The Role of Innovation Portfolio Management in the Nexus between Deliberate and Emergent Innovation Strategies

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ABSTRACT

Planning and implementing innovation strategies are typically considered to be top-down processes and innovation portfolio management plays a decisive role in this context by aligning the project portfolio to the firm's strategy. However, in strategic management research it is well accepted that strategies are not solely deliberate but can also be emergent. Thus, between top-down innovation strategy formulation and its implementation, responding dialectic elements are required to sense emerging strategic impetuses and cope with changing environmental conditions. This paper addresses the role of portfolio management in the nexus between strategy formulation and implementation. Using a sample of 182 medium and large firms with two informants, we show that portfolio management not only fosters the implementation of intended innovation strategies through vertical integration but also discloses strategic opportunities by unveiling emerging patterns. The findings show that portfolio management contributes to innovation portfolio success by supporting both the implementation of deliberate and emergent strategies through vertical integration and strategic disclosure. The effects are complementary in that both activities increase the positive effects of the other. Furthermore we find that strategic control (i.e. premise control, implementation control, and strategic surveillance) on a portfolio level indirectly contributes to success mediated by vertical integration and strategic disclosure. Finally, we show that the influence of vertical integration on innovation portfolio success is reduced under high environmental turbulence.

INTRODUCTION

A traditional perception of the relationship between innovation strategy and projects is that strategy is formulated at a high level within the organization, and is cascaded down through the levels of the organization to be implemented in projects (de Brentani, Kleinschmidt and Salomo, 2010; Salomo, Talke and Strecker, 2008; Talke, Salomo and Kock, 2011). Similar perceptions extend to strategic control, which is also often viewed as a top-down capability focusing on implementation and oversight. These perceptions influence innovation management as innovation strategy is largely implemented through a portfolio of projects (Cooper, Edgett and Kleinschmidt, 2001; Jonas, Kock and Gemünden, 2013; Kester et al., 2011). However, such traditional perceptions are being challenged. Through a focus on the long-term and emphasis on the top-down translation of strategies into actions, strategic processes can seem rigid and unresponsive to changes in the environment. Change is an increasingly disruptive factor affecting organizational competitiveness, and emergent or 'bottom-up' strategy processes play an important role in ensuring that the strategy remains relevant in a changing environment. These emergent strategies are increasingly recognized as part of a two-way relationship between strategy and actions. To better understand this relationship and the factors influencing innovation portfolio success, we examine the role of strategic control capabilities in both top-down and bottom-up strategy formation processes, and explore how strategic control capabilities contribute to innovation portfolio performance.

While the formulation of strategies attracted considerable attention by scholars (e.g. Ansoff, Porter) and managers, the implementation of strategies has received less attention (Hrebiniak, 2006). Ultimately, however, the success of any strategy stands and falls with its implementation (Noble, 1999). Strategy implementation is a matter of increasing interest in the research discipline of innovation and project portfolio management (hereafter referred to as portfolio management). Projects, programs and project portfolios are often considered to be the primary vehicles for strategy implementation (Morris and Jamieson, 2005). In particular, portfolio management has been described as the bridge between strategy formulation and its implementation (Meskendahl, 2010). However, as in the field of strategic management (Mintzberg, 1990), perspectives on portfolio management tend to dissociate strategy formulation from implementation. Portfolio management traditionally focuses primarily on the implementation, whereas the senior management's perspective concerns the strategy formulation in the first place as a deliberate and autonomous activity (Hrebiniak, 2006).

The strict distinction between strategy formulation and implementation in the dominant 'design school' does not reflect reality (Mintzberg, 1990). Mintzberg argues that strategy formulation requires the simplification of reality and definition of assumptions, which inherits the risk of selectivity. Earlier, Mintzberg and Waters (1985) assert that in reality intended strategies are never implemented as envisaged. Aspects of the intended strategy remain unrealized while new elements emerge that become part of realized strategy. The main critique of the 'design school' of strategy is that it fails to consider the effects of emerging elements and changing conditions. Instead of trying to formulate strategies in detail *a priori*, it is argued that managers also need to focus on the emerging elements and unfolding patterns and *'strategy formation walks on two feet, one deliberate, one emergent'* (Mintzberg and Waters, 1985, p. 271)

In this study we explore the nexus between deliberate and emergent innovation strategies. Specifically, we explore the role of the portfolio management and the application of strategic control on portfolio management level.

The article is guided by the following research questions:

1. *What role does the portfolio management play in the nexus between deliberate and emergent innovation strategy?*

2. *How does strategic control affect the implementation of intended and emergent innovation strategies?*

We address these research questions with a conceptual framework that relates strategic control to both top-down operationalization of deliberate innovation strategy (vertical integration) and bottom-up disclosure of opportunities and emerging patterns (strategic disclosure) and subsequently innovation portfolio success. The framework is empirically tested on a cross-industry survey of 182 medium-sized and large firms using two informants for each portfolio. This study contributes to literature on strategic innovation management and innovation portfolio management in several ways. First, we show that portfolio management not only fosters the implementation of intended innovation strategies through vertical integration but also discloses strategic opportunities by unveiling emerging patterns. Second, we observe a complementary effect between both functions in line with Mintzberg and Waters (1985) assumption that strategies have both deliberate and emerging elements. Third, we find that strategic control contributes to both types of function, which jointly mediate the influence of strategic control on innovation portfolio success.

The remainder of this article is structured in five sections. In the next section the theoretical concepts of strategy formation, strategic control and strategy implementation through portfolio management are reviewed. Section three provides an overview of the conceptual model and the hypotheses. In section four our methodology, the quantitative study sample and measurement are described followed by the empirical results. In the last section we discuss the results and their implications for future research and management.

THEORETICAL BACKGROUND

Strategy formation and emerging strategies

The strategy determines the firm's objectives, purposes and goals and define the plans to achieve them (Evered, 1983) and deals with the question how to achieve and sustain a competitive advantage (Teece, Pisano and Shuen, 1997). The formation of a strategy refers to the question of how companies make and interrelate strategic decisions (Mintzberg, 1978). In this paper we follow Chandler's definition of strategy as '*the determination of the basic long-term goals and objectives of an enterprise, and the adoption of courses of action and the allocation of resources necessary for carrying out these goals.'* (Chandler, 1990, p.13).

Strategy formation is often divided into two parts: strategy formulation refers to goal-setting and planning of strategies and strategy implementation concerns the realization of the strategy. Based on a literature review Noble (1999) states that although its importance is frequently highlighted strategy implementation is treated by scholars and managers as afterthought to strategy formulation. However, Mintzberg (1978; 1990) criticizes the dichotomy of strategy formulation and implementation and he argues that this dichotomy is based on the assumptions the *'formulator is fully informed'* and the *'environment is sufficiently stable'* (Mintzberg, 1978, p. 964). If only one condition is not met, strategy formation becomes a learning process that requires an adaptive rather than a planning approach. In the same vein, Johnson et al. (Johnson, Scholes and Whittington, 2008) argue that in practice, due to unanticipated opportunities or threats, the strategies that are actually pursued are typically a mixture of both intended and adapted strategy.

Mintzberg and Waters (1985) explored the discrepancy between the strategic plans and intentions of the leadership and what the organization actually did. For that purpose they

distinguished between deliberate strategies, which are realized as intended and emergent strategies, which appear despite or in the absence of intensions (see figure 1).

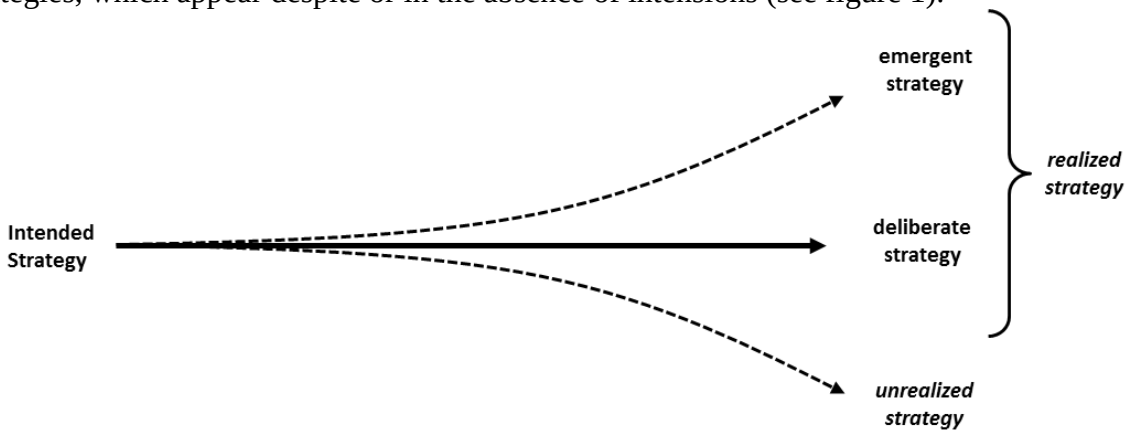

Figure 1. The continuum between intended and realized strategy (based on (Mintzberg and Waters, 1985)

For a perfectly deliberate strategy three conditions have to be met: 1) strategic intentions must be precise and fully articulated 2) the commitment to implement the strategy must be shared by all actors of an organization 3) the strategy must not be affected by external forces (either the environment must be absolutely predictable or under control). Therefore a perfectly deliberate strategy is unlikely to be found in reality. On the other side, a purely emergent strategy requires the absence of any intention which is also highly unlikely. (Mintzberg and Waters, 1985) discussed various types of strategies along the continuum between the two extremes (deliberate and emergent) and argued that 'real-world' strategies must deal with environmental boundaries and are both emergent and deliberate. They presented different types of strategies along this continuum. One example is the umbrella strategy that is characterized by directions and guidelines for behavior defined by the leadership. Within these boundaries the strategy is allowed and encouraged to be emergent.

Thus, (Mintzberg and Waters, 1985) propose that the most realistic strategy is a mixture of deliberate and emerging elements which interact and co-exist. They conclude that strategy formation '*walks on two feet, one deliberate, the other emergent'.* That implies that the management needs to simultaneously set direction to realize intended strategies and be responsive to '*unfolding pattern of action'* (in the following referred to as *emergent elements* or *emergent strategic elements*). In order to explore the responding side of this directing/responding dialectic they refer to the concept of strategic control.

Strategic control

In the context of strategic control, Simons (2013) distinguishes between two different control systems: diagnostic control and interactive controls. While diagnostic controls can be applied to motivate, monitor, and reward the achievement of strategic goals, interactive control systems facilitate organizational learning and the emergent elements such as new ideas or new strategic directions. Consequently, in order to control *'emerging patterns of actions',* Simons recommends using interactive controls that focus on addressing uncertainties that could affect the basis of competitive advantage.

Schreyögg and Steinmann's (1987) conceptualization of interactive strategic control consists of the control of a strategy implementation, the concurrent validation of the strategy's premises (underlying assumptions) and the surveillance of environmental issues that may affect the strategy (Band and Scanlan, 1995; Preble, 1992; Schreyögg and Steinmann, 1987; van Veen-Dirks and Wijn, 2002).. Previous approaches understand strategy

formulation, implementation, and evaluation as distinct and consecutive activities. This perspective is different because strategic control is proposed to be a concurrent control function and a countervailing force to strategic planning that may impact strategy formulation and implementation at all stages.

(Schreyögg and Steinmann, 1987) dissociate the concept of strategic control from previous approaches to control by emphasizing a 'feed-forward' concept where the shortcomings of strategic planning that takes place under the condition of uncertainty – especially the selectivity of planning - can be rectified through concurrent and simultaneous control functions. While feedback controls follow a post-action approach, the feed-forward model enables strategic management to anticipate deviations, threats and opportunities in a timely fashion. In essence, feed-forward means monitoring input variables from the internal and external environment and anticipating their effect on the intended strategy (Preble, 1992). By taking explicit account of the ambiguity resulting from uncertainty and complexity this conceptualization of strategic control strongly differs from the alternative approaches to strategic control (Band and Scanlan, 1995).

Strategic control according to (Schreyögg and Steinmann, 1987) comprises three steps: *Premise control* refers to the continuous verification of planning assumptions (premises) during strategy formulation and implementation. *Implementation control* scrutinizes the currently implemented and pursued strategic direction in contrast to the operational control that monitors whether strategy implementation is proceeding according to plan. *Strategic surveillance* takes a less focused approach to scan both the internal and external environment of the organization in order to identify '*unforeseeable or previously undetected critical events'* (Schreyögg and Steinmann, 1987, p. 97).

Muralidharan (1997) argued that strategic control approach developed by Schreyögg and Steinmann differs not only from diagnostic controls, which are based on feedback mechanisms, but also from traditional interactive controls. While those traditional controls focus on strategy implementation, their concept refers to strategy content and aims at reviewing and reformulating the strategy (van Veen-Dirks and Wijn, 2002). By doing so, this concept not only compensates for the selectivity of planning as stated by Schreyögg and Steinman, but is also a purposeful tool for the management of emergent strategies.

By monitoring the internal and external environment for changes, strategic control enables strategic management to identify antecedents of emergent and anticipate 'unfolding patterns of action'. Furthermore, the implementation control aspect of strategic control scrutinizes the current strategic direction and the already realized strategy, enabling the organization to recognize patterns of emergent strategies. Both the anticipation of arising patterns and the recognition of realized emergent patterns is a crucial ability of an effective organization (Mintzberg and Waters, 1985). We connect the concept of strategic control with the discussion on deliberate and emergent strategies and argue in the following that strategic control will enable a firm to better implement deliberate *and* emergent innovation strategies.

Strategy implementation and innovation portfolio success

The phenomenon of emergent strategies refers to elements of a realized strategy which have been implemented without being intentionally formulated. Hence, in order to learn about the emergence of innovation strategies, the strategy implementation has to be examined. This is where portfolio management – a function that provides a bridge between innovation strategy formulation and its implementation - comes into play.

The relevance of innovation portfolio management in this context is twofold: first, project portfolio success implies the successful implementation of strategies (Cooper et al., 2001). Hence, the way project portfolio success is defined determines how strategies are appreciated and if emergent strategies are neglected or included in the understanding of project portfolio

management. Second, looking at the project portfolio management process provides a higher level of details on how strategies are actually implemented. Consequently, potential sources and origins of emergent strategies may be revealed.

Regardless of the way strategies are formulated and planned, their success stands and falls with the implementation (Noble, 1999). Frequently, studies show that the majority of articulated strategies are never realized (Johnson, 2004; Mankins and Steele, 2005). However, implementation success is a crucial condition/requirement for a successful strategy.

Projects are a common vehicle for implementing strategies (Morris and Jamieson, 2005). Especially, innovation strategies are typically implemented through a portfolio of research and development or new product development projects (Cooper et al., 2001; Killen, Hunt and Kleinschmidt, 2008). Therefore, the corporation's portfolio of such projects represents the actual pursued innovation strategy. Hence, portfolio management is strongly wedded to corporate strategy and strategic management. This also becomes evident in definition of innovation portfolio success. Cooper et al. (1999) stated that portfolio management is about making strategic choices and defined its success by the economic value, the strategic fit and the portfolio balance. In more recent research the success definition has been developed further, but the strong strategic notion is consistent across these studies (Heising, 2012; Jonas et al., 2013; Voss and Kock, 2013).

Building on this research, this study defines innovation portfolio success through the five measures of strategic implementation success, future preparedness, portfolio balance, usage of synergies and average product success. *Strategic implementation success* is defined by the strategic fit of the project portfolio (Meskendahl, 2010). *Future preparedness* reflects the long-term perspective on portfolio success and describes the organizations preparedness for the future in terms of technological assets and competences (Shenhar et al., 2001). It evaluates the long-term benefits offered by an innovation portfolio (i.e. creation of new markets and development of new technologies and capabilities) (Voss and Kock, 2013) and by that is a measure for the quality of the innovation strategy. *Portfolio balance* concerns the equilibrium of risks, long- and short-term opportunities and the steady utilization of resources within the innovation portfolio's execution (Killen et al., 2008; Teller et al., 2012). The *average product success* is measured by the commercial success of project outcomes, which determine in their entirety the quality and success the strategy implementation. *Synergy exploitation* represents the added value that emerges from dedicated portfolio management in addition to the single projects' contribution through the capitalization of interdependencies and the avoidance of redundancies (Jonas, 2010; Meskendahl, 2010).

Innovation portfolio success as defined above comprises three aspects of the strategy formation: the alignment with the intended strategy (strategic implementation success), the coherent realization of single strategic innovation initiatives (average product success and synergy exploitation) and the quality of the currently pursued strategy (portfolio balance and future preparedness). While the first aspect refers only to deliberate strategies, the latter two do not differentiate between deliberate or emergent strategy. Hence, to its major extent innovation portfolio success is a success measure equally for deliberate and emergent strategy.

CONCEPTUAL FRAMEWORK AND HYPOTHESES

Building on the theoretical concepts introduced above, this section develops a framework of hypotheses relating strategic control, portfolio management, and innovation portfolio success in the nexus of deliberate and emerging innovation strategies. The basic assumption is that strategic control at the portfolio level contributes to innovation portfolio success indirectly through strategy implementation, which is conceptualized by the portfolio management mechanisms *vertical integration* and *strategic disclosure*.

Vertical integration refers to the top-down implementation of the intended strategy resulting in the deliberate part of the strategy and *strategic disclosure* refers to the role of project portfolio management with regards to bottom-up emerging elements. Both are argued to be positively related to *innovation portfolio success*; following Mintzberg and Waters' (1985) observation that strategy formation walks on two feet, it is assumed that they complement each other in their performance effect. Furthermore, we take the context in terms of external turbulence into account and hypothesize a moderating effect of strategy implementation on innovation portfolio success. Figure 2 summarizes our research framework and we argue the hypothesized relationships in more detail in the following sections.

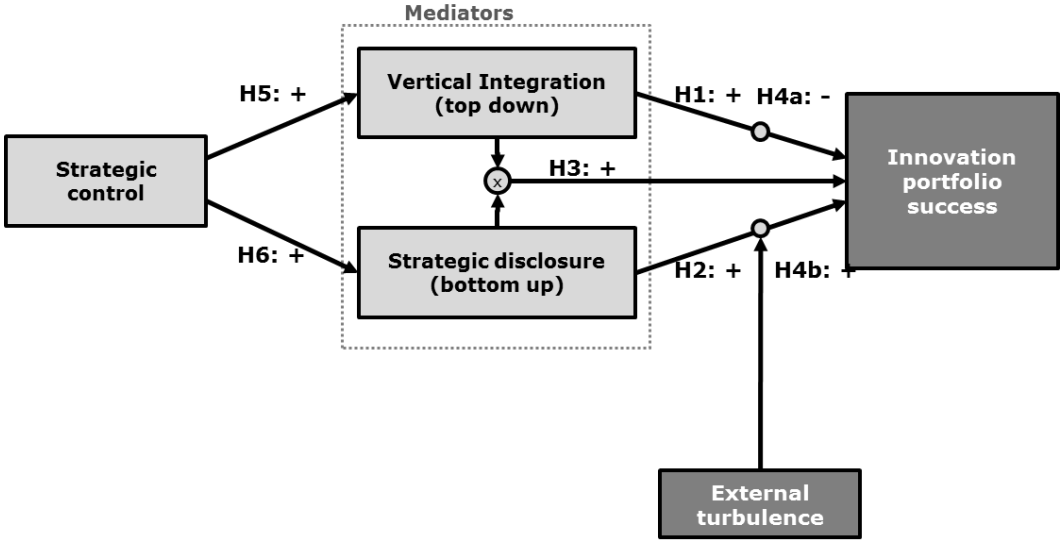

Figure 2. Research framework.

Innovation portfolio success and vertical integration

Projects and programs are vehicles for implementing strategies (Morris and Jamieson, 2005; Shenhar et al., 2001; Srivannaboon and Milosevic, 2006). In organizations where projects and programs form the building blocks for strategy implementation, the project portfolio in its entirety represents organization's strategy (Benko and McFarlan, 2003; Morgan, Levitt and Malek, 2008) and determines it's future situation (Cooper et al., 1999).

Project portfolio management processes traditionally focus on three phases: portfolio structuring (Archer and Ghasemzadeh, 2004), resource allocation (Engwall and Jerbrant, 2003; Killen et al., 2008) and portfolio steering (Blichfeldt and Eskerod, 2008; Blomquist and Müller, 2006). Through these processes, innovation portfolio management plays a decisive role when it comes to the implementation of innovation strategies in terms of translating the business strategy to operations and managing its execution.

In search of best practices for new product development, Cooper et al. (1999) report that high performing project portfolios are characterized by strong alignment with the business strategy and conclude that project selection should be closely linked to the business strategy. Similarly, Englund and Graham (1999) highlight the importance of linking projects to organizational goals for successful strategy implementation and cite a lack of strategic emphasis as a reason for project failure. Dietrich and Lehtonen (2005) state that firms that successfully implement their strategies integrate project portfolio management in their strategy formation process.

Research on project portfolio management from a strategic perspective repeatedly emphasizes the importance of the project portfolio structuring (Archer and Ghasemzadeh,

2004; Blichfeldt and Eskerod, 2008; Dietrich and Lehtonen, 2005; Englund and Graham, 1999; Müller, Martinsuo and Blomquist, 2008). This research is united by the common idea that project portfolio management bridges the gap between strategy formulation and its implementation (Meskendahl, 2010).

During portfolio structuring, the portfolio strategy is derived from the corporate strategy and projects are prioritized and selected accordingly. Traditionally, the process of breaking down the corporate strategy is cascaded and aims to align the portfolio and project strategies with the corporate strategic objectives (Morris and Jamieson, 2005). The cascade model of strategy implementation through projects follows a traditional top-down approach with a focus on the realization of deliberate strategies, rather than considering the emergent aspect of strategies.

In accordance with this top-down approach we argue that vertical integration, defined as the alignment of the portfolio with the intended innovation strategy by linking portfolio planning to the strategic planning process, will be positively related to innovation portfolio success.

Hypothesis 1: Vertical integration is positively related to innovation portfolio success.

Strategic disclosure and innovation portfolio success

Vertical integration contributes to the realization of strategies as intended. But as Mintzberg and Waters (1985) stated, realized strategies only partially correspond to the strategic intention. While *vertical integration* may foster the deliberate part of the strategy, it does not explain the occurrence of emergent strategies. However, emergence is not only an issue from the strategic management perspective, but also at the project portfolio level. Recent research in the field of project portfolio management has addressed the issue of emergent elements from various perspectives.

In a comprehensive exploratory interview-based study Blichfeldt and Eskerod (2008) point out that companies typically have a plethora of projects which are ’under the radar level’ and are not managed nor considered by project portfolio management. Although the authors identified those projects as a primary barrier to successful resource allocation, they did not conclude that all projects must be managed by portfolio management; instead they highlighted the need for firms to decide whether or not they want to control all projects through a dedicated project portfolio management. However, they recommended that firms which officially allow projects outside of the managed portfolio should consider these projects within their resource allocation.

Beyond the limited coverage of project portfolio management across the project landscape, another study revealed that project portfolio management is not only a structured and rational top-down driven process, but also *‘can be viewed as negotiation and bargaining and as structural reconfiguration’* (Martinsuo, 2013, p. 794). In conclusion, Martinsuo (2013) states that project portfolios are not only deliberate but emergent and affected by unplanned changes. In the same vein (Christiansen and Varnes, 2009) observe that senior project portfolio managers do not necessarily follow defined procedures and rules but that their actions are also driven by observation of others, the organizational context and learning. Moreover, based on two case studies Jerbrant and Gustavsson (2013) emphasize that project portfolio managers are moving away from formal procedures and is improvising in order to increase their ‘action space’.

The presented research shows that project portfolio management in practice is not exclusively a rigid and formal process that is characterized by a top-down approach. Instead projects are emerging and undermining the project portfolio process and the dedicated

portfolio management function is not limited to process standards and strategic plans, but acts on its own initiative in response to its organizational and environmental context.

Considering that emergence exists, the question arises as to how the emergent elements in the project portfolio affect the strategy formation and its success. Previous research has identified two phenomena which represent examples of emergent strategies within multi-project landscape: bootlegging and lineage management.

Bootlegging describes secretly organized innovation projects which ignore management directives. Hence, they are not under control of the portfolio management and do not follow the top-down defined selection process. Augsdorfer (2005) defines bootlegging as an activity which usually emerges from bottom-up and is beneficial for the firm. Augsdorfer's empirical study revealed that bootlegging takes place in R&D departments across multiple industries and primarily involves incremental innovations which are aligned with the corporate strategy and support the company's goals. Hence, he argues that bootlegging not only valuable commercially, but is also valuable in terms of strategic success.

Another perspective on emerging strategies in multi-project environments is offered by Midler (2013) who describes the emergence of a strategy through cross-project learning based on a longitudinal case study. 'Lineage management' is the term used to describe the dialectic process between strategy formulation and implementation through project sequencing observed in the study. Furthermore, Midler and Silberzahn (2008) highlight that lineage management is a key success factor for a firm's success, especially in terms of agility.

Both examples highlight the positive effect emerging elements in project portfolios can have on the firm's strategy. In particular, lineage management shows how strategic implementation can affect strategy formulation and widen the role project portfolio management plays in the nexus between strategy formulation and implementation. As Artto et al. (2004) stated, the two-way connection between projects and the dedicated multi-project management with the strategy not only increases the strategic alignment, but also enhances the bottom-up strategic renewal. In other words *'Projects in the future will no longer be just operational tools for executing strategy—they will become the engines that drive strategy into new directions' p. 703* (Shenhar et al., 2001, p. 703)

Based on the extant research on the impact projects have on the firm's strategy we conclude that,

- strategies are to some extent emergent and to some extent deliberate,
- antecedents of emergent strategies can be found in the project portfolio,
- and project portfolio management can facilitate the positive effect emerging elements.

Thus, project portfolios can be both means for vertical integration of intended strategies and valuable sources of emergent information. Therefore we argue that the dedicated portfolio management function facilitates the dialectic process between deliberate and emergent strategies. We hypothesize that the portfolio management can also provide valuable information regarding the need for strategic change and reveals strategic investment needs and opportunities. We refer to this information function as *strategic disclosure* and propose that it contributes to innovation portfolio success by providing the sensing mechanism to respond to emerging elements or changing conditions in the environment.

> *Hypothesis 2: Strategic disclosure is positively related to innovation portfolio success.*

We have elucidated two aspects regarding the role of portfolio management in the nexus between deliberate and emergent innovation strategies: first, portfolio management integrates the firm's innovation strategy with the project portfolio and by that aligns the currently

pursued strategy with the intended strategy. Second, it provides impetus for the adaptation and renewal of the intended strategy. Both aspects have the potential to increase strategic success. Beyond that, we argue that vertical integration and strategic disclosure complement each other in their positive effect. Complementarity assumes superadditive value of resource combinations, meaning that increases in either aspect amplifies the benefits of the other aspect. Since strategies are always both emerging and deliberate, the corresponding management approach should be both directive and responsive (Mintzberg and Waters, 1985). On the one hand, strategic disclosure contributes to the improvement and clarity of the intended strategy, and its implementation is facilitated by vertical integration. On the other hand, the intended strategy can be taken as a frame of reference that is necessary to disclose strategic threats and opportunities that may impact the strategy formulation. We therefore assume a positive interaction between vertical integration and strategic disclosure.

Hypothesis 3: Vertical integration and strategic disclosure are complementary in their effect on innovation portfolio success, i.e. there is a positive interaction effect.

Figure 3 illustrates the role of project portfolio management in the strategy formation process. It highlights the two roles project portfolio management can play in the strategy formation process in the context of emergent and deliberate strategies. While vertical integration fosters the realization of the intended strategy and may minimize the unrealized strategy, strategic disclosure focuses on emergent strategies. As the latter may influence the strategy formulation in a way that integrates upcoming or already realized emergent elements into the intended strategy, eventually it also increases the share of the deliberate strategy by incorporating formerly emergent elements into the intended strategy.

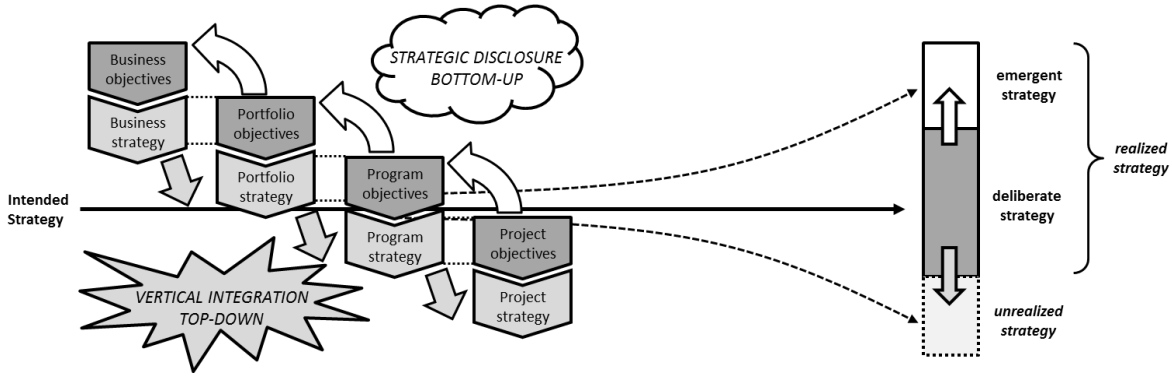

Figure 3. The role of portfolio management in the nexus between deliberate and emergent strategies (adapted from Mintzberg and Waters, 1985; Morris and Jamieson, 2005)

When exploring the two roles of project portfolio management, context, in terms of external turbulence, matters. Previous research identified stable long-term strategies as an antecedent of vertical integration (Cooper and Kleinschmidt, 1995) that provide long-term orientation for the project portfolio. However, long-term strategies require long-term predictions about market-related and technological developments. Hence, the more the firm's market and applied technology are subject to high turbulence, the less accurate long-term predictions are and the more often strategies need to be revised. Therefore, the requirement of long-term strategies is more unlikely to be met in a turbulent environment.

Hypothesis 4a: The relationship between vertical integration and innovation portfolio success is moderated by external turbulence such that the relationship is stronger in environments of low turbulence.

On the other side, strategic disclosure refers to the revealing of unplanned and unforeseen events. Such events are much more likely to occur in a turbulent environment. Furthermore, strategic disclosure provides a sensing capability that can enable organizations to detect and respond to changes in the environment. In this way, strategic disclosure can form an important part of a 'dynamic capability' that contributes to organizational competitive advantage (Teece, 2007; Teece et al., 1997). Similarly, the benefits of adaptability and responsiveness are dependent on the environment; Loch (2000) shows that radically new product development projects benefit from a less structured approach than incremental development projects. Especially in a turbulent environment, creativity and flexibility are required for successful strategies because they are less deliberate and irrevocable but emerging and evolutionary (Mintzberg and Waters, 1985).

Hence, we expect that the relationship between strategic disclosure and project portfolio success is stronger in turbulent environments.

Hypothesis 4b: The relationship between strategic disclosure and innovation portfolio success is moderated by external turbulence such that the relationship is stronger in environments of high turbulence.

Strategic control on portfolio management level

Band and Scanlan claimed that in order to be effective strategic control *'needs to be pitched at a level which is sufficient to capture the full range of threats, opportunities and contingencies which might bear upon an organization's strategic choices'* (Band and Scanlan, 1995, p. 106). We argue that the project portfolio management at the ideal level in the organization to facilitate effective strategic control.

Portfolio management is directly involved in breaking down the intended strategy and closely monitors its realization. Hence, project portfolio management needs to be very familiar with the corporate strategy in order to operationalize it into portfolio, program or project strategies. Furthermore, portfolio management includes capabilities to monitor and analyze the progress of the strategy implementation so that deviations or unexpected events can be detected. Through a comprehensive understanding the corporate strategy and by recognizing deviations and changing conditions in a timely manner, portfolio management is well-suited for the strategic control functions that validate strategic assumptions (premise control) and scrutinize the pursued strategy (implementation control). In addition, the project portfolio includes emergent elements that may arise from internal resources or from external events; portfolio management is much closer to those 'emerging patterns' and its antecedents than the traditional strategic management level.

Therefore, we conclude that strategic control is best located at the portfolio management level. The portfolio level provides a perspective for the validation of strategy premises, challenging the strategy itself and the surveillance in regards to unexpected events that may affect the strategy (Muralidharan, 1997; Schreyögg and Steinmann, 1987).

Based on previous research, we build on an underlying assumption that *strategic control* is positively related to strategy implementation in terms of *innovation portfolio success*, and explore this relationship in more detail (Ittner and Larcker, 1997). We have discussed the role of innovation portfolio management in the nexus between deliberate and emergent strategies and we have hypothesized that both are positively related to *innovation portfolio success*. We have hypothesized positive individual effects and an additional effect that occurs if both roles

are pursued simultaneously (an interaction effect). In the following section, strategic control is discussed as an antecedent to both vertical integration and strategic disclosure, which in turn mediates the effect of *strategic control* on *innovation portfolio success*.

How does *strategic control* facilitate *vertical integration*? Scrutinizing the strategy content and monitoring its underlying assumptions foster the portfolio management's comprehension and hence the clarity of the strategy. A previous study by Kock et al. (2012) reported a positive relationship between clarity of strategy and *vertical integration*. Moreover, Schreyögg and Steinmann (1987) state that implementation control refers to questions about whether or not strategic projects should be continued. Such 'stop-or-go' decisions foster the alignment of the portfolio with the strategy in two ways: by ensuring that ongoing projects remain aligned with corporate strategy and strategic goals and in case of termination by unlocking additional resources that then can be allocated to more strategically aligned projects. The termination quality has been explicitly identified as a key success factor to strategic fit (Unger et al., 2012). In conclusion, we argue that strategic control contributes to vertical integration by fostering the clarity of the strategy and facilitating project termination decisions that re-align the project portfolio with the strategy.

Hypothesis 5: strategic control is positively related to vertical integration.

How does *strategic control* facilitate *strategic disclosure*? Strategic control represents an interactive control that is designed to 'stimulate organizational learning and the emergence of new ideas and strategies' (Simons, 2013, p. 7). This stimulation is brought about primarily through two effects: the identification of changing conditions or unforeseen events through premise control and strategic surveillance and the recognition of emerging strategies or unfolding patterns of action through implementation control. Thereby strategic control processes provide the mechanisms for the disclosure of information that may result in an impetus for strategic change.

Hypothesis 6: strategic control is positively related to strategic disclosure.

METHODOLOGY

Sample

A cross-industry sample of medium to large firms in Germany is used to test the proposed framework. Our object of analysis is the innovation portfolio of a firm or a business unit in case of large firms. For each portfolio we contacted two key informants – a decision maker and a coordinator. Decision maker informants were senior managers with decision authority over the portfolio in deciding on initiation, termination, or reprioritization of projects. Typical positions were CEO, head of business unit or head of R&D. Coordinator informants were middle managers with a good overview of the project landscape who were in charge of actively managing the portfolio. Typical titles for coordinator informants were portfolio manager, department manager, or innovation manager. This two-informant approach allowed the integration of information from different perspectives and hierarchies within each firm and addressed problems associated with common method variance. For hypotheses testing, we use the decision maker assessment of innovation portfolio success and environmental turbulence, and the coordinator assessment for the remaining variables.

We contacted firms explaining the study in general and we sent a call for registration to potential coordinator informants or their superiors. We followed up by phone to encourage registration and participation in the study. All registered informants received a personal letter

explaining the multi-informant design and the questionnaires with an introduction describing the terms and definitions. To increase the response rate, we used phone calls and reminder e-mails. We received 189 decision maker questionnaires and 195 coordinator questionnaires from 200 firms, resulting in 184 matched dyads with data from both types of informants. Two observations were removed from analysis due to missing data. After the study each firm received an individual report on findings from their organization, and the overall study results were presented, discussed, and validated during a conference with about 90 participants. The 182 firms representing the final sample represent diverse industries (26% automotive, 18 % electronics/IT, 16% finance, 11 % construction and utility, 8 % health care, 7 % logistics, 5% pharmaceuticals/chemicals, 9 % others). Firm size varies across the sample with 32 % having less than 500 employees, 29 % between 500 and 2000 employees, and 39 % with more than 2,000 employees. Portfolio budget was less than 20 million € in 37 %, between 20 and 100 million € in 39 %, and higher than 100 million € in 24 % of the portfolios.

Measurement

We use multi-item scales for the constructs, which are anchored from 1, "strongly disagree", to 7, "strongly agree". Scales were operationalized based on existing literature and pretested with 12 representatives from academia and industry to assure face validity of constructs, improve item wording, and remove ambiguity. We validated the scales using principal components factor analysis (PCFA) and confirmatory factor analysis (CFA) (Ahire and Devaraj, 2001). PCFA tests for unidimensionality of each scale by checking whether all items load onto a single factor. Cronbach's Alpha is used to assess scale reliability with acceptable values larger than 0.7. We follow the guidelines of Hu and Bentler (1998) to evaluate structural equation models. They suggest a Comparative Fit Index (CFI) of 0.95 for good and of 0.90 for acceptable fit, and a Standardized Root Mean Squared Residual (SRMSR) and a Root Mean Squared Error of Approximation (RMSEA) below 0.08 for acceptable fit.

The dependent variable *innovation portfolio success* is measured as a five-dimensional second-order construct using dimensions and their items from existing literature (Cooper et al., 2001; Jonas et al., 2013; Voss and Kock, 2013): strategic implementation success (4 items), future preparedness (3 items), portfolio balance (3 items), average product success (4 items), and synergy exploitation (3). PCFA showed that all items load highly on their respective dimensions with no cross-loadings above 0.30. The CFA confirms the second-order structure in that all dimensions load highly on the overall construct project portfolio success and the model fit is acceptable. The results and item wordings are shown in table 1. The coordinator informant also assessed all items for project portfolio success. Although we do not use these data for hypothesis testing, we used the information for further validation of the scale. The coordinator responses resulted in the same factor structure with similar loadings and fit. Coordinator and decision maker assessments are highly correlated ($r=0.57$, $p<0.000$), which gives strong confidence in the validity of our performance measure.

Table 1. Confirmatory Factor Analysis for Project Portfolio Success

Construct Dimension Item	Description	loading
Innovation Portfolio Success (2nd order construct)		
Strategic Implementation success (Cronbach's Alpha α = 0.85)		0.78
	The project portfolio is consistently aligned with the future of the company.	0.81
	The corporate strategy is implemented ideally through our project portfolio.	0.92
	Resource allocation to projects reflects our strategic objectives.	0.78
	The implementation of the strategy is considered a great success in the organization.	0.78
Future Preparedness (α = 0.88)		0.66
	We sufficiently develop new technologies and/or competences in our projects.	0.70
	With our projects we are a step ahead of our competition with new products, technologies, or services.	0.90
	The projects enable us to shape the future of our industry.	0.74
Portfolio Balance (Cronbach's Alpha α = 0.85)		0.68
There is a good balance in our project portfolio ...		
	... between new and old areas of application.	0.82
	... between new and existing technologies.	0.89
	… of project risks.	0.60
Average Product Success (α = 0.88)		0.69
Please assess the average success of completed projects:		
	Our products achieve the target costs defined in the project.	0.57
	Our products achieve the planned market goals (e.g., market share).	0.64
	Our products achieve the planned profitability goals (e.g., ROI).	0.94
	Our products achieve the planned amortization period.	0.89
Synergy Exploitation (α = 0.88)		0.70
	During the project execution, development synergies (e.g. shared use of modules, platforms, technologies etc.) between projects are rigorously exploited.	0.83
	After project completion, exploitation synergies (e.g. shared marketing/sales channels, infrastructure, etc.) between projects are rigorously exploited.	0.85
	We hardly ever have double work or redundant development.	0.66

χ^2 = 214.40 (df = 114; p < 0.00); RMSEA = 0.071; SRMR = 0.068; CFI = 0.94.

Vertical integration was measured as a three-item construct evaluating the degree to which the strategic planning process forms the basic conditions for the portfolio and how closely strategic and portfolio planning are linked to each other. The items were based on related constructs in the literature (Meskendahl, 2010). *Strategic disclosure* was measured by three items evaluating in how far portfolio analyses lead to new opportunities that were not visible during strategic planning. *Strategic Control* was measured with four items adapted from Schreyögg and Steinmann (1987) and Preble (1992). *Environmental turbulence* included 3 technology and 3 market turbulence items taken from (Sethi and Iqbal, 2008). The PCFA for the dependent and moderator variables showed that all items loaded on their respective constructs with no cross-loadings higher than 0.30. The results of the CFA are displayed in table 2 along with the item wording. The fit of the model can be deemed satisfactory.

Table 2. Confirmatory Factor Analysis for independent and moderator variables

Construct Item	Description	loading
Vertical integration (top-down) (*α = 0.88)*		
	We put down the general guidelines for the portfolio via our strategic planning.	0.83
	Portfolio planning and strategic planning are closely linked with each other in our company.	0.92
	The goals of our project portfolio are derived from our company's goals.	0.77
Strategic disclosure (bottom-up) (*α = 0.83)*		
	Through our project portfolio analyses we obtain valuable impulses for our strategy.	0.73
	Through our project portfolio analyses we discover major new investment needs.	0.84
	Through our project portfolio analyses we discover new business opportunities.	0.83
Strategic control (*α = 0.90)*		
	We frequently review …	
	… the feasibility of portfolio strategy based on information acquired in projects.	0.87
	... the validity of the premises defined within strategic planning.	0.90
	... whether the strategy of the project portfolio is further justified in the light of changed conditions.	0.86
	Based on the information gained in the projects we deliberately challenge the portfolio strategy.	0.70
Environmental Turbulence (*α = 0.84)*		
	The technology in our industry is changing rapidly.	0.87
	There are frequent technological breakthroughs in our industry.	0.91
	Technological changes provide big opportunities in our industry.	0.70
	In our industry, it is difficult to predict how customers' needs and requirements will evolve.	0.43
	In our kind of business, customers' product preferences change quite a bit over time.	0.54
	In our industry, it is difficult to forecast competitive actions.	0.60

χ^2 = 167.06 (df = 97; p < 0.00); RMSEA = 0.064; SRMR = 0.071; CFI = 0.96.

Finally we control for several variables that might affect the dependent or mediating variables of our model. First, we control for *firm size* measured as the natural logarithm of the number of employees of the firm or business unit. Second, we include *portfolio budget* to control for the size of the innovation project portfolio. Portfolio budget is measured as natural logarithm of the overall yearly budget of the portfolio (measured in millions of Euros). Third, we include the variable *portfolio innovativeness* (Cronbach's Alpha = 0.84), in which the decision maker informant assesses the average technological innovativeness of projects in the portfolio along three items taken from (Kock et al., 2011; Talke et al., 2011). A sample item is "our products/project results are based on completely new technological principles." Finally, we control for the formalization of the portfolio process (Alpha = 0.93) that we measure with four items taken from (Teller et al., 2012). A sample item is "essential project decisions are made within clearly defined portfolio meetings." Correlations and descriptives for all variables are shown in table 3. Strategic control is strongly correlated to vertical integration and strategic disclosure, which could constitute a threat to discriminant validity. However, the CFA shows that all three constructs are discriminant. When pair-wise correlations between the constructs are constrained to one, the model significantly worsens (Delta χ^2 = 99.35 (p<0.00) and Delta χ^2 = 113.37 (p<0.00) respectively). Furthermore, the average variance extracted (AVE) is higher than 0.64 for all three constructs. The square root of the AVE is consequently higher than the highest correlation between constructs, which is a strong sign of discriminant validity (Fornell and Larcker, 1981). Overall, the measurement of the model variables can be considered satisfactory.

Table 3. Correlations and Descriptives

	Variable	Mean	Std. dev	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1)	Innovation Portfolio Success	4.57	0.80	1.00							
(2)	Environmental Turbulence	4.01	1.07	0.09	1.00						
(3)	Firm Size (ln)	7.03	1.91	0.09	0.04	1.00					
(4)	Portfolio Budget (ln)	3.39	1.65	0.06	0.08	0.36	1.00				
(5)	Portfolio Innovativeness	4.16	1.25	0.26	0.44	0.02	0.13	1.00			
(6)	Formalization of Portfolio Management	4.71	1.75	0.32	0.03	0.16	0.14	-0.03	1.00		
(7)	Strategic Control	3.84	1.41	0.34	-0.04	-0.02	0.01	0.04	0.39	1.00	
(8)	Vertical Integration	4.67	1.43	0.38	-0.05	0.01	0.03	0.00	0.35	0.68	1.00
(9)	Strategic Disclosure	3.61	1.25	0.36	0.05	0.02	0.02	0.12	0.29	0.60	0.44

n = 182.

RESULTS

We use ordinary least squares regression in order to test the hypotheses. The results are displayed in table 4. The first model contains the direct effects of all control and moderator variables as well as strategic control on innovation portfolio success. Model 2 introduces the two mediators in order to test hypotheses 1 and 2. Vertical integration ($b=0.13$, $p<0.01$) and strategic disclosure ($b=0.13$, $p<0.01$) both have positive and significant coefficients. Hypothesis 1 and 2 are therefore supported by the data. Model 3 tests the complementary effect of top-down vertical integration and bottom-up disclosure. Following Aiken, West and Reno (1991) we introduce the product-term between the centered variables and evaluate whether the explained variance significantly increases. Model 3 shows that the interaction of vertical integration and strategic disclosure is positive and significant ($b=0.06$, $p<0.01$), which is in support of hypothesis 3. Model 4 tests the moderation effects of external turbulence. As expected in hypothesis 4a we find a negative moderation effect on vertical integration ($b=-0.08$, $p<0.05$). However, we cannot find any significant moderating effects with strategic disclosure, therefore hypothesis 4b is not supported by the data.

Table 4. Regression Results

	Innovation Portfolio Success				Vertical Integration	Disclosure of Opportunities
Independent Variables	(1)	(2)	(3)	(4)	(5)	(6)
Environmental Turbulence	-0.02	-0.02	-0.01	-0.03	-0.02	0.04
Firm Size (ln)	0.03	0.03	0.03	0.03	0.00	0.01
Portfolio Budget (ln)	-0.01	-0.01	-0.01	-0.02	0.01	-0.01
Portfolio Innovativeness	0.17**	0.16**	0.16**	0.17**	-0.02	0.09
Portfolio Management Formalization	0.11**	0.09**	0.09**	0.09**	0.08†	0.05
Strategic Control	0.14**	-0.00	-0.02	-0.01	0.64**	0.50**
Vertical Integration		0.13**	0.15**	0.15**		
Strategic Disclosure		0.11*	0.12*	0.11*		
Vertical Integration X Strategic Disclosure			0.06*	0.06*		
Vertical Integration X Environmental Turbulence				-0.08*		
Strategic Disclosure X Environmental Turbulence				0.02		
Constant	4.57**	4.57**	4.52**	4.52**	4.67**	3.61**
R^2	0.23	0.28	0.30	0.32	0.47	0.38
R^2 (adjusted)	0.20	0.24	0.26	0.28	0.45	0.35
Delta R^2		0.05**	0.02*	0.02*		
F	8.59**	8.33**	8.23**	6.45**	25.53**	17.57**

Hierarchical OLS regression; n=182; mean-centered variables; unstandardized regression coefficients are reported; † p<0.10; * p<0.05; ** p<0.01 (two-sided).

To visualize the moderation effect we use a marginal plot instead of simple slopes in order to show the strength and significance for all possible values of the moderator variable (Brambor, Clark and Golder, 2006). The solid line in Figure 4 represents the effect vertical integration on innovation portfolio success over the whole range of external turbulence. The dashed lines represent 95%-confidence intervals. Figure 4 shows that vertical integration only has a positive and significant effect on innovation portfolio success, if external turbulence is below 4.3 (mean is 4.01). Higher turbulence diminishes the positive effect of vertical integration on success.

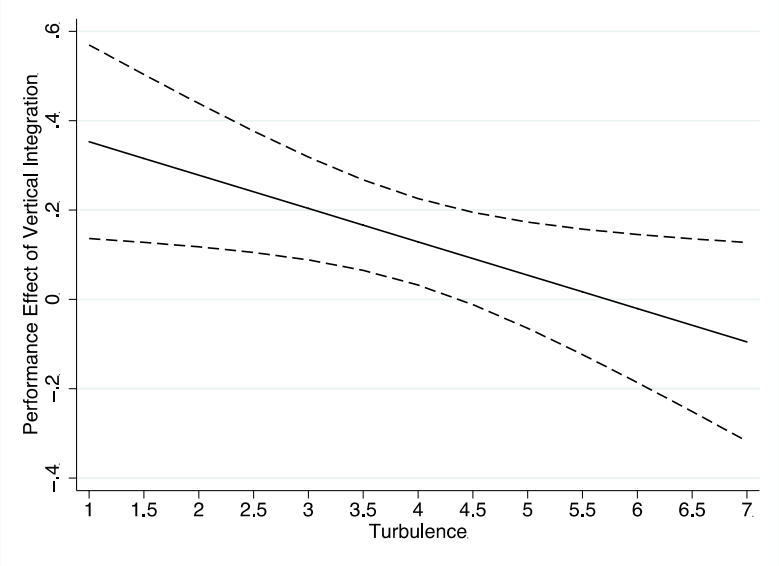

Figure 4. Marginal effects of vertical integration depending on environmental turbulence

We furthermore test whether the effect of strategic control on innovation portfolio success is mediated by vertical integration and strategic disclosure. We follow the procedure suggested by (Zhao, Lynch and Chen, 2010) and calculate the significance of the indirect effects using bootstrapping with 1000 replications. Both indirect effects of strategic control through vertical integration (b_{ind}=0.09, p<0.01) and strategic disclosure (b_{ind}=0.06, p<0.05) are positive and significant. Since the direct effect of strategic control on innovation portfolio success is not significant when controlling for the mediator variables, the mediation is an indirect-only mediation (Zhao et al., 2010).

DISCUSSION & CONCLUSION

The findings show that portfolio management contributes to innovation portfolio success by supporting both the implementation of deliberate and emergent strategies through vertical integration and strategic disclosure. The effects are complementary in that both activities increase the positive effects of the other. Furthermore we find that strategic control at a portfolio level indirectly contributes to success mediated by vertical integration and strategic disclosure. Finally, a moderation analysis shows that the influence of vertical integration on innovation portfolio success is reduced under high environmental turbulence.

Theoretical Implications

The results of this study show the relevance of emergent strategies in innovation portfolio management and contribute to the literature on innovation portfolio management and strategic management in two primary ways.

First, by introducing insights from strategic management on emerging strategies and strategic control to the field of innovation portfolio management, the findings of this study put the role of portfolio management as a bridge between innovation strategy and its implementation into a new perspective. The results suggest that portfolio management not only contributes to the implementation of deliberate innovation strategy, as the dominant view in the literature assumes. Rather, it becomes an active player in shaping innovation strategy by disclosing strategic opportunities and thus giving important impetus for strategy

formulation in response to environmental conditions. The finding that the traditional role of top-down operationalization of innovation strategy (i.e. vertical integration) becomes less relevant for success under conditions of high environmental turbulence further highlights the importance of this new role. By illustrating mechanisms for sensing and reconfiguring, the results of this study reinforce and further justify the position of portfolio management as a dynamic capability (Killen and Hunt, 2010; Killen, Hunt and Kleinschmidt, 2007; Killen et al., 2008; Killen et al., 2012; Petit and Hobbs, 2010).

Second, this study also contributes to strategic management literature by connecting the concepts of emerging strategies and strategic control and applying them in the context of portfolio management. While the literature suggests that managers need to be aware of emergence in strategy formation (Mintzberg and Waters, 1985), no clear recommendations exist about how it can be managed. This study conceptualizes strategic control on the level of the portfolio, suggesting that it is a portfolio management activity relating to strategy implementation, and shows that it not only supports the implementation of deliberate but also emerging strategies.

Managerial Implications

For Practitioners this study provides three main insights regarding the role of innovation portfolio management in the context of strategy implementation and emergent strategies, the relevance of emerging elements in the context of environmental turbulence, and the application of strategic control. First, the results suggest that innovation portfolio management should be integrated in the strategic formation process not only as an instrument to implement the innovation strategy, but also as a valuable source for strategic renewal and change. Second, we highlight the existence of emergent strategies and provide management with illustrations of proactive approaches to sense and respond to these emergent elements. The study encourages managers to use innovation portfolio management as a facilitator between strategy formulation and implementation with consideration of both deliberate *and* emergent strategies. Especially in turbulent environments, organization should focus on the emergent aspect of strategies and the corresponding management through the innovation portfolio. Third, this study suggests that strategic control should not be conducted from above, but instead should be located at the interface between strategy formulation and implementation. At the innovation portfolio management level, strategic control fosters both the vertical integration and the strategic disclosure aspects of innovation portfolio management and facilitates the dialectic between deliberate and emergent strategies.

Avenues for Future Research

This study gives rise to future research opportunities, some of which stem from its limitations. First, this study investigated the interface between innovation strategy formulation and implementation only from the perspective of portfolio management on the implementation side. While we included senior managers to assess success, we did not fully capture both the top-down and bottom-up perspectives in the strategy formation process. For example, the performance effect of strategic disclosure is still rather a black box. We were able to show that bottom-up identification and communication of strategic opportunities affects performance, but our study did not investigate what happens with this information and how it is acted upon in strategy formulation. Future studies could investigate this dialectic process in more depth and also include the perspective of top management.

Second, this study investigates emergent phenomena in innovation portfolios only from a system-level view. However, understanding how strategies actually emerge in complex

systems like innovation portfolio management systems requires a longitudinal and multi-level perspective. A microfoundational perspective (Barney and Felin, 2013) to innovation portfolio management might enable an identification of the drivers that give rise to these emergent elements. For example, the study of multi-project lineage management (Midler, 2013) is a first step in this direction.

Finally, given the prevalence and importance of emergence in portfolio management, future research might identify and empirically test other mechanisms to facilitate and exploit emerging elements. For example, some companies are experimenting with bottom-up project selection and resource allocation approaches such as innovation dating platforms, where idea givers and team members of potential new projects can court each other . It would be interesting to analyze how such bottom-up approaches perform in comparison to existing top-down project selection and resource allocation approaches and how they complement each other.

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