young seemed more willing to engage in architectural BMI than those that performed well or had existed longer. From the industry controls we can observe that the propensity for architectural BMI was lower when the industry experienced strong growth or was capital intense, while the propensity became higher when the industry was more volatile.

Table 2: OLS Regression for BMI Scope

BMI scope	Model 1	Model 2	Model 3	Model 4
Control variables				
Company Size	0.19 (0.20)	0.16 (0.21)	0.14 (0.21)	0.14 (0.21)
Company Age	- 0.01 (0.01)	- 0.02* (0.01)	- 0.02** (0.01)	- 0.02** (0.01)
TMT Size	0.01 (0.11)	- 0.14 (0.13)	- 0.12 (0.13)	- 0.11 (0.13)
Performance	- 1.88 (1.32)	- 2.55* (1.33)	- 2.44* (1.32)	- 2.50* (1.33)
Industry Growth	- 0.75*** (0.27)	- 0.91*** (0.29)	- 0.99*** (0.29)	- 0.94*** (0.29)
Industry Volatility	0.66** (0.28)	0.47* (0.27)	0.50* (0.27)	0.47* (0.27)
Industry Capital intensity	- 0.30** (0.13)	-0.22* (0.13)	-0.22* (0.13)	- 0.21* (0.13)
Independent variables				
Gender - diversity		1.74** (0.80)	1.78** (0.80)	0.96 (1.55)
Gender - diversity x Tenure in job market - diversity				5.74 (9.04)
Ethnicity - diversity		2.58*** (0.91)	2.69*** (0.92)	1.11 (2.16)
Ethnicity - diversity x Tenure in job market - diversity				9.92 (11.99)
Education level - diversity		1.28 (0.91)	- 0.25 (2.57)	0.53 (1.71)
Education level - diversity x Education level - diversity			2.42 (3.33)	
Education level - diversity x Tenure in job market - diversity				6.69 (10.84)
Education specialization -diversity		0.11 (0.82)	- 4.53* (2.79)	0.28 (1.68)
Education specialization -diversity x Education specialization -diversity			8.28* (4.63)	
Education specialization -diversity x Tenure in job market - diversity				0.29 (9.73)
Tenure in position - diversity		1.85*** (0.53)	1.95*** (0.53)	1.89*** (0.53)
Tenure in company - diversity		- 1.45** (0.62)	- 1.63** (0.63)	- 1.43** (0.63)
Tenure in job market - diversity		- 5.33*** (2.03)	- 4.93** (2.03)	- 10.91** (5.33)
R2	0.07	0.21	0.22	0.21
Adjusted R2	0.04	0.15	0.16	0.14
F for change in R2	2.41**	4.66***	1.90	0.47

* p < 0.1 ** p < 0.05 *** p < 0.01

Focusing on the independent variables in Model 2, we find that only gender and ethnicity/immigration history (the two non-task related variables on information diversity) had a positive association with the scope of BMI. This only offers partial support for Hypothesis 1. Both *education level* and *education specialization* had positive but insignificant coefficients; hence, they failed to provide support for task related information diversity (Hypothesis 1). Extant studies that have analyzed the effects of task-related information diversity have occasionally found evidence of non-linear associations (Dahlin et al., 2005; Schubert and Tavassoli, 2020). Therefore, we included squared terms of the education variables in Model 3 and plotted the *BMI scope* predictions of each variable in Figure 2. This indicates that *education specialization* has a convex curvilinear relationship with *BMI scope* ($p < 0.1$), indicating that educational diversity must be above a certain level to provide the hypothesized contributions to BMI. No such evidence was found for *education level*.



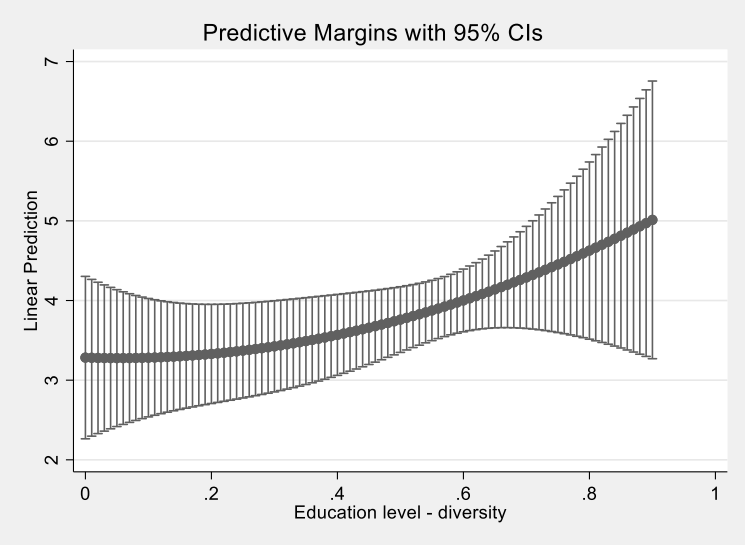


Figure 2: Predicting BMI-scope through Education Diversity

With respect to tenure-diversity, Model 2 indicates that two out of three tenure-diversity variables had a negative association with *BMI scope*. Diversity in *tenure in organization* and *tenure in job market* both had significant negative coefficients, while diversity in *tenure in position* exhibited a significant positive coefficient. Accordingly, this offers only partial support for Hypothesis 2a. Model 4 tested for moderation effects. Specifically, Model 4 demonstrated the interaction terms and regression results using *tenure in job market* as a moderator. These results

do not represent evidence that diversity in *tenure in job market* moderates the association between information diversity and BMI scope; hence, we found no support for Hypothesis 2b. It should be noted that we also conducted similar moderation tests for diversity in *tenure in organization* and *tenure in position*, which also failed to provide support for Hypothesis 2b. Consequently, with regard to tenure-diversity, we only discovered evidence of a direct association with BMI scope, meaning an increase in tenure-diversity is negatively or positively associated with the propensity to implement architectural BMI.

The results for tenure-diversity were bolstered by a robustness check using the alterative dependent variable (*management innovation*). While the pursuit of management innovation does not substantially require the TMT to draw on a variety of perspectives and information sources, it still requires the TMT to be "hands-on" throughout the process and has the potential to significantly challenge existing interests and powers structures within the team (Birkinshaw et al., 2008). Consequently, while we expect *management innovation* to be less associated with information diversity in the TMT, it will have a significant association with power diversity and intergroup bias among TMT members. The regression output is presented in Table 3 and the coefficients for the tenure variables were largely in line with those found in Model 2 (Table 2). This provides additional support for our diversity results towards Hypothesis 2a.

Table 3: Logistic Regression for Management Innovation

Management innovation	Model
Control variables	
Company Size	0.40** (0.20)
Company Age	- 0.01 (0.01)
TMT Size	- 0.08 (0.12)
Performance	0.43 (1.17)
Industry Growth	- 0.24 (0.25)
Industry Volatility	- 0.13 (0.24)
Industry Capital intensity	0.03 (0.11)
Independent variables	
Gender - diversity	0.48 (0.71)
Ethnicity - diversity	0.73 (0.83)
Education level - diversity	0.12 (0.82)
Education specialization -diversity	0.01 (0.72)
Tenure in position - diversity	0.91* (0.51)
Tenure in company - diversity	- 0.26 (0.58)
Tenure in job market - diversity	- 5.06*** (1.85)
Adjusted R2	0.08

* p < 0.1 ** p < 0.05 *** p < 0.01

DISCUSSION

Our findings provide significant evidence pertaining to the role of TMT diversity on a firm's propensity for modular versus architectural BMI. First, we found that diversity in the key demographic characteristics of gender and ethnicity/immigration history within the TMT are positively associated with a wider BMI scope. This provides support for our hypothesis on the importance of non-task related information diversity in helping the TMT envision a more complex type of innovation (Hypothesis 1). A TMT composed of different genders and ethnicities/immigration histories is likely to provide access to a variety of views and information based on different life experiences and professional and social connections (Harrison and Klein, 2007; Lyngsie and Foss, 2017), and is then beneficial for the initiation and implementation of architectural BMI. While this finding is also in line with extant research on TMT composition and team performance, it should be noted that previous results were multifaceted and heavily context dependent (Homberg and Bui, 2013; Lyngsie and Foss, 2017; Nielsen, 2010).

Second, while the association between educational diversity in the TMT and the scope of BMI was unclear in our analysis, we uncovered evidence of a curvilinear relationship between diversity in education specialization and more architectural BMI. Accordingly, this provides some support for our hypothesis on the importance of task related information diversity pertaining to the scope of BMI (Hypothesis 1). The results imply that the variety of educational specializations within the TMT must reach a certain threshold before positively affecting the scope of BMI. While the positive effects of education diversity have been demonstrated in previous studies, our finding of convex curvilinearity stands in contrast to the limited research that exists on curvilinear effects. Previous studies present arguments for a concave relationship based on the cost of information sharing with excessive levels of diversity (Dahlin et al., 2005; Schubert and Tavassoli, 2020). A possible explanation for our own results may be based on an interpretation of education specialization as a driver of social categorizations and the forming of sub-groups having conflicting views within the TMT, such as economists versus engineers (Williams and O'Reilly, 1998; Shemla and Wegge, 2019). The negative effects of such groups should be most prominent and overshadow information benefits when the diversity (according to Blau's index) is limited. Hence, members assign themselves and others to groups according to just a couple or a few educational specializations (Harrison and Klein, 2007). When diversity increases and the types of specialization within the TMT become more numerous, the foundation for such sub-groups quickly disappears because "no two people" have the same educational background. Consequently, the benefits of information diversity may again become the dominant effect.

Third, while we found no support for moderation effects (Hypothesis 2b), we did find that diversity based on job-market and organizational tenure are negatively associated with the implementation of architectural BMI (Hypothesis 2a). Conversely, diversity based on TMT-

tenure is positively associated with the implementation of architectural BMI. While the latter finding is contrary to our theoretical argument, we believe this result indicates that TMT tenure is less probable as a driver of social categorization and power, and more probable as a driver of reduced TMT rigidity. Existing research has pointed to age (or entry into the job market) and entry into the organization as the strongest drivers of power-diversity and sub-groups among top managers (Ancona and Caldwell, 1992; Ryder, 1965; Wagner et al., 1984), while entry into the TMT has received less attention in the literature. Given our sample of established firms, low levels of diversity in position tenure are typically associated with teams that consist of long tenured managers (i.e., teams with long mean tenure). A long-lived and static team will probably result in rigidity, where members become overly committed to the status quo (Finkelstein et al., 2009; Smith et al., 1994). Such commitments should decrease the propensity for BMIs that fundamentally challenge existing business structures and be most noticeable for large scope architectural BMIs.

Another possible explanation for the results on TMT-tenure may be due to the limitation of cross-sectional data. A firm's decision to opt for architectural BMI may cause changes in the TMT, making the team more diverse with respect to position tenure. For instance, following a BMI decision involving a move into a new market with an offering that is also new to the firm, it will probably add a manager responsible for this new market and/or offering to the TMT. Such a new addition to a long tenured team would greatly increase the diversity score in our analysis. Moreover, the probability of such a scenario increases with BMI scope. Given the nature of our data we are unable to separate this scenario from the one we relied on for the development of our theoretical argument. We shall return to this latter point in the limitations section below.

Based on the abovementioned findings, we argue that the TMT composition best suited to implement architectural BMIs should be diverse with respect to the following three

characteristics: 1) the core demographics of gender and ethnicity/immigration history, to ensure the non-task related information perspectives needed to engage in effective exploration for new BMI opportunities; 2) education specialization, to ensure the task related information perspectives needed to engage in effective exploration for new BMI opportunities; and 3) team tenure. A fourth requirement is that TMT composition should be homogenous with respect to organization and job market tenures, to reduce the negative consequences of power diversity and intergroup bias when it comes to architectural BMI

CONCLUSION

Innovating a firm's BM is essential to stay on par with changes in the external environment such as new technological opportunities, competitors, regulations, and stakeholder demands (Bocken and Geradts, 2019; Deshler and Smith, 2011; Keiningham et al., 2020; Schneider et al., 2017). The responsibility for ensuring that this development occurs ultimately resides with the TMT. Theorists of the Carnegie School have argued that complex decisions in firms are largely the outcome of behavioral dispositions among top managers, including their prior beliefs, knowledge, assumptions, and values (Cyert and March, 1963; March and Simon, 1958).

Based on upper echelons theory (Hambrick and Mason, 1984) and literature on team diversity (Williams and O'Reilly, 1998), while focusing on the diversity of observable proxies for the cognitive characteristics of top managers, we find evidence supporting the role of TMTs' cognitive characteristics in shaping the scope of BMI. Moreover, we find that the influence of such characteristics is intrinsically linked to the role of the TMT in the innovation process, a role that will differ significantly for modular versus architectural BMI.

Contributions to the BMI Literature

Our study contributes to the emerging BMI literature that links the role of microlevel cognitive characteristics among top management to the initiation and implementation of new BMIs (e.g., Frankenberger and Sauer, 2019; Laszczuk and Mayer, 2020; Osiyevskyy and Dewald, 2015; Schneckenberg et al., 2019; Täuscher and Abdelkafi, 2017). To date, only a handful of studies have provided empirical evidence on the effects of TMT composition on BMI outcomes (e.g., Al Humaidan and Sabatier, 2017; Diller et al., 2020; Guo et al., 2013). We offer a fine-grain view of how TMT composition (in terms of diversity) is associated with the choice to innovate a firm's existing BM, and specifically how TMT diversity is associated with the scope of BMI (i.e., modular versus architectural innovation). However, more cumulative theorizing in BMI research is required to understand the microlevel antecedents, together with the moderating and mediating variables, that affect BMI outcomes (Foss and Saebi, 2017). As demonstrated in our study, linking BMI research to the upper echelons theory and the (social psychology) literature on group diversity provides a fruitful avenue to understand how TMT's cognitive characteristics play a role in BMI.

Implications for TMT Research

While extant literature on TMT composition and performance outcomes is well established, it has produced largely inconsistent results. By introducing BMI as a new dependent variable, our contribution to TMT literature is two-fold. First, in prior studies that link TMT characteristics to innovation outcomes, the innovation (e.g., new product development) appears one-dimensional (e.g., a binary dependent variable) and occurs in isolation from other changes happening in the firm. In contrast, the concept of BMs as a complex system (Fleming and Sorenson, 2001; Levinthal, 1997) implies that changing one element will require considerations of how this change affects other elements and how these are interlinked (i.e., architectural BMI). Thus,

introducing BMI as a new unit of analysis to TMT research allows us to proffer a dimensionalization of innovation as the dependent variable that considers the scope of change (modular – architectural). For example, the wider the scope of BMI, the higher the level of complexity and ambiguity that the TMT has to deal with in the initiation and implementation of the BMI. As demonstrated in our study, certain TMT characteristics (e.g., tenure diversity) play a more significant role with more complex forms of innovation but are less decisive in modular innovation. Such dimensionalization can also be used to categorize other types of innovation, justifying the fine-grain view on the use of innovation as a dependent variable. Second, and related to our previous point, the influence of TMT composition (e.g., in terms of diversity) is heavily context dependent. As illustrated in our findings, the influence of cognitive characteristics is intrinsically linked to the role of the TMT in the innovation process. As the TMT assumes a "hands-off" approach in modular innovation, TMT diversity plays a less substantial role here compared to architectural BMI. In the latter, the involvement and influence of the TMT composition will be extensive both in the decision and implementation stages. Therefore, the effect of their cognitive and behavioral characteristics will weigh more heavily on the outcome.

Managerial Implications

The ability to (continuously) innovate an existing BM is crucial for firms operating in a dynamic environment (Saebi, 2015; Saebi et al., 2017). The TMT needs to scan the business environment for signals that warrant a change in its existing BM, search for new BM solutions, decide which BM needs to be implemented and manage the implementation process. As indicated in our study, the TMT composition (in terms of member diversity) plays a decisive role in the firm's ability to handle these stages of the BMI process. First, scanning the environment for

signals that warrant a change in the existing BM can be overwhelming, and a TMT that thinks "too much alike" may misinterpret or entirely miss signals in the external environment. Thus, composing a TMT that is diverse in relation to the core demographics of gender and ethnicity/immigration history invokes a variety of non-task related information and perspectives that can help in effective scanning of the external environment. Second, searching for new BMI opportunities (beyond the familiar ways of doing business) is often a challenge for established firms. Architectural BMI can involve a fundamental reconfiguration of how the firm creates, delivers, and captures value (not only changing the individual BM elements). Initiating a search for such a complex form of innovation requires the combination of a variety of knowledge and fields of specialization, including marketing, engineering, finance, and supply chain management. Thus, as illustrated in our findings, composing a TMT that is diverse in terms of education specialization helps to ensure the task related information perspectives needed to engage in effective exploration for new BMI opportunities. Finally, the TMT must decide which BM should be implemented and follow up on this implementation. The more radically different the new BM solution is from the existing way of doing business, the more likely it is to challenge existing power structures and group interests within the firm. The resulting power struggles, conflicts, and entitlements are likely to surface as the innovation becomes more tangible in the organization, potentially delaying or blocking further progress. Thus, composing a TMT that is diverse with respect to team tenure, while being homogenous with respect to organization and job market tenures, can help reduce team rigidity and conflict in BMI.

Limitations and Future Research

The research-design used in this study introduces limitations that should be considered when interpreting our findings. First, the findings are based on cross-sectional data collected

using surveys and data registries. Therefore, our analysis cannot establish causality. Our argument is that certain characteristics of TMT composition are associated with the firm's propensity for BMI. While the findings seem to support our theorizing, it is also possible to offer alternative interpretations. We have to acknowledge the following: (1) certain strategic decisions such as BMI may "cause" TMT-composition, and the reverse is also true; (2) the lag time for BMI propensity to manifest itself may differ; and (3) in some firms there may be high turnover in the TMT. Additional research using longitudinal designs will be useful for determining if the relationship between our independent and dependent variables are causal and the direction of that causality. Second, we use proxies as representations of the "givens" among top managers, and we aggregate these characteristics up to the TMT-level through diversity measures. This means there is a "black box" in the relationships where we lack direct data (Finkelstein et al., 2009). Accordingly, even if we base our study on proxies established in existing research, we cannot claim to have certain knowledge about the psychological characteristics of the individual manager or about the dynamics of the relationship between managers within the TMT. Third, social desirability, which "refers to the need for social approval and acceptance and the belief that it can be attained by means of culturally acceptable and appropriate behaviors" (Crowne and Marlowe, 1964, p. 109), can bias the answers of survey respondents (Ganster et al., 1983, Moorman and Podsakoff, 1992; Podsakoff and Organ, 1986). While we do not find changes to business model elements to be particularly sensitive to the phenomenon of social desirability, such biases can still have some influence on our BMI data. In the current study certain procedures were applied to reduce the impact of such biases (Ozer and Zhang, 2015; Podsakoff et al., 2003). This included respondents being provided with an assurance of anonymity and the questions being worded and designed to minimize the likelihood of biased results. Fourth, there are additional concerns related to omitted variable bias, where an unobserved variable (e.g.,

development trajectory within the industry) is causing the association between TMT characteristics and BMI. While we have included several control variables that remove many of the sources of omitted variable bias identified in previous research, we cannot rule out that such problems remain. Finally, issues regarding the generalizability of the findings to other settings may arise since the sample only includes Norwegian firms. Therefore, empirical analyses using data from other contexts would also be beneficial to validate and generalize the association between TMT composition and BMI documented herein.

In addition to addressing the abovementioned limitations, we invite future research to dig deeper into the role of TMT composition on BMI outcomes. Such topics can include the role of (and suitable proxies for) task-related information diversity in the context of BMI. The nature of an architectural BMI may take many forms (e.g., in terms of degree of novelty), as will the tasks within this type of innovation process. Accordingly, other task-related proxies of information diversity should be investigated and compared. It would also be valuable to investigate non-task related diversity in more detail, as the current study only addressed a sub-set of what may be accessible and relevant TMT member characteristics. Moreover, we encourage further studies to separate CEO characteristics from those of the rest of the TMT. This is because the CEO is in a special position to influence such processes as social categorization, thereby affecting team dynamics and innovation outcomes.

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NOTES

[1] To test for non-response bias, we compare the responses of those who responded to the first mailing of the questionnaire during the first work week (n=91) to those who responded to the final remainders (n=48). Those who only responded to the final remainders are then considered representative of non-responders. The following tests indicates that the late responders are not significantly different from early responders regarding key data elements used in the final analysis.

Data elements - survey	**Test result**
BMI (0-11)	Pearson chi2(11) = 17.24, Pr = 0.11
Data elements – registries	**Test result**
Gender - diversity	Pearson chi2(12) = 9.71, Pr = 0.73
Ethnicity - diversity	Pearson chi2(8) = 8.14, Pr = 0.42
Education level - diversity	Pearson chi2(27) = 25.91, Pr = 0.52
Education specialization - diversity	Pearson chi2(20) = 18.34, Pr = 0.57
Tenure in position - diversity	T-statistic (137) = 0.27, Pr = 0.79
Tenure in company - diversity	T-statistic (137) = 0.54, Pr = 0.59
Tenure in job market - diversity	T-statistic (137) = -0.82, Pr = 0.41
Data elements – accounting	**Test result**
Company size	T-statistic (137) = 0.86, Pr = 0.39
Company age	T-statistic (137) = -0.63, Pr = 0.53
Performance	T-statistic (137) = 1.45, Pr = 0.15
Industry (NACE sector)	Pearson chi2(9) = 12.31, Pr = 0.27

2 In order to check for non-independence of observations because of cross level influences of industry characteristics, Variance Partition Coefficients were calculated for the dependent variable. This represents the proportions of the total variability in the variable that can be attributable to the industry level. For BMI the result shows a proportion below 0.01% attributed to the industry level. This is then well below the 5.00% level often recommended as a trigger for multi-level analysis (Mehmetoglu and Jakobsen, 2016). We have therefore chosen a single level analysis with industry controls for this study.

APPENDIX

A. Survey questions

1. Which of the following changes to its target market(s) has your firm undertaken in the last three years? During the last three years, did your firm… *(Yes/No; and if Yes, was it: "new to firm, known to industry" or "new to firm, new to industry").*

1.1. …target a new customer segment?

1.2. …enter a new market it had not previously targeted?

1.3. …target customers that competitors ignored?

2. Which of the following changes to its value proposition and value capture has your firm undertaken in the last three years? During the last three years, did your firm… *(Yes/No; and if Yes, was it: "new to firm, known to industry" or "new to firm, new to industry").*

2.1. ... introduce a significant new bundle of products and services to its existing customers?

2.2. ... introduce a significant new bundle of products and services to new customers?

2.3. ... introduce any significant changes in its pricing scheme?

2.4. ... change its main source of revenue?

2.5. … implement any new or significant changes to its use of trademarks, patents, or copyrights?

3. Which of the following changes to its value chain has your firm undertaken in the last three years? During the last three years, did your firm … *(Yes/No; and if Yes, was it: "new to firm, known to industry" or "new to firm, new to industry").*

3.1. ... collaborate in a novel way with parties in its supply chain, such as suppliers and customers?

3.2. ... collaborate in a novel way with parties outside its supply chain?

3.3. ... significantly change the traditional roles and power relationships in its industry?

4. Management innovation

During the last three years, did your firm … *(Yes/No)*

4.1. introduce any significant changes to its organizational structure?

4.2. implement any new or significantly altered management practices, processes, or techniques?

ARTICLE 3

SEARCHING WIDE AND DEEP: THE LINK BETWEEN EXTERNAL KNOWLEDGE SEARCH AND BUSINESS MODEL INNOVATION

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SEARCHING WIDE AND DEEP: THE LINK BETWEEN EXTERNAL KNOWLEDGE SEARCH AND BUSINESS MODEL INNOVATION

ABSTRACT

Innovating an existing business model entails multiple interdependencies which requires managers to search over a (rugged) fitness landscape. In this study, we link theories on open innovation and NK-modelling to examine how different external knowledge sourcing activities help managers search the fitness landscape of different business model solutions. Analyzing Norwegian firm-level data we find that a firm's choice of external knowledge sourcing activity is closely associated with the type of business model innovation (BMI) it will engage in. The wider the firm's search, the wider is the scope of its BMI. The deeper the firm's search, the more novel is the BMI. Our findings contribute new and empirically supported insights at the intersection of open innovation and business model research.

INTRODUCTION

Firms increasingly find their current way of doing business challenged by new forms of competition, emerging technologies, and demands for sustainability. Successfully addressing such changes may require innovating the existing business model (BM)—the way the firm creates, delivers, and captures value (Amit and Zott, 2012; Foss and Saebi, 2018; Teece, 2010). Business model innovation (BMI) refers to the process of innovating an existing BM through the "designed, novel, nontrivial changes to the key elements of a firm's business model and/or the architecture linking these elements" (Foss and Saebi, 2017, p. 2).

However, the best BM solution is often not readily visible or even imaginable to managers. Borrowing from NK-modeling (Levinthal, 1997), a BM can be seen as a complex system where the optimal design may not be in the proximity of any current or familiar model (Foss and Saebi, 2018; Foss and Stieglitz, 2015). In a dynamic environment, the new optimum BM (i.e., the one associated with the creation of the most appropriable value) will often lie beyond the current field of vision of managers. If so, a deliberate and distant-looking search in the space of possible BMIs is required (Levinthal and March, 1993). However, such a distant-looking search is hampered if decision makers are cognitively constrained by previous mental maps, choices, and resource commitments (i.e., path dependence), and the resulting search will be myopic (Coombs and Hull, 1998; Levinthal and March, 1993). How, then, can managers effectively search for and find a new BM?

A central tenet in the open innovation (OI) literature is that managers need to establish search channels outside the boundaries of the organization to enhance their exposure to external knowledge, ideas, and perspectives (Bogers et al., 2018, 2019; Chesbrough, 2010; Enkel et al., 2020; Kauppila, 2010; Foss et al., 2013; Laursen and Salter, 2006; West and Bogers, 2014, 2017). Extant research has found that the use of external knowledge sources plays a key role in the search for innovative solutions in general, such as new products (Laursen and Salter, 2006), services (Mina et al., 2014), processes (Mol and Birkinshaw, 2009), or business and market areas (Chesbrough, 2019).

Are firms that engage in external knowledge search more likely to engage in BMI as well? And furthermore, are different external knowledge sourcing activities associated with different types of BMI? These research questions are prompted by emerging evidence that external knowledge sourcing has not only led to new products or services, but also to BMI (Chesbrough, 2003, 2010; Snihur and Wiklund, 2019; Yu et al., 2020). Unlike product, service or

process innovations, most firms do not have designated structures and resources in place to handle BMI, holding back progress in this area (Chesbrough, 2010, 2019). As BMI can fundamentally alter many areas of the existing BM simultaneously (e.g., value creation, delivery, capture) and thereby challenge the traditional way the firm conducts its business, more empirical research is required to investigate whether the use of external knowledge sources helps firms to initiate and implement BMI.

Moreover, because external knowledge sourcing activities can differ with regard to both the *breadth* of search (i.e., number of different external knowledge sources used) and *depth* of search (i.e., intensity with which the external sources are used) (Laursen and Salter, 2006), different BMIs may be associated with different kinds of external search activities (Saebi and Foss, 2015). Although the literature has increasingly recognized the variety of external knowledge sourcing activities (e.g., Enkel et al., 2020; Leiponen and Helfat, 2010; Robaczewska et al., 2019; Salge et al., 2012; West and Bogers, 2014), empirical studies accounting for the variety of BMIs are limited. However, BMIs can conceptually take various forms: *the scope of change* may be limited to altering one BM component (modular BMI) or it may simultaneously affect several complementary components (architectural BMI). The *degree of novelty* can be limited to choosing a BM design that is already known in the industry or it may be radical in that it moves the firm and its BM beyond the familiar ways of doing business in the industry (Foss and Saebi, 2017; Foss and Stieglitz, 2015). These different forms of BMI are likely to pose different information-, knowledge-, and coordination- challenges. Since they are associated with different knowledge needs, we expect different types of BMIs to correlate with different search and sourcing patterns for external knowledge.

Our data was collected through an online questionnaire sent to chief executive officers (CEOs) in Norwegian companies, resulting in a cross-sectional dataset of 256 responses. We find

that firms relying on the use of external knowledge sources are more likely to engage in BMI. Furthermore, firms that increase the breadth of knowledge search, but keep the search depth low, show a higher propensity for architectural BMI (simultaneously changing several components) compared to firms maintaining a low search breadth; however, these are BMIs already known in the industry. In contrast, firms that increase both the breadth and depth of their external knowledge search show a higher propensity for BMIs that are both architectural in scope *and* high in novelty, compared to firms maintaining low search breadth and depth —in other words, they significantly deviate from existing BMs in the industry.

Because we cannot demonstrate causation, we cautiously interpret our findings to indicate that firms that search widely and deeply tend to implement more complex forms of BMI compared to those that do not engage in external knowledge search. In doing so, our study responds to an important call for more research at the intersecting literatures of BMI and OI (Bogers et al., 2019; Foss and Saebi, 2017; Saebi and Foss, 2015). To date, BMI research lacks studies that have "empirically tested the effect of different drivers of the propensity to engage in BMI" (Foss and Saebi, 2017, p. 13), specifically the link between OI activities and BMI (Saebi and Foss, 2015). On the contrary, empirical research on OI has mainly focused on the effects of external search on product and service innovations, neglecting the link to BMI (Chesbrough, 2019). In sum, by linking ideas from NK-models, OI, and BMI, our findings contribute a new perspective on how external knowledge search is associated with BMI in established firms.

THEORETICAL BACKGROUND AND HYPOTHESES

The Search for BMI

In line with prior research, we take a BM to refer to the "design or architecture of the value creation, delivery, and capture mechanisms" of a firm (Teece, 2010, p. 172). Notably, firms' BMs vary based on the extent to which the components of target market, value creation,

delivery, and appropriation mechanisms are interdependent (Foss and Saebi, 2017, 2018). For example, strong interdependencies between BM components prevent Walmart stores from combining low prices with fancy stores or Rolls-Royce Motor Cars from selling cheap bespoke cars (Christensen et al., 2016).

The degree of interdependency determines the ease with which managers can perceive and implement new combinations of BM components. Thus, in a decomposable (or "loosely coupled" or "highly modular") system, interactions among the components are negligible, whereas in a non-decomposable system, interactions among the components are many and tangled (Simon, 1962). Innovating an existing BM "where the value creation, delivery, and appropriation mechanisms are tightly interdependent implies architectural change; conversely, a more loosely coupled business model will entail less architectural change, but potentially more modular change" (Foss and Saebi, 2017, p. 216). If, for example Walmart were to incorporate fancy stores into its BM, it would have to change more than just one component because this choice would affect its entire business logic (i.e., architectural change). Typically, more modular changes of BMs are less taxing on managerial attention than more architectural changes, because a modular change involves altering BM components in isolation whereas an architectural change simultaneously affects several components.

In addition to dimensionalizing BMIs in terms of the scope of change (i.e., modular or architectural), BMIs can be differentiated with respect to their degree of novelty. A firm may change its existing BM (through either modular or architectural change) only to end up with a model that is already known in the industry. For example, a firm that attempts to emulate a competitor's BM will change its existing model within the familiar forms of its industry (known to industry). In contrast, a firm may change its existing BM (through either modular or architectural change) and end up with a model that is significantly different from the industry's

established way of doing business (unknown to the industry); see Figure 1 (Foss and Saebi, 2017; Foss and Stieglitz, 2015).

Novelty	**Scope**		
		Modular	***Architectural***
	Known to industry	Evolutionary BMI	Adaptive BMI
	Unknown to industry	Focused BMI	Complex BMI

Figure 1: BMI Typology (Source: Foss and Saebi, 2017)

Prior studies indicate that firms often innovate their BM in response to external stimuli, such as discontinuities (e.g., Doz and Kosonen, 2010), changes in the competitive landscape (e.g., Berends et al., 2016), and increases in environmental complexity (e.g., Schneider et al., 2017), as well as based on internal changes in capabilities (Foss and Saebi, 2017; Teece, 2007). Thus, BMI is typically considered as a strategic response to opportunities or threats in the firm's internal/external environment (Saebi et al., 2017) or as changes in the firm's internal strengths or weaknesses. However, how managers effectively search for and find a new BM is less understood.

When searching for a new BM, the "large number of choices give rise to a large number of possible combinations, which creates a multidimensional search space" wherein the "interdependencies among choices imply that the different combinations vary in terms of their performance or viability" (Baumann et al., 2019, p. 288). For managers, this means that the new optimum BM (i.e., the one associated with the creation of the most appropriable value over time) will often lie beyond their field of vision. *Local search*, wherein managers search "for solutions

in the neighborhood of its current expertise or knowledge" (Rosenkopf and Nerkar, 2001, p. 288), may not always suffice to find a novel, high-performing BM (Foss and Saebi, 2017). In such cases, we expect that a more deliberate and *distant-looking* search in the space of possible BMs is required (Levinthal and March, 1993).

For example, *focused BMI* is difficult to attain because it requires a solution that is entirely new to the industry, and accordingly it comes with a high degree of uncertainty; *adaptive BMI* is difficult because it involves understanding which components of the BM that need to be changed in unison to get the desired performance effect; and *complex BMI* is even more difficult because it combines the challenges of both novel and architectural changes.

In the following, we link research on BM/BMI with NK-models and the OI literature to show how different types of BMI can benefit from different external knowledge sourcing activities.

The Link between NK-Models and BMI

NK-models in management research. Replacing the complex systems of nature's lifeforms in evolutionary biology with the complex systems of organizations (Ganco and Hoetker, 2009; Kauffman, 1993; Levinthal, 1997; Simon, 1962; Wright, 1932), the NK-models applied in management research provide a valuable perspective on the interdependent choices that underpin the search for BMI. In the NK-model (the fitness landscape), managers must identify sets of choices (combinations) that mutually reinforce each other and yield a high performance. Within such landscapes, every possible organizational setup has its own coordinates, represented by a unique combination of N business attributes. The level of complementarity between the attributes is signified by the K in the NK-model and the fitness score of each combination (each position in the landscape) represents how well the setup is suited for performance within the specific environment. These coordinates, complementarities and

fitness scores jointly shape the topology of the landscape. Zero complementarities means that each business attribute provides value independent of the other attributes. This results in a smooth fitness landscape. In contrast, a high level of complementarities means the contribution from each attribute is dependent on the state of many other attributes, creating a complex and rugged fitness landscape with several peaks and valleys.

Connecting NK-models and BMI. The attributes of the BM as a complex system are represented by the architecture of the interrelated activities and components (value creation, delivery, and appropriation mechanisms) of the BM. Each possible BM variant in a business environment can then be ranked by its fitness according to a performance criterion, such as profitability or sales volume. Over time, as the firm fine-tunes its BM, the interdependencies between the BM components strengthen. Specifically, in successful firms, a high degree of interdependency prevents competitors from imitating their BM (Rivkin, 2000; Siggelkow, 2001). However, the more interdependent the BM components are, the more rugged the surrounding fitness landscape will be, with multiple peaks and valleys associated with varying levels of performance (Ennen and Richter, 2010). For example, Ikea's no-frills BM is centered on its mutually reinforcing choices of standard product design and customer self-service, representing a peak in the furniture retailing landscape. As Bauman et al. (2019, p. 288) exemplify, if "Ikea were to change only the product-design dimension but retain its choice on the customer-service dimension, the resulting combination would likely reduce performance."

In established industries, most incumbent companies have adapted to a position where they are clustered together in a few dominant forms of relatively high fitness and rigidity. Here, managements' motivation for further adaptation is lessened through the cognitive constraints of previous choices and resource commitments. However, as environments become more dynamic and new opportunities and threats arise, the fitness landscape with its peaks and valleys does not

remain static. What was once an attractive BM in the fitness landscape may soon face declining performance as other models rise to take its place. Consequently, and pushed by the fundamental impetus to improve ones' fitness or perish, managers must be ready to adapt to new positions (Gavetti and Levinthal, 2000).

Searching for BMI over a fitness landscape. Navigating to a new position requires managers to gather new knowledge that helps them identify the most attractive path and to overcome the cognitive and structural constraints that hold a firm to its existing BM (Ethiraj and Levinthal, 2004; Levinthal, 1997; Nickerson and Zenger, 2004). The fitness landscape typically comprises local optima and more distant peaks (potentially associated with higher levels of appropriable value creation). These local optima can potentially obscure the view to the best-performing and more distant BM variants. Such landscapes complicate managers' search for new possibilities, often making it difficult to find the right path and to make leaps that go beyond local search and adaptation (Baumann and Siggelkow, 2013; Gavetti and Levinthal, 2000; Siggelkow and Levinthal, 2005).

BM changes aimed towards a known practice within a tightly clustered industry landscape (what we label evolutionary and adaptive BMI in Figure 1) are attained through search within the neighborhood of the current BM (Andries et al., 2013; Levinthal, 1997). This implies a continued exploitation of known BM forms through small or large steps toward a local optimum in the fitness landscape. In other words, these are changes toward BM forms within the known industry landscape in the "immediate neighborhood of the existing organization" (Levinthal, 1997, p. 937). The proximity of the new practice and within-industry knowledge diffusion (De Bondt, 1997; Sorenson et al., 2006) makes us expect such changes to be based on a local search for knowledge, targeting external knowledge closely related to the current knowledge inventory of the firm (Katila and Ahuja, 2002; Rosenkopf and Nerkar, 2001). In contrast, a change can also

result in a BM that is new and unknown to the industry (what we label focused or complex BMI in Figure 1). This implies exploration of BM forms outside the known industry landscape and often "far removed from the organization's current mode of operation" (Levinthal, 1997, p. 938). Hence, we can expect such changes to be based on search for knowledge more distant from the current knowledge inventory (Bierly et al., 2009; Ehls et al., 2020; Katila and Ahuja, 2002; Rosenkopf and Nerkar, 2001). Below, we argue how the use of external knowledge sources (through local or distant search for knowledge) is associated with different types of BMI.

Linking External Knowledge Sourcing and BMI by Means of the NK-Model

Knowledge search beyond the boundaries of the firm is a central tenet in OI literature. Building on previous OI studies on search activities (Katila and Ahuja, 2002; Levinthal and March, 1993), Laursen and Salter (2006) proposed the dimensions of *breadth* and *depth* to characterize the openness of firms' external search. Search breadth refers to the number of different external sources or search channels that a firm relies upon in their innovative activities. Increasing the search breadth ensures that the firm gains access to a wider diversity of knowledge. In contrast, search depth refers to the intensity of use of the external sources or search channels in the innovation process. Intensifying the search depth—for example, through close collaborations— creates a stronger relationship and favorable learning environment. Borrowing a visualization from Saebi and Foss (2015), firms' external knowledge sourcing activities can be placed in one of the four quadrants (Figure 2).

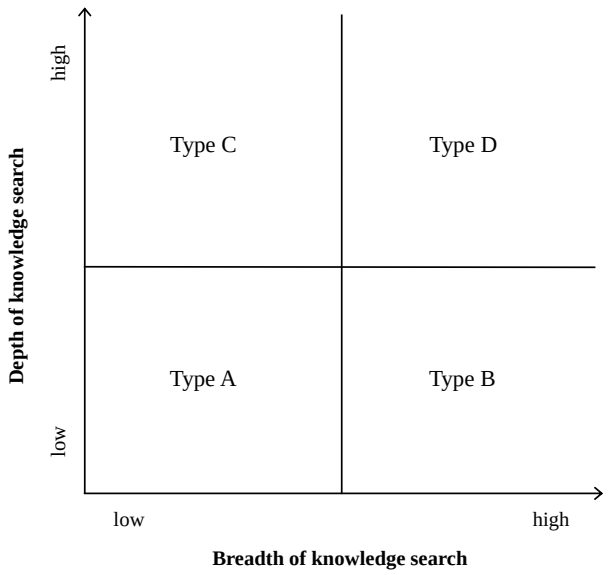

Figure 2: Typology of External Knowledge Sourcing Activities (Source: Saebi and Foss, 2015)

Firms in quadrant A make limited use of external knowledge sources (e.g., participation in a few trade conferences). Firms in quadrant B draw knowledge from a wide portfolio of external sources but do not integrate these sources into their organization (e.g., crowdsourcing). In contrast, firms in quadrants C (e.g., research collaboration with a selected partner) and D (e.g., wide-spanning collaboration with several different partners) tightly integrate their knowledge sources into their innovation processes.

In line with prior studies on the effects of external knowledge sourcing on product, process, and service innovations (e.g., Katila and Ahuja, 2002; Laursen and Salter, 2006; Mina et al., 2014; Terjesen and Patel, 2015), we expect that search breadth and search depth are key predictors of a firms' propensity for specific types of BMI. Arguably, managers engage in external knowledge sourcing to find new combinations of knowledge that would not be found if the search was based only on internal combinations of knowledge (see e.g., Almirall and Casadesus-Masanell, 2010; Leiponen and Helfath, 2010; Rosenkopf and Nerkar, 2001). Engaging in external knowledge sourcing can therefore increase the potential for new knowledge

combinations and spur the probability of innovations such as BMI (Bierly et al. 2009; Fey and Birkenshaw, 2005; Nickerson and Zenger, 2004; Schumpeter, 1934). Linking extant insights on BMI, complex systems, and knowledge sourcing, we hypothesize that different combinations of search breadth and depth are associated with knowledge combinations that are either close to or distant from the current inventory, and therefore associated with different forms of BMI along the dimensions of scope (i.e., modular or architectural change) and novelty (i.e., within or outside the know industry landscape).

Hypotheses: Search Breadth, Search Depth, Absorptive Capacity and BMI

The scope of BMI can vary from modular change (BM components change in an isolated manner) to architectural change (simultaneously affecting several components). As modular BMI involves a single BM component change it depends little on the interactions among dispersed knowledge sets (Nickerson and Zenger, 2004). Contrasting this, architectural BMI requires managers to fully grasp which BM components need to be innovated in unison to get the desired performance effect (Ennen and Richter, 2010; Foss and Saebi, 2017), thus requiring a combination of widely dispersed knowledge sets (Nickerson and Zenger, 2004). Thus, the wider the scope of the BMI, the less likely it is to find an adequate "pool" of knowledge via just one or a few knowledge sources (Oerlemans and Knoben, 2010). Firms that perform broad external search are more likely to increase their access to such dispersed sources of knowledge (e.g., through access to customers, users, and suppliers) and accordingly their chances of identifying sets of choices (i.e., combinations of BM components) that mutually reinforce each other in an architectural BMI. We therefore argue that the breadth of external knowledge search is positively associated with the scope of the firm's BMI.

The degree of novelty of BMI can vary from BMIs that are known and familiar to the industry to those that are novel and unknown. In terms of NK-models and the associated fitness landscapes, the former type of BMI only takes the firm to a new position within the known industry landscape, while the latter takes the firm outside this known landscape and often involves what has been termed radical reorientation (Billinger et al., 2013; Ganco, 2017) or long jumps in the fitness landscape (Kauffman, 1993). As BMIs within the known industry landscape are based on knowledge close to the current inventory of the firm, relevant knowledge from external sources is easily codified (Hansen, 1999; Saviotti, 1998). This type of knowledge can then be effectively transferred even if the external relationships are infrequent and distant (i.e., weak ties) (Hansen, 1999). Contrasting this, novel BMI is based on knowledge combinations on the frontier of knowledge development and further removed from the current inventory of incumbent firms (Bierly et al., 2009; Cohen and Levinthal, 1990; Saviotti, 1998). The transfer of this type of knowledge is more likely to be challenging, as it is noncodified and highly tacit, and requires external relationships with a higher frequency of interactions, shared language, and trust (i.e., strong ties) (Bierly et al., 2009; Oerlemans and Knoben, 2010).

Firms that perform deep search seek to intensify their relationship with external knowledge partners, for example, through strategic alliances and partnerships (Laursen and Salter, 2006). The increased interactions that follow from deeper search set the foundation for trust and a common language between the partners (Fey and Birkinshaw, 2005; Oerlemans and Knoben, 2010; Saviotti, 1998). From this follows favorable conditions for greater knowledge assimilation (Cohen and Levinthal, 1990), especially when noncodified and tacit knowledge is transferred (Bierly et al., 2009; Hansen, 1999; Oerlemans and Knoben, 2010). Building on extant research we therefore argue that the prolonged and deep exposure to a particular knowledge source can lead to the new knowledge combinations needed for novel BMI. Hence, that the depth

of external knowledge search is positively associated with the degree of novelty of the firm's BMI.

Search for BMI known to industry. Based on the above reasoning, a firm's choice of search activity (Figure 2) is a combination (i.e., interaction effect) of high/low degrees of search breadth and high/low degrees of search depth, which taken together favors a particular innovation outcome. Increasing the breadth of low intensity knowledge search allows managers to gather new insights close to the current knowledge inventory and closely related to existing BMs in the local fitness landscape. A firm that uses external knowledge sources sparsely (e.g., conducting a few customer interviews, Activity A in Figure 2) might collect sufficient insight to support BMI within a single area (evolutionary BMI). A firm that expands the breadth of knowledge search while still keeping the depth of knowledge search low (e.g., moving from Activity A to Activity B in Figure 2), is likely to identify new knowledge combinations involving several areas, and thereby increase the potential scope of BMIs already known within the industry (i.e., increase the scope from evolutionary to adaptive BMI). Consequently, we hypothesize the following:

Hypothesis 1a: *A low depth, low breadth search activity is positively associated with evolutionary BMI.*

Hypothesis 1b: *A low depth, high breadth search activity is positively associated with adaptive BMI.*

Search for BMI unknown to industry. A firm that focuses on close integration with a few external knowledge sources (e.g., forming a joint venture with a key supplier, Activity C in Figure 2) is likely to create a learning environment that fosters mutual exchange of proprietary knowledge (Oerlemans and Knoben, 2010) and thus gather targeted insights to support a novel BMI within a single BM component (focused BMI). In contrast, a firm that dedicates itself to closer collaborations and draws on a large variety of external sources is more likely to gather

diverse and novel insights. Thus, firms that increase the depth as well as breadth of knowledge search (e.g., from Activity C to Activity D in Figure 2) are more likely to engage in BMIs that are architectural and unknown to the industry (complex BMI). In terms of NK-models, increasing both the breadth and depth of knowledge search allows managers to search both the near and distant fitness landscape (i.e., both near and distant knowledge) and thus find possible paths to more distant and attractive BMs. Thus, we expect the following:

Hypothesis 2a: *A high depth, low breadth search activity is positively associated with focused BMI.*

Hypothesis 2b: *A high depth, high breadth search activity is positively associated with complex BMI.*

Capacity for absorbing external knowledge. Absorptive capacity is a key limitation for the effective use of external knowledge sources including their use in BMI efforts. The importance of absorptive capacity springs from the insight that the mere availability of external knowledge sources is not sufficient; an organizational ability to exploit these sources is also required (Cohen and Levinthal, 1990; Zahra and George, 2002). Our interpretation of absorptive capacity is based on the definition of Cohen and Levinthal (1989) as the firm's ability to identify, assimilate, and exploit the knowledge gained from external sources. This ability plays an important part in BMI as wider search increases the complexity of handling diverse knowledge from a variety of sources (Leiponen and Helfat, 2010) and as deeper search introduces the company to noncodified and tacit knowledge (Hansen, 1999). Thus, a firm's absorptive capacity needs to be considered when analyzing the external knowledge search activities in the context of BMI (cf. Spithoven et al., 2011; West and Bogers, 2017). Consequently, we hypothesize the following:

Hypothesis 3: *Absorptive capacity positively moderates the associations between types of search activity and types of BMI as hypothesized in hypotheses 1 and 2, such that the associations are stronger for higher levels of absorptive capacity.*

In our analysis, external search is represented by two independent variables (i.e., breadth and depth), absorptive capacity is represented by one independent variable, and BMI is represented by two dependent variables capturing the extent to which the changes in the scope of the BMI are novel (i.e., known to industry and unknown to industry). By basing our analysis on this design, we can account for the interaction effects between search breadth, search depth, and absorptive capacity, and test the associations between different knowledge search activities (Figure 2) and the type of BMI firms are likely to engage in (Figure 1).

DATA AND METHODS

Sample and Data

The data for the analysis were collected from two sources. The main part of the data (e.g., BMI and search data) was collected in 2014 by the Center for Service Innovation at the Norwegian School of Economics (NHH) via an online questionnaire sent by email to 4,000 CEOs of Norwegian firms in the fall of 2014. In particular, the targeted companies had more than 30 employees. The remaining data were collected by accessing official accounting data covering all Norwegian firms over a period from 1992 until 2016. Data elements from this source were used as control variables in our analysis (e.g., company size and age).

The survey provided 286 responses, amounting to 7.2% response rate. Excluding those with missing answers or missing control variables yielded a sample of 256 responses (6.4%). Although this response rate may seem low, it is not uncommon for organizational research, particularly when the target respondent is the CEO (Baruch, 1999; Baruch and Holtom, 2008).

Nevertheless, the large number of firms that did not respond raises the question of sample bias. To ensure the representativeness of the sample we tested for non-response bias. These tests did not indicate any significant differences (based on chi-square and t -statistics) between early and late responding firms with respect to the data used in the analysis (for independent, dependent, and control variables) [1]. When we consider how the sample firms compare to the relevant total population, tests did not indicate significant differences for any control variables except for firm age. For this control, our test showed our sample to have a slight over-representation of older firms. Overall, we believe that our sample is sufficiently representative.

A further problem is that except the control variables, all our variables were from the same survey, collected in the same time period, and based on self-reports by CEOs. This means that common method variance (CMV) may potentially bias our data and coefficient estimates (Williams and Brown, 1994). Procedural remedies included in the survey design were the anonymization of the respondents and methodical separation of the items of the independent and dependent variables within the survey. Post-hoc statistical tests were also utilized to identify potential CMV issues without indicating any "red flags". The tests included the Harman's one-factor test and the Common Latent Factor test (Podsakoff et al., 2003) [2]. Even if we cannot conclusively rule out the CMV threat, we interpret these post-hoc tests to indicate a limited impact on our data and analyses. Furthermore, in the text below, the internal consistency tests using Cronbach's alpha are provided for each variable. Moreover, tests for discriminant validity were also carried out with satisfactory results [3].

Variables

***Independent variables*.** The independent variables for search breadth and depth in this study were drawn from 11 survey items. These items were based on questions from the Eurostat Community Innovation Survey and captured 11 different knowledge sources relevant in the

context of innovation (see Appendix A for details). These items and scales are in line with Laursen and Salter's (2006) operationalization of external knowledge sourcing in their seminal study on OI. The use of each external knowledge source was measured using a four-point scale ("not used" = 1 to "highly used" = 4). Our composite independent variables were constructed from all 11 knowledge sources, with no discrimination between the different types. The survey responses for these source-items showed a relatively high degree of internal consistency (Cronbach's alpha coefficient = 0.81). The independent variable *Search_breadth* was constructed as the total number of different sources a firm utilizes to some degree (excluding those "not used"). Within the sample, the number of knowledge sources used by firms varied between 0 and 11. Consequently, a firm received a score of 0 when no knowledge sources were used and a maximum score of 11 when all knowledge sources were used. The independent variable *Search_depth* is defined as the extent to which a firm intensively draws from different external knowledge sources. The variable was constructed as the total number of sources a firm utilizes to a high degree ("highly used" = 4). A firm received a score of 0 when no knowledge sources were used to a high degree, whereas it received a maximum score of 11 when all knowledge sources were used to such a degree. Within the sample of firms, the number of knowledge sources used to a high degree varied between 0 and 7.

To test the robustness of the results for search depth, an alternative *Search_depth_collab* measure was included. This measure was drawn from seven survey items (Cronbach's alpha coefficient = 0.64) based on the Eurostat Community Innovation Survey. It captured whether the firm had formal innovation collaboration with different external sources (see Appendix A for details). As with the other independent variables, this variable was constructed as the total number of collaborations a firm utilizes in its innovation activities. A firm received a score of 0

when no collaborations were in place and a maximum score of 7 when all types of sources were used.

To operationalize the independent variable of absorptive capacity, we argue for a proxy-measure that covers a firm's strategic orientation with respect to innovation and development. This goes beyond more narrowly-focused proxies, such as those covering only R&D personnel or -spending (Flatten et al., 2011). A measure that covers a wider set of higher-level indicators is important because the knowledge and learning processes required for achieving BMI may be quite diverse. This contrasts with purely technology-driven innovations, where R&D spending is more likely to be a satisfactory measure. Consequently, in the current study, we rely on a proxy of absorptive capacity that is a composite variable drawn from the CEOs' answers to questions about the strategic orientation of the firm (see Appendix A for details). Through a seven-point scale ("not important" = 1 to "very important" = 7), nine different items captured what the CEO sees as most important for the firm in its competitive efforts (Cronbach's alpha = 0.70). The items representing absorptive capacity were drawn from a factor analysis of these items, where the resulting factor included items covering the strategic importance the firm places on: (1) innovation and R&D, (2) patents and trademarks, (3) launching new products and services, and (4) creating high switching costs for customers [4].

Dependent variables. The dependent variables represent the type of BMI undertaken by the firms (Figure 1) and were drawn from 11 survey items (see Appendix A for details). The items are based on the four main components of a BM; target market, value proposition, value capture and value delivery. To measure change in target market, respondents were asked to indicate whether their firm had entered a new market not targeted before or targeted a new customer segment. To measure change in value proposition, respondents were asked to indicate whether their firm had introduced a significant new bundle of products and services to either

existing or new customers. To measure change in value capture, respondents were asked to indicate whether their firm had changed its main source of revenue, implemented any new or significantly changed any uses of trademarks, patents, or copyrights, or introduced significant changes to its pricing scheme. To measure change in value delivery, respondents were asked to indicate whether their firm had collaborated in novel ways with parties inside or outside their supply chain or significantly changed traditional roles and power relationships in their industry.

Through the survey items we mapped whether elements within the BM components had been subjected to change during the three years prior to 2014 ("yes" or "no"). We further distinguished whether these changes were already known to the industry ("new to firm, known to industry") or new to the industry ("new to firm, new to industry"). Among the responding firms we found the number of BM elements changed to vary between 0 and 11 for configuration known to industry, and between 0 and 10 for configuration new to industry. The survey responses also showed the survey items to have a relatively high degree of internal consistency (Cronbach's alpha = 0.75).

The dependent variable *BMI_low_novelty* is based on the "new to firm, known to industry" responses, and represents the BMI scope that is known to industry (evolutionary and adaptive BMI). The dependent variable *BMI_high_novelty* is based on the "new to firm, new to industry" responses, and represents the BMI scope that is unknown to industry (focused and complex BMI). Continuous factor scores were generated from the basic binary items using confirmatory factor analysis (CFA) through GSEM [5].

Control variables. Firms of different sizes and ages may have different challenges and capabilities related to BMI. Larger and older firms may have access to greater financial, human, and other resources that might help facilitate change while, at the same time be more prone to biases, rigidity, prior commitments and overall path dependency in the face of BM change

(Leiponen and Helfat, 2010). We controlled for size (measured as the log of number of employees) and age (years since incorporation), both collected through official accounting data. Financial performance compared to industry peers can also serve as an important predictor of changes in the existing BM (Greve, 1998, 2003). We therefore include industry adjusted return on assets (ROA) as a control variable. In addition, regarding the industry association of firms, we include measures of industry growth, volatility, and capital intensity to control for general demand growth, level of uncertainty, and path dependency. For these controls, industry associations were based on four-digit NACE industry codes. The sample distribution across industries is shown in Table 1 (using two-digit NACE industry codes). A test for non-independence of observations originating in these industry associations was also performed [6]. Because our sample represented the population diversity in ownership structure, we controlled for different propensities to innovate across such structures. Ownership was represented by a single control variable that distinguishes limited liability firms from the less common ownership structures.

Table 1: Sample Distribution across Industries

Industry	Number of companies	Mean Breadth	Mean Depth
Accomodation and food services	15	7.47	0.87
Professional, scientific and technical services	41	8.12	1.59
Primary industries	20	7.35	1.80
Construction	30	8.17	1.17
Electrical supply, water supply and renovation	10	8.50	1.10
Financial, insurance and real estate	8	7.63	0.89
Human health, social and cultural work	29	8.38	1.76
Information and communication	12	8.17	1.67
Manufacturing	55	8.13	1.24
Transportation and storage	8	7.63	0.88
Wholesale and retail	28	7.07	1.43
Average		**7.88**	**1.38**

ANALYSIS AND RESULTS

Table 2 presents the descriptive statistics and pairwise correlations between the main variables. These results do not indicate that multicollinearity is an actionable concern. Moreover, in line with the motivation to study the effects of external search on the propensity for BMI, Table 2 shows how *Search_breadth* and *Search_depth* are positively correlated with *BMI_low_novelty* and *BMI_high_novelty*. It also shows how absorptive capacity is positively correlated with the BMI variables. A negative correlation is observed between *BMI_low_novelty* and *BMI_high_novelty*, which is in line with our presumption that the search activity of a firm will benefit one over the other. Moreover, we find a positive correlation between *Search_breadth* and *Search_depth*, as is expected given that high intensity use of external sources can only occur within the sources the firm is engaged with. The direction of correlations among other variables is within what can be expected based on the motivation for their inclusion.

Table 2: Descriptive Statistics and Pairwise Correlations

Variable	Mean	S.D	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) BMI_low_novelty	0.012	0.298	1.000										
(2) BMI_high_novelty	-0.001	0.155	-0.181***	1.000									
(3) Company_size	4.311	1.380	-0.082	0.011	1.000								
(4) Company_age	25.195	25.927	-0.059	-0.050	0.105*	1.000							
(5) Performance	0.007	0.138	-0.055	-0.013	0.086	0.051	1.000						
(6) Industry growth	0.018	0.659	-0.150**	0.113*	-0.024	-0.204***	-0.130**	1.000					
(7) Industry volatility	0.074	1.467	0.001	-0.054	0.041	0.461***	-0.030	0.026	1.000				
(8) Industry capital intensity	0.440	3.203	-0.029	-0.091	0.011	0.510***	0.007	-0.097	0.908***	1.000			
(9) Search_breadth	7.875	2.890	0.174***	0.117**	0.189***	-0.112*	-0.057	-0.003	0.010	-0.002	1.000		
(10) Search_depth	1.379	1.323	0.106*	0.268***	0.146**	-0.116*	0.074	0.003	-0.062	-0.066	0.316***	1.000	
(11) Absorptive_capacity	0.011	0.997	0.143**	0.335***	0.098	-0.062	0.080	-0.047	-0.007	-0.028	0.267***	0.242***	1.000

* p < 0.1 ** p < 0.05 *** p < 0.01

We used hierarchical linear regressions for both our dependent variables, as presented in Table 3 and Table 4. Variables were sequentially entered starting with control variables covering basic firm and industry attributes (Model 1), and independent variables (Model 2). Next, we performed the robustness test for search depth using the alternative *Search_depth_collab* measure (Model 3). Then, we included the interaction term between *Search_breadth* and *Search_depth* (Model 4) and finally, we included the interaction term for *Absorptive_capacity* (Model 5).

Association between Search Activity and BMI

For *BMI_low_novelty* (Table 3), Model 2 shows the control for size and ownership to be significant, indicating that firms of larger size and firms with other than limited liability ownership may have somewhat lower propensity for BMI known to the industry. Moreover, the industry controls of growth and volatility are significant, indicting a lower propensity for BMI known to the industry for firms in industries experiencing strong growth and low levels of volatility. Model 2 shows a positive and significant ($p < 0.05$) coefficient for *Search_breadth*, providing the first indication of how an increased use of external knowledge sources may increase the propensity for engaging in architectural BMI that is low in novelty. With respect to the role of *Absorptive-capacity*, Model 2 does not show any significant relationship with *BMI_low_novelty*.

Table 3: Hierarchical Ordinary Least Squares (OLS) Regression for BMI_low_novelty

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Company_size	-0.02 (0.02)	-0.03* (0.02)	-0.03* (0.02)	-0.02 (0.02)	-0.03* (0.02)
Company_age	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)	-0.00 (0.00)
Company ownership	-0.12* (0.06)	-0.13** (0.06)	-0.13** (0.06)	-0.11* (0.06)	-0.10* (0.06)
Performance	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)
Industry growth	-0.10*** (0.03)	-0.10*** (0.03)	-0.10*** (0.03)	-0.10*** (0.03)	-0.10*** (0.03)
Industry volatility	0.06** (0.03)	0.06** (0.03)	0.06* (0.03)	0.06** (0.03)	0.06** (0.03)
Industry capital intensity	-0.02 (0.01)	-0.02 (0.01)	-0.02 (0.01)	-0.02 (0.01)	-0.02 (0.01)
Search_breadth		0.02** (0.01)	0.01** (0.01)	0.03*** (0.01)	0.03*** (0.01)
Search_depth		0.02 (0.02)		0.18*** (0.05)	0.19*** (0.06)
Absorptive_capacity		0.01 (0.02)	0.01 (0.02)	0.02 (0.02)	-0.06 (0.08)
Search_depth_collab			0.01 (0.01)		
Search_breadth x Search_depth				-0.02*** (0.01)	-0.02*** (0.01)
Search_breadth x Absorptive_capacity					0.01 (0.01)
Search_depth x Absorptive_capacity					0.01 (0.05)
Search_breadth x Search_depth x Absorptive_capacity					-0.00 (0.01)
R2	0.07	0.11	0.11	0.15	0.15
Adjusted R2	0.05	0.08	0.07	0.11	0.10
F for change in R2	2.81***	3.51**		9.96***	0.18

* p < 0.1 ** p < 0.05 *** p < 0.01

For *BMI_high_novelty* (Table 4), Model 2 shows that the industry control for growth is significant, indicting a higher propensity for BMI high in novelty for firms in industries experiencing strong growth. Model 2 also shows a positive and significant ($p < 0.01$) coefficient for *Search_depth*, providing the first indication of how an increased use of deep collaborations may increase the propensity for engaging in architectural BMI that is high in novelty. Moreover, Model 2 shows a significant positive relationship ($p < 0.01$) between *Absorptive_capacity* and *BMI_high_novelty*. Therefore, although this variable is not significant for *BMI_low_novelty*, it does become significant for more novel forms of BMI. This indicates that absorptive capacity is the most important for BMI requiring knowledge that is unfamiliar and distant from the current knowledge inventory.

Table 4: Hierarchical OLS Regression for BMI_high_novelty

Variable	Model 1	Model 2	Model 3	Model 4	Model 5
Company_size	0.01 (0.01)	0.00 (0.01)	0.00 (0.01)	-0.00 (0.01)	-0.00 (0.01)
Company_age	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Company ownership	-0.00 (0.03)	0.01 (0.03)	0.02 (0.03)	0.01 (0.03)	0.01 (0.03)
Performance	0.00 (0.01)	-0.00 (0.01)	-0.00 (0.01)	-0.00 (0.01)	0.00 (0.01)
Industry growth	0.02 (0.02)	0.03** (0.02)	0.03* (0.02)	0.03** (0.02)	0.04** (0.02)
Industry volatility	0.01 (0.02)	0.01 (0.02)	0.00 (0.02)	0.01 (0.02)	0.00 (0.02)
Industry capital intensity	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)	-0.01 (0.01)
Search_breadth		-0.00 (0.00)	-0.00 (0.00)	-0.01** (0.00)	-0.01** (0.01)
Search_depth		0.03*** (0.01)		-0.05* (0.03)	-0.06* (0.03)
Absorptive_capacity		0.05*** (0.01)	0.05*** (0.01)	0.05*** (0.01)	0.09** (0.04)
Search_depth_collab			0.01* (0.00)		
Search_breadth x Search_depth				0.01*** (0.00)	0.01** (0.00)
Search_breadth x Absorptive_capacity					-0.01 (0.01)
Search_depth x Absorptive_capacity					-0.06** (0.02)
Search_breadth x Search_depth x Absorptive_capacity					0.01** (0.00)
R2	0.03	0.17	0.15	0.20	0.22
Adjusted R2	-	0.14	0.11	0.17	0.18
F for change in R2	1.06	14.61***		7.97***	6.53**

* p < 0.1 ** p < 0.05 *** p < 0.01

Before including the interaction term, these findings on *BMI_low_novelty* and *BMI_high_novelty* provide some support for hypotheses 1 and 2 and the argument that a general increase in the use of external knowledge sources increases the propensity for BMIs of larger scope. So far, it seems that what matters for low novelty BMI is search breadth, whereas what matters for high novelty BMI is search depth. The results are bolstered by a robustness check using the alterative measure for external search depth (*Search_depth_collab*). These results are shown in Model 3 for both BMI variables, and we find *Search_depth_collab* to have coefficients largely in line with those found in Model 2 (Table 3 and 4).

The Conditional Association between Search Activity and BMI

Through Model 4 in Table 3, the interaction effect between *Search_depth* and *Search_breadth* on *BMI_low_novelty* can be interpreted. The coefficient of the interaction term is negative and significant. However, if we examine the influence of increasing *Search_breadth* at

different levels of *Search_depth*, we find that a positive relationship exits at low levels of *Search_depth*. In other words, when *Search_depth* is maintained constant at a low level, increasing *Search_breadth* results in an increased propensity for engaging in architectural BMI that is low in novelty. This is illustrated by the positively sloped curve in Figure 3, which shows the relationship when *Search_depth* is maintained constant at one. The positive association is found to be significant ($p < 0.10$) at depth levels of zero and one (or at depth level zero, $p < 0.05$).

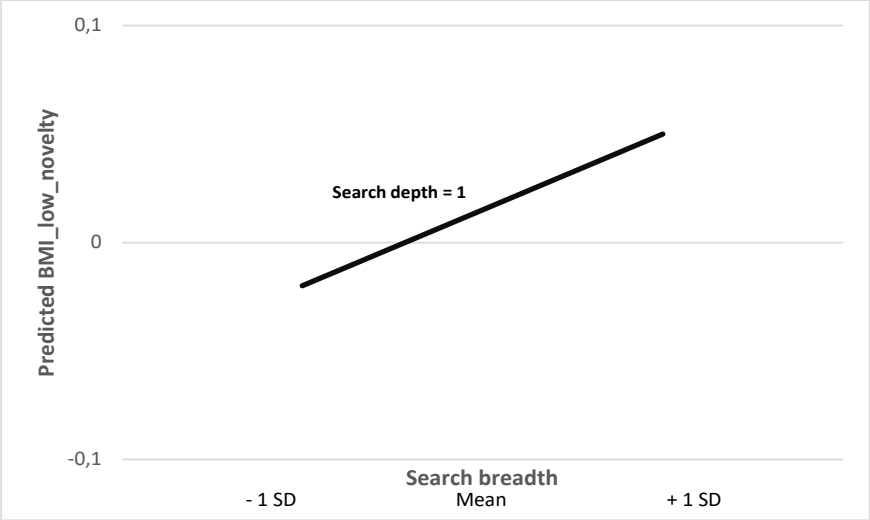

Figure 3: Predicted BMI_low_novelty When Increasing Search_breadth While Keeping Search_depth Low and Constant

In contrast, at high levels of *Search_depth*, the relationship is negative. Increased *Search_breadth* now results in a lower propensity for engaging in architectural BMI that is low in novelty. This association is illustrated by the negatively sloped curve in Figure 4, where *Search_depth* is maintained constant at seven. The negative association is found to be significant ($p < 0.10$) at depth levels above three (or at depth levels above four, $p < 0.05$).

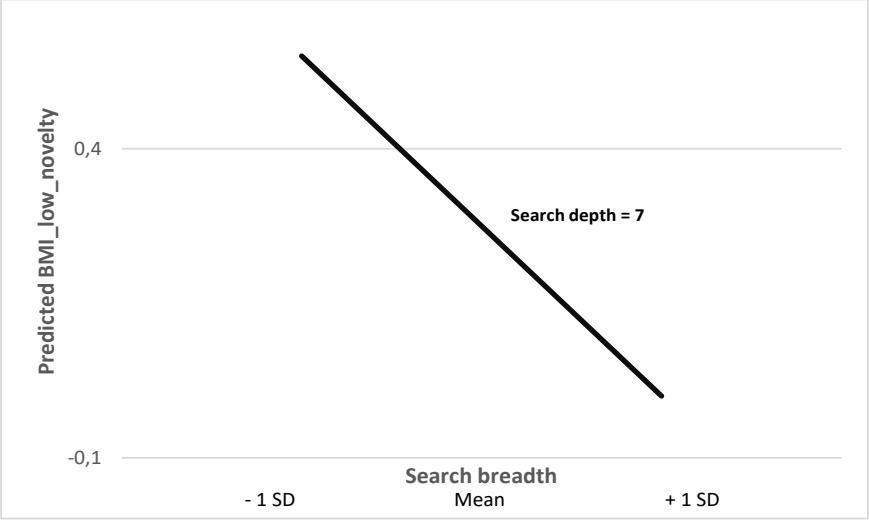

Figure 4: Predicted BMI_low_novelty When Increasing Search_breadth While Keeping Search_depth High and Constant

Seen in combination, these relationships show support for hypotheses 1a and 1b. The scope of low novelty BMI increases when *Search_depth* is kept low while increasing *Search_breadth* (as illustrated in Figure 3).

Regarding *BMI_high_novelty*, interaction effect between *Search_depth* and *Search_breadth* can be interpreted through Model 4 in Table 4. We now maintain *Search_breadth* constant at different levels while changing *Search_depth*. The interaction term in Model 4 is positive, but a negative relationship does exist at low levels of *Search_breadth*. In Figure 5, *Search_breadth* is maintained constant at one while allowing *Search_depth* to vary. This results in a negative slope. In other words, when *Search_breadth* is held constant at a low level, increasing *Search_depth* results in a decreased propensity for engaging in architectural BMI that is high in novelty. This negative association is found to be significant ($p < 0.10$) at breadth levels below two.

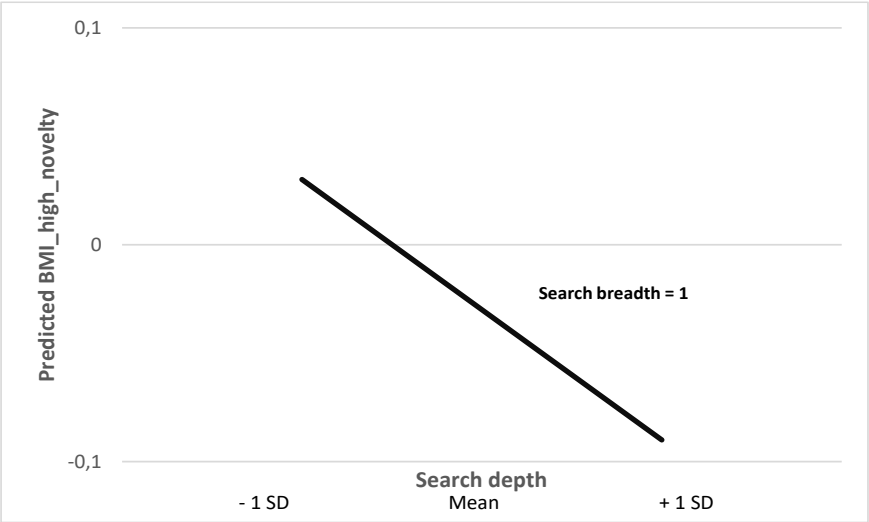

Figure 5: Predicted BMI_high_novelty When Increasing Search_depth While Keeping Search_breadth Low and Constant

Conversely, we find that a positive conditional relationship exists at high levels of *Search_breadth*. In Figure 6, *Search_breadth* is maintained constant at nine while allowing *Search_depth* to vary. The slope is now positive, which means that increasing *Search_depth* results in an increased propensity for engaging in architectural BMI that is high in novelty. The positive association is found to be significant ($p < 0.10$) at breadth levels above seven (or at breadth level above eight, $p < 0.05$).

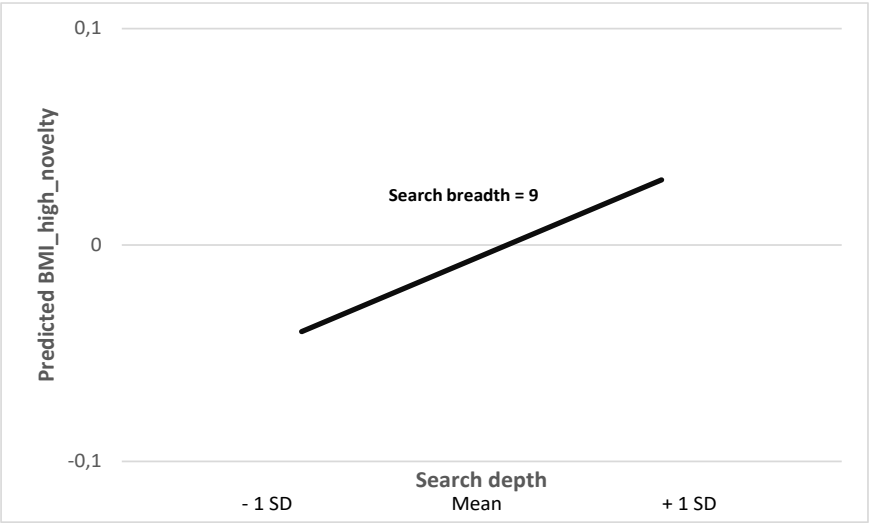

Figure 6: Predicted BMI_high_novelty When Increasing Search_depth While Keeping Search_breadth High and Constant

Moreover, by considering the range of non-significant breadth levels between two and seven, we find that the association between *Search_depth* and *BMI_high_novelty* turns from negative to positive at breadth levels around six, providing support for hypothesis 2b. On the contrary, these results do not support hypothesis 2a because low *Search_breadth* results in a negative slope when increasing *Search_depth*. The propensity for focused BMI will instead, according to our results, be higher when *Search_breadth* is high and *Search_depth* is low.

The Conditional Association between Absorptive Capacity, Search Activity and BMI

Through Model 5 in Table 3, the interaction effect between *Absorptive_capacity*, *Search_depth* and *Search_breadth* on *BMI_low_novelty* can be interpreted. Here we find that the coefficient of the interaction term is nonsignificant. This is not surprising given that *Absorptive_capacity* did not provide any significant result in Model 2 in Table 3. Contrasting this, through Model 5 in Table 4, we find significant interaction results between *Absorptive_capacity*, *Search_depth* and *Search_breadth* on *BMI_high_novelty*. In Figure 7, we

keep *Search_breadth* and *Search_depth* constant at low and high levels (i.e., mean value +/- 1 standard deviation) while allowing *Absorptive_capacity* to vary. The slopes are found to be positive for all four search activity combinations, and significant ($p < 0.01$) for the two steepest slopes (i.e., low depth and low breadth, high depth and high breadth). Taken together, these results indicate that a firm increases its propensity for engaging in architectural BMI that is high in novelty by increasing its *Absorptive_capacity* in combinations with external search activities. Hence, the results also provide us with partial support for hypothesis 3.

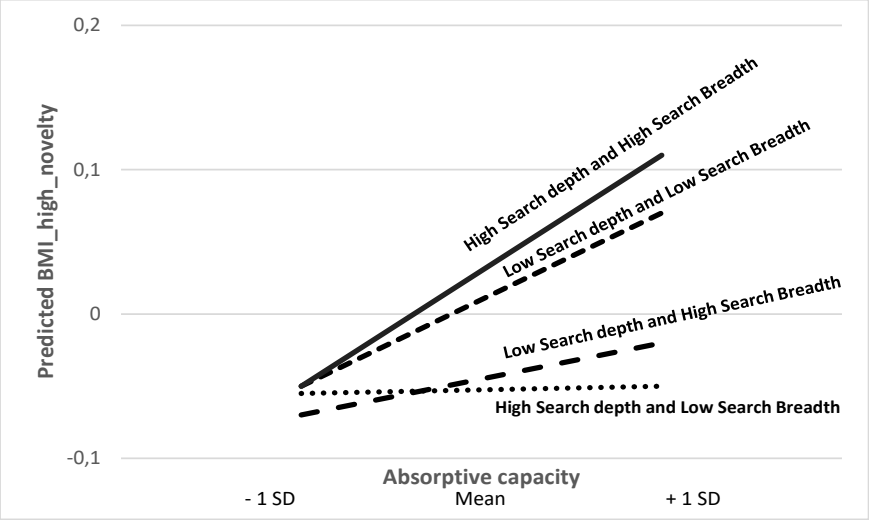

Figure 7: Predicted BMI_high_novelty When Increasing Absorptive_capacity While Keeping Search_breadth and Search_depth Constant at High and Low Levels

CONCLUDING DISCUSSION

The Association between External Knowledge Search and BMI

Dynamic changes in the business environment of a firm often require a radical transformation of the firm's existing BM. This may entail changes in the way the firm creates, delivers, and captures value (Foss and Saebi, 2017; Teece, 2010; Zott and Amit, 2013) and thus

affects the interdependencies in a firm's BM. Understanding BM as a complex system helps the OI literature to expand the empirical analysis of the effect of external search on firm innovation beyond simple product, service, and process outcomes.

Both our theorizing and the consequent findings point to an important association between a firm's choice of external knowledge search and BMIs of different scope and novelty. Linking back to the BM-fitness landscape (Levinthal, 1997), we find that the utilization of codified knowledge easily accessible in the environment is associated with BMIs within the known landscape of the industry. This implies that the focal firm gathers and uses the knowledge of BM combinations already familiar to industry players. In contrast, we find that unfamiliar knowledge only accessible through high-intensity connections with external knowledge sources is associated with the propensity to engage in BMIs that take the focal firm outside the known industry landscape (long jumps).

When considering the conditional effects between *Search_breadth* and *Search_depth*, the four different search activities represented by quadrants A–D in Figure 2 can be linked to a more fine-grained view of a firm's propensity to engage in different types of BMI. We summarize the following associations between the choice of external search activity and type of BMI.

- Activity A (low breadth, low depth): A search activity that involves few external knowledge sources, and a low degree of high-intensity relationships provides the highest propensity for evolutionary BMI.
- Activity B (high breadth, low depth): A search activity that involves many different external knowledge sources, but a low degree of high-intensity relationships provides the highest propensity for adaptive or focused BMI.

- Activity C (low breadth, high depth): A search activity that involves few external knowledge sources, and a high degree of high-intensity relationships does not provide increased propensity for BMI.
- Activity D (high breadth, high depth): A search activity that involves many different external knowledge sources, and a high degree of high-intensity relationships provides the highest propensity for complex BMI.

The above analysis of the conditional association between search activity and BMI shows that Activity C diverges from hypothesis 2a and does not provide a clear propensity for BMI. We argue that this finding may point to a higher than expected importance of access to a wide variety of knowledge sources to have the absorptive capacity needed to distil and interpret novel information through deep cooperation.

Furthermore, we find that whereas BMIs within the known landscape of the industry do not significantly rely on absorptive capacity, more novel changes paint a different picture. The propensity for novel BMIs is observed to be higher for firms with a higher absorptive capacity. These results may not be surprising, given that moving the firm into an uncharted part of the fitness landscape (outside what is known in the industry) requires several iterations of learning and change where the firm develops and tests new BM configurations. As extant research on absorptive capacity has shown, a long-term commitment to developing knowledge is of key importance (Cohen and Levinthal, 1990). Investments in new knowledge in one period will expand the organizational absorptive capacity in the periods that follow. Moreover, "by having already developed some absorptive capacity in a particular area, a firm may more readily accumulate what additional knowledge it needs in the subsequent periods in order to exploit any critical external knowledge that may become available" (Cohen and Levinthal, 1990, p. 136). A long-term commitment by the firm (over several such iterations) will then be critical for

accumulating the absorptive capacity needed to exploit non-codified knowledge relevant for distant positions within the fitness landscape.

Contributions

This study adds to the growing literature on both OI (West and Bogers, 2014, 2017) and BMI (Andreini and Bettinelli, 2017; Foss and Saebi, 2017, 2018) by providing empirical insights on the association between the use of external knowledge sources and BMI. By linking research on NK-models, OI, and BMI, we provide a valuable new perspective on interpreting this association. This contributes to the emerging field of BMI research, which is lacking studies that have "empirically tested the effect of different drivers on the propensity to engage in BMI" (Foss and Saebi, 2017, p. 13). In the last decade, a growing number of studies have been conducted within OI research that target firms' use of external knowledge. Our study adds to this research with empirically backed insight on the association between inbound OI (Chesbrough, 2003) and forms of innovations with varying levels of interdependencies such as BMI. Moreover, our findings may constitute a valuable tool for managers in their efforts to form the innovative capabilities of their firm and maneuver it to positions of higher performance (fitness).

Limitations

The research design of this study introduces limitations that need to be taken into account when considering the findings. First, the findings are based on cross-sectional data collected in 2014; therefore, our analysis cannot establish causality. We argue that the use of external knowledge sources is positively associated with the propensity for BMI and that an increased interaction with such sources is associated with the scope of more novel forms of BMI. However, alternative interpretations of our findings are also possible. A BMI initiated by a firm may trigger a requirement for establishing more, or a higher intensity use of, external sources. Thus,

additional research using longitudinal or experimental designs may be useful in clarifying the direction of causality among these independent and dependent variables. Second, self-reported data in surveys may be subject to social desirability bias (Podsakoff and Organ, 1986). Social desirability "refers to the need for social approval and acceptance and the belief that it can be attained by means of culturally acceptable and appropriate behaviors" (Crowne and Marlowe, 1964, p. 109). This is problematic in surveys as it can bias the answers of respondents towards certain levels and so mask the true relationships between variables that are measured through the same source (Ganster et al., 1983, Moorman and Podsakoff, 1992). Such biases can then influence our findings on the relationship between external search and BMI. While we do not find a firm's external knowledge search and changes to BM elements to be particularly sensitive to the phenomenon of social desirability, certain procedural methods can further reduce the risk of biases influencing the results (Ozer and Zhang, 2015; Podsakoff et al., 2003). In the current study several such procedures have been applied. The respondents were provided with an assurance of anonymity, which can reduce such bias even in cases of social sensitive topics. The questions were also worded to minimize the likelihood of responses being affected by social desirability bias, with all questions being closed-ended (e.g., yes/no, Likert scales) and subject to adjustments based on feedback from pilot testing. Moreover, there were a psychological separation between the questions for search and BMI in the survey design. Third, our research design does not allow for the analysis of search breadth and depth within each individual type of knowledge source. Future research could develop more fine-grained items for each knowledge source. Fourth, limitations related to endogeneity may exist. One source of such a limitation could be the omitted variable bias, where an unobserved variable (e.g., development trajectory within the industry) causes the association between external knowledge search and BMI. Nevertheless, we have included several control variables to account for this. Finally, the sample

only includes Norwegian firms, which raises issues regarding the generalizability of the findings to other settings. Both cross-national studies and replications in other settings are therefore warranted.

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NOTES

[1] To test for non-response bias, we compare the responses of those who responded to the first mailing of the questionnaire during the first work week (n=97) to those who responded to the final remainders (n=52). Those who only responded to the final remainders are then considered representative of non-responders. The following tests indicates that the late responders are not significantly different from early responders regarding key data elements used in the final analysis.

Data elements - survey	**Test result**
Search breadth (0-11)	Pearson chi2(11) = 16.50, Pr = 0.13
Search depth (0-11)	Pearson chi2(6) = 6.19, Pr = 0.40
Strategic orientation – Patents (1-7)	Pearson chi2(6) = 6.80, Pr = 0.34
Strategic orientation – New product/Services (1-7)	Pearson chi2(6) = 4.67, Pr = 0.59
Strategic orientation – Innovation/R&D (1-7)	Pearson chi2(6) = 2.95, Pr = 0.82
Strategic orientation – Switching costs (1-7)	Pearson chi2(6) = 5.12, Pr = 0.53
BMI - known (0-11)	Pearson chi2(10) = 7.65, Pr = 0.66
BMI - new (0-11)	Pearson chi2(9) = 8.30, Pr = 0.50
Data elements – accounting	**Test result**
Company size (mean)	T-statistic (147) = 0.97, Pr = 0.33
Company age (mean)	T-statistic (147) = -0.62, Pr = 0.54
Performance (mean)	T-statistic (147) = 0.74, Pr = 0.46
Company ownership (0-1)	Pearson chi2(1) = 0.31, Pr = 0.58
Industry (NACE sector)	Pearson chi2(9) = 14.60, Pr = 0.15

2 CMV post-hoc tests

Harman's one-factor test:

Based on the 42 observed items used in the analysis (not including the robustness test) the single-factor model explained 23.9% variance, well below the conventional 50% threshold. When the model was not constrained to a single factor, we obtained 10 distinct factors with eigenvalues >1.0. These factors accounted for a total of 73.4% of the variance in our data.

Factor	**Eigenvalue**	**Difference**	**Proportion**	**Cumulative**
Factor 1	7.40730	3.80942	0.2389	0.2389
Factor 2	3.59787	1.15075	0.1161	0.3550
Factor 3	2.44713	0.62362	0.0789	0.4339
Factor 4	1.82350	0.15306	0.0588	0.4928
Factor 5	1.67044	0.35453	0.0539	0.5467
Factor 6	1.31591	0.04785	0.0424	0.5891
Factor 7	1.26806	0.09493	0.0409	0.6300
Factor 8	1.17313	0.12659	0.0378	0.6678
Factor 9	1.04654	0.04104	0.0338	0.7016
Factor 10	1.00549	0.05320	0.0324	0.7340
Factor 11	0.95229	0.15928	0.0307	0.7648

The unrotated factor loadings connected to this analysis, detailed for the 10 factors with eigenvalue greater than 1.0, are presented in the table below.

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9	Factor 10	Uniqueness
Question 1.1	0.4766	0.1552	0.0593	-0.1886	-0.0174	0.2820	-0.0539	-0.1476	-0.3046	0.2230	0.4627
Question 1.2	0.3878	0.2910	0.0104	0.0908	-0.1684	0.0768	-0.1983	-0.2786	0.0187	-0.3764	0.4634
Question 1.3	0.3933	0.2556	-0.0985	-0.3689	-0.1988	0.0801	0.1995	-0.1804	0.1222	0.1608	0.4752
Question 1.4	0.3440	0.4373	-0.2301	-0.0990	-0.0921	0.2517	0.1660	-0.2313	0.0656	-0.1363	0.4519
Question 1.5	0.5309	0.1027	-0.4313	0.2346	0.0361	-0.3035	-0.1793	-0.0386	-0.0818	-0.0769	0.3269
Question 1.6	0.5179	0.0854	-0.6556	0.0657	-0.1071	-0.1192	-0.0243	0.0583	-0.1055	-0.0140	0.2493
Question 1.7	0.5386	0.1493	-0.6245	-0.0069	-0.1217	-0.1819	-0.0740	-0.0041	0.0012	0.0376	0.2428
Question 1.8	0.5460	0.2325	-0.3105	-0.0100	0.0382	-0.0063	-0.0505	0.2140	0.0029	0.0421	0.4997
Question 1.9	0.5305	0.1782	-0.4793	-0.0420	-0.0626	-0.0233	0.0805	0.2861	0.0684	0.1103	0.3457
Question 1.10	0.3660	0.2170	-0.4764	-0.0683	-0.0975	0.2518	0.0265	-0.0902	0.2338	-0.0672	0.4464
Question 1.11	0.5256	0.2333	-0.4419	0.0344	-0.1645	0.1693	-0.0206	-0.0833	0.0448	-0.1233	0.3926
Question 4.1	0.2849	0.1704	0.3759	-0.1461	-0.2768	-0.1022	0.4066	0.0848	-0.0743	-0.3196	0.3598
Question 4.2	0.3964	0.2536	0.3704	-0.2649	-0.3790	-0.2315	0.1222	-0.0908	0.0647	-0.1922	0.3097
Question 4.3	0.0981	0.1669	0.2471	0.1109	-0.1835	-0.0354	-0.0288	-0.5104	-0.1386	0.4530	0.3685
Question 4.4	0.3710	0.1104	0.2165	-0.3367	-0.1721	-0.0246	0.4189	0.0904	0.1524	-0.0915	0.4424
Question 4.5	0.4897	0.1398	0.3306	0.1687	0.0792	-0.1985	0.0028	-0.2488	-0.0954	-0.2401	0.4286
Question 4.6	0.6446	0.1362	0.4399	-0.0424	-0.0565	-0.2914	0.0411	0.0226	0.0252	-0.1449	0.2587
Question 4.7	0.7028	-0.0196	0.1303	-0.0861	0.1012	-0.1987	-0.0999	0.2421	-0.0806	-0.0683	0.3519
Question 4.8	0.2924	0.1237	0.2119	0.2345	0.0652	-0.3229	0.0702	-0.1526	-0.0351	0.0580	0.6580
Question 4.9	0.3483	0.1138	0.1020	0.0435	-0.1245	0.1096	0.1062	-0.4897	-0.3138	0.2493	0.4142
Question 5.1_new	0.6982	-0.3436	0.0033	-0.0268	0.2635	-0.0125	-0.1111	-0.0005	0.2116	0.1192	0.2528
Question 5.2_new	0.4357	-0.4004	0.0716	-0.2045	0.3433	-0.1634	0.3020	0.0158	0.3107	0.3557	0.0734
Question 5.3_new	0.5963	-0.3833	0.1784	0.0815	0.3071	0.0522	0.3285	0.0520	-0.0586	-0.1245	0.2325
Question 6.1_new	0.5224	-0.3910	0.3207	-0.0659	-0.1226	-0.2136	-0.3270	0.0219	0.0009	-0.0091	0.2235
Question 6.2_new	0.5296	-0.4123	0.3145	-0.0749	0.0862	-0.0462	-0.2986	-0.1005	0.1735	-0.0545	0.2333
Question 6.3_new	0.6222	-0.3479	-0.0275	0.1675	0.3726	0.1767	0.1225	-0.1052	-0.1779	0.0106	0.2352
Question 6.4_new	0.3816	-0.4288	0.4435	-0.2549	0.2263	0.3112	-0.1959	0.0898	0.1528	-0.0578	0.1153
Question 6.5_new	0.2894	-0.2011	0.0758	0.5246	-0.2145	0.1067	0.1019	0.0656	0.2356	-0.2017	0.1768
Question 7.1_new	0.3964	-0.5350	0.0900	0.2194	-0.3241	0.1075	-0.0392	0.3125	-0.2972	0.1413	0.1753
Question 7.2_new	0.5102	-0.3719	0.0669	0.2880	-0.3864	0.1088	0.1150	0.0562	0.2665	0.3406	0.1495
Question 7.3_new	0.4762	-0.4241	-0.1425	-0.2970	0.0219	0.3941	-0.0869	0.1443	-0.1671	-0.0408	0.1823
Question 5.1_known	0.0427	0.6210	0.2955	0.0048	-0.0807	0.2623	-0.0633	0.2182	0.2579	0.2529	0.2678
Question 5.2_known	0.0994	0.6033	0.1988	0.0847	-0.1239	0.4313	-0.2860	0.1405	-0.1741	-0.1513	0.2233

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Factor 9	Factor 10	Uniqueness
Question 5.3_known	0.1438	0.5293	0.1511	-0.2140	-0.1578	-0.0583	-0.4554	0.0656	0.2369	0.2023	0.2936
Question 6.1_known	0.0468	0.6816	0.2629	-0.0742	0.0084	0.0769	0.1379	0.2842	-0.0221	0.0950	0.3434
Question 6.2_known	0.0639	0.6570	0.3063	0.0139	-0.1360	0.0694	0.1565	0.2600	-0.1375	0.0955	0.3268
Question 6.3_known	0.0766	0.3636	0.2011	0.3319	0.2229	0.1365	-0.3686	-0.0661	0.3484	-0.0188	0.3047
Question 6.4_known	0.0719	0.3396	0.0335	0.3594	0.3867	0.2508	0.2676	-0.0273	0.0208	-0.1007	0.1609
Question 6.5_known	0.3058	0.4253	0.2329	0.2735	0.2519	0.0541	-0.0718	0.1094	-0.3338	0.1622	0.2274
Question 7.1_known	0.1154	0.5805	-0.0599	-0.2314	0.3775	0.0449	0.0089	-0.2628	0.3052	-0.0406	0.1986
Question 7.2_known	0.1186	0.3972	-0.1057	-0.4535	0.3362	-0.2636	-0.1662	0.1165	-0.2711	-0.0424	0.1379
Question 7.3_known	0.1107	0.5788	-0.0071	0.4342	0.1461	-0.3967	0.0592	0.1983	0.0819	0.1916	0.1992

Common Latent Factor test:

We introduce a common latent factor to estimate the common variance among the 42 observed items used in the analysis. By squaring the unstandardized regression weights between the common factor and the observed items we get the common variance of 0.0081 (0.81%) which is well below the often used 0.5 “red flag” limit.

In addition, we run the model with and without the common latent factor comparing the standardized regression weights of each observed item (see Appendix A for details). This result in the following delta values for these weights, all well below the often used 0.2 “red flag” limit.

Path	**Delta (absolute)**
Question 1.1 <– External sources	0.006
Question 1.2 <– External sources	0.006
Question 1.3 <– External sources	0.012
Question 1.4 <– External sources	0.007
Question 1.5 <– External sources	0.004
Question 1.6 <– External sources	0.001
Question 1.7 <– External sources	0.002
Question 1.8 <– External sources	0.000
Question 1.9 <– External sources	0.002
Question 1.10 <– External sources	0.004
Question 1.11 <– External sources	0.007
Question 4.1 <– Strategic orientation	0.008
Question 4.2 <– Strategic orientation	0.007
Question 4.3 <– Strategic orientation	0.007
Question 4.4 <– Strategic orientation	0.007
Question 4.5 <– Strategic orientation	0.004
Question 4.6 <– Strategic orientation	0.000
Question 4.7 <– Strategic orientation	0.003
Question 4.8 <– Strategic orientation	0.003
Question 4.9 <– Strategic orientation	0.022
Question 5.1_new <– BMI_new	0.050
Question 5.2_new <– BMI_new	0.048

Path	Delta (absolute)
Question 5.3_new <– BMI_new	0.038
Question 6.1_new <– BMI_new	0.014
Question 6.2_new <– BMI_new	0.008
Question 6.3_new <– BMI_new	0.074
Question 6.4_new <– BMI_new	0.098
Question 6.5_new <– BMI_new	0.073
Question 7.1_new <– BMI_new	0.043
Question 7.2_new <– BMI_new	0.026
Question 7.3_new <– BMI_new	0.078
Question 5.1_known <– BMI_known	0.032
Question 5.2_known <– BMI_known	0.041
Question 5.3_known <– BMI_known	0.016
Question 6.1_known <– BMI_known	0.076
Question 6.2_known <– BMI_known	0.057
Question 6.3_known <– BMI_known	0.043
Question 6.4_known <– BMI_known	0.085
Question 6.5_known <– BMI_known	0.024
Question 7.1_known <– BMI_known	0.022
Question 7.2_known <– BMI_known	0.051
Question 7.3_known <– BMI_known	0.009

3 Analysis of discriminant validity

In Note 2 the details on the exploratory factor analysis (EFA) that was run in the context of CMV is provided. This includes the factor loadings connected to the 10 factors with eigenvalues above 1.0. Overall, we find that the factor loadings of the measures are consistent with the theoretical argument and with limited cross-loadings. To further inspect a possible issue with discriminant validity, we conducted a confirmatory factor analysis (CFA) through a structural equation modeling (SEM) based measurement model. This model included all measures and main factors targeted in the study. From this we calculated the squared correlations (SC) among the latent variables and the average variance extracted (AVE) by the latent variables. In the overview of results (see tables below) we find that all values of AVE are above the associated SC among factors. Hence, this analysis does not highlight discriminant validity to be an issue (Mehmetoglu and Jakobsen, 2016).

Squared correlations (SC) among latent variables

	Absorptive capacity	BMI known	BMI new	Breadth of search	Depth of search
Absorptive capacity	1.000				
BMI known	0.048	1.000			
BMI new	0.154	0.054	1.000		
Breadth of search	0.098	0.042	0.027	1.000	
Depth of search	0.055	0.001	0.099	0.123	1.000

Average variance extracted (AVE) by latent variables

Absorptive capacity	0.520
BMI known	0.210
BMI new	0.201
Breadth of search	0.347
Depth of search	0.157

[4] The items representing absorptive capacity were drawn from a factor analysis of the strategic orientation items (see Appendix A for details), starting with an exploratory factor analysis (EFA) of all items before conducting a confirmatory factor analysis (CFA) utilizing the identified factor structure.

EFA of strategic orientation items:

Method:	Principal component
Rotation:	Orthogonal verimax

Factor	**Variance**	**Difference**	**Proportion**	**Cumulative**
Factor 1	2.23072	0.31777	0.2479	0.2479
Factor 2	1.91295	0.49175	0.2125	0.4604
Factor 3	1.42120	-	0.1579	0.6193

LR test: chi(36) = 590.65, prob > chi2 = 0.0000

Variable	**Factor 1**	**Factor 2**	**Factor 3**	**Uniqueness**
Question 4.1	0.0860	0.8182	0.1488	0.3010
Question 4.2	0.2625	0.7161	0.1632	0.3916
Question 4.3	-0.0362	0.1142	0.8415	0.2775
Question 4.4	0.2193	0.6824	0.0082	0.4862
Question 4.5	0.7565	0.0666	0.1834	0.3897
Question 4.6	0.7689	0.3635	0.0413	0.2749
Question 4.7	0.7453	0.2589	-0.1591	0.3522
Question 4.8	0.5894	-0.1471	0.3280	0.5234
Question 4.9	0.1965	0.1634	0.7042	0.4388

CFA through structural equation model:

Method: Structural equation model
Estimation: Maximum likelihood

Measurement	Coef.	OIM Std. Err.	z	p > |z|	[95% Conf.	Interval]
Question 4.5 <–						
Factor 1	1	(constrained)				
_cons	3.02807	0.10407	29.10	0.000	2.82409	3.23205
Question 4.6 <–						
Factor 1	1.40230	0.15262	9.19	0.000	1.10317	1.70142
_cons	3.93684	0.09767	40.31	0.000	3.74541	4.12828
Question 4.7 <–						
Factor 1	1.09558	0.12543	8.73	0.000	0.84975	1.34142
_cons	4.23158	0.10531	40.18	0.000	4.02519	4.43797
Question 4.8 <–						
Factor 1	0.55653	0.10630	5.24	0.000	0.34819	0.76487
_cons	3.17544	0.10031	31.66	0.000	2.97884	3.37204
Question 4.1 <–						
Factor 2	1	(constrained)				
_cons	6.13684	0.07983	76.87	0.000	5.98037	6.29331
Question 4.2 <–						
Factor 2	1.36400	0.16646	8.19	0.000	1.03774	1.69026
_cons	4.72631	0.09841	48.03	0.000	4.53343	4.91919
Question 4.4 <–						
Factor 2	0.91300	0.12400	7.36	0.000	0.66997	1.15604
_cons	5.47368	0.08939	61.23	0.000	5.29848	5.64889
Question 4.3 <–						
Factor 3	1	(constrained)				
_cons	4.45614	0.09941	44.83	0.000	4.26130	4.65098
Question 4.9 <–						
Factor 3	1.25607	0.39922	3.15	0.002	0.47361	2.03853
_cons	5.32281	0.08809	60.42	0.000	5.15015	5.49546
var (e.q4.5)	1.96390	0.19015			1.62444	2.37431
var (e.q4.6)	0.51046	0.16172			0.27433	0.94980
var (e.q4.7)	1.81244	0.18153			1.48940	2.20555
var (e.q4.8)	2.51964	0.21731			2.12777	2.98368
var (e.q4.1)	1.00265	0.12040			0.79239	1.26870
var (e.q4.2)	1.24626	0.18228			0.92985	1.67033
var (e.q4.4)	1.59908	0.15929			1.31547	1.94384
var (e.q4.3)	2.13200	0.27884			1.64992	2.75495
var (e.q4.9)	1.13165	0.35089			0.61628	2.07799
var (Factor1)	1.12302	0.22113			0.76346	1.65193
var (Factor2)	0.81372	0.15342			0.56232	1.17750
var (Factor3)	0.68449	0.26386			0.32155	1.45712
cov (Factor1,Factor2)	0.60396	0.10437	5.79	0.000	0.39940	0.80853
cov (Factor1,Factor3)	0.29216	0.10075	2.90	0.004	0.09470	0.48962
cov (Factor2,Factor3)	0.32772	0.11277	2.91	0.004	0.10671	0.54874

Fit statistic	Value	Description
Likelihood ratio		
chi2_ms (24)	58.269	model versus saturated
p > chi2	0.000	
chi2_bs (36)	598.704	baseline versus saturated
p > chi2	0.000	
Population error		
RMSEA	0.071	Root mean squared error of approximation
90% CI, lower bound	0.048	
upper bound	0.094	
pclose	0.067	Probability RMSEA <= 0.05
Information criteria		
AIC	9248.542	Akaike's information criterion
BIC	9358.116	Bayesian information criterion
Baseline comparison		
CFI	0.939	Comparative fit index
TLI	0.909	Tucker-Lewis index
Size of residuals		
SRMR	0.049	Stand. root mean squared residual
CD	0.973	Coefficient of determination

[5] Continuous factor scores are generated for both dependent variables from the BMI survey items (questions 5-7 in Appendix A) using CFA through generalized structural equation model estimation (GSEM). The GSEM method is here needed (replacing structural equation model) because of the binary nature of BMI survey items (yes/no). Notice that the use of GSEM also limits the range of postestimation possibilities, including limiting available fit statistics to Akaike's and Bayesian information criterion.

BMI_low_novelty:

Method:	Generalized structural equation model
Family/Link:	Bernulli / Logit

Measurement	**Coef.**	**Std. Err.**	**z**	**p > |z|**	**[95% Conf. Interval]**	
Question 5.1 <–						
BMI_low_novelty	1	(constrained)				
_cons	-0.95921	0.31153	-3.08	0.002	-1.56981	-0.34861
Question 5.2 <–						
BMI_ low_novelty	0.72154	0.19299	3.74	0.000	0.34328	1.09980
_cons	-1.08620	0.24773	-4.38	0.000	-1.57173	-0.60066
Question 5.3 <–						
BMI_ low_novelty	0.42691	0.14005	3.05	0.002	0.15242	0.70141
_cons	-2.17601	0.26325	-8.27	0.000	-2.69197	-1.66005
Question 6.1 <–						
BMI_ low_novelty	0.68159	0.23132	2.95	0.003	0.22820	1.13497
_cons	-1.66007	0.28841	-5.76	0.000	-2.22534	-1.09480
Question 6.2 <–						
BMI_ low_novelty	0.67119	0.21821	3.08	0.002	0.24351	1.09887
_cons	-1.50619	0.26944	-5.59	0.000	-2.03430	-0.97809
Question 6.3 <–						
BMI_low_novelty	0.28761	0.10029	2.87	0.004	0.09105	0.48417
_cons	-2.02546	0.21960	-9.22	0.000	-2.45586	-1.59506
Question 6.4 <–						
BMI_ low_novelty	0.24465	0.09807	2.49	0.013	0.05244	0.43687
_cons	-2.19145	0.22627	-9.69	0.000	-2.63495	-1.74798
Question 6.5 <–						
BMI_ low_novelty	0.42220	0.15485	2.73	0.006	0.11870	0.72569
_cons	-3.21144	0.39097	-8.21	0.000	-3.97772	-2.44516
Question 7.1 <–						
BMI_ low_novelty	0.29573	0.09348	3.16	0.002	0.11251	0.47895
_cons	-0.41293	0.14288	-2.89	0.004	-0.69296	-0.13289
Question 7.2 <–						
BMI_ low_novelty	0.22217	0.08491	2.62	0.009	0.05575	0.38860
_cons	-1.45968	0.17034	-8.57	0.000	-1.79354	-1.12581
Question 7.3 <–						
BMI_ low_novelty	0.45560	0.15102	3.02	0.003	0.15961	0.75160
_cons	-2.86560	0.34684	-8.26	0.000	-3.54540	-2.18581
var(BMI_low_novelty)	9.39003	4.46716			3.69591	23.85683

Fit statistic		**Value**	**Description**
Information criteria			
	AIC	2804.781	Akaike's information criterion
	BIC	2884.981	Bayesian information criterion

BMI_high_novelty:

Method:	Generalized structural equation model
Family/Link:	Bernulli / Logit

Measurement	**Coef.**	**Std. Err.**	**z**	**p > |z|**	**[95% Conf. Interval]**	
Question 5.1 <–						
BMI_high_novelty	1	(constrained)				
_cons	-4.31837	0.78740	-5.48	0.000	-5.86164	-2.77510
Question 5.2 <–						
BMI_ high_novelty	0.62785	0.20391	3.08	0.002	0.22820	1.02750
_cons	-3.41672	0.48752	-7.01	0.000	-4.37222	-2.46120
Question 5.3 <–						
BMI_ high_novelty	0.91199	0.29628	3.08	0.002	0.33130	1.49270
_cons	-3.87019	0.66265	-5.84	0.000	-5.16895	-2.57143
Question 6.1 <–						
BMI_ high_novelty	0.84737	0.30142	2.81	0.005	0.25660	1.43815
_cons	-1.94293	0.36319	-5.35	0.000	-2.65478	-1.23109
Question 6.2 <–						
BMI_ high_novelty	1.13279	0.41766	2.71	0.007	0.31418	1.95139
_cons	-3.30841	0.68515	-4.83	0.000	-4.65128	-1.96553
Question 6.3 <–						
BMI_ high_novelty	0.64272	0.22541	2.85	0.004	0.20092	1.08453
_cons	-3.95444	0.59052	-6.70	0.000	-5.11183	-2.79705
Question 6.4 <–						
BMI_ high_novelty	0.98216	0.37618	2.61	0.009	0.24487	1.71946
_cons	-5.63184	1.15192	-4.89	0.000	-7.88957	-3.37411
Question 6.5 <–						
BMI_ high_novelty	0.35051	0.16054	2.18	0.029	0.03586	0.66515
_cons	-3.39700	0.40187	-8.45	0.000	-4.18465	-2.60935
Question 7.1 <–						
BMI_ high_novelty	0.49994	0.16500	3.03	0.002	0.17654	0.82334
_cons	-2.06001	0.26290	-7.84	0.000	-2.57533	-1.54478
Question 7.2 <–						
BMI_ high_novelty	0.58630	0.20008	2.93	0.003	0.19414	0.97845
_cons	-2.89649	0.38103	-7.60	0.000	-3.64328	-2.14969
Question 7.3 <–						
BMI_ high_novelty	0.53320	0.19555	2.73	0.006	0.14994	0.91647
_cons	-3.43497	0.44992	-7.63	0.000	-4.31679	-2.55314
var(BMI_high_novelty)	7.05050	3.58801			2.60041	19.11600

Fit statistic		**Value**	**Description**
Information criteria			
	AIC	1723.547	Akaike's information criterion
	BIC	1803.747	Bayesian information criterion

[6] In order to check for non-independence of observations because of cross level influences of industry characteristics, Variance Partition Coefficients were calculated for the dependent variables. These represent the proportions of the total variability in variables that can be attributable to the industry level. For BMI_high_novelty the result shows a proportion of 0.48% attributed to the industry level, and for BMI_low_novelty the result shows a proportion below 0.01% attributed to the industry level. Both these results are then well below the 5.00% level often recommended as a trigger for multi-level analysis (Mehmetoglu and Jakobsen, 2016). We have therefore chosen a single level analysis, with industry controls, for this study.

APPENDIX

A: Survey Questions

1. Sources of information and co-operation for innovation.

How important were each of the following information sources for your firm's innovation activities during the last three years? *(1 = Not used, 4 = Highly used)*

1.1. Other firms within your group

1.2. Suppliers of equipment, materials, services, or software

1.3. Clients or customers

1.4. Competitors or other firms in your industry

1.5. Consultants, commercial laboratories, or private R&D institutes

1.6. Universities or other higher education institutions

1.7. Government or public research institutes

1.8. Conferences, trade fairs, and exhibitions

1.9. Scientific journals and trade/technical publications

1.10. Professional and industry associations

1.11. Technical, industry, or service standards

2. Did your firm co-operate on any of your innovation activities with other firms or institutes during the last three-year period? ***(Yes/No)***

3. Which types of co-operation partners did you use and where were they located?

3.1. Other firms within your firm group

3.1.1. Within Norway

3.1.2. Outside Norway

3.2. Suppliers of equipment, materials, services, or software

3.2.1. Within Norway

3.2.2. Outside Norway

3.3. Clients or customers

3.3.1. Within Norway

3.3.2. Outside Norway

3.4. Competitors or other firms in your industry

3.4.1. Within Norway

3.4.2. Outside Norway

3.5. Consultants, commercial laboratories, or private R&D institutes

3.5.1. Within Norway

3.5.2. Outside Norway

3.6. Universities or other higher education institutions

3.6.1. Within Norway

3.6.2. Outside Norway

3.7. Government or public research institutes

3.7.1. Within Norway

3.7.2. Outside Norway

4. Strategic orientation.

How important are the following for your firm in the competition against your closest competitors? *(1 = Not important, 7 = Very important).*

4.1. Excellent customer service

4.2. Wide product/service range

4.3. Low prices

4.4. Customization/tailoring for customers

4.5. Patents/trademarks

4.6. Launch of new products/services

4.7. Innovation/R&D

4.8. Creation of high switching costs for customers

4.9. Reduction of costs (marketing and sales costs, transaction-processing costs)

5. BM dimension: change in target customer/new market.

Which of the following changes to its target market(s) has your firm undertaken in the last three years? During the last three years, did your firm… *(Yes/No; and if Yes, was it "new to firm, known to industry" or "new to firm, new to industry").*

5.1. …target a new customer segment?

5.2. …enter a new market it had not previously targeted?

5.3. …target customers that competitors ignored?

6. BM dimension: change in value proposition and value capture.

Which of the following changes to its value proposition and value capture has your firm undertaken in the last three years? During the last three years, did your firm…

(Yes/No; and if Yes, was it "new to firm, known to industry" or "new to firm, new to industry").

6.1. ...introduce a significant new bundle of products and services to its existing customers?

6.2. ...introduce a significant new bundle of products and services to new customers?

6.3. ...introduce any significant changes in its pricing scheme?

6.4. ...change its main source of revenue?

6.5. …implement any new or significant changes to its use of trademarks, patents, or copyrights?

7. BM dimension: change in value chain.

Which of the following changes to its value chain has your firm undertaken in the last three years? During the last three years, did your firm …

(Yes/No; and if Yes, was it "new to firm, known to industry" or "new to firm, new to industry").

7.1. ...collaborate in a novel way with parties in its supply chain, such as suppliers and customers?

7.2. ...collaborate in a novel way with parties outside its supply chain?

7.3. ...significantly change the traditional roles and power relationships in its industry?