A Contingency Approach on the Impact of Front-End Success on Project Portfolio Success

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PAPERS

A Contingency Approach on the Impact of Front-End Success on Project Portfolio Success

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ABSTRACT

The pre-project or ideation phase is often disregarded in project portfolio management. Senior managers put more emphasis on later project stages, and researchers predominantly investigate the front end from a single project perspective. This study investigates how and under which circumstances the performance of the front end affects project portfolio success. Using a sample of 175 firms, we confirm a strong positive relationship between front-end success and project portfolio success. Results show that this effect becomes stronger for larger project portfolios, for portfolios with more interdependency between projects and, finally, for firms that have a strategic orientation toward riskiness.

KEYWORDS: front-end success; project portfolio success; turbulence; riskiness; complexity; project portfolio management

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INTRODUCTION

A major trend in today's business environment is "projectification"—the tendency to carry out more and more tasks in project-organized undertakings (Maylor, Brady, Cooke-Davies, & Hodgson, 2006; Midler, 1995; Packendorff & Lindgren, 2014). Projects and project portfolios gain in importance in the upper echelon agenda. A holistic view on the multitude of projects becomes one of the major topics for organizations striving for competitive advantage, and successful project portfolio management increasingly determines sustainable business success (Meskendahl, 2010).

Although project portfolio success and eventually company success have many antecedents (Kester, Hultink, & Griffin, 2014; Martinsuo, 2013; Meifort, 2015), one of the major sources for success is a company's ability to innovate (Eisenhardt & Martin, 2000; Wheelwright & Clark, 1992). Not surprisingly, new product development success has been elaborated in depth in the last decades (Evanschitzky, Eisend, Calantone, & Jiang, 2012; Kock, Gemünden, Salomo, & Schultz, 2011; Salomo, Weise, & Gemünden, 2007; Sicotte, Drouin, & Delerue, 2014). Although front-end activities are recognized as a driver for successful product launches and business success (Cooper, 1988; Martinsuo & Poskela, 2011; Pinto & Slevin, 1989; Poskela & Martinsuo, 2009; Reid & de Brentani, 2012; Verworn, 2009; Williams & Samset, 2010), CEOs and senior management prefer to enter the arena in later development stages (Cooper, Edgett, & Kleinschmidt, 2004). Surprisingly, also in academic research, ideation and front-end activities are not the main focus in the literature (Page & Schirr, 2008; Williams & Samset, 2010), and studies investigating the consequences of a successful front-end are scarce (Kock, Heising, & Gemünden, 2015). Thus, our current understanding of the impact of front-end success on project portfolio success remains vague. One of the reasons for this lack of research may be the fact that front-end success is rather difficult to measure (Manion & Cherion, 2009) and only few quantitative studies have assessed front-end success on the project (Martinsuo & Poskela, 2011) or the portfolio level (Kock et al., 2015).

Studies analyzing the front end usually deal with it in a conceptual manner (Khurana & Rosenthal, 1997; Kim & Wilemon, 2002; Koen et al., 2001; Smith & Reinertsen, 1991), and quantitative research is limited. Moreover, most studies investigate either the process setting and do not look at success of the front end itself or they have a single project view on a specific innovation. A portfolio view on ideation is neglected (Heising, 2012)—a connection

between the front end and project portfolio management is rarely within the scope of contributions in academic research. Khurana and Rosenthal (1997) point out that there is often a discontinuity between front-end processes and portfolio management and argue for a need to adopt a holistic view.

More importantly, the conditions under which front-end performance affects project portfolios have never been addressed in previous research. While the idea that portfolio performance depends on the quantity and quality of ideas for project proposals seems likely (Kock et al., 2015), we do not know which environmental, firm, or portfolio characteristics affect the relationship between front-end performance and eventual project portfolio success.

Based on an integration of literature from innovation and project portfolio management, the current study addresses the following research question: Under which circumstances do project portfolios profit more (or less) from a strong idea pipeline (i.e., high front-end success)? This research question considers that different context factors, as well as different integration mechanisms of ideation portfolios may influence the impact of the front end on the success of a project portfolio. Such a contingency approach is needed to better understand the complex performance, inducing mechanisms, which link the early front end with the rather late project implementation stage (for contingency approaches in project management research see Hanisch & Wald, 2012).

This study contributes to the literature in project and innovation management in the following ways: First, we empirically investigate the relationship between front-end success and project portfolio success using a large cross-industry sample of firms with multiple informants. Second, we address several contingency factors of this relationship and investigate the moderating effects stemming from the firm's environment (market and technological turbulence), the firm's strategic orientation (riskiness), and characteristics of the portfolio (size and project interdependency). This research thus broadens our understanding of the relationship between innovation and project portfolio management and provides guidance for practitioners and academics alike: For portfolio managers the results highlight the importance of paying attention especially to the front end of innovation, when actual projects have not yet been defined. For researchers, this article provides proof of the predictive relevance of the construct front-end success for portfolio performance. Furthermore, the findings show important contingency factors that demonstrate under which conditions front-end success is especially important.

Conceptual Background

Ideation and the Success of the Front End

Front end is a general term used for the somewhat unstructured period between the proverbial "blank sheet of paper," up to the project proposal. Smith and Reinertsen (1991) introduced the term "fuzzy front end" for this phase. The front end is characterized by a large degree of uncertainty (Kim & Wilemon, 2002). Several scholars analyzed how this front end looks like: Khurana and Rosenthal (1998) suggest that the fuzzy front end comprises product strategy formulation and communication, opportunity identification and assessment, idea generation, product definition, project planning, and early executive reviews. Nobelius and Trygg (2002) identify six components of the front-end process following the opportunity identification: mission statement, concept generation, concept screening, concept definition, business analysis, and project planning. According to Kim and Wilemon (2002, p. 270) the front end begins "when an opportunity is first considered worthy of further ideation, exploration, and assessment and ends when a firm decides to invest in the idea, commit significant resources to its development, and launch the project." Koen et al. (2001) described this period as characterized by those activities and actions that take place prior to any well-structured and formal new product development process.

One of the critical activities in this pre-project phase is ideation (Spanjol, Qualls, & Rosa, 2011). The ideation process has to ensure that a sufficient number of ideas are generated and further elaborated to crystallize new project concepts. Moreover, evaluation and selection mechanisms have to be installed to choose the most promising concepts to formally become projects. Scholars state that especially the ideation phase and the front ends of projects have significant strategic relevance for the success of projects, project portfolios, and eventually the organization at large (Zhang & Doll, 2001). A majority of projects fail in the beginning—here mistakes tend to have the most sustainable impact. The right activities at the beginning of the project funnel can lead to the biggest savings at least cost (Reid & de Brentani, 2004; Verworn, 2009). Surprisingly, ideation does not play a dominant role in the literature on new product development projects. In an extensive meta-analysis of the top journal innovation literature, Page and Schirr (2008) report that only 5% of the identified innovation research has dealt with ideation and creativity.

Despite these approaches, success of the actual front end or ideation phase itself is rarely in the scope of scientific literature (Heising, 2012; Kock et al., 2015). The existing literature is usually conceptual in nature and does not approach this field empirically (Khurana & Rosenthal, 1998; Kim & Wilemon, 2002). Front-end success is often blurred by looking at the overall innovation success or the rate of successful new product introductions. But taking such a success measure does not account for the specific role of the front end in the overall project portfolio process. If an organization is able to successfully launch a new product,

this is not only the merit of a successful front end but also of successful development project portfolio management and several other factors (Jonas, Kock, & Gemünden, 2013; Müller, Martinsuo, & Blomquist, 2008). This implies that a successful front end does not necessarily guarantee that the project will be successful or, vice versa, that every successful project also had a successful front end. Thus, we state that front-end success can be evaluated according to the quantity and quality of implementable ideas and according to the characteristics of the front-end process. It is important to note that the number of implementable ideas is not necessarily equal to the amount of implemented ideas, because there are manifold reasons why even the best ideas can and should be stopped during the later phases of project execution (Meyer, 2014; Unger, Kock, & Gemünden, 2012). We translate this rather broad definition into three dimensions for success measurement (Kock et al., 2015; Verworn, Herstatt, & Nagahira, 2008): *Effectiveness, timeliness,* and *efficiency* of the front end.

To assess the effectiveness of the front end we suggest determining if a sufficient amount of *good* ideas are generated in the ideation stage (Reinig, Briggs, & Nunamaker, 2007). Besides the sheer number of ideas, the potential for value generation can be assessed along the lines of the following questions. How much revenue increase is likely to be realized with the current front-end pipeline within the next couple of years? Is the current pipeline likely to strengthen the competitive positioning of the firm (Bertels, Kleinschmidt, & Koen, 2011; Ernst & Kohn, 2007)? Evaluating front-end timeliness and front-end efficiency is more straightforward: these measures deal with the speed and productivity of the system; in other words, how fast ideas are screened and converted into concepts and eventually project proposals, and how well the scarce financial and personnel resources are utilized (Kock et al., 2015).

Project Portfolio Management

Once an idea has evolved through the ideation process and passes the *money gate*—the point in time at which an idea turns into a project and receives considerable resources—it is managed as a project within one of the organization's project portfolios. A project portfolio is a collection of single projects that compete for the same resources and are carried out under the management of a specific organization (Archer & Ghasemzadeh, 1999). Project portfolio management can be seen as those actions and activities that allow an organization to select, develop, and commercialize a pipeline of new projects that are in line with the organization's strategy and that will enable it to sustainably grow further (Jonas et al., 2013; Korhonen, Laine, & Martinsuo, 2014). Its ultimate goal is to maximize the contribution of projects to corporate success. Therefore, project portfolio management can be interpreted as the concurrent management of the set of projects that reflect the investment strategy of an organization (Dye & Pennypacker, 1999; Meskendahl, 2010; Patanakul & Milosevic, 2009).

Objectives of project portfolio management are rather well established in the project management literature. The main themes are maximization of portfolio value, a link to strategy, and balancing the projects within the portfolio in consideration of the firm's capacities (Cooper, Edgett, & Kleinschmidt, 2001; Jonas et al., 2013; Killen, Hunt, & Kleinschmidt, 2008; Martinsuo & Killen, 2014; Martinsuo & Lehtonen, 2007). We follow established definitions of project portfolio success that conceptualize it along five dimensions (Jonas et al., 2013; Teller, Kock, & Gemünden, 2014; Teller, Unger et al., 2012; Voss & Kock, 2013): *business success* focuses on the impact of the portfolio on the firm's economic performance; *average success of project results* addresses this issue on the individual product level; *strategic fit* corresponds to the degree to which all projects combined reflect and are consistent with the firm's strategy; *portfolio balance* addresses the strategic perspective of balancing risk and innovativeness within the portfolio; and, finally, *preparing for the future* addresses the long-term opportunities and benefits for the firm that are created in the project portfolio.

Framework and Hypotheses

The conceptual framework in Figure 1 depicts the relationship between front-end success and project portfolio success. We draw on contingency theory (Donaldson, 2001), which has been widely applied in project management (Hanisch & Wald, 2012), and propose that the strength of the relationship depends on external and internal

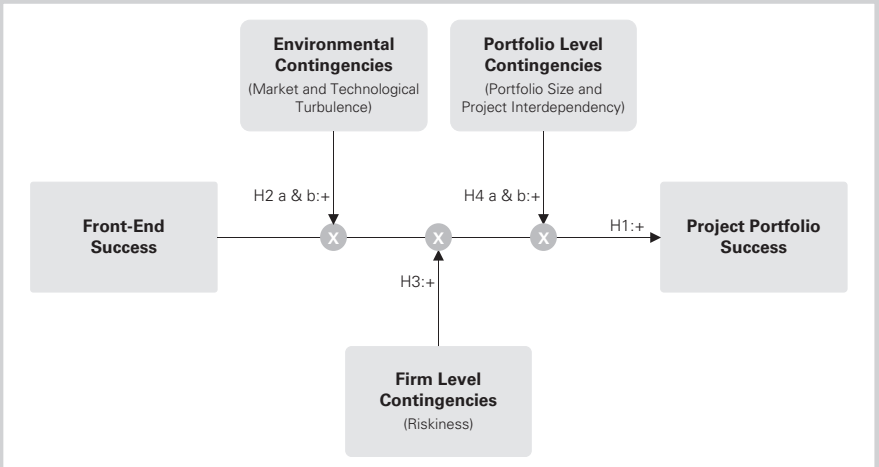

Figure 1: Research framework with hypothesized main and moderating effects.

factors. We argue that front-end success is a necessary determinant of project portfolio success, but the actual benefits of front-end success depend on the task at hand, the environment, and the corporate mindset as well as additional measures taken by management to support the exploitation of promising project candidates. A multitude of potential contingency factors exists. Donaldson (2001) argues that in task-related contingency theory two dominant themes prevail: One stream builds on uncertainty and the other elaborates the consequences of interdependence (Thompson, 1967). With respect to uncertainty, we concentrate on environmental factors such as market and technology turbulence. We interpret interdependence as a portfolio level contingency factor and consider the interdependence between projects as well as the size of the portfolio. Finally, we consider aspects of entrepreneurial orientation, in particular riskiness, as a firm level contingency that is argued to be necessary to actually seize opportunities created in the front end. In the following sections, we argue in detail for the proposed hypotheses.

Front-End Success and Project Portfolio Success

There is support for a positive link between a successful front end and overall success in previous literature (Kock et al., 2015). For Khurana and Rosenthal (1998), the key to product development success lies in the front-end activities. We follow this view and argue that activities and decisions of the front end are the starting point for the subsequent development processes and therefore are the source for competitive advantage. Especially in the portfolio management context it is important to consider the front end (Heising, 2012). The portfolio management process does not just start with the prioritization of project proposals or resource allocation to projects. In fact, these project proposals have to be fed by the right ideas that have to be generated much earlier. Front-loading activities are beneficial, because relatively low efforts have great leverage to facilitate later success. A significant proportion of eventual production costs is already defined in the early stages. If more high-qualitative ideas are available for selection, structuring of the portfolio will be improved, as more and better options to influence the results of project portfolio management are established and the potential for innovation can be built up. This argumentation is in line with previous academic contributions: In their conceptual paper on the front end, Reid and de Brentani (2004) see the front end as the root for success for organizations. Cooper and co-authors empirically confirmed in their studies that effective front-end activities and *up-front homework* directly contribute to new product success (Cooper, 1988). Verworn (2009) also empirically shows the positive impact of the front end on single project success. Finally, Kock et al. (2015) show the high relevance for successful ideation in project portfolio management. Based on this line of argumentation and previous empirical results, we propose our base hypothesis:

> *Hypothesis 1: Front-end success is positively related to project portfolio success.*

Environmental Contingency Factors

Innovation projects—especially in the front end—face several uncertainties from the environment (Danneels & Kleinschmidt, 2001; Poskela & Martinsuo, 2009). External turbulence is mainly triggered by market and technology uncertainties. Nevertheless, "there are only a few studies reported on the dynamics of multi-project settings and how management tries to coordinate the portfolio in action" (Engwall & Jerbrant, 2003, p. 404). Uncertainty rooted in market or technology turbulence is often chosen as a contingency variable in the literature when analyzing performance (Danneels & Kleinschmidt, 2001; Koufteros, Vonderembse, & Jayaram, 2005; Langerak, Hultink, & Robben, 2004; Poskela & Martinsuo, 2009). This choice of contingency factor can also be underpinned by dynamic capabilities theory (Teece, Pisano, & Shuen, 1997). In their seminal work, Teece et al. (1997, p. 516) define dynamic capabilities "as the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments." Thus, an organization has to be able to change its resource combinations to adequately adapt to a turbulent environment in striving for competitive advantage and success. Eisenhardt and Martin (2000) explicitly identify product development as such a dynamic capability. Some authors have suggested that project portfolio management constitutes a dynamic capability (Killen, Jugdev, Drouin, & Petit, 2012; Martinsuo, Korhonen, & Laine, 2014; Petit & Hobbs, 2010). In an ideation and portfolio context that means that the thorough selection and compilation of the organization's idea pipeline and thus its front-end success become even more important in a turbulent environment. In a turbulent environment an organization has to be able to innovate faster to successfully stay in business; therefore, the number of high-quality ideas and the speed of idea processing from idea to concept to project proposal gain in importance under turbulent conditions. Thus, we posit the following:

> *Hypothesis 2: The positive impact of front-end success on project portfolio success is higher when (a) market and (b) technological turbulence is high (positive moderation).*

Firm Level Contingency Factors

Entrepreneurship literature discusses the necessity to choose an entrepreneurial rather than an orchestrated approach to ideation when it comes to radical ideas and opportunities (Covin & Miles, 2007). The exploitation of new ideas and the pursuit of new market opportunities imply an entrepreneurial orientation of the organization (Talke, 2007). Entrepreneurial orientation refers to processes and policies that provide the basis for

new entry opportunities (Lumpkin & Dess, 1996). For Talke (2007, p. 77) "entrepreneurial orientation is understood as a corporate posture toward entrepreneurial behavior, for example, the pursuit of new market opportunities, which has shown to have an impact on innovation activities and ultimately performance." Miller (1983) proposed three components to characterize entrepreneurship: innovativeness, risk taking, and proactiveness; thus, entrepreneurial orientation describes the willingness to engage in novel services and products, pursue risky and new ventures, and come up first with proactive initiatives (Miller, 1983).

While the importance of entrepreneurial orientation is widely acknowledged in the literature (Lumpkin & Dess, 1996; Miller, 1983), the empirical findings are mixed regarding the performance-enhancing effects of entrepreneurial orientation. Depending on the context, not all components of entrepreneurial orientation may be necessary for the pursuit of new opportunities (Lumpkin & Dess, 1996). Venkatraman (1989, p. 949) defined proactiveness as "seeking new opportunities which may or may not be related to present line of operations, introductions of new products and brands ahead of competition, strategically eliminating operations which are in the mature or declining stages of life cycle." Following (Lumpkin & Dess, 1996, p. 142), innovativeness is "a firm's tendency to engage in and support new ideas, novelty, experimentation, and creative processes that may result in new products, services, or technological processes." In the context of this study, innovativeness and proactiveness are implicitly accounted for in the construct front-end success, which is why we do not consider these dimensions of entrepreneurial orientation as additional contingency factors. We rather concentrate on the remaining component: *riskiness*. Following Venkatraman (1989, p. 949), "this dimension captures the extent of riskiness reflected in various resource allocation decisions as well as choice of products and markets." We consider riskiness in the context of this article not as an individual trait, but rather as a construct on the organizational level.

Typically, ideation involves taking risks, because its outcome is unknown. Thus, this study investigates the effects of riskiness on the relationship between front-end success and project portfolio success. We explore whether organizations that are willing to take risks can leverage their front-end performance more successfully in turning it into project portfolio success than risk-averse organizations. Risk taking describes the affinity of pursuing new and unknown ventures or committing a vast amount of resources to uncertain projects where the output could be dubious and costly failure could result (Lumpkin & Dess, 1996; Miller, 1983). In return, risky ventures may obtain higher returns as they may seize opportunities in the marketplace (Lumpkin & Dess, 1996).

Empirical results on the effects of riskiness are mixed. Some studies suggest that riskiness positively influences performance (Lumpkin & Dess, 1996). Others argue for a negative impact of riskiness on performance (Talke, 2007; Venkatraman, 1989). Riskiness may enable the organization to fully exploit new ideas and to explore new opportunities. Consequently, more ideas may be implemented. This is crucial as it is not sufficient to solely identify ideas, but to implement them as well. The implementation of new ideas enables the organization to launch new products and services, which gives it differentiation potential from other competitors and, therefore, competitive advantage. Risk and opportunity lie closely together: a tendency to take risks may encourage a faster implementation of ideas and an efficient use of resources, because a venturesome organization may decide more quickly. Consequently, we posit the following hypothesis:

> *Hypothesis 3: The positive impact of front-end success on project portfolio success is higher if the strategic orientation of the firm is characterized by high riskiness (positive moderation).*

Portfolio Level Contingency Factors

The management challenges to keeping a project portfolio on its road to success increase significantly the more projects are managed within the portfolio and the more distinct interactions between the projects exist (Teller et al., 2012). These interdependencies can result from resource competition or direct dependencies (Archer & Ghasemzadeh, 1999). Not surprisingly, the concepts of project portfolio size and project interdependency can be found in the literature as contingency factors for complexity in project portfolio management (Teller et al., 2012, 2014; Voss & Kock, 2013). Nobeoka and Cusumano (1994), for example, stress the importance of project interdependency as a contingency factor when evaluating the impact on performance. We argue that with higher project interdependency and increasing portfolio size, a strong idea pipeline, in other words, high front-end success, becomes even more essential to achieving project portfolio success, because with increasing complexity a sound basis for decision making within the project portfolio management becomes increasingly important. The higher front-end success is, the more and better options are built up and the organization can put together the right set of projects. The better these options are, the better the company is positioned. In light of this argumentation we suggest the following hypothesis:

> *Hypothesis 4: The positive impact of front-end success on project portfolio success is higher if (a) portfolio size and (b) project interdependency is high (positive moderation).*

Method

Sample

This study was part of a large-scale study on the best practices in project portfolio management. We tested

our hypotheses with a cross-industry sample of 175 project portfolios and only included organizations that actually ran several projects simultaneously. We identified two informants for each analyzed portfolio—one from senior management and one project portfolio coordinator. Participating senior managers (e.g., CEO, head of business unit) usually had decision authority over the company's or business unit's project portfolio concerning initiation, termination, or reprioritization of projects. Project portfolio coordinators (e.g., head of the PMO, portfolio manager) were typically responsible for actively managing the project portfolio. This dual-informant design on two different management levels was chosen for two reasons: (1) to obtain a broader picture of the processes, information flows, and responsibilities of the analyzed portfolios, and (2) to mitigate the problem of common method bias (Podasakoff, MacKenzie, Lee, & Podasakoff, 2003), because in each firm the coordinator informant assessed the independent variable and the senior management informant assessed the dependent variable. The number of fully completed matched pairs of questionnaires that could be used for our analysis was 175. The sample contained organizations from various industries and of varying sizes from less than 500 employees up to well more than 100,000 employees. The sample incorporated organizations from various industries: manufacturing (27%), financial services (19%), information and communication technologies (18%), energy and infrastructure (10%), pharmaceuticals and chemicals (9%), and other service business (17%).

Measurement

We based our variables on multi-item scales, which were taken from recent literature on innovation and project portfolio management. Unless otherwise stated, the items were measured on a 7-point Likert scale ranging from 1 ("strongly disagree") to 7 ("strongly agree"). We validated our item scales by applying principal components factor analysis (PCFA), followed by confirmatory factor analysis (CFA) (Ahire & Devaraj, 2001). PCFA checks for the unidimensionality of each scale by investigating whether all items load on a single factor (i.e., only one eigenvalue larger than one). Cronbach's alpha was used to evaluate scale reliability (acceptable values are larger than 0.7). Finally, a CFA was conducted to confirm the measurement model and the second-order latent factor structure of the independent and dependent variables. We assessed the model fit following the criteria of Hu and Bentler (1998) in that a comparative fit index (CFI) above 0.90 and a standardized root-mean-square residual (SRMR) below 0.08 were considered acceptable. A detailed list of used items and their statistics can be found in the Appendix. All scales fulfill the above criteria and can therefore be considered satisfactory.

Dependent Variable

We measured project portfolio success as a second-order construct with the following dimensions taken from the literature (Jonas et al., 2013; Teller & Kock, 2013; Teller et al., 2012, 2014; Voss & Kock, 2013): Business success of the firm/business unit (four items), average success of project results (four items), strategic fit (three items), portfolio balance (three items), and preparing for the future (three items). The senior management informant assessed project portfolio success.

Independent Variable

Front-end success was assessed as a second-order construct along the constructs front-end effectiveness (four items), front-end timeliness (three items), and front-end efficiency (three items). These items were taken from Kock et al. (2015). The project portfolio coordinator informant assessed front-end success.

Moderators

Environmental contingency factors were measured by two constructs based on Jaworski and Kohli (1993): market turbulence, consisting of four items, and technological turbulence, consisting of four items. The senior management informant assessed both constructs. At the firm level, we measured the riskiness dimension of strategic orientation using three items that capture the willingness to engage in risky projects. The items were based on (Talke, 2007) and Venkatraman (1989). The senior manager assessed riskiness. At the portfolio level, portfolio size was captured using the natural logarithm of the annual portfolio budget in M€ (Unger et al., 2012). Project interdependency was measured with a construct containing six items based on Teller et al. (2012). With this construct we analyzed how strongly the projects influence and depend on each other. Project portfolio size and project interdependency were assessed by portfolio coordinator informants.

Controls

Several control factors had to be considered to eliminate any distorting effects and to isolate the predictive influence of front-end success. We accounted for four factors. First, we included the industry sector of the company since our study contains businesses from different industries. We clustered the participating organizations into six industry sectors: manufacturing, financial services, information and communication technologies, pharmaceuticals and chemicals, energy, and other service businesses. Second, we controlled for the size of the participating organization. We chose organization size as the natural logarithm of the number of employees in the organization or business unit. As organizations grow, structural rigidity and inertia forces might affect the ability of the company to innovate; therefore, the size of the organization is an important variable to control for in the ideation and project portfolio environment. Third, we checked the percentage of internal projects (ranging from 0 to 1 = 100%) in contrast to client projects. This internal

Variables	M	SD	1	2	3	4	5	6	7	8	9
1. Project Portfolio Success	4.95	0.71	1.00								
2. Front-End Success	4.53	0.93	0.47*	1.00							
3. Firm Size (ln)	7.17	2.12	–0.03	–0.01	1.00						
4. Internal Project Ratio	0.65	0.35	–0.03	0.05	0.21*	1.00					
5. R&D Project Ratio	0.40	0.38	0.08	0.15*	–0.05	0.12	1.00				
6. Portfolio Size (ln)	3.59	1.71	–0.01	0.05	0.60*	–0.12	–0.13	1.00			
7. Project Interdependency	4.60	1.00	0.05	–0.02	0.02	0.07	0.06	0.02	1.00		
8. Technological Turbulence	4.41	1.32	0.25*	0.06	–0.08	–0.10	0.02	–0.12	–0.06	1.00	
9. Market Turbulence	3.43	0.95	0.00	0.04	–0.16*	–0.18*	–0.05	–0.15*	–0.13	0.36*	1.00
10. Riskiness	4.38	1.16	0.07	0.08	0.01	–0.03	0.14	0.03	0.06	0.13	0.23*

*$p < 0.05$; n = 175; M = mean; SD = standard deviation.

Table 1: Descriptive statistics and correlation table of research variables.

project ratio serves as an approximation for the composition of the portfolio, as internal projects follow different rules-of-the-game than external client projects (Müller et al., 2008; Voss & Kock, 2013). Fourth, we included percentage of NPD projects (from 0 to 1 = 100%) to control for potential distorting effects of the portfolio type (Teller et al., 2014; Voss & Kock, 2013). Table 1 shows the descriptive statistics and correlations of the variables of the research framework.

Results

The hypotheses were tested with hierarchical ordinal least squares regression. Contingency effects were analyzed using the procedures of Aiken, West, and Reno (1991). Variables were first mean-centered. Then the product term of the independent variable front-end success with the respective moderator was included in a new model. This model was then compared with the previous model without interaction term. If the coefficient and the increase in explained variance were both significant, a moderating effect was assumed. Significant interaction effects were further investigated by simple slope analysis in order to illustrate the nature of the effect. Simple slopes were calculated for a standard deviation above and below the mean of the moderator variable.

Table 2 shows the results for different models. Model 0 contained only control and moderator variables. Model 1 included the direct effect of front-end success. The unstandardized regression coefficient was significantly positive ($b = 0.34$, $p < 0.01$), supporting hypothesis 1. The overall model was significant and explained 35% of the variance in project portfolio success. This result is highly satisfactory, considering the fact that we used different informants for independent and dependent variables.

The subsequent models tested the interaction effects of contingency variables with front-end success. Models 2a and 2a investigated the moderation effects of technological and market turbulence, respectively. Surprisingly, both interaction coefficients were not significant, so hypotheses 2a and 2b could not find support. Contrary to expectations, the relevance of a successful front end for portfolio success does not increase in more turbulent environments.

Model 3 shows the impact of riskiness on the relationship between front-end success and portfolio success. The results support hypothesis 3 in that with increasing willingness to take risks, the positive effect of front-end success increased ($b = 0.10$, $p < 0.01$). The simple slopes in Figure 2 show that also for low riskiness a successful front end was beneficial for portfolio success; however, the benefits were larger for firms with higher willingness to take risks.

Portfolio size had a significant and positive interaction effect (Model 4a, $b = 0.08$, $p < 0.05$) and the increase in explained variance was significant. This result supports hypothesis 4a in that with increasing size, the positive effect of front-end success on portfolio success increases. Figure 3 shows that for smaller portfolios the effect was still positive but significantly weaker than for larger portfolios.

Finally, Model 4b shows that project interdependency also positively moderated the relationship between front-end success and portfolio success, supporting hypothesis 4b ($b = 0.12$, $p < 0.01$). The relationship and the effect of project interdependency are visualized in Figure 4. The simple slope graph shows that this effect resembles the effect of portfolio size.

Discussion

This article aims at linking the literature on project portfolio and innovation management by investigating the relationship between front-end success and project portfolio success. In line with the previous contributions of front-end literature on the single project level (Reid & de Brentani, 2004), the results of the current study show that front-end success is highly important

	Project Portfolio Success						
Independent Variables	**(0)**	**(1)**	**(2a)**	**(2b)**	**(3)**	**(4a)**	**(4b)**
Firm Size	–0.02	0.00	0.00	0.00	0.01	–0.01	0.01
Internal Project Ratio	–0.01	–0.10	–0.10	–0.11	–0.13	–0.10	–0.13
R&D Project Ratio	–0.24	–0.29*	–0.29†	–0.27†	–0.28†	–0.30*	–0.28†
Portfolio Size	0.01	–0.02	–0.02	–0.02	–0.04	–0.04	–0.02
Project Interdependency	0.02	0.03	0.03	0.03	0.01	0.04	0.02
Technological Turbulence	0.15**	0.13**	0.13**	0.13**	0.13**	0.13**	0.13**
Market Turbulence	–0.05	–0.07	–0.07	–0.07	–0.08	–0.07	–0.07
Riskiness	0.00	0.00	0.00	0.00	0.00	–0.01	–0.01
Industry Controls (5 Dummies)	incl.	incl.	incl.	incl.	incl.	incl.	incl.
Front-End Success (FES)		0.34**	0.34**	0.33**	0.35**	0.33**	0.32**
FES × Technological Turbulence			–0.03				
FES × Market Turbulence				–0.03			
FES × Riskiness					0.10**		
FES × Portfolio Size						0.08*	
FES × Project Interdependency							0.12**
Constant	4.71**	4.79**	4.80**	4.81**	4.76**	4.77**	4.83**
R^2	0.17	0.35	0.35	0.35	0.38	0.37	0.37
Delta R^2		0.18**	0.00	0.00	0.03**	0.02*	0.02*
Adjusted R^2	0.10	0.29	0.29	0.29	0.32	0.31	0.31
F	2.49**	6.13**	5.74**	5.71**	6.40**	6.25**	6.17**

Hierarchical regression models with project portfolio success as the dependent variable; unstandardized regression coefficients are reported; all variables are mean-centered; †$p<0.10$; *$p<0.05$; **$p<0.01$; n = 175; FES = front-end success.

Table 2: Results.

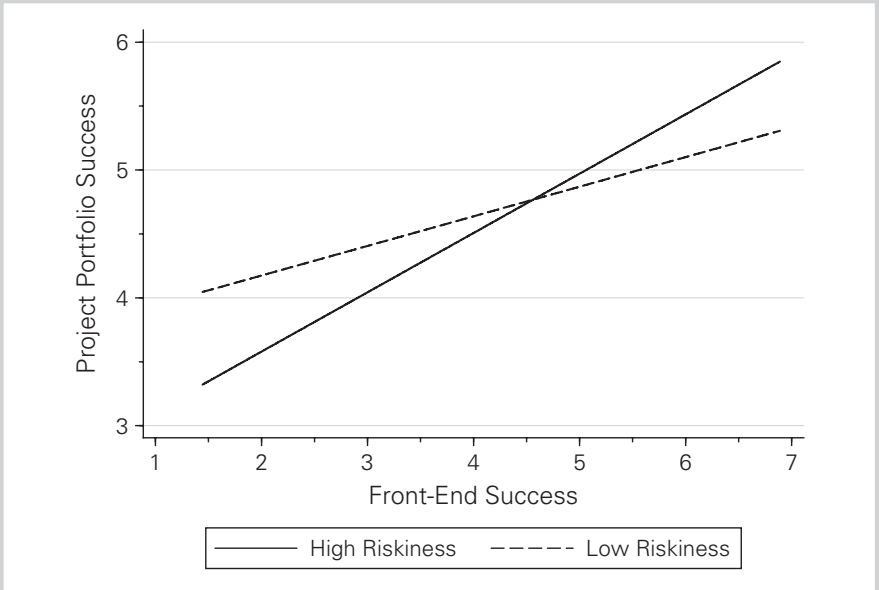

Figure 2: Simple slopes for the moderator riskiness.

for later success. Project-related "homework" (Cooper, 2011) is therefore not only important on an individual project level, but also on the portfolio level. Findings of this study underscore the importance of an effective and efficient front end for project portfolio success. Decisions and activities of the front end constitute the starting point for the following development process stages and therefore are a key source for competitive advantage. Results show that, especially in the portfolio management context, it is important to pay attention to the front end: Portfolio management does not just start with the prioritization of project proposals. In fact, the right ideas have to be generated and further processed much earlier to become such a project proposal. To front-load activities at relatively low

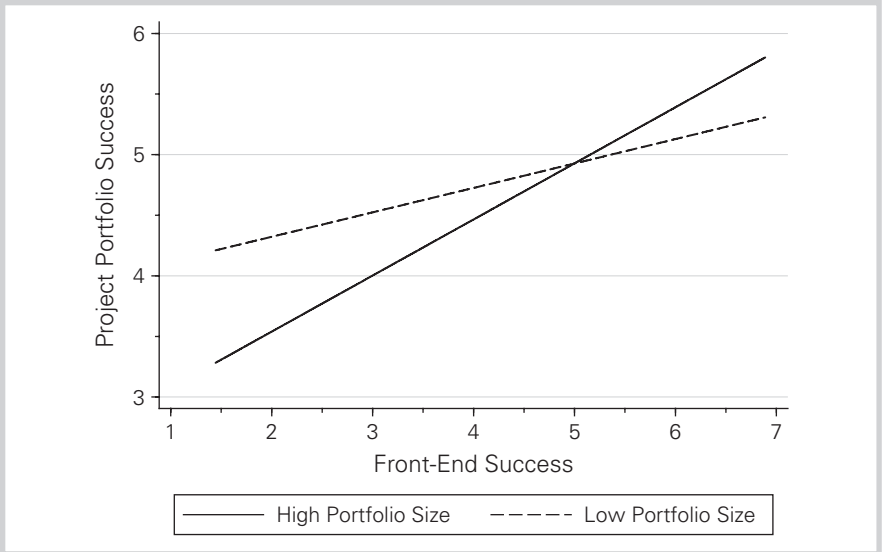

Figure 3: Simple slopes for the moderator portfolio size.

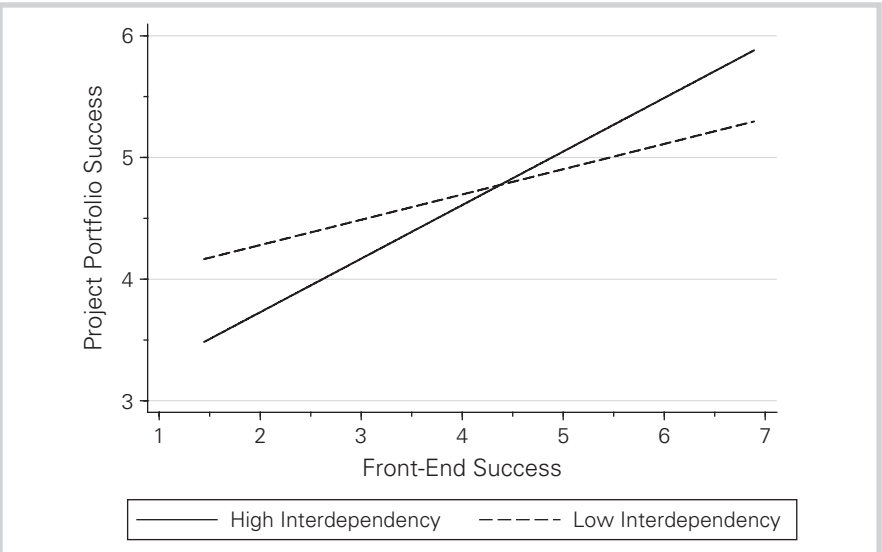

Figure 4: Simple slopes for the moderator project interdependencies.

levels of effort, gives the organization the leverage to facilitate later portfolio success.

More importantly, this study sheds light on key contingency factors that affect the strength of the relationship between the front end and the project portfolio. The framework accounts for influences in the firm's environment, the firm's strategic orientation, and the characteristics of the project portfolio itself. First, the study could not show significant moderating effects of environmental dynamics, such as market or technological turbulence on the relation between front-end success and project portfolio success. Thus, our findings indicate that front-end success is important for project portfolio success independently of environmental turbulence, in other words, in both stable and turbulent environments. Therefore, ideation and the generation of a sound idea pipeline for future projects are not only important in dynamic industries such as, for instance, high-tech business, but is also a source of competitive advantage in the less turbulent environments of stable and traditional industries. The absence of the moderating effects of external dynamics is still surprising, because evidence suggests that technological and market turbulence are likely to have an impact on relations where performance serves as a dependent variable (Kohli & Jaworski, 1990). However, the non-significant findings are not completely unexpected considering the mixed and non-significant findings on the contingent effects of external dynamics in performance and success contexts in literature (Jaworski & Kohli, 1993; Koufteros et al., 2005; Langerak et al., 2004).

Secondly, the results suggest that aspects of the organization's entrepreneurial and strategic orientation, namely riskiness, moderate the positive effect of front-end success on project portfolio success. Risk and opportunity lie closely together: An organization prepared to take risks is able to implement new ideas more quickly and efficiently. This is crucial because it is not sufficient to solely identify ideas; identified ideas also need to be implemented. The results imply that the positive effects of front-end success become even stronger with increasing riskiness. This strengthens previous findings, which indicate that entrepreneurial orientation helps exploiting new ideas and new market opportunities (Talke, 2007). Furthermore, our findings help to reconcile inconclusive findings regarding the performance effects of riskiness. While riskiness on its own might not directly influence performance, it increases the positive effects of proactiveness and innovativeness by facilitating the exploitation of front-end activities. Therefore, this study also contributes to the stream of risk management literature that calls for a coherent view on the effects of opportunities and risks (Teller, 2013; Ward & Chapman, 2003). Riskiness may mean that a vast amount of resources is

committed to uncertain projects where the output can be unclear and costly failures could result (Lumpkin & Dess, 1996; Miller, 1983). Future studies could consider that project portfolios with interdependent projects sharing scarce resources may encourage riskier undertakings, because each project can be supported by the entire resource pool cushioning costly failures and environmental uncertainties.

Finally, results show a positive moderating effect of both project interdependency and portfolio size on the relation between front-end success and project portfolio success. These findings suggest that front-end success becomes even more important for organizations running a large project portfolio with many interdependent projects. Portfolio size and interdependency of projects add to complexity of portfolio management. Consequently, Dickinson, Thornton, and Graves (2001, p. 518) point out "when projects are interdependent, the complexity of optimizing even a moderate number of projects over a small number of objectives and constraints can become overwhelming." In this complexity it is even more necessary to be able to rely on a sound basis of the project portfolio that was laid by a successful front end and a valuable idea pipeline. The higher the front-end success is, the more options are built up and the organization can put together the right set of projects. The better these options are, the better the company is positioned. Large and complex portfolios have more potential for synergies to be exploited. The sound foundations therefore play a larger role than in less complex, straightforward portfolios. In small portfolios, it is easier for portfolio management to trouble-shoot, in other words, to dive deeper into specific projects, improve their concepts, and bring them on track.

In addition to the above-discussed implications for academia, this article holds useful implications for practitioners as well. The results underpin the necessity for managers of project portfolios to not only focus on their project portfolio but also to pay attention to the front end. They should make sure that the front-end phase of their project portfolio becomes a success as this positively impacts their project portfolio performance. This holds even more true if their organization's orientation allows for the willingness to take risks and if their project portfolio consists of a large number of projects that are highly interdependent.

A few limitations should be pointed out for this study when interpreting the results. The study was conducted in Germany. Whether our results can be transferred to an international context can only be shown with an international research set-up that also takes cultural aspects into consideration (Unger, Rank, & Gemünden, 2014). For instance, scholars have often pointed out that risk culture and the willingness to bear risks vary with cultural settings and context. Following de Brentani and Kleinschmidt (2004), this study could therefore be brought to the next level in conducting this research in an international setting that does not only incorporate Europe but also Asia and the Americas to get a profound international picture of how front-end success impacts project portfolio success. Furthermore, the findings presented here represent a cross-sectional snapshot of the relation between front-end and project portfolio success taken at a single point in time. In managerial day-to-day business, however, we face a time lag between front-end and project portfolio success that we cannot account for in the study at hand. To underline the time effects a longitudinal study would have to be employed; thus, this study could be the sound basis for a longitudinal research setting. Moreover, this article can be seen as a good vantage point for further research into the interface of innovation and project management.

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Appendix: List of Items

Project Portfolio Success, second order construct consisting of the following five dimensions ($\chi^2 = 229.84$ (df = 114; $p < 0.00$), SRMR = 0.067, CFI = 0.92):

Business Success (four items, Cronbach's alpha = 0.85, Second-order factor loading $\lambda = 0.65$)

How do you evaluate the success of your organization/entity compared to your competitors …

- … regarding the overall business success.
- … regarding the market share.
- … regarding the revenue growth.
- … regarding the profitability.

Average Success of Project Results (four items, alpha = 0.84, $\lambda = 0.71$)

Please evaluate the average success of your project results.

- Our products/project results reach the planned target costs.
- Our products/project results reach the planned market goals (e.g., market share, revenue).
- Our products/project results reach the planned financial goals (e.g., ROI).
- Our products/project results reach the planned payback period.

Strategic Fit (three items, alpha = 0.79, $\lambda = 0.81$)

- The project portfolio is consistently aligned with the future of the company.
- The corporate strategy is ideally implemented through our project portfolio.
- Resource allocation to projects reflects our strategic objectives.

Portfolio Balance (three items, alpha = 0.69, $\lambda = 0.70$)

- There is a good balance in our project portfolio between new and old areas of application.
- There is a good balance in our project portfolio between new and existing technologies.
- There is a good balance in our project portfolio of project risks.

Preparing for the Future (three items, alpha = 0.82, $\lambda = 0.71$)

- We sufficiently develop new technologies and/or competencies in our projects.
- With our projects we are a step ahead of our competitors with new products, technologies, or services.
- Our projects enable us to shape the future of our industry.

Front-End Success, second order construct consisting of the following three dimensions ($\chi^2 = 64.03$ (df = 32; $p < 0.00$), SRMR = 0.051, CFI = 0.92):

Front-End Effectiveness (four items, alpha = 0.85, $\lambda = 0.79$)

- We generate sufficiently "good" and/or "right" project ideas for our portfolio.
- Our current idea pipeline will strengthen our competitive positioning.
- With our current idea pipeline we will be able to strongly increase our sales with new products within the next three years.
- At large, our current idea pipeline has a strong value generating potential.

Front-End Timeliness (three items, alpha = 0.87, $\lambda = 0.94$)

- At our organization new ideas are quickly developed into concepts.
- For the development of concepts resources are made available quickly.
- Accepted concepts are quickly converted into projects.

Front-End Efficiency (three items, alpha = 0.88, $\lambda = 0.69$)

- The available and allocated budget is used efficiently in our ideation phase.
- The available and allocated personnel resources (engineering-hours) are used efficiently in our ideation phase.
- At large, our ideation phase has a good cost-benefit-ratio.

Market turbulence *(four items, alpha = 0.68)*

- In our industry it is difficult to anticipate the development of customer preferences.
- Our customers tend to look for new product all the time.
- In our kind of business, customers' product preferences change quite a bit over time.
- In our industry it is difficult to anticipate competitor moves and activities.

Technological turbulence *(four items, alpha = 0.87)*

- The technology in our industry is changing rapidly.
- Technological changes provide big opportunities in our industry.
- A large number of new product ideas have been made possible through technological breakthroughs in our industry.
- Technological developments in our industry are rather minor (inverse item).

Riskiness *(three items, alpha = 0.74)*

- We are not afraid of taking risks when making fundamental project decisions.
- We frequently support projects when the expected return is still uncertain.
- Within our strategic limits we accept a high degree of risk.

Portfolio size

- How high is the annual budget of the project portfolio? (natural logarithm of M€)

Project Interdependency *(six items, alpha = 0.83)*

- A high degree of alignment between our projects is required with respect to the scopes.
- Scope changes of individual projects inevitably impact on the execution of other projects.
- Often projects can only be continued if the concrete results of other projects are known.
- Delays in individual projects inevitably impact on other projects.
- As a consequence of joint utilization of human resources, projects are highly interdependent on each other.
- Projects must share skilled employees/experts.