# Governing the Portfolio Management Process for Product Innovation—A Quantitative Analysis on the Relationship Between Portfolio Management Governance, Portfolio Innovativeness, and Firm Performance

Christian Urhahn and Patrick Spieth

***Abstract*—Past strategy and innovation research has basically ignored potential effects of portfolio management governance issues on portfolio innovativeness, and thereby on innovation management results such as firm performance. Building on the dynamic capabilities view, we hypothesize that portfolio management governance enhances firm performance by enabling higher levels of portfolio innovativeness through market and technological aspects. Our findings support the relevance of considering portfolio management governance to explain higher innovation outcomes. In particular, we can show that formality and explicitness, information support, as well as partial review frequency have a strong impact on the innovativeness of the firm's product portfolio. Consequently, higher technological and market innovativeness drives firm performance. We derive implications for both managers and researchers.**

***Index Terms*—Dynamic capability, innovation project portfolio management, managing portfolio governance, portfolio innovativeness, quantitative study.**

## I. Introduction

In R&D and innovation management, typically myriads of ideas are considered in order to improve existing product offerings and develop new goods and services [1]. But since funds are limited, only a finite number of ideas can be simultaneously pursued in actual innovation projects. Innovation and new product managers must therefore constantly make appropriate investment decisions in ongoing product renewal and line extensions, as well as in different products that are targeted at completely new market spaces [2]. In other words, a firm's existing and limited resource base must be effectively assigned to a portfolio of more or less innovative new product projects that compete for scarce firm resources. In this context, innovativeness is an important factor that is believed to enhance many firms' ability to differentiate themselves and offer increased value to the customers. Hence, firms increasingly employ portfolio management (PM) approaches to provide a holistic vision to align the portfolio with strategy, ensuring that valuable and balanced initiatives are pursued to maximize long-term return on investment [3]–[5], [7]. A large body of literature has dealt with the management of innovation project portfolios and ways to improve its successful execution [6]. The focus of previous PM research however lays predominantly on operational aspects through developing and improving methods for selecting, e.g., [7], [8] or terminating, e.g., [9], [10] new product projects.

Two aspects have still not been sufficiently addressed. First, the complexity of the portfolio decision making and management process remains largely neglected. Just recently, scholars have started to recognize the relevance of supporting processes, capabilities, and organizational structures for PM [11], [2], [9]. PM governance—the manner of steering, guiding, and directing the entire PM process including the stakeholders involved—is a construct that is still lacking of a clear and explicitly defined conceptualization. This argues for a more strategic perspective of portfolio management. Second, while extant empirical studies focus on identifying performance effects of such PM government structures [6], [13], [14], the link between PM governance, portfolio innovativeness, and a firm's success has not been investigated yet. The way new product PM processes are steered and managed however has not been reflected as a driver for innovation yet. Firm success, however, depends more on the performance of the entire product range than on the performance of a single product. Hence, scholars have started to call for applying a more holistic, portfolio perspective to product innovativeness [15]–[18]. Research on product portfolio innovativeness and firm performance is at an infant stage, with findings reported of linear positive correlations [15]–[17] as well as curvilinear relationships [19]–[21]. Such findings suggest that further studies are needed to better understand this relationship and to reconcile differences in extant findings.

Hence, we aim at contributing to extant literature on both PM and innovativeness by shedding light on the role of a firm's

Manuscript received April 27, 2013; revised January 9, 2014 and April 8, 2014; accepted May 18, 2014. Date of publication July 7, 2014; date of current version July 15, 2014. Review of this manuscript was arranged by Department Editor C. Tucci.

C. Urhahn is with the Department of Innovation Management and Entrepreneurship, EBS Universität für Wirtschaft und Recht, EBS Business School, Oestrich-Winkel 65375, Germany (e-mail: christian.urhahn@ebs.edu).

P. Spieth is with the Department of Innovation Management and Entrepreneurship, EBS Universität für Wirtschaft und Recht, EBS Business School, Oestrich-Winkel 65375, Germany; and also with the Department of Innovation and Technology Management, University of Kassel, Faculty of Business Studies, Kassel 34125, Germany (e-mail: patrick.spieth@ebs.edu).

Digital Object Identifier 10.1109/TEM.2014.2327254

PM governance as an antecedent to new product portfolio innovativeness which mediates its relationship to overall firm performance. Therefore, the paper develops and tests a model that connects the way firms govern their PM process with their product portfolio innovativeness to better explain firm performance. We thus conducted a quantitative empirical study building on data collected through a computer-assisted telephone interview survey among portfolio and innovation managers employed at German companies.

The remainder of the paper is organized as follows. After briefly reviewing the theoretical concept of PM governance, we develop a conceptual model by drawing on the theory of dynamic capabilities. Subsequently, the research design is outlined and the findings from the analysis are reported. We conclude by deriving implications for theory and practice and discussing limitations as well as avenues for future research.

## II. Theoretical Background

### A. From PM to PM Governance

Literature usually defines the term PM as the strategic decision-making process that involves evaluating, prioritizing, selecting, and terminating competing new product choices as well as allocating scarce resources to them [3]. PM is performed at certain decision points where responsible managers decide whether the firm will continue to pursue a new product development project in the future [18]. This is accompanied by decisions on priority and resource input [18]. These decision points can either be process gates of individual projects or special portfolio review (PR) meetings that simultaneously take into account the entire new product portfolio [3], [26]. Since various portfolio methods can only be applied if all innovation projects are simultaneously considered, we here assume that PR meetings are crucial elements of the PM process [18], [20].

Project selection and termination methods have been extensively discussed in the extant literature on PM, e.g., [27], [28]. While early methods predominantly aim at optimizing selection decisions through algorithms of increasing mathematical sophistication, e.g., [29], scholars gradually introduced new approaches that additionally considered visual elements and more qualitative criteria. However, more recent studies reveal that simply applying different PM methods is less effective than facilitating PM through supporting processes and capabilities [3], [8], [11], 22]–[24].

Consequently, there is a need for proactively designing and managing the PM process over time. Such a metamanagement has to take place on a higher level than PM and it must consider the various stakeholders of PM involved. It is setting the rules for PM and thus governs the usage of different project selection or prioritization techniques and portfolio decision-making methods. By drawing on the governance definition by Hughes [30] and Lynn [31], we hence introduce *PM governance* as the manner of steering, guiding, and directing the entire PM process including the stakeholders involved. Thereby, we attempt to express the concept's superordinate nature in contrast to the management function of PM.

### B. PM Governance as a Dynamic Capability

The management of new product portfolios constitutes as a strategic management task [12], [22], [24], [25]. Therefore, we draw on theory on the dynamic capabilities approach to explain the performance and innovation effects of PM governance. Dynamic capabilities have recently confirmed to be a viable concept in the context of innovation management [24], [32], [33]. The dynamic capability view put emphasis on the ability to integrate, build, and reconfigure internal and external competences to attain new forms of innovative combinations, particularly in turbulent environments [36]. Hence, dynamic capabilities describe a firm's potential to systematically solve problems by sensing opportunities, making timely and market-orientated decisions and adequately transforming its resource base [34], [35], [37]. Thus, dynamic capabilities are seen to be central in technology and innovation management [18], [38], [39].

Scholars distinguish between operational and higher order capabilities, e.g., [18], [40], [41]. In line with Winter [42], operational capabilities maintain a firm's functional activities and enable it to make a living in the short term. Dynamic capabilities in contrast are higher order capabilities that are needed to create, change, and modify a firm's operational capabilities or resource base [42], [43]. These can be disaggregated into the ability to identify emerging opportunities and create knowledge (*sensing*), the ability to assimilate, integrate, and commercialize knowledge (*seizing*), as well as the ability to recombine knowledge and resources for successful innovation (*reconfiguring*) [44]. The authors in [39], [40], [43], and [45] refer them to learning, respectively, learning-to-learn processes. In order to establish knowledge assets that continuously improve existing routines and processes through learning from external and internal sources describe a source of sustained competitive advantage that competitors may not be able to easily duplicate [18], [46].

Such capabilities may particularly be found on PM governance and management level [18] since "a firm's ability to strategically structure its innovation portfolio, to commit resources, and to stimulate synergies between related projects can be seen as a central catalyst for resource reconfiguration and ultimately successful innovation" [13, p. 562]. While the development of new products and services describes an operating capability of the firm, the PM process can represent the corresponding dynamic capability that reconfigures the product development process [18], [47]. Previous innovation experiences can be shared across different innovation projects on portfolio and thus provide a system of learning that institutionalizes a firm's ability to adapt and evolve by routinizing its experience at the reconfiguration of operating capabilities [18], [47]. By shaping the entire PM process, PM governance shapes the framework for this learning process and can facilitate the transfer of knowledge and know how. Therefore, we regard PM governance as a dynamic capability [18].

## III. Hypothesis Development

Following [12] and [18] with findings from extant PM literature [3], [16], [48], [49], PM governance is analyzed in terms of four central elements: 1) formality and explicitness; 2) review frequency; 3) decision transparency; and 4) information support. They represent crucial parameters top management can influence in order to shape a firm's PM process. Within innovating organizations, these basic elements of PM governance are suggested to induce and facilitate critical learning activities of different nature that enable firms to enhance performance through a portfolio of successful and innovative new products.

Portfolio innovativeness is defined as the average level of innovativeness embodied in the totality of a firm's new product portfolio. We regard innovativeness as newness-to-the-industry and distinguish between a market and a technological dimension [50]–[53]. Market innovativeness describes the degree to which an innovation differs from a marketing point of view. Technological innovativeness indicates the state of science or technology a new product entails [53]. We follow up on previous conceptual research by Urhahn and Spieth [18].

### *A. Relationship Between PM Governance and Portfolio Innovativeness*

*Formality and explicitness* represent the extent to which portfolio managers design their PM process in a structured and formal way [54]. If PM governance comprises a high level of formality, management relies on established and explicit PM methods, it supports well-defined PM procedures, and PM methods are consistently applied to every innovation project [3], [26].

A high level of formality and explicitness in PM governance increases the effectiveness of portfolio decision making and help meeting project performance objectives by acting as a dynamic capability [18]. By providing an analytical framework for highlighting what is actually important, it could direct R&D and the selection of new technologies (*sensing*) [44]. Evidence-based portfolio decision making may be encouraged and innovation projects get objective chances of being selected regardless of the level of discontinuity they entail [2]. This could nurture radical innovation projects which may even cannibalize the existing product base (*seizing*) [44], [49]. Thus, resource allocation becomes more efficient and firms can respond more quickly to dynamic challenges by reconfiguring their resource base (*reconfiguring*). Innovation projects that involve high degrees of market or technological innovativeness can get more resources and are more likely to be conducted successfully [55].

Additionally, formal and explicit PM governance may foster organizational learning [56], [57]. This may enable learning processes by institutionalizing knowledge transfers across departments [56] and encourage successful collaboration among locally dispersed R&D units [58]. Since it allows for know-how transfer across individual projects and learning from past project experience the portfolio perspective may foster such positive effects [18], [73] [59]. Formalized and explicit PM governance can be seen as a dynamic capability that creates new knowledge from past project experience and therefore extends this knowledge to value creating activities and modifies it to address changing market conditions [44]–[46], [60]–[62]. Although some scholars reveal that rules, structure, and formality in innovation project management may hamper the ability to handle uncertainties [63], formality and explicitness—in the context of PM governance—are related to the process of selecting and prioritizing new product projects only [18], [74], [75]. Thus, informal exchange and spontaneity among employees on execution level should not be restricted. Therefore, we state:

*H1a:* Formality and explicitness have a positive impact on portfolio-level market innovativeness.

*H1b:* Formality and explicitness have a positive impact on portfolio-level technological innovativeness.

*Review frequency* reflects how frequently portfolio managers summon board meetings in which the current status of the portfolio is reviewed and decisions about the continuation or termination of the individual projects are made. Here, responsible managers from different functional backgrounds congregate, holistically regard the entire portfolio of new product projects, discuss portfolio alternatives, and thereby share their expertise and knowledge. This may encourage combinative learning processes on top-management level that improve and accelerate the sensing and seizing of opportunities as well as the modification of existing innovation capabilities in response to dynamic challenges by purposefully synthesizing current and acquired knowledge [18], [46]. PM governance that features frequent review meetings can be seen as a firm's dynamic capability that fosters creativity and enhances its innovation activities [18]. In doing so, it can lead to superior process competence in product development which eventually results in higher levels of portfolio innovativeness [39]. Thus, we propose:

*H2a:* Review frequency has a positive impact on portfolio-level market innovativeness.

*H2b:* Review frequency has a positive impact on portfolio-level technological innovativeness.

*Decision transparency* refers to the extent to which the portfolio decision process is traceable and comprehensible for those people who are eventually affected by the portfolio decision. In line with Urhahn and Spieth [18], project staff and managers are more likely to accept the PM decisions made and therefore enhance a trustful relationship across hierarchies, if criteria and approaches to PM are widely transparent. Trust and leadership are important preconditions for creating an atmosphere of continual organizational learning and capability reconfiguration. It can be seen as a dynamic capability enabler [64]. Thus, the combinative learning processes encouraged on top-management level during the review meetings could be extended to lower hierarchical levels which help to deeply anchor this dynamic capability within the firm [18]. Accordingly, we assume positive effects on portfolio innovativeness from a market and a technology perspective. We therefore suggest:

*H3a:* Decision transparency has a positive impact on portfolio-level market innovativeness.

*H3b:* Decision transparency has a positive impact on portfolio-level technological innovativeness.

*Information support* is the degree to which decision-makers are endowed with accurate, relevant, and timely information. Portfolio decision-makers who have correct and truthful up-to-date information about the individual new product projects at their disposal can base their decisions on a more precise and reliable basis [18]. This could not only increase the objectivity and decision quality but also leverage combinative learning processes on top-management level. In response to dynamic challenges, the sensing and seizing of opportunities as well as the modification of the existing innovation capabilities could be improved [18]. The portfolio decision-makers may be more likely to take the risk of engaging in radical new product projects as the complexity involved in more innovative new product projects may be handled more effectively [18]. Subsequently, we hypothesize:

*H4a:* Information support has a positive impact on portfolio-level market innovativeness.

*H4b:* Information support has a positive impact on portfolio-level technological innovativeness.

### B. Relationship Between Portfolio Innovativeness and Firm Performance

New products that involve high levels of market innovativeness frequently increase customer value by addressing previously unmet needs [55], [65], [66], bear the potential to open entirely new markets or introduce completely new benefit dimensions [18], [67]. Such unique competitive advantages may lead to price premiums, higher sales, and business growth [68], [69]. Extant research reveals that these encompass positive effects on intangible firm assets such as brand and reputation [70]–[72]. Thus, market innovativeness of a new product offering seems to promise positive effects on customer satisfaction, market effectiveness, as well as financial performance [18], [73]. Radical innovations bear the potential for extraordinary high returns [68], [72] that should overcompensate for negative effects as risk and potential losses are spread over the entire portfolio [17], [18]. If firms put emphasis on close observations of customer responses they facilitate learning process [76], [77] which also embodies a dynamic capability [46]. This dynamic capability is likely to increase competitive advantages on a more long-term basis as generated by radical new products in terms of market innovativeness [18], [74], [75]. Subsequently, we state:

*H5:* Market innovativeness on portfolio level has a positive impact on firm performance.

In accordance with Urhahn and Spieth [18], technologically radical product innovations are based on substantially different core technologies, involve technologies that make existing technologies obsolete. New products based on such innovative technologies may result in price-performance improvements that can never be achieved by products based on old technologies [78]. Technology-based radical innovation can hence contribute to product differentiation which may lead to greater customer benefits and competitive advantages of the firm [79].

Firms acquire tacit knowledge by developing technologically radical new products [80]. Tacit knowledge cannot easily be transferred to other companies [78]. Patents for highly radical innovations may protect from imitation and these are likely to allow for charging price premiums [17], [18], [81]. In doing so, a technologically radical new product portfolio can also feature a process of episodic learning [18] since previously created new technological capabilities are likely to be applied in future product development projects [82]. A higher degree of technological portfolio innovativeness is likely to comprise of a larger number of technologically radical projects. This may result in more synergies between different projects and accelerate the process of learning and capability development [18]. Therefore, we claim:

*H6:* Technological innovativeness on portfolio level has a positive impact on firm performance.

Fig. 1 provides a summary of the conceptual model hypothesized.

## IV. Methodology

### A. Sample and Data Collection

We conducted a cross-sectional survey among innovation, R&D, and portfolio managers from German companies. Companies were selected using a criterion sampling strategy controlling for the contingency factors firm size and industry sector [83]. Equal shares of medium-sized (500–1500 employees), large (1500–5000), and very large companies (>5000 employees) from industry sectors with a fierce competition for innovative new products and services were chosen. The final sample includes companies from industries like manufacturing (49%), high-tech (19%), metal/steel (9%), electrical (8%), automotive (6%), chemical/ pharmaceutical (4%), and others (5%). Potential respondents were contacted via computer-assisted telephone interviews over a period of three weeks in September and October 2011. On average, the interviews took 25:02 min and 2.8 callbacks were made before categorizing a firm as nonresponder. Additionally, we could not detect a potential nonresponse bias through significant differences between the first 10% and the last 10% respondents. In total, we received 200 responses representing a response rate of 19%. To ensure valid results, data sets with a high degree of missing values (>10%) were excluded from the analysis. Altogether, this leads to a final sample of $n = 184$ valid cases.

### B. Measures

To operationalize the variables of interest, we intensively reviewed the extant literature on PM as well as innovation management. Wherever possible, we relied on established scales or closely followed prior conceptual work. To increase comparability across different industries, we draw on common subjective measures to assess the level of innovativeness of new products or new product portfolios by experts or managers to measure [84], [85]. Apart from review frequency, each construct used was operationalized as a reflective measure using multiitem scales. Respondents were asked to assess each item on a 7-point-Likert-scale ranging from $1 =$ strongly disagree to $7 =$ strongly agree. In a pilot study, all construct measurements were repeatedly pretested by ten selected innovation management experts from

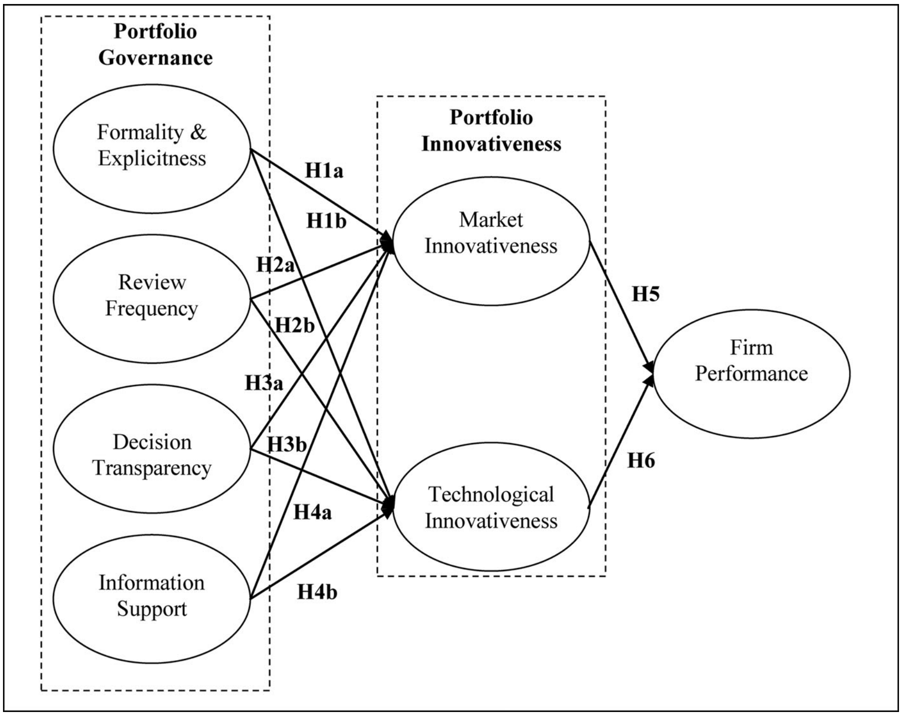


Fig. 1. Hypothesis framework.

different industries, six academics, and three professional market researchers to ensure scale content validity, to improve item wording, and to remove ambiguities. Slight modifications have been made based on this pretest.

Since *PM governance* has not explicitly been addressed in empirical research so far, we combined results from Lerch and Spieth [12] with findings from the extant PM literature. PM governance was measured with 15 items distributed among the four dimensions of formality and explicitness, review frequency, decision transparency, and information support. *Formality and explicitness* was adapted from Cooper *et al*. [3]. *Review frequency* was measured by the time period portfolio review meetings are held. For *decision transparency*, we use five items which have been developed in the aforementioned prestudy. *Information support* was measured according to Martinsuo and Lehtonen [85]. In order to increase composite reliability (CR), one item has been eliminated due to a factor loading below 0.50 [86] eventually leading to a three-item scale. An exploratory factor analysis (EFA) based on principal component analysis (PCA) with an eigenvalue of 1.0 as the cutoff point confirmed the classification of items into the four dimensions mentioned (see Appendix A).

*Portfolio innovativeness* distinguishes a market and a technological dimension. In slight alignment with [87], we measured *market innovativeness* and *technological innovativeness* according to Talke *et al*. [17] using a four-item-scale each.

In line with recent studies about PM [13], *firm performance* has been operationalized as a second-order construct comprising the three dimensions of customer satisfaction, market effectiveness, and financial performance [88].

## V. Analysis and Results

To simultaneously consider the multitude of constructs and their mutual interrelationships hypothesized, we tested our model using partial least squares (PLS) structural equation modeling (SEM) [89]–[91].

We employed SmartPLS 2.0 [92] for the estimation of the outer and inner model parameters [93], [94] and used nonparametric bootstrapping with 1000 replications [89], [94], [95]. We followed a sequential, two-stage approach to evaluate the reliability and validity of our model [96] and largely relied on the criteria suggested by Hair *et al*. [86], [97].

### A. Measurement Model Results

To assess the psychometric properties of the measures, we first ignored the structural relations and specified a null model for the first-order constructs [98]. All variables are operationalized as reflective constructs, so we analyzed 1) indicator reliability [86], [89], [96], [97], 2) internal consistency reliability [97], 3) convergent validity [99], [100], and (4) discriminant validity [97], [99]. An overview of the results for the exogenous and endogenous first- and second-order constructs is given in Appendixes B and C.

### B. Structural Model Results

The empirical results of the model are based on an effective sample of $n = 184$ cases and a 1000 bootstrap sample to calculate *t*-values. Table I summarizes the results.

A significant, positive effect of formality and explicitness on both portfolio-level market innovativeness ($\beta = 0.369$,

TABLE I
HYPOTHESIS TESTING RESULTS

| | Hypothesis | | $\beta$ | $t$-value |
|---|---|---|---|---|
| H1a: | Formality and explicitness → Market innovativeness | 0.369 | 4.133 | supported |
| H1b: | Formality and explicitness → Technological innovativeness | 0.266 | 2.618 | supported |
| H2a: | Review frequency → Market Innovativeness | 0.090 | 1.415 | not supported |
| H2b: | Review frequency → Technological innovativeness | 0.174 | 2.534 | supported |
| H3a: | Decision transparency → Market innovativeness | −0.116 | 1.181 | not supported |
| H3b: | Decision transparency → Technological innovativeness | −0.138 | 1.132 | not supported |
| H4a: | Information support → Market innovativeness | 0.257 | 3.439 | supported |
| H4b: | Information support → Technological innovativeness | 0.177 | 2.139 | supported |
| H5: | Market innovativeness → Firm Performance | 0.167 | 2.116 | supported |
| H6: | Technological innovativeness → Firm performance | 0.214 | 2.692 | supported |

$p < 0.001$) and technological innovativeness ($\beta = 0.266$, $p < 0.01$) was detected. This finding provides support for H1a and H1b, which stated that formality and explicitness in PM governance positively impact portfolio innovativeness from a market and a technological perspective. Empirical results, on the other hand, do not provide sufficient evidence for a positive relationship between review frequency and market innovativeness as well as decision transparency and both market innovativeness and technological innovativeness. H2a, H3a, and H3b are thus not supported. Regarding the influence of review frequency on technological innovativeness however, our results show a significant positive relationship ($\beta = 0.174$, $p < 0.05$). H2b is supported. Information support was found to again positively affect market innovativeness ($\beta = 0.257$, $p < 0.001$) and technological innovativeness ($\beta = 0.177$, $p < 0.05$) of new product portfolios. Hence, H4a as well as H4b are supported. Results furthermore indicate that the market dimension of new product portfolio innovativeness significantly impacts firm performance ($\beta = 0.167, p < 0.05$) supporting H5. The technological dimension of portfolio innovativeness was found to also account for a significant, positive effect on-firm performance ($\beta = 0.214$, $p < 0.01$) providing support for H6.

The calculated $R^2$ values are 24.6% for market innovativeness, 14.6% for technological innovativeness, and 11.1% for firm performance. Compared to comparative studies that rely on the same scales for innovativeness [15]–[17] and firm performance [13], $R^2$ values obtained are largely congruent with our results. An effect size of $f2 > 0.02$ can be confirmed for seven of the ten effects. Especially, when there is a multitude of explaining variables, small effect sizes do not necessarily account for an unimportant effect. On an aggregated level, the model in fact contributes to an explanation.

Additionally, the Stone-Geisser $Q^2$ value [101], [102] was measured for the endogenous second-order construct of firm performance via blindfolding [94]. Following Appendix C, our model entails a predictive relevance for explaining the dependent variable's indicators [89], [15], [16], [13].

## VI. Discussion and Conclusion

Our objective was to shed light on the role of a firm's PM governance as an antecedent to new product portfolio innovativeness which mediates its relationship to overall firm performance. For this purpose, we developed a conceptual model that relates four major aspects of PM governance—namely formality and explicitness, review frequency, decision transparency, and information support—to a firm's technology-related and market-related portfolio innovativeness and its performance. We tested this model based on a quantitative survey among portfolio and innovation managers from German companies using PLS-SEM. Results basically confirm our hypothesized model of positive relationships between PM governance, innovativeness, and firm performance but we also detected some first indication of a counter-intuitive relationship. Our paper contributes to PM and innovativeness literature in five ways.

First, we combined different elements of PM governance that had previously been examined only separately and argued for complexity of the portfolio decision-making and management process. We introduced and tested the construct of PM governance as the manner of steering, guiding, and directing the entire PM process. Since this construct and measurement goes far beyond than managing the process solely, we extend previous findings for PM [2], [11], [12], which recognized the relevance of supporting processes, capabilities, and organizational structures.

Second, our results show that PM governance has mainly a positive effect on portfolio innovativeness which complies with previous qualitative and conceptual research [3], [13], [14], [18]. Particularly, we provide evidence that formality, review frequency, and information support as subdimensions of PM governance relate to increases in portfolio innovativeness. This is partly in line with past research on PM where formal PM approaches tend to increase the performance in developing new products [3], [8], [103] and information support was linked to PM efficiency [85]. Additionally, we advance previous PM research by providing this unique link between the two streams of PM and innovativeness research.

Third, contrary to our expectations, we find no significant relationships between review frequency and market innovativeness as well as between decision transparency and both dimensions of portfolio innovativeness. This is quite surprising as previous PM literature stresses the importance of review meetings, traceability, and communication for successful PM [3], [8], [103]. While being counterintuitive at first glance, product innovation projects that aim at totally new market segments imply major learning efforts from existing customers or rely on totally different technologies are more likely to face adoption barriers and to involve long payback periods [104]. This could result in internal resistance to radical new products [105]. Hence, courageous and venturous decisions by active entrepreneurs are required [106] that could imply fatal consequences for responsible decision-makers in case of failure. Therefore, decision transparency may be detrimental to increasing market and technological innovativeness in new product portfolios.

Fourth, our results show that both dimensions of portfolio innovativeness positively affect firm performance. We hence support extant research results thatsystematization, managerial commitment as well as an open, free, and extensive knowledge transfer represent crucial aspects of a firm's learning capabilities and can be seen as antecedents of product innovativeness and firm performance [107], [108].

Fifth, this study furthermore adds a clear portfolio-perspective on innovativeness and breaks down the innovation effects into a technology- and market-orientated dimension. Earlier findings about the positive performance effect of portfolio innovativeness [15]–[17], [109] are further strengthened. In addition to those previous studies, we did not only consider a firm's financial performance but enlarged the meaning of firm performance with regard to customer satisfaction and sales growth.

### A. *Limitations and Future Research*

Our study includes several limitations that open avenues for further research. First, our survey was conducted at one point in time only. Predominantly, we based our theoretical justification on the aspect of learning within the dc theory rather than on the microfoundations of sensing, seizing, and reconfiguring [3], [4], [12], [22], [25]. However, the development of dynamic capabilities is a gradual process that must be maintained over time [23], [24]. Hence, a longitudinal survey design may be able to further validate our results and better capture the sustainable competitive advantage the dynamic capability of PM governance is supposed to involve.

Second, while the application of PLS-SEM benefits the exploratory character of our study our research design might be facing some methodological shortcomings [86]. Therefore, we followed the recommendations of [110] and combined procedural with statistical remedies to minimize and to control for potential methods biases. Some of the actions undertaken were: on procedural level, we treated answers anonymously, used different scales, briefed interviewers, clearly separated dependent and independent variables in the questionnaire, reduced item complexity and ambiguity and kept questions as simple as possible [110], [111]. On the statistical level, we applied Harman's single-factor test addressing the issue of common method variance [110]. In the exploratory factor analysis, we found that no single factor emerged, and that the first factor only accounted for far less than the critical threshold of 50%. This supports our assumption that our study's results are not due to common methods variance [110].

Third, the direct positive relationship observed between portfolio innovativeness and firm performance may oversimplify the reality. On a portfolio level, especially the extent to which a new product portfolio is balanced could be essential for determining the strength or maybe even the direction of this relationship. Future studies should hence focus on finding ways to fathom the role of portfolio balance in this framework. That may serve as a first step toward capturing the distribution of radical and incremental new product projects within a firm's portfolio and help to further dovetail PM and innovativeness research [15]–[20].

Fourth, PM governance was defined as consisting of four central elements: formality and explicitness, review frequency, decision transparency, and information support. As we could not find support for every hypothesized positive effect of review frequency and decision transparency on portfolio innovativeness, further research seems also necessary in order to specify these variables' role as elements of PM governance. Additionally, given the detailed conceptualization and testing of PM governance, no methods were considered in our framework. Although this is in line with the governance definition by [30] and [31], our research contrasts previous research of Petit [112] who analyzes the usage of organizational methods in a qualitative study. This advocates for an additional consideration of this aspect in future research to combine strategic and operational aspects in PM governance and innovativeness research.

### B. *Managerial Implications*

From a practitioner's point-of-view, our results highlight that successful PM is not only determined by the application of sophisticated project selection methods. A proactively governed PM process does not only tend to increase the performance impact of the portfolio selection, it is also likely to allow for calibrating the level of market and technological innovativeness of new product portfolios. A formal and explicit PM process where decision-makers have timely access to relevant and accurate information has been shown to particularly favor the emergence of radical innovation projects. Consequently, rules and criteria for the application of PM should be defined explicitly and consistently applied in regular portfolio reviews. At the same time, it must be assured that decision makers have access to correct information relevant for profound portfolio decisions. These measures can support decision quality as well as enable the transfer of knowledge and know-how across different projects and functions. Such an institutionalized capability of organizational learning can allow firms to maintain and expand their know-how base in a way that keeps them qualified to successfully deal with the difficulty of more radical innovation projects. A firm focusing on new products and services that are new-to-the-market and entail new technologies are generally favorable to achieve a higher performance in terms of customer satisfaction, market effectiveness as well as financial performance.

## Appendix A
## Exploratory Factor Analysis

Rotated component matrix[a]

| Item | Components 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Our firm relies on established and explicit PM methods. | 0.839 | | | |
| PM methods in use follow a formal process | 0.864 | | | |
| PM methods in use have clearly defined rules and procedures | 0.819 | | | |
| PM methods in use are consistently applied to all innovation projects | 0.783 | | | |
| All innovation projects are considered together | 0.624 | | | |
| Management buys into the PM methods in use. | 0.654 | | | |
| How often do you review your portfolio? | | | | 0.883 |
| Portfolio reviews are held regularly | | 0.570 | | |
| PM methods in use are transparent | | 0.749 | | |
| Criteria in use are transparent | | 0.785 | | |
| People involved in PM have insights into the process | | 0.774 | | |
| Decisions are transparent | | 0.785 | | |
| Decision makers have all the required information on projects | | | 0.797 | |
| Decision makers have truthful information on projects | | | 0.779 | |
| Decision makers have up-to-date information on projects | | | 0.744 | |
| Decision makers have all the required information but not to the extent that is necessary on this stage | | | 0.613 | |

Extraction method: Principal component analysis (PCA).
Rotation method: Varimax with Kaiser-Normalization.
Values below 0.40 suppressed.
[a]Rotation has converged in five iterations.

## Appendix B
## First-Order Hierarchical Measurement Results

| Variable | Description | Loading ($\lambda$) | *t*-value |
|---|---|---|---|
| PM governance | | | |
| Formality and Explicitness | Our firm relies on established and explicit PM methods. | 0.848 | 32.748 |
| $\mathrm{CR} = 0.929$ | | | |
| $\mathrm{AVE} = 0.686$ | | | |
| | PM methods in use follow a formal process | 0.880 | 42.868 |
| | PM methods in use have clearly defined rules and procedures | 0.868 | 45.054 |
| | PM methods in use are consistently applied to all innovation projects | 0.854 | 36.877 |
| | All innovation projects are considered together | 0.769 | 24.971 |
| | Management buys into the PM methods in use | 0.743 | 14.714 |
| Review Frequency | How often do you review your portfolio? | 1.00 | n.a. |
| $\mathrm{CR} = 1.00$ | | | |
| $\mathrm{AVE} = 1.00$ | | | |
| Decision transparency | Portfolio reviews are held regularly | 0.700 | 8.434 |
| $\mathrm{CR} = 0.876$ | | | |
| $\mathrm{AVE} = 0.588$ | | | |
| | PM methods in use are transparent | 0.853 | 22.156 |
| | Criteria in use are transparent | 0.825 | 19.333 |
| | People involved in PM have insights into the process | 0.745 | 11.827 |
| | Decisions are transparent | 0.699 | 9.155 |
| Information support | Decision makers have all the required information on projects | 0.835 | 18.502 |
| $\mathrm{CR} = 0.888$ | | | |
| $\mathrm{AVE} = 0.726$ | | | |
| | Decision makers have truthful information on projects | 0.879 | 37.567 |
| | Decision makers have up-to-date information on projects | 0.842 | 18.495 |
| Portfolio Innovativeness | | | |
| Market Innovativeness | In our firm's product portfolio, the majority of innovations . . . | | |
| $\mathrm{CR} = 0.813$ | | | |
| $\mathrm{AVE} = 0.527$ | | | |
| $Q = 0.129$ | | | |
| | . . . address completely new customer benefits. | 0.849 | 28.097 |
| | . . . offer customers unique advantages over competitors' products | 0.804 | 15.541 |
| | . . . require changes in established attitude and behavioral patterns from customers | 0.634 | 5.437 |
| | . . . require major learning efforts by mainstream customers | .582 | 4.754 |

Continued

CONTINUED

| **Variable** | Description | Loading (λ) | *t*-value |
|---|---|---|---|
| Technological Innovativeness<br>$\mathrm{CR} = 0.887$<br>$\mathrm{AVE} = 0.664$<br>$Q = 0.129$ | In our firm's product portfolio, the majority of innovations . . . | | |
| | . . . are based on substantially different core technology never used in our industry before | 0.668 | 10.413 |
| | . . . involve technology that makes old technologies obsolete | 0.839 | 20.180 |
| | . . . use new technology that permits quantum leaps in performance | 0.839 | 19.502 |
| | . . . use technologies that have an impact on or cause significant changes in the whole industry | 0.897 | 58.066 |
| | Firm performance | | |
| Customer Satisfaction<br>$\mathrm{CR} = 0.835$<br>$\mathrm{AVE} = 0.559$ | The performance of our firm over the last three years (2008–2010) compared to our major competitors in terms of . . . | | |
| | . . . customer satisfaction | 0.720 | 14.876 |
| | . . . delivering value to our customers | 0.728 | 15.708 |
| | . . . delivering what our customer wants | 0.788 | 24.462 |
| | . . . retaining valued customers | 0.753 | 20.449 |
| Market Effectiveness<br>$\mathrm{CR} = 0.895$<br>$\mathrm{AVE} = 0.681$ | The performance of our firm over the last three years (2008–2010) compared to our major competitors in terms of . . . | | |
| | . . . market share growth relative to competitors | 0.816 | 24.101 |
| | . . . growth in sales revenues | 0.869 | 42.320 |
| | . . . growth in acquiring new customers | 0.835 | 28.555 |
| | . . . increasing sales to existing customers | 0.778 | 20.224 |
| Financial Performance<br>$\mathrm{CR} = 0.950$<br>$\mathrm{AVE} = 0.825$ | The performance of our firm over the last three years (2008–2010) compared to our major competitors in terms of . . . | | |
| | . . . profitability | 0.911 | 55.799 |
| | . . . return on investment (ROI) | 0.940 | 93.695 |
| | . . . return on sales (ROS) | 0.921 | 57.321 |
| | . . . reaching financial goals | 0.860 | 31.408 |

## APPENDIX C
## GLOBAL MEASUREMENT RESULTS

| Second-order construct | First-order construct | Loading (λ) | *t*-value |
|---|---|---|---|
| Firm performance | Customer satisfaction | 0.775 | 24.779 |
| $\mathrm{CR} = 0.927$ | Market effectiveness | 0.872 | 47.245 |
| $\mathrm{AVE} = 0.520$ | Financial performance | 0.928 | 88.104 |
| $Q^2 = 0.072$ | | | |

## REFERENCES


[1] K. Girotra, C. Terwiesch, and K. T. Ulrich, "Idea generation and the quality of the best idea," *Manag. Sci.*, vol. 56, no. 4, pp. 591–605, 2010.

[2] L. Kester, A. Griffin, E. J. Hultink, and K. Lauche, "Exploring portfolio decision-making processes," *J. Product Innov. Manag.*, vol. 28, no. 5, pp. 641–661, 2011.

[3] R. G. Cooper, S. J. Edgett, and E. J. Kleinschmidt, "New product portfolio management: Practices and performance," *J. Product Innov. Manag.*, vol. 16, no. 4, pp. 333–351, 1999.

[4] C. P. Killen, R. A. Hunt, and E. J. Kleinschmidt, "Learning investments and organizational capabilities: Case studies on the development of project portfolio management capabilities," *Int. J. Manag. Projects Bus.*, vol. 1, pp. 334–351, 2008.

[5] C. P. Killen, R. A. Hunt, and E. J. Kleinschmidt, "Project portfolio management for product innovation," *Int. J. Quality Rel. Manag.*, vol. 25, pp. 24–38, 2008

[6] M. Lerch and P. Spieth, "Innovation project portfolio management: A meta-analysis," *Int. J. Product Develop.*, vol. 16, no. 1, pp. 77–94, 2012.

[7] G. E. Blau, J. F. Pekny, V. A. Varma, and P. R. Bunch, "Managing a portfolio of interdependent new product candidates in the pharmaceutical industry," *J. Product Innov. Manag.*, vol. 21, no. 4, pp. 227–245, 2004.

[8] R. G. Cooper, S. J. Edgett, and E. J. Kleinschmidt, "Portfolio management for new product development: Results of an industry practices study," *R&D Manag.*, vol. 31, no. 4, pp. 361–380, 2001.

[9] R. Balachandra, K. K. Brockhoff, and A. W. Pearson, "R&D project termination decisions: Processes, communication, and personnel changes," *J. Product Innov. Manag.*, vol. 13, no. 3, pp. 245–256, 1996.

[10] E. Biyalogorsky, W. Boulding, and R. Staelin, "Stuck in the past: Why managers persist with new product failures," *J. Marketing*, vol. 70, no. 2, pp. 108–121, 2006.

[11] G. Barczak, A. Griffin, and K. B. Kahn, "Perspective: Trends and drivers of success in NPD practices: Results of the 2003 PDMA best practices study," *J. Product Innov. Manag.*, vol. 26, no. 1, pp. 3–23, 2009.

[12] M. Lerch and P. Spieth, "Innovation project portfolio management: A qualitative analysis," *IEEE Trans. Eng. Manag.*, vol. 60, no. 1, pp. 18–29, Feb. 2013.

[13] L. Kester, A. Griffin, and E. J. Hultink, "An empirical test of the antecedents and consequences of portfolio decision-making effectiveness," presented at the 18th Int. Product Develop. Manag. Conf., Delft, The Netherlands, Jun. 5–7, 2011.

[14] M. Lerch and P. Spieth, "How to boost performance of innovation project portfolio management: An inductive study of success factors and key performance drivers," in *Proc. SMS 31st Annu. Int. Conf.*, Nov. 6–9, 2011, Miami, FL, USA, 2012.

[15] S. Salomo, K. Talke, and N. Strecker, "Innovation field orientation and its effect on innovativeness and firm performance," *J. Product Innov. Manag.*, vol. 25, no. 6, pp. 560–576, 2008.

[16] K. Talke, S. Salomo, and K. Rost, "How top management team diversity affects innovativeness and performance via the strategic choice to focus on innovation fields," *Res. Policy*, vol. 39, no. 7, pp. 907–918, 2010.

[17] K. Talke, S. Salomo, and A. Kock, "Top management team diversity and strategic innovation orientation: The relationship and consequences for innovativeness and performance," *J. Product Innov. Manag.*, vol. 28, no. 6, pp. 819–832, 2011.

[18] C. Urhahn and P. Spieth, "Governing portfolio management for innovative new product portfolios: A conceptual framework," *Int. J. Product Develop.*, vol. 18, no. 5, pp. 377–394, 2013.

[19] O. M. Khessina, "Direct and indirect effects of product portfolio on firm survival in the worldwide optical disk drive industry, "*Adv. Strategic Manag.*, vol. 23, pp. 591–630, 2006.

[20] G. B. Voss, M. Montoya-Weiss, and Z. G. Voss, "Aligning innovation with market characteristics in the nonprofit professional theater industry," *J. Marketing Res.*, vol. 43, no. 2, pp. 296–302, 2006.

[21] J. K. Christiansen and C. Varnes, "From models to practice: Decision making at portfolio meetings," *Int. J. Quality Rel. Manag.*, vol. 25, no. 1, pp. 87–101, 2008.

[22] C. P. Killen and R. A. Hunt, "Dynamic capability through project portfolio management in service and manufacturing industries," *Int. J. Manag. Projects Bus.*, vol. 3, no. 1, pp. 157–169, 2010.

[23] C. P. Killen, R. A. Hunt, and E. J. Kleinschmidt, "Dynamic capabilities: Innovation project portfolio management," presented at the Australia New Zealand Acad. Manag., Sydney, Australia, 2007.

[24] C. P. Killen, K. Jugdev, N. Drouin, and Y. Petit, "Advancing project and portfolio management research: Applying strategic management theories," *Int. J. Project Manag.*, vol. 30, pp. 525–538, 2012.

[25] C. Urhahn and P. Spieth, "Governing portfolio management for innovative new product portfolios—A conceptual framework," *Int. J. Product Develop.*, vol. 18, pp. 377–394, 2013.

[26] R. Müller, M. Martinsuo, and T. Blomquist, "Project portfolio control and portfolio management performance in different contexts," *Project Manag. J.*, vol. 39, no. 3, pp. 28–42, 2008.

[27] R. G. Cooper, S. J. Edgett, and E. J. Kleinschmidt, "Best practices for managing R&D portfolios," *Res. Technol. Manag.*, vol. 41, no. 4, pp. 20–34, 1998.

[28] K. L. Poh, B. W. Ang, and F. Bai, "A comparative analysis of R&D project evaluation methods," *R&D Manag.*, vol. 31, no. 1, pp. 63–75, 2001.

[29] K. Heidenberger and C. Stummer, "Research and development project selection and resource allocation: A review of quantitative modeling approaches," *Int. J. Manag. Rev.*, vol. 1, no. 2, pp. 197–224, 1999.

[30] O. Hughes, "Does governance exist?," in *The New Public Governance? Emerging Perspectives on the Theory and Practice of Public Governance*, S. P. Osborne, Ed. London, U.K.: Routledge, 2010, pp. 87–104.

[31] L. E. Lynn Jr.,"Has governance eclipsed government?," in *The Oxford Handbook of American Bureaucracy*, R. F. Durant, Ed. Oxford, U.K.: Oxford Univ. Press, 2010, pp. 669–690.

[32] K. M. Eisenhardt and J. A. Martin, "Dynamic capabilities: What are they?," *Strategic Manag. J.*, vol. 21, no. 10/11, pp. 1105–1513, 2000.

[33] H.-K. Ellonen, A. Jantunen, and O. Kuivalainen, "The role of dynamic capabilities in developing innovation-related capabilities," *Int. J. Innov. Manag.*, vol. 15, no. 3, pp. 459–478, 2011.

[34] B. Wernerfelt, "A resource-based view of the firm," *Strategic Manag. J.*, vol. 5, no. 2, pp. 171–180, 1984.

[35] J. B. Barney, "Firm resources and sustained competitive advantage," *J. Manag.*, vol. 17, no. 1, pp. 99–120, 1991.

[36] D. J. Teece, G. Pisano, and A. Shuen, "Dynamic capabilities and strategic management," *Strategic Manag. J.*, vol. 18, no. 7, pp. 509–533, 1997.

[37] I. Barreto, "Dynamic capabilities: A review of past research and an agenda for the future," *J. Manag.*, vol. 36, no. 1, pp. 256–280, 2010.

[38] D. Centindamar, R. Phaal, and D. Probert, "Understanding technology management as a dynamic capability: A framework for technology management activities," *Technovation*, vol. 29, no. 4, pp. 237–246, 2009.

[39] I. M. Prieto, E. Revilla, and B. Rodriguez-Prado, "Building dynamic capabilities in product development: How do contextual antecedents matter?," *Scandinavian J. Manag.*, vol. 25, no. 3, pp. 313–326, 2009.

[40] D. J. Collis, "Research note: How valuable are organizational capabilities?," *Strategic Manag. J.*, vol. 15, pp. 143–152, Winter 1994.

[41] C. E. Helfat and M. A. Peteraf, "The dynamic resource-based view: Capability lifecycle," *Strategic Manag. J.*, vol. 24, no. 10, pp. 997–1010, 2003.

[42] S. G. Winter, "Understanding dynamic capabilities," *Strategic Manag. J.*, vol. 24, no. 10, pp. 991–995, 2003.

[43] M. Zollo and S. G. Winter, "Deliberate learning and the evolution of dynamic capabilities," *Org. Sci.*, vol. 13, no. 3, pp. 339–351, 2002.

[44] D. J. Teece, "Explicating dynamic capabilities: The nature and microfoundations of (sustainable) enterprise performance," *Strategic Manag. J.*, vol. 28, no. 13, pp. 1319–1350, 2007.

[45] V. Ambrosini and C. Bowman, "What are dynamic capabilities and are they a useful construct in strategic management?," *Int. J. Manag. Rev.*, vol. 11, no. 1, pp. 29–49, 2009.

[46] S. Salunke, J. Weerawardena, and J. R. McColl-Kennedy, "Towards a model of dynamic capabilities in innovation-based competitive strategy: Insights from project-oriented service firms," *Ind. Marketing Manag.*, vol. 40, no. 8, pp. 1251–1263, 2011.

[47] L. R. Newey and S. A. Zahra, "The evolving firm: How dynamic and operating capabilities interact to enable entrepreneurship," *British J. Manag.*, vol. 20, no. s1, pp. 81–100, 2009.

[48] N. P. Archer and F. Ghasemzadeh, "An integrated framework for project portfolio selection," *Int. J. Project Manag.*, vol. 17, no. 4, pp. 207–216, 1999.

[49] S. E. Fricke and A. J. Shenhar, "Managing multiple engineering projects in a manufacturing support environment," *IEEE Trans. Eng. Manag.*, vol. 47, no. 2, pp. 258–268, May 2000.

[50] A. Kock, "Innovativeness and innovation success—A meta-analysis," *Zeitschrift für Betriebswirtschaft*, vol. 77, no. 2, pp. 1–21, 2007.

[51] D. M. Szymanski, M. W. Kroff, and L. C. Troy, "Innovativeness and new product success: Insights from the cumulative evidence," *J. Acad. Marketing Sci.*, vol. 35, no. 1, pp. 35–52, 2007.

[52] R. K. Chandy and G. J. Tellis, "Organizing for radical product innovation: The overlooked role of willingness to cannibalize," *J. Marketing Res.*, vol. 35, no. 4, pp. 474–487, 1998.

[53] R. J. Garcia and R. Calantone, "A critical look at technological innovation typology and innovativeness terminology: A literature review," *J. Product Innov. Manag.*, vol. 19, no. 2, pp. 110–132, 2002.

[54] S. Meskendahl, "The influence of business strategy on project portfolio management and its success—A conceptual framework," *Int. J. Project Manag.*, vol. 28, no. 8, pp. 807–817, 2010.

[55] H. Gatignon and J.-M. Xuereb, "Strategic orientation of the firm and new product performance," *J. Marketing Res.*, vol. 34, no. 1, pp. 77–90, 1997.

[56] M. V. Tatikonda and M. M. Montoya-Weiss, "Integrating operations and marketing perspectives of product innovation: The influence of organizational process factors and capabilities on development performance," *Manag. Sci.*, vol. 47, no. 1, pp. 151–172, 2001.

[57] E. Naveh, "Formality and discretion in successful R&D projects," *J. Operations Manag.*, vol. 25, no. 1, pp. 110–125, 2007.

[58] A. Persaud, "Enhancing synergistic innovative capability in multinational corporations: An empirical investigation," *J. Product Innov. Manag.*, vol. 22, no. 5, pp. 412–429, 2005.

[59] V. Acha, D. M. Gann, and A. Salter, "Episodic innovation: R&D strategies for project-based environments," *Ind. Innov.*, vol. 12, no. 2, pp. 255–281, 2005.

[60] H.-K. Ellonen, P. Wikström, and A. Jantunen, "Linking dynamic-capability portfolios and innovation outcomes," *Technovation*, vol. 29, no. 11, pp. 753–762, 2009.

[61] R. F. Hurley and G. T. M. Hult, "Innovation, market orientation, and organizational learning: An integration and empirical examination," *J. Marketing*, vol. 62, no. 3, pp. 42–54, 1998.

[62] R. J. Calantone, S. T. Cavusgil, and Y. Zhao, "Learning orientation, firm innovation capability, and firm performance," *Ind. Marketing Manag.*, vol. 31, no. 6, pp. 515–524, 2002.

[63] K. M. Eisenhardt and B. N. Tabrizi, "Accelerating adaptive processes—Product innovation in the global computer industry," *Admin. Sci. Quart.*, vol. 40, no. 1, pp. 84–110, 1995.

[64] A. L. Pablo, T. Reay, J. R. Dewald, and A. L. Casebeer, "Identifying, enabling and managing dynamic capabilities in the public sector," *J. Manag. Studies*, vol. 44, no. 5, pp. 687–708, 2007.

[65] R. J. Calantone, K. Chan, and A. S. Cui, "Decomposing product innovativeness and its effects on new product success," *J. Product Innov. Manag.*, vol. 23, no. 5, pp. 408–421, 2006.

[66] R. K. Chandy and G. J. Tellis, "The incumbent's curse? Incumbency, size, and radical product innovation," *J. Marketing*, vol. 64, no. 3, pp. 1–17, 2000.

[67] K. Z. Zhou, C. K. Yim, and D. K. Tse, "The effects of strategic orientations on technology- and market-based breakthrough innovations," *J. Marketing*, vol. 69, no. 2, pp. 42–60, 2005.

[68] I. L. Sandvik and K. Sandvik, "The impact of market orientation on product innovativeness and business performance," *Int. J. Res. Marketing*, vol. 20, no. 4, pp. 355–376, 2003.

[69] A. B. Sorescu, R. K. Chandy, and J. C. Prabhu, "Sources and financial consequences of radical innovation: insights from pharmaceuticals," *J. Marketing*, vol. 67, no. 4, pp. 82–102, 2003.

[70] G. J. Avlonitis, P. G. Papastathopoulous, and S. P. Gounaris, "An empirically-based typology of product innovativeness for new financial services: Success and failures scenarios," *J. Product Innov. Manag.*, vol. 18, no. 5, pp. 324–342, 2001.

[71] K. Pauwels, J. Silva-Risso, S. Srinivasan, and D. M. Hanssens, "New products, sales promotions, and firm value: The case of the automobile industry," *J. Marketing*, vol. 68, no. 4, pp. 142–156, 2004.

[72] R. Adner, "When are technologies disruptive? A demand-based view of the emergence of competition," *Strategic Manag. J.*, vol. 23, no. 8, pp. 667–688, 2002.

[73] A. B. Sorescu and J. Spanjol, "Innovation's effect on firm value and risk: Insights from consumer packaged goods," *J. Marketing*, vol. 72, no. 2, pp. 114–132, 2008.

[74] A. Ali, "The impact of innovativeness and development time on new product performance for small firms," *Marketing Lett.*, vol. 11. no. 2, pp. 151–163, 2000.

[75] Y. Lee and G. C. O'Connor, "The impact of communication strategy on launching new products: The moderating role of product innovativeness," *J. Product Innov. Manag.*, vol. 20, no. 1, pp. 4–21, 2003.

[76] R. S. Livengood, "Can you hear me now? Examining market discourse as a sense making mechanism of entrepreneurial actions in the U.S. wireless telephone industry, 1998–2007," Ph.D. dissertation, Robert H. Smith School of Business, University of Maryland, College Park, MD, USA, 2010.

[77] K. G. Smith and Q. Cao, "An entrepreneurial perspective on the firm-environment relationship," *Strategic Entrepreneurship J.*, vol. 1, no. 3/4, pp. 329–344, 2007.

[78] M. L. Tushman and P. Anderson, "Technological discontinuities and organizational environments," *Administ. Sci. Quart.*, vol. 31, no. 3, pp. 439–465, 1986.

[79] A. Kock, H. G. Gemünden, S. Salomo, and C. Schultz, "The mixed blessings of technological innovativeness for the commercial success of new products," *J. Product Innov. Manag.*, vol. 28, no. 1, pp. 28–43, 2011.

[80] R. Mascitelli, "From experience: Harnessing tacit knowledge to achieve breakthrough innovation," *J. Product Innov. Manag.*, vol. 17, no. 3, pp. 179–193, 2000.

[81] S. K. McEvily and B. Chakravarthy, "The persistence of knowledge-based advantage: An empirical test for product performance and technological knowledge," *Strategic Manag. J.*, vol. 23, no. 4, pp. 285–305, 2002.

[82] E. Danneels, "The dynamics of product innovation and firm competences," *Strategic Manag. J.*, vol. 23, no. 12, pp. 1095–112, 2002.

[83] M. B. Miles and A. M. Huberman, *Qualitative Data Analysis: An Expanded Sourcebook*. London, U.K.: Sage, 1994.

[84] R. C. McNally, E. Cavusgil, and R. J. Calantone, "Product innovativeness dimensions and their relationships with product advantage, product financial performance, and project protocol," *J. Product Innov. Manag.*, vol. 27, no. 7, pp. 991–1006, 2010.

[85] M. Martinsuo and P. Lehtonen, "Role of single-project management in achieving portfolio management efficiency," *Int. J. Project Manag.*, vol. 25, no. 1, pp. 56–65, 2007.

[86] J. F. Hair, C. M. Ringle, and M. Sarstedt, "PLS-SEM: Indeed a silver bullet," *J. Marketing Theory Practice*, vol. 19, no. 2, pp. 139–151, 2011.

[87] E. Danneels and E. J. Kleinschmidt, "Product innovativeness from the firm's perspective: Its dimensions and their relation with project selection and performance," *J. Product Innov. Manag.*, vol. 18, no. 6, pp. 357–373, 2001.

[88] D. W Vorhies and N. A. Morgan, "Benchmarking marketing capabilities for sustainable competitive advantage," *J. Marketing*, vol. 69, no. 1, pp. 80–94, 2005.

[89] J. Henseler, C. M. Ringle, and R. R. Sinkovics, "The use of partial least squares path modeling in international marketing," in *New Challenges to International Marketing* (Advances in International Marketing), vol. 20, R. R. Sinkovics and P. N. Ghauri, Eds. Bingley, U.K.: Emerald Group Publishing, 2009, pp. 277–319.

[90] W. W. Chin and P. R. Newsted, "Structural equation modeling analysis with small samples using partial least squares," in *Statistical Strategies For Small Sample Research*, R. H. Hoyle, Ed. Thousand Oaks, CA, USA: Sage, 1999, pp. 307–341.

[91] W. J. Reinartz, M. Haenlein, and J. Henseler, "An empirical comparison of the efficacy of covariance-based and variance based SEM," *Int. J. Res. Marketing*, vol. 26, no. 4, pp. 332–344, 2009.

[92] C. M. Ringle, S. Wende, and A. Will 2005, Smart PLS 2.0 (beta.), Univ. of Hamburg, Hamburg, Germany, [Online]. Available: http://www.smartpls.de

[93] W. W. Chin, "The partial least squares approach to structural equation modeling," in *Modern Methods For Business Research*, G. A. Marcoulides, Ed. Mahwah, NJ, USA: Lawrence Erlbaum, 1998, pp. 295–358.

[94] M. Tenenhaus, V. E. Vinzi, Y.-M. Chatelin, and C. Lauro, "PLS path modeling: Partial least squares," *Comput. Statist. Data Anal.*, vol. 48, no. 1, pp. 159–205, 2005.

[95] B. Efron and R. J. Tibshirani, *An Introduction to the Bootstrap*. New York, NY, USA: Chapman & Hall, 1993.

[96] J. Hulland, "Use of partial least squares (PLS) in strategic management research: A review of four recent studies," *Strategic Manag. J.*, vol. 20, no. 2, pp. 195–204, 1999.

[97] J. F. Hair, M. Sarstedt, C. M. Ringle, and J. A. Mena, "An assessment of the use of partial least squares structural equation modeling in marketing research," *J. Acad. Marketing Sci.*, vol. 40, no. 3, pp. 414–433, 2012.

[98] M. Wetzels, G. Odekerken-Schroder, and C. van Oppen, "Using PLS path modeling for assessing hierarchical construct models: Guidelines and empirical illustration," *MIS Quart.*, vol. 33, no. 1, pp. 177–195, 2009.

[99] C. Fornell and D. F. Larcker, "Structural equation models with unobservable variables and measurement error: Algebra and statistics," *J. Marketing Res.*, vol. 18, no. 3, pp. 328–388, 1981.

[100] O. Götz, K. Liehr-Gobbers, and M. Krafft, "Evaluation of structural equation models using the partial least squares (PLS) approach," in *Handbook of partial least squares: Concepts, methods, and Applications*, V. E. Vinzi, W. W. Chin, J. Henseler, and H. Wang, Eds. Berlin, Germany: Springer-Verlag, 2010.

[101] S. Geisser, "A predictive approach to the random effect model," *Biometrika*, vol. 61, no. 1, pp. 101–107. 1974.

[102] M. Stone, "Cross-validatory choice and assessment of statistical predictions," *J. Royal Statist. Soc., Series B*, vol. 36, no. 2, pp. 111–133, 1975.

[103] N. Acur, D. Kandemir, P. C. de Weerd-Nederhof, and M. Song, "Exploring the impact of technological competence development on speed and NPD program performance," *J. Product Innov. Manag.*, vol. 27, no. 6, pp. 915–929, 2010.

[104] E. M. Rogers, *Diffusion of innovations*. New York, NY, USA: Free Press, 2003.

[105] S. Ram and H.-S. Jung, "Forced adoption of innovations in organizations: Consequences and implications," *J. Product Innov. Manag.*, vol. 8, no. 2, pp. 117–126, 1991.

[106] G. J. Avlonitis and H. E. Salavou, " Entrepreneurial orientation of SMEs, product innovativeness, and performance," *J. Bus. Res.*, vol. 60, no. 5, pp. 566–575, 2007.

[107] A. E. Akgün, H. Keskina, J. C. Byrne, and S. Aren, "Emotional and learning capability and their impact on product innovativeness and firm performance," *Technovation*, vol. 27, no. 9, pp. 501–513, 2007.

[108] C. Droge, R. Calantone, and N. Harmancioglu, "New product success: Is it really controllable by managers in highly turbulent environments?," *J. Product Innov. Manag.*, vol. 25, no. 3, pp. 272–286, 2008.

[109] H.-J. Cho and V. Pucik, "Relationship between innovativeness, quality, growth, profitability, and market value," *Strategic Manag. J.*, vol. 26, no. 6, pp. 555–575, 2005.

[110] P. M. Podsakoff, S. B. Mackenzie, J.-Y. Lee, and N. P. Podsakoff, "Common method biases in behavioral research: A critical review of the literature and recommended remedies," *J. Appl. Psychol.*, vol. 88, no. 5, pp. 879–903, 2003.

[111] C. B. Jarvis, S. B. Mackenzie, P. M. Podsakoff, D. G. Mick, and W. O. Bearden, "A critical review of construct indicators and measurement model misspecification in marketing and consumer research," *J. Consum. Res.*, vol. 30, no. 2, pp. 199–218, 2003.

[112] Y. Petit, "Project portfolios in dynamic environments: Organizing for uncertainty," *Int. J. Project Manag.*, vol. 30, pp. 539–552, 2012.

**Christian Urhahn** received the Doctoral degree from EBS Universität, Oestrich-Winkel, Germany, in 2013.

His research interests include innovativeness and innovation success, as well innovation project portfolio management.

**Patrick Spieth** received the Doctoral degree from the University of Kassel, Kassel, Germany.

From 2013, he is with the University of Kassel. He is Interim Full Professor for Innovation and Technology Management at the Faculty of Business Studies. Since 2010, he is an Assistant Professor for Innovation Management at EBS Business School. He had Visiting Positions at Arizona State University, Department of Management, as well as at Copenhagen Business School, Department of Innovation and Organizational Economics. His research interests include business model innovation, innovativeness and innovation success, innovation project portfolio management, and innovation networks.