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# Origins and emergence of exploration and exploitation capabilities in new technology-based firms

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## ABSTRACT

The essence of new technology-based firms (NTBFs) is to generate new technologies and employ them in practice, contributing to a business sector in which many approaches to innovation have been exhausted. NTBFs are typically established around a founding team that possesses few resources but specific knowledge and a promising idea; NTBFs lack most of the advantages of incumbent organizations. To have a chance to succeed, these firms need to develop their organizational capabilities, particularly those for exploration and exploitation. Capabilities are fundamental building blocks of firms and key to organizational functioning. However, we have little understanding of how capabilities emerge within new organizations, including NTBFs. Therefore, we examine the origins of exploration and exploitation capabilities in NTBFs. A model of capability emergence is sourced from the literature, highlighting the role of routines for deliberate learning. A set of hypotheses concerning the antecedents and effects of routines for deliberate learning is tested, using a sample of 84 NTBFs and partial least squares structural equation modeling (PLS-SEM). This analysis offers empirical support for our model and hypotheses. Hence, the paper provides knowledge on the origins of NTBFs' exploration and exploitation capabilities and, in particular, the role of routines for deliberate learning in this regard.

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## 1. Introduction

New technology-based firms (NTBFs) are often highlighted as an important source of innovation and economic growth. One reason for this is that the essence of NTBFs is the generation, development and introduction of new technologies, ideas and innovations to the business sector in particular and society more broadly. A key advantage of NTBFs, as seen from a macro perspective and a societal standpoint, is that such companies ensure that a wider variety of approaches to innovation is employed, complementing the innovation searches and efforts of NTBFs' larger, established counterparts in the business sector (Cohen and Malerba, 2001; Cohen and Klepper, 1992).

NTBFs are typically established around a founding team that possesses few resources but specific knowledge and a promising idea; NTBFs lack the established organizational capabilities that support the innovation search efforts of incumbent organizations. To have a chance to succeed, NTBFs need to develop their organizational capabilities, particularly those for exploration and exploitation. Capabilities are fundamental building blocks of firms and key to organizational functioning, as they comprise the repertoires that the

organization's members have and allow the organization's resources to be employed productively (Helfat and Lieberman, 2002; Nelson and Winter, 1982).

Within the context of exploratory and exploitative innovation, Jansen et al. (2006) [1661] note the following: "Research on exploration and exploitation is burgeoning, yet our understanding of the antecedents and consequences of both activities remains rather unclear." Recently, scholars have demonstrated renewed interest in the topic, including in the context of new firms (Stettner et al., 2014; Bryant, 2014; Frigotto et al., 2014). The present paper helps to clarify the antecedents and consequences of exploration and exploitation within the context of NTBFs along three avenues. First, we study the origins of capabilities for exploration and exploitation. Second, we examine their temporal relationship, as a set of pre-organizational behaviors and as an organizational proclivity for subsequent exploration and exploitation. Third, we examine the mechanisms that convert their antecedents into actual capabilities.

Most theorizing on capabilities focuses on the nature of these capabilities (e.g., Lavie et al., 2010; Gupta et al., 2006) and their influence on firm performance (e.g., Baum et al., 2014; Lin et al., 2013; Sirén et al., 2012; Nielsen and Gudergan, 2012; Yamakawa et al., 2011; Tu, 2010; Hoang and Rothaermel, 2010; Uotila et al., 2009; Yalcinkaya et al., 2007) within the context of large, established organizations. However, specific theorizing on capability emergence is

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largely lacking, which contributes to the difficulty in predicting firm performance and development, particularly for new organizations such as NTBFs. Thus, we have a limited understanding of how capabilities originate and emerge in new organizations, including NTBFs. More than a decade has passed since Helfat and Peteraf (2003) concluded in their discussion of capability emergence and heterogeneity that “we lack a clear conceptual model that includes an explanation of how this heterogeneity arises” (:997). We remain in the dark in this regard.

The purpose of this paper is to help theorize and build empirical research on how capabilities emerge in NTBFs. This is achieved by examining in greater detail the origins and emergence of the organizational capabilities of exploitation and exploration in NTBFs. We examine this issue by sourcing a model of capability emergence from a relatively scattered literature on this topic. In particular, the sourced model highlights how founder-managers of NTBFs—a type of firm for which knowledge is the primary resource—share and combine their pre-organizational and newfound knowledge through routines for deliberate learning and how these recurring actions affect their firm’s proclivity for exploration and exploitation. To empirically test the sourced model, we ask the following research question: *What is the role of routines for deliberate learning in NTBFs’ exploration and exploitation capabilities?* A set of hypotheses concerning the antecedents and effects of routines for deliberate learning in the emergence of NTBFs’ capabilities for exploitation and exploration is derived from the model and subsequently tested, using a sample of 84 NTBFs from Norway and partial least squares structural equation modeling (PLS-SEM).

Our research contributes to the search literature in the following ways: *First*, we craft a theory-derived model of how exploitation and exploration capabilities emerge in NTBFs during the early stages of their life-cycle and highlight the role of routines for deliberate learning in this regard. However, while our model highlights these routines, we also theorize about their antecedents in the context of NTBFs. Thus, we make the argument that routines for deliberate learning do not emerge as “manna from heaven” but result from the founder-managers’ prior knowledge and their behavior, two vitally important assets and resources to which otherwise resource-scarce NTBFs have access. Accordingly, our paper helps to develop a more complete and elaborate account of the emergence of NTBFs’ exploration and exploitation capabilities. Additionally, we derive hypotheses from the model and test them in the NTBF context.

*Second*, and related, we address an important *loci of analysis* issue regarding the origins of exploration and exploitation capabilities, particularly in NTBFs. Our theorizing, model, and empirical results show that organizational exploration and exploitation capabilities can emerge through interactions among individuals within the firm through routines for deliberate learning. While the role of inter-firm knowledge transfer routines is explored by, e.g., Dinger and Enkel (2016), we show that similar types of routines are equally important for intra-firm knowledge search. We also show that routines do not necessarily reduce flexibility. In the context of NTBFs, routines can translate into both a proclivity for associated with both efficiency (exploitation) and flexibility (exploration) (Eisenhardt et al., 2010).

*Finally*, our paper contributes to the literature on firms’ innovation search activities. This literature often assumes the existence of a large, mature organization with both completed and ongoing organizational search processes (Santos, 2003). Less is known about how search capabilities initially emerge during firms’ youth. We address this issue by elucidating how NTBFs, the very essence of which is innovation search, acquire their initial capacity to explore and exploit, including (some of) the processes and mechanisms involved.

## 2. Theory and hypothesis development

Exploration and exploitation play key and distinct roles in firms’ development. The following explanation is offered by March (1991):

“Exploration includes things captured by terms such as search, variation, risk taking, experimentation, play, flexibility, discovery, innovation. Exploitation includes such things as refinement, choice, production, efficiency, selection, implementation, execution” (:71). Whereas exploitation concerns searching for efficiency (Eisenhardt et al., 2010) or for deep knowledge in areas related to what one already knows (Katila and Ahuja, 2002), exploration describes a broad search, or searching for knowledge in areas that are new to the firm (March, 1991). Capitalizing on exploitation leads to modest, fairly reliable, short-term market rents, whereas capitalizing on exploration is fraught with uncertainty and the potential for greater rewards if successful (March, 1991; Andries et al., 2013; Schulz, 2001). For mature firms, this translates into efficiency gains (exploitation) and avoiding competency traps and organizational inertia (exploration) (Lavie et al., 2010; Greve, 2007; Levinthal and March, 1993), often through innovation (Aloini and Martini, 2012).

While most studies on exploration and exploitation focus on large and mature firms (e.g., Baum et al., 2014; Lin et al., 2013; Nielsen and Gudergan, 2012; Yamakawa et al., 2011; Tu, 2010; Hoang and Rothaermel, 2010; Uotila et al., 2009; Yalcinkaya et al., 2007), they are just as relevant for new firms (Sirén et al., 2012). For example, exploitation is essential for new firms, as it leads to efficiency, standardization and reliability (Eisenhardt et al., 2010) — key survival-enhancing attributes of organizations that are attempting to develop and commercialize new technologies (Aldrich and Yang, 2012). In contrast, exploration translates into flexibility—a key attribute for NTBFs since technology development can necessitate search in uncharted territories, thereby allowing for unexpected and promising opportunities (Eisenhardt et al., 2010). Thus, whereas exploitation reduces the liability of newness, exploration enhances and makes up opportunity recognition (Politis, 2005). We consider firms’ capacity to explore and exploit as two related—yet distinct—capabilities. Organizational capabilities and their definition represent a hotly discussed topic. In this paper, we take them to mean “the repertoires of organization members ‘that are ‘associated with the possession of particular collections’ of resources including the ability to utilize those resources productively” (Helfat and Lieberman, 2002, :725, referring to Nelson and Winter (1982)). Therefore, the capability of exploitation would be the firm’s ability to exploit its resources to increase efficiency (Eisenhardt et al., 2010), and in the case of knowledge, further deepen it (Katila and Ahuja, 2002). The firm’s exploration capability would be its ability to search broadly (Katila and Ahuja, 2002) to remain flexible (Eisenhardt et al., 2010). Since the context of this study is NTBFs, the primary resource they would exploit and explore is knowledge that is either directly relevant for innovation search or for supporting the organizational ability to conduct search, although we recognize that other resources will also come into play, especially as the firm develops. The above definition of capabilities highlights the central role of individuals in the new firm setting. Ultimately, it is the organizations’ members who effectuate the firm’s capability to exploit and explore. The founder-managers are in this case those most likely to have both an understanding of the day-to-day operations of the firm and the organization as a whole, making them particularly useful informants.

Moreover, we consider routines as both constituents of and inputs to capabilities (Helfat and Peteraf, 2003; Zollo and Winter, 2002). Whereas routines represent ways to perform actions associated with task execution or coordination (Helfat and Peteraf, 2003), a capability indicates the ability to successfully combine and direct several activities, together with resources, toward a specific goal (Helfat and Peteraf, 2003; Zollo and Winter, 2002). From this perspective, a routine is something that resides within the organization and is not considered a constituent of individuals. Therefore, in NTBFs, these routines must somehow be created by their founders.

While entirely new capabilities may be born and created in mature firms, their progenitors are often already established

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