Risk Management in Project Portfolios Is More Than Managing Project Risks: A Contingency Perspective on Risk Management

Juliane Teller, Berlin Institute of Technology, Germany
Alexander Kock, Technische Universität Darmstadt, Germany
Hans Georg Gemünden, Berlin Institute of Technology, Germany

ABSTRACT

Project risk management aims at reducing the likelihood of project failure. To manage risk in project portfolios, research suggests adopting a perspective that is wider than the individual project risk. The results from a hierarchical multiple regression analysis on a sample of 177 project portfolios suggest that formal risk management at the project level and integration of risk information at the portfolio level are positively associated with overall project portfolio success. Simultaneous risk management at both levels increases this positive effect. Furthermore, risk management at the project level is more important for R&D-dominated project portfolios, whereas the integration of risk information is more important with high levels of turbulence and portfolio dynamics.

KEYWORDS: project portfolio management; portfolio risk management; project risk management

INTRODUCTION

A growing number of organizations are using projects to implement new products, processes, and other types of change. Because organizations tend to run several projects concurrently, project portfolio management is a key competence to flexibly adjust to environmental changes and maintain competitive advantages. Project portfolio management refers to the set of managerial activities that are required to manage a collection of projects and programs needed to achieve strategic business objectives (Blichfeldt & Eskerod, 2008; Project Management Institute, 2008b). Projects are frequently dynamic by nature and exposed to risk.

The literature has widely acknowledged the positive effects of risk management by focusing primarily on the project level across various industries (de Bakker, Boonstra, & Wortmann, 2011). Many studies have shown a positive relationship between project risk management and the success of R&D projects (Mu, Peng, & MacLachlan, 2009; Salomo, Weise, & Gemünden, 2007) and the success of information systems and software development projects (de Bakker et al., 2011; Barki, Rivard, & Talbot, 2001; Ropponen & Lytyinen, 1997). In the context of project portfolios, however, it is insufficient to consider only individual project risks (Olsson, 2008); the literature also suggests incorporating identified risks into the project portfolio management process (Bannerman, 2008; Sanchez, Robert, & Pellerin, 2008). Integrating risks into the project portfolio management process allows the portfolio manager to adapt the evaluation and selection of projects, the allocation of resources, and the steering of projects in accordance with the identified risks. Furthermore, integration facilitates an overview of and focus on the relevant risks. A project portfolio management approach that neglects risks may lead to an unbalanced portfolio and without risk consideration at the portfolio level, an organization may not build sufficient reserves and may be ill prepared for the future.

Previous studies suggest that the effectiveness of different management approaches is contingent upon project and portfolio characteristics (Salomo et al., 2007), in addition to the nature of the environment (Tatikonda & Montoya-Weiss, 2001). The benefits of risk management, however, may not justify the costs of its implementation for all project portfolios (Kutsch & Hall, 2009); therefore, this study adopts a contingency perspective (Donaldson, 2001) and addresses the impact of external turbulence on risk management. Previous research has found that the degree of uncertainty calls for different
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risk management approaches (Floricel & Ibanescu, 2008; Jun, Qiuzhen, & Qin-gguo, 2011); however, we also investigate the influence of different project types on risk management. We focus specifically on R&D-dominated project portfolios, because R&D projects are associated with higher levels of uncertainty than other types of projects (Lenfle & Loch, 2010). Furthermore, project portfolios may have varying levels of fluctuation: some are static in nature, whereas others are subject to constant change. High levels of fluctuation indicate that an organization starts and ends new projects frequently; thus, we examine the influence of portfolio dynamics on risk management.

Research on risk management in the context of project portfolios is scarce. To our knowledge, no study has yet investigated how formal risk management at the project level interacts with the integration of risk information at the portfolio level and how this interaction affects project portfolio success. It remains unclear as to whether or not risk management at the project level is related to portfolio success and whether or not it is sufficient for managing risks in project portfolio environments; the previous research is limited to empirical examinations of the contingencies that influence risk management and the nature of that influence (Barki et al., 2001). To determine whether risk management activities at the project level and at the portfolio level depend on one another to enhance effectiveness, we link risk management at the project level with risk management activities at the portfolio level. Overall, we attempt to answer the following research questions: How does project risk management contribute to project portfolio success? How does formal risk management at the project level interact with the integration of risk information at the portfolio level? What contextual factors affect the relationship between risk management and project portfolio success?

This study contributes to the literature on risk management and project portfolio management by providing empirical evidence and suggesting the following: (1) a formal project risk management process is positively related to project portfolio success; (2) project risk management is necessary but not sufficient for the success of a project portfolio; (3) a formal project risk management process is even more important for R&D-dominated portfolios; and (4) the integration of risk information at the portfolio level is more important for rapidly changing portfolios that operate in highly turbulent environments. We thus verify the claim that project risk management is related to project portfolio success and confirm the need to adopt a contingency view in risk management research.

Literature Review

Project Risk Management and Project Success

The Project Management Institute defines project risk as “an uncertain event or condition that, if it occurs, has a positive or negative effect on a project’s objectives” (Project Management Institute, 2008a, p. 127). The Association for Project Management (APM) uses a similar definition, defining risk as “an uncertain event or set of circumstances that, should it occur, will have an effect on the achievement of the project’s objectives” (Association for Project Management, 2006, p. 156). Several authors support the view that risk encompasses both threat and opportunity; they emphasize that both opportunities and threats should be considered in the processes of risk identification and analysis (Ward & Chapman, 2003).

Project risk management enables an organization to limit the negative impact of uncertain events and/or to reduce the probability of these negative events materializing, while simultaneously aiming to capture opportunities (Petit, 2012). The project risk management process includes the following activities: (1) identifying project risks, (2) analyzing project risks, (3) defining and implementing risk response actions, and (4) monitoring project risks (Project Management Institute, 2008a). The information gathered during this process serves as a basis for decision making and various tools and techniques have been developed to support these activities. Brainstorming helps identify risks; the probability impact matrix is frequently used to assess risks (Project Management Institute, 2008a), and the decision tree can help with choosing among risk response actions. Risk response measures can include avoiding risk, transferring risk, mitigating risk, and accepting risk (Project Management Institute, 2008b).

Various studies have found a positive relationship between project risk management and project success. Mu et al. (2009) performed an empirical study in China and found a positive relationship between risk management strategies and the performance of new product development projects. Research by Salomo et al. (2007) underlines the positive effect of risk management on new product development projects; in their study, project risk planning and goal stability throughout the development process demonstrate a significant positive effect on the performance of projects involving new product development. Nonetheless, Raz, Shenhar, and Dvir (2002) suggest that risk management procedures are still not widely implemented. When implemented, risk management is positively associated with project success. The findings of Ropponen and Lyytinen (1997) support the assertion that risk management is connected to project success, particularly with respect to managing software risk. These authors highlight the importance of frequent and continuous utilization of risk management practices, experienced project managers, and an appropriate project size. The interviews of de Bakker et al. (2011) indicate that risk management is deliberately used to deliver messages to other stakeholders, with the aim of influencing their behavior, perceptions, and awareness of the situation and its attendant risks.
Their study enhances the understanding of risk management by investigating how it influences project success. Although many studies suggest that risk management is related to project success, other studies have shown that risk management underperforms in practice (Bannerman, 2008; Raz et al., 2002). Perminova, Gustafsson, and Wikström (2008) highlight the need for further empirical research on standardized and modularized processes, which are assumed to make expert knowledge readily accessible and to support learning.

**Risk Integration at the Portfolio Level**

The literature suggests a broader scope to managing risks (Artto, Kahkonen, & Pitkanen, 2000; Bannerman, 2008; Olsson, 2008; Olsson & Teller, 2013). Specifically, Bannerman (2008) and Sanchez et al. (2008) propose the idea of integrating processes to manage threats into project portfolio management. Research on integrating risk management into the project portfolio management process has been relatively scarce, and currently most portfolio risk management approaches focus on evaluating and balancing processes (Sanchez et al., 2008). A substantial proportion of highly risky projects may be dangerous for an organization because of the potential failures of these projects, whereas too many low-risk projects in a portfolio may lead to low returns (Archer & Ghasemzadeh, 1999). The results from de Reyck et al. (2005) indicate that risks should be assessed at the portfolio level to increase the positive impact of project portfolio management. Only a few frameworks and methodologies have been developed that integrate risk management into project portfolio management (Olsson, 2006; Project Management Institute, 2008b; Sanchez et al., 2008). Olsson (2006) developed a methodology that integrates risk management into the portfolio management process and provides the portfolio manager with an overview of the risks within the project portfolio. Sanchez et al. (2008) developed a theoretical framework that integrates risk management concepts into project portfolio management and that takes into account interdependencies regarding resources, knowledge, and strategy. The *Standard for Portfolio Management – Second Edition* (Project Management Institute, 2008b) addresses portfolio risk management and provides guidelines for integrating risk management into project portfolio management. The Project Management Institute (2008b) proposes that the portfolio manager must add, reprioritize, and terminate projects based on risk information, project performance, and alignment with strategy.

**Contingency View of Risk Management**

Several empirical studies have identified the need to adapt management tools and procedures to various project characteristics, including risk profile, project complexity, or environmental factors, such as turbulence (McFarlan, 1981; Raz et al., 2002; Ropponen & Lyytinen, 2000; Sommer, Loch, & Dong, 2009). In their empirical study in Israel, Raz et al. (2002) found that risk management appears to be more applicable to high-risk projects. McFarlan (1981) identified three dimensions that influence project risk: project size, project structure, and experience with technology. According to McFarlan (1981), high-risk projects require more experienced managers, careful planning, close monitoring, and stringent control. Barki et al. (2001) developed and tested a contingency model in a study of 75 software projects and found that high-risk projects called for higher levels of communication among decision makers.

By contrast, in a study of 58 startups in Shanghai, Sommer et al. (2009) found that risk planning is sufficient when uncertainty and complexity are low. These authors suggest using trial-and-error learning and selectionism (i.e., running several approaches in parallel until the best solution can be identified) when uncertainty is unforeseeable and project complexity is high. Pich, Loch, and de Meyer (2002) support this suggestion and posit that risk management is sufficient when information about the environment is available and adequate. Jun et al. (2011) conducted a quantitative study of 93 projects and revealed that project planning and control are particularly important when uncertainty is low. In highly turbulent environments with rapidly changing circumstances, the literature suggests going beyond traditional risk management and adopting procedures and methods to increase flexibility and learning (de Meyer, Loch, & Pich, 2002; Perminova et al., 2008). Certain authors emphasize the use of a wider perspective that includes all sources of uncertainty rather than narrowing management down to risks (Ward & Chapman, 2003). Nonetheless, uncertainty management that focuses solely on threats and events is too focused, because it may lead to inattention with respect to other important areas (Perminova et al., 2008; Petit, 2012).

These contradictory findings suggest that there is a need for further research on adapting risk management to the characteristics of specific projects, portfolios, and environments. Furthermore, few empirical studies seek to understand how risks can be managed in project portfolios; therefore, the present study includes the direct effects of risk management on portfolio success and adopts a contingency perspective. Contingency theory suggests that the structural factors in organizations should suit the contextual factors to increase performance (Donaldson, 2001). In specific environments, different approaches are more or less effective. Contingency theory has been widely used in project management research (Shenhar, 2001) and project portfolio management research (Teller, Unger, Kock, &Gemünden, 2012). A contingency perspective predicts the conditions under which the positive effects of risk management will be stronger than the negative effects and the conditions under which the opposite is more likely.
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Because the degree of uncertainty calls for different approaches to risk management (Floricel & Ibanescu, 2008; Jun et al., 2011), we will investigate how external turbulence influences the impact of risk management on portfolio success. Furthermore, not all project portfolios are identical. Project portfolios may consist of different types of projects and may have varying levels of fluctuation. In particular, R&D projects are associated with higher levels of uncertainty than other types of projects (Lenfle & Loch, 2010; Shenhar & Dvir, 1996); whereas certain project portfolios are static in nature, others change constantly, which leads to a higher degree of uncertainty. Therefore, this study incorporates the level of R&D focus in project portfolios and portfolio dynamics into the investigation.

Theoretical Framework and Hypotheses

The framework of this study describes how project risk management and the integration of risk information into project portfolio management are linked to project portfolio success (see Figure 1). The underlying hypothesis is that the simultaneous use of project risk management and risk integration into project portfolio management will have a complementary effect that leads to a greater benefit than the sum of both individual effects. The following section describes the dependent and independent variables, their relationships, and the effects of certain moderators.

Project Portfolio Success

Project portfolio success is a well-established and widely used construct in the literature (Jonas, Kock, & Gemünden, 2013; Meskendahl, 2010; Müller, Martinsuo, & Blomquist, 2008; Teller et al., 2012). The dimensions of project portfolio success are based on the objectives of project portfolio management: the maximization of portfolio value, portfolio balance, and the alignment of projects with strategic goals (Cooper, Edgett, & Kleinschmidt, 2001; Elonen & Artto, 2003; Kendall & Rollins, 2003). We follow the approaches of Cooper et al. (2001), Jonas et al. (2013), Müller et al. (2008), and Teller et al. (2012) and include the following dimensions in project portfolio success: (1) average project success, (2) average product success, (3) strategic fit, (4) portfolio balance, (5) preparing for the future, and (6) economic success.

Average project success encompasses the criteria of the iron triangle of cost, time, and quality, in addition to compliance with the fulfillment of the defined specifications of all projects in the portfolio (Martinsuo & Lehtonen, 2007; Shenhar, Dvir, Levy, & Maltz, 2001). Average project success describes the market success and commercial success of all projects in the portfolio (Meskendahl, 2010; Shenhar et al., 2001). Strategic fit incorporates the extent to which projects reflect the corporate business strategy. Portfolio balancing describes the equilibrium between high-risk and low-risk projects, long-term and short-term projects, and technologies and markets (Killen, Hunt, & Kleinschmidt, 2008). Preparing for the future refers to the ability to quickly react to changes in the environment and seize opportunities in the long term (Shenhar et al., 2001). Economic success addresses the overall market success and commercial success of an organization or business unit (Meskendahl, 2010; Shenhar et al., 2001).

Formal Project Risk Management

A formal process encompasses a clear process description and the consistent use of clear rules in projects (Cooper et al., 2001; Teller et al., 2012). Several studies have shown that a formal risk management process is positively associated with performance (Kwak & Stoddard, 2004; Ropponen & Lytinen, 2000). According to Nidumolu (1996), defining milestones and procedures is associated with decreased risk and, consequently, better process and product performance. With defined procedures for managing project risk, the project manager can assess potential threats and opportunities, understand the feasible impact of potential events on project objectives, and make realistic assumptions (de Bakker, Boonstra, & Wortmann, 2010; Ropponen & Lytinen, 1997). Such enhanced awareness and understanding of risks, in turn, appear to be related to fulfilling the projects’ cost, time, quality, and economic objectives (Raz et al., 2002). Using identical procedures and tools for managing project risks allows for a common understanding of risk management and knowledge exchange between project managers. A consistently applied process makes the risk level of individual projects transparent, which lays the foundation for balancing the portfolio with regard to risks. In turn, balancing the portfolio ensures that the portfolio consists of neither too many nor too few high-risk projects. However, formalization can also be counterproductive for certain types of projects. For example, Sethi and Iqbal (2008) reveal that formal stage-and-gate type processes can lower the flexibility of projects. The question is whether this finding also applies to formal risk management processes. Furthermore, a formal risk management process can lead to rigidity and may not help the project manager identify unforeseeable risks. Nevertheless, a well-defined process is believed to foster control and predictability, which, in turn, can influence flexibility and the ability to quickly react to changes in the environment (Liu, Chen, Chan, & Li, 2008). Empirical evidence about the effects of a formal project risk management process on project portfolio success is scarce. Based upon findings in the project context, we suggest that formalization of project risk management will have a positive effect on project portfolio success.

Hypothesis 1. Formal project risk management is positively related to project portfolio success.

The Integration of Risk Information into Project Portfolio Management

It is widely acknowledged in the literature that risk management supports
the decision-making process (de Bakker et al., 2011; Chapman & Ward, 2004; Perminova et al., 2008; Sanchez, Robert, Bourgault, & Pellerin, 2009). Risk management activities are frequently used to convey messages among stakeholders (de Bakker et al., 2011). According to Sanchez et al. (2008), risk management must be an integral part of project portfolio management. Risk information can be integrated into various phases of the project portfolio management process, including portfolio structuring, resource management, and portfolio steering (Jonas et al., 2013). Portfolio structuring involves strategic portfolio planning, including project evaluation, project prioritization, and project selection consistent with the business strategy (Archer & Ghasemzadeh, 1999; Jonas et al., 2013). During portfolio structuring, the portfolio manager can include risk information to balance the portfolio regarding risks and to prioritize projects (Olsson, 2008). During strategic portfolio planning, this risk integration may help select the right projects. Resource management consists of the allocation of scarce resources in an efficient and effective manner across the project portfolio (Blanchfeld & Eskerod, 2008; Jonas et al., 2013). When risks materialize, the portfolio manager can easily shift resources from one project to another, if necessary, based on the overview of the portfolio’s state of affairs. During portfolio steering, portfolio managers gather information to monitor resource utilization and strategic alignment, to identify synergies between projects, and to develop corrective actions if deviations occur (Jonas et al., 2013). The underlying assumption is that portfolio managers, who integrate risk information into portfolio steering, can better recognize necessary changes and make adjustments accordingly (Teller & Kock, 2013). Furthermore, integrating risk management practices with project portfolio management practices and policies is assumed to enhance strategic fit (Sanchez et al., 2008). Hence, the following hypothesis is proposed:

Hypothesis 2. The integration of risk information into project portfolio management is positively related to project portfolio success.

Interaction Between Project Risk Management and Its Integration at the Portfolio Level

Previous research has emphasized the importance of project risk management and its integration into project portfolio management. The portfolio manager can only operate if information on an individual project is available. Well-defined procedures and clear rules improve the availability of risk information and allow for a consistently applied process; thus, the risk level of individual projects becomes transparent and comparable. Without project risk management, the integration of risk information at the portfolio level is elusive. In other words, integrating risk information into project portfolio management that is not based on meaningful risk information from the project level will be ineffective in enhancing project portfolio success. However, project risk management alone is only effective to a limited extent because it lacks a portfolio-wide view. Moreover, integrating risk information at the portfolio level increases and reinforces project risk management. For example, risks that occur in several projects at once can be identified and risk response actions can be pooled. Based upon these arguments, we propose that project risk management and its simultaneous integration at the portfolio level result in a complementary effect that leads to increased portfolio success.

Hypothesis 3. The simultaneous use of a formal project risk management process and the integration of risk information into project portfolio management increase the positive effect on project portfolio success (positive interaction effect).

R&D Focus of Project Portfolios as a Contingency Factor

Previous research has suggested the need to distinguish among different types of projects and corresponding strategies to manage risks (Lenfle & Loch, 2010; Loch, de Meyer, & Pich, 2006). Certain types of projects, such as R&D projects, seem to be associated with a higher level of uncertainty than other types of projects (Lenfle & Loch, 2010; Shenhar & Dvir, 1996). The results of empirical and conceptual studies suggest that risk management appears to be more applicable to high-risk projects (Couillard, 1995; Raz et al., 2002); therefore, a formal risk management process may be more important for project portfolios with a focus on R&D projects. At the same time, it is suggested that risk should be managed in low-risk projects (Raz et al., 2002); conversely, some studies suggest adopting a lower level of formalization in projects with a high level of uncertainty (Jun et al., 2011). We follow the literature stream that proposes that risk management becomes more prominent when projects are highly risky (Couillard, 1995; Raz et al., 2002). At the same time, management strategies that focus on uncertainty management may also become more prominent. Because risk management is assumed to reduce failure rates and lower the occurrence of risk, we suggest that the proposed positive effects of project risk management and its integration at the portfolio level are even more prominent for project portfolios with a focus on high-risk R&D projects.

Hypothesis 4a. The relationship between formal project risk management and project portfolio success is stronger in portfolios with an R&D focus.

Hypothesis 4b. The relationship between the integration of risk information into project portfolio management and project portfolio success is stronger in portfolios with an R&D focus.

External Turbulence as a Contingency Factor

Environmental uncertainties lead to risk. The risk management process may need to be modified, depending...
on environmental turbulence (Teller, 2013). Raz et al. (2002) found that projects with high technological uncertainty implement project risk management practices more frequently than projects with low technological uncertainty, whereas the results of projects with both low and high technological uncertainty are comparable. Prior research has suggested that certain risk management practices, such as well-defined procedures, may be related to a decrease in uncertainty and risk (de Bakker et al., 2011; Nidumolu, 1996). High uncertainty seems to call for experienced staff (McFarlan, 1981), flat hierarchy, rapid decision-making capabilities, a portfolio-wide view, and structured processes (Floricel & Ibanescu, 2008) with a lower level of formalization (Jun et al., 2011). Empirical evidence on the effects of formalization in highly uncertain environments is mixed. Some authors find that formalization can be counterproductive for projects in highly uncertain environments (Jun et al., 2011; Salomo et al., 2007). Other researchers find that the continuous use of standardized procedures is a key element in managing uncertainty (Perminova et al., 2008). In their investigation of formality in the context of project management, Tatakonda and Montoya-Weiss (2001) found that technological uncertainty has no significant influence on the positive impact of process formality on project outcomes.

Project risk management practices may increase the predictability of stakeholder behavior (de Bakker et al., 2011). Formal rules simplify the detection of threats and allow for fast answers to potential issues. However, formal rules may reduce the ability to cope with uncertainty arising from unanticipated technological problems due to a lack of flexibility (Tatakonda & Montoya-Weiss, 2001). The greater the level of uncertainty, the more valuable flexibility is. Some authors even argue that risk management is insufficient for managing uncertainty (Perminova et al., 2008), because no risk information is available when uncertainty is high. High uncertainty makes learning from the past difficult (Kutsch & Hall, 2009); we argue, however, that the structure that is gained by risk management practices at the project level, and the portfolio level assists in coping with unexpected events arising from highly uncertain environments. Based upon the above-described arguments, we propose that risk management is more important when external turbulence is high. We measure external turbulence as technological uncertainty, which represents the degree to which technology changes.

Hypothesis 5a. The relationship between formal project risk management and project portfolio success becomes stronger as external turbulence increases.

Hypothesis 5b. The relationship between the integration of risk information into project portfolio management and project portfolio success becomes stronger as external turbulence increases.

Portfolio Dynamics as a Contingency Factor

Portfolio dynamics refers to the degree to which portfolio structure changes over the course of a year. Project portfolios with high fluctuation may contain a higher number of smaller and shorter projects. Changes in the portfolio structure may cause the emergence of new risks or the omission of old risks. A high fluctuation of projects can lead to frequently changing risks, and a project portfolio with projects that change frequently may entail higher levels of uncertainty and complexity. A formal risk management process that involves clear rules is associated with less initial effort for each project and helps project managers to identify new risks quickly. Integrating risk information into the portfolio management process helps to quickly identify the dependencies between projects and their risks and allows the portfolio manager to consistently consider strategic aspects.

Figure 1: Conceptual framework.
Therefore, we argue that the more important risk management is, the greater the portfolio dynamics are, (Olsson, 2008). Therefore, we argue that the greater the portfolio dynamics are, the more important risk management is.

**Hypothesis 6a.** The relationship between formal project risk management and project portfolio success becomes stronger with increasing portfolio dynamics.

**Hypothesis 6b.** The relationship between the integration of risk information into project portfolio management and project portfolio success becomes stronger with increasing portfolio dynamics.

### Method

#### Data Collection

We base the testing of our hypotheses on a cross-industry sample of 177 medium-sized and large firms in Germany. The object of analysis of this study is the project portfolio of a firm or business unit. To investigate the effects of risk management at the project and portfolio levels, we restrict our study to firms with project portfolios of at least 20 projects managed concurrently. In total, we contacted approximately 650 organizations via mail and provided general information about the study with a solicitation for registration. The response rate was approximately 27%. To achieve a high response rate, we cooperated with project management institutions. We surveyed our informants during a three-month period in 2011. There were no significant differences (alpha 5%) between early and late responses. To reduce the risk of bias due to common-method variance (Podsakoff, Mackenzie, Lee, & Podsakoff, 2003), we adopted a dual-informant design, which included two different levels of management. In every participating firm, two informants were identified: (1) a project portfolio coordinator and (2) a senior manager. Project portfolio coordinators were in charge of the operative management of the project portfolio and therefore well suited to assessing the applied procedures and processes for managing the project portfolio. Job titles for project portfolio coordinators were typically portfolio manager, head of project management office, division manager, or department manager. The informants from senior management exercised decision-making authority over the organization’s project portfolio; their job titles were typically chief executive officer, head of business units, or head of R&D. The project portfolio coordinator assessed risk management at the project and portfolio levels, the R&D focus of project portfolios, and portfolio dynamics. The senior management informant assessed project portfolio success and external turbulence. This study was followed by a conference during which the findings were presented, discussed, and validated with approximately 80 participants. The sample incorporates firms from diverse industries, including manufacturing (27%), financial services (19%), information and communication technologies (19%), energy and infrastructure (10%), pharmaceuticals and chemicals (9%), and other industries (16%). Of these firms or business units, 29% had fewer than 500 employees, 26% had between 500 and 2,000 employees, and 45% had more than 2,000 employees. The average project portfolio consisted of 124 projects.

#### Measures

We measured our variables based on multi-item scales that we derived from the literature on project portfolio management, risk management, and related fields. To suit our context, we adapted the wording of certain scales. A pretest with 20 scholars and practitioners increased confidence in the validity of the adapted scales. Informants assessed each item on a seven-point Likert scale, ranging from 1 ("strongly disagree") to 7 ("strongly agree"), and the variables were constructed by averaging the respective items. The validity of the item scales was verified by a principal components factor analysis (PCFA), followed by a confirmatory factor analysis (CFA) (Ahire & Devaraj, 2001). A PCFA was used to test whether all items load on a single factor. Cronbach’s alpha denotes the scale reliability, and acceptable values are greater than 0.7. A CFA was used to verify the measurement model. The measurement model is considered satisfactory if the comparative fit index (CFI) exceeds 0.90 and the standardized root mean square residual (SRMR) is below 0.08 (Hu & Bentler, 1998); terminology for all items can be found in the Appendix.

**Independent Variables.** Project portfolio success is measured by the senior management informant as a second-order construct based on the dimensions of average project success (three items), average product success (three items), strategic fit (three items), portfolio balance (three items), preparing for the future (three items), and economic success (four items). These dimensions and items are based on studies by Cooper et al. (2001), Jonas et al. (2013), Müller et al. (2008), and Teller et al. (2012). A CFA verified the validity of the second-order construct with the six dimensions as first-order factors. The model fit is acceptable ($\chi^2 = 276.61$; $df = 129; \ p < 0.00$), $SRMR = 0.076, CFI = 0.902$), and the first-order factors had significant factor loadings between 0.62 and 0.78.

**Controls.** The R&D focus of project portfolios is the percentage of R&D projects in the project portfolio (from 0 to 1 = 100%). External turbulence is captured using four items that measure the degree to which technology changes (Sethi & Iqbal, 2008). Portfolio...
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<th>Variables</th>
<th>Mean</th>
<th>Std.-Dev.</th>
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<td>3 Mandatory projects</td>
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<td>0.23</td>
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<td>–0.03</td>
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<td>5 External turbulence</td>
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<td>1.32</td>
<td>0.22**</td>
<td>0.22**</td>
<td>–0.08</td>
<td>–0.19**</td>
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<td>1.40</td>
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<td>–0.09</td>
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<td>0.14</td>
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<td>0.14</td>
</tr>
</tbody>
</table>

Note. n = 177. RM, risk management; PPM, project portfolio management. 7-point Likert scale, ranging from 1 (“strongly disagree”) to 7 (“strongly agree”). *p < 0.05. **p < 0.01 (two-sided t-test).

Table 1: Descriptive statistics and correlations.

### Results

We used hierarchical multiple regression analysis to determine the effects of formal project risk management and the integration of risk information into project portfolio management on project portfolio success. Model 1 in Table 2 shows the direct effects of formal project risk management, the integration of risk information into project portfolio management, and the control variables on project portfolio success. Models 2 through 6 test the interaction effects by

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**Table 2: Regression results.**

<table>
<thead>
<tr>
<th>Project Portfolio Success</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
</tr>
<tr>
<td>Firm size (ln)</td>
</tr>
<tr>
<td>Mandatory projects</td>
</tr>
<tr>
<td>R&amp;D focus</td>
</tr>
<tr>
<td>External turbulence</td>
</tr>
<tr>
<td>Portfolio dynamics</td>
</tr>
<tr>
<td>Formal project RM</td>
</tr>
<tr>
<td>Integration of RM into PPM</td>
</tr>
<tr>
<td>Formal Project RM x</td>
</tr>
<tr>
<td>Integration of RM into PPM</td>
</tr>
<tr>
<td>Formal Project RM x R&amp;D</td>
</tr>
<tr>
<td>focus x R&amp;D focus</td>
</tr>
<tr>
<td>Integration of RM into PPM xR&amp;D focus</td>
</tr>
<tr>
<td>Formal Project RM x External turbulence</td>
</tr>
<tr>
<td>Integration of RM into PPM xExternal turbulence</td>
</tr>
<tr>
<td>Formal Project RM x Portfolio dynamics</td>
</tr>
<tr>
<td>Integration of RM into PPM xPortfolio dynamics</td>
</tr>
<tr>
<td>Constant</td>
</tr>
<tr>
<td>R²</td>
</tr>
<tr>
<td>Delta R²</td>
</tr>
<tr>
<td>Adjusted R²</td>
</tr>
<tr>
<td>F</td>
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</tbody>
</table>

Note. Hierarchical Regression Models with Project Portfolio Success (Models 1–6) as dependent variables; unstandardized regression coefficients are reported; all variables are mean-centered. n = 177. RM, risk management; PPM, project portfolio management. *p < 0.10. †p < 0.05. ‡p < 0.01 (two-sided t-test).
adding the multiplication terms into the models and comparing the models with Model 1. To test the interaction effects, we used the procedures proposed by Aiken, West, and Reno (1991). For this purpose, we mean-centered the variables and included the product term in the regression model. We can assume an interaction effect if the interaction term is significant and the inclusion of the term significantly increases the explained variance of the model. Table 2 shows the results.

Model 1 reveals that formal project risk management has a marginally significant positive impact \((b = 0.06, p < 0.10)\) on project portfolio success, as does the integration of risk information into project portfolio management \((b = 0.11, p < 0.05)\). In addition, the moderator external turbulence shows a significant direct positive impact on project portfolio success \((b = 0.10, p < 0.05)\). Consequently, hypotheses 1 and 2 are supported. Model 2 includes the product term of both independent variables. Here, we find a positive interaction \((b = 0.06, p < 0.05)\) that supports hypothesis 3, which states that simultaneous use of a formal project risk management process and the integration of risk information into project portfolio management increases the positive effect on project portfolio success. Model 3 tests the interaction effect of an R&D focus of project portfolios. Although there is a positive interaction effect with formal project risk management \((b = 0.19, p < 0.05)\), there is no significant interaction with the integration of risk information into project portfolio management. Consequently, we find support for hypothesis 4a and no support for hypothesis 4b. Model 4 reveals a significant positive interaction effect between external turbulence and the integration of risk information into project portfolio management \((b = 0.05, p < 0.10)\), which supports hypothesis 5b; however, no support is found for hypothesis 5a. Model 5 tests the interaction effect of portfolio dynamics. We find a positive interaction with the integration of risk information into project portfolio management \((b = 0.07, p < 0.05)\); thus, hypothesis 6b is supported, which indicates that integrating risk information into project portfolio management becomes more important with increasing portfolio dynamics. Contrary to hypothesis 6a, there is no significant interaction effect with formal project risk management. Model 6 includes all effects in one model. Overall, the adjusted variance is 14%, which is satisfactory, considering the fact that we are using a dual informant design with no common method variance. Figure 2 depicts simple slopes to visualize the interaction effects for high and low values of the interaction terms. According to Aiken et al. (1991), a low
(high) value is the mean minus (plus) one standard deviation.

**Discussion and Conclusions**

The objectives of this study were to link formal risk management at the project level with the integration of risk information at the portfolio level and to investigate the impact of both of these on project portfolio success. A contingency view was adopted to examine the effects of R&D-dominated project portfolios, external turbulence, and portfolio dynamics on risk management. The results of this study have theoretical and managerial implications for managing project portfolios.

**Theoretical Implications**

Our major finding is that the interaction between risk management practices on different management levels is highly relevant for project portfolio success. Our study therefore answers the call to further examine the link between single project management and project portfolio management (Martinsuo & Lehtonen, 2007; Söderlund, 2004). Martinsuo and Lehtonen (2007) show that single project management efficiency affects project portfolio management. The results of the present study extend this finding by providing evidence that project risk management is linked to project portfolio success. On the one hand, a formal risk management process at the project level is necessary for achieving high project success and is equally important to achieving high project portfolio success. On the other hand, we find that integrating risk information into project portfolio management is associated with increased project portfolio success. These findings support the claim that identified risks should be integrated into the project portfolio management process (Sanchez et al., 2008). More importantly, our findings suggest that joint risk management at both management levels increases the positive effect on project portfolio success. When risk information is integrated at the portfolio level, the positive impact of risk management at the project level is strengthened and vice versa. The results suggest that risk management implemented solely at one management level and not at the other has a lower impact; therefore, we strongly recommend implementing risk management at both management levels simultaneously. For formal project risk management to develop to its full potential, it is necessary to ensure that risk information is integrated at the portfolio level. Integration at the portfolio level only makes sense when risks are identified at the project level. Our findings deliver quantitative evidence for Olsson’s (2008) assertion that it is insufficient to consider only project risks in the context of project portfolios.

This study also contributes to a deeper understanding of the extent to which contingencies affect risk management. Our findings demonstrate that formal risk management at the project level is even more important for portfolio success in R&D-dominated project portfolios, whereas the benefits of integrating risk information at the portfolio level are even greater for project portfolios that are highly dynamic in nature and operate in environments with high external turbulence. The results are consistent with previous research, which confirm the increased benefits of risk management for high-risk projects (Couillard, 1995; Raz et al., 2002). Furthermore, the fluctuation of projects seems to play an important role for portfolio management practices. Our findings suggest that risk integration at the portfolio level is more prominent for dynamic project portfolios. Moreover, the greater the level of technological uncertainty, the more valuable the integration of risk information at the portfolio level becomes. The increase indicates that risk management practices for integrating risk information at the portfolio level gain importance as uncertainty increases. As a result, this study supports the claim that firms must tailor their risk management to their environment (Ropponen & Lytyinen, 2000). In other words, there is no single method of risk management that fits all portfolios (Shenhar, 2001). Furthermore, this study addresses the call to examine the fit among the type of project, the style of project management, and success (Shenhar, 2001; Shenhar & Dvir, 1996).

We could not confirm all the hypothesized interaction effects, however; for example, we could not find an interaction effect between formal project risk management and portfolio dynamics (as well as external turbulence). A formal risk management process at the project level might therefore be important regardless of the environmental or portfolio-inherent turbulence. Similarly, integrating risk information into the portfolio management process seems to be of equal relevance for R&D- and non-R&D-dominated portfolios.

**Managerial Implications**

For practitioners, our results highlight the need to address risks at the portfolio level in addition to addressing risks at the project level. Research has found that risk management approaches at the portfolio level are, de facto, still in their infancy (de Reyck et al., 2005). Our findings suggest that a holistic view will positively influence portfolio success. Integrating risk information at the portfolio level is an important step for advancing portfolio managers’ understanding of risks. Portfolio managers must adapt project prioritization and resource allocation based on risk information. For example, risk information may lead to the postpone- ment or cancellation of projects. Finally, portfolio managers must consider portfolio and environmental characteristics when managing risks. Project portfolios with a high percentage of R&D projects may benefit from a formal project risk management process more so than other types of project portfolios. Project portfolios with low external turbulence and portfolio dynamics may not profit as much from integrating risk information at the portfolio level. As a result of the costs of applying risk management, a high degree of risk management may not be beneficial for all types of project portfolios. In certain cases, the costs of
implementing risk management may not justify the benefits (Kutsch & Hall, 2009).

**Limitations and Avenues for Future Research**

When interpreting our results, some limitations must be considered. First, the independent variables and the dependent variable were measured during the same time period. Consequently, there might be a risk of halo or attribution bias. Although we used different informants, the actual relationship between the independent variables and the dependent variable might be lower. Moreover, the focus of this study was on German firms and risks might be handled differently in other cultural contexts. Further research might build upon our findings and examine risk management practices in other countries.

The independent variables addressed aspects of risk management at a high level. Future research might address risk management issues at more of an operational level. For example, we have shown that risk integration at the portfolio level is important. Future research might examine the effectiveness of different approaches to achieve this integration. Moreover, the literature has emphasized other methods to enhance flexibility and rapid decision making when managing uncertainty, such as reflective learning or simultaneously pursuing various candidate solutions (Perminova et al., 2008; Pich et al., 2002). Future research might include uncertainty management approaches into the proposed model and investigate how these proposed methods interact with risk management approaches at the project and portfolio levels and how they influence portfolio success.

To increase success, contingencies must be carefully considered. In this respect, other portfolio or environmental characteristics might be relevant to other dimensions of risk management. For example, the degree of interdependencies within a project portfolio may influence the risk level because new risks emerge in addition to single project risks due to interdependencies between projects (Project Management Institute, 2008b). Consequently, identifying portfolio risks may become more important as interdependencies between projects increase. Additional contextual factors might be investigated in future risk management and project portfolio management research.

Finally, to enhance the understanding of risk management practices, further research seems appropriate to investigate the interaction effect between risk management at the project level and the portfolio level for other dimensions of risk management. For example, research might address the process of weighing threats and opportunities to obtain a balanced project portfolio (Shenhar, 2001) and might also examine how this weighing interacts with risk management practices at the project level. For instance, portfolio managers seeking to reduce a portfolio’s risk can initiate projects with offsetting effects for existing projects in the portfolio in terms of exposure to uncertainty. As with organizational portfolio diversification, the overall risk of the portfolio could be lower than the individual risks of its projects.

**References**


A Contingency Perspective on Risk Management


Dr. Juliane Teller studied as a doctoral researcher at the Chair for Technology and Innovation Management at the Berlin Institute of Technology. Her research focuses on the management of risks in a project portfolio environment, as well as formalization in project management and project portfolio management. Her research has been published in refereed journals, including *International Journal of Project Management* and *Journal of Project Management*. Juliane Teller works in the medical technology industry and can be contacted at mail@julianeteller.com

Alexander Kock, Dr. rer. oec. habil., is a Professor of Technology and Innovation Management at Technische Universität Darmstadt, Germany and holds a diploma in business engineering and a doctorate in business administration from Berlin Institute of Technology. Professor Kock’s research interests cover project portfolio management and organizational issues of innovation management and his work has been published in various journals, including *Journal of Product Innovation Management*, *IEEE Transactions on Engineering Management*, and *International Journal of Project Management*. He can be contacted at kock@tim.tu-darmstadt.de

Hans Georg Gemünden, Dr. rer. oec. habil., is a Professor of Technology and Innovation Management at the Berlin Institute of Technology. He holds a Diploma and a Doctorate in Business Administration from the University of the Saarland in Saarbrücken, and a Habilitation degree and an honorary doctorate from the University of Kiel. Professor Gemünden has received several Awards of Excellence for his research, which has been published in refereed journals, including, among others, *Organization Science*, *Research Policy*, *Journal of Product Innovation Management*, *Creativity and Innovation Management*, *International Journal of Research in Marketing*, *IEEE Transactions on Engineering Management*, and *International Journal of Project Management*, and *Journal of Project Management*. He can be contacted at hans.gemuenden@tim.tu-berlin.de


## Appendix: Item Wording and Measurement

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Items</th>
<th>Alpha</th>
<th>Factor Loading (λ)</th>
</tr>
</thead>
</table>
| **Project Portfolio Success** (second order construct; $\chi^2 = 276.61$ (df = 129; $p < 0.00$), SRMR = 0.076, CFI = 0.902) | Please evaluate the average success of completed projects:  
- Our projects are completed with a high degree of schedule adherence.  
- Our projects are completed with a high degree of budget adherence.  
- Our projects fulfill the defined specifications. |         |                    |
| **Average Project Success** (3 items, $\alpha = 0.66$, factor loading $\lambda = 0.70$) | Please evaluate the average success of completed projects:  
- Our projects are completed with a high degree of schedule adherence.  
- Our projects are completed with a high degree of budget adherence.  
- Our projects fulfill the defined specifications. |         |                    |
| **Average Product Success** (3 items, $\alpha = 0.86$, $\lambda = 0.77$) | Please evaluate the average success of completed projects:  
- Our project results reach the level of market goals planned in the project (e.g., market share).  
- Our project results reach the level of financial goals planned in the project (e.g., ROI).  
- Our project results reach the amortization periods planned in the project. |         |                    |
| **Strategic Fit** (3 items, $\alpha = 0.80$, $\lambda = 0.78$) | The project portfolio is rigorously oriented toward the future of the company.  
The corporate strategy is optimally realized by our project portfolio.  
The allocation of resources to the projects reflects our strategic thrust. |         |                    |
| **Portfolio Balance** (3 items, $\alpha = 0.75$, $\lambda = 0.71$) | There is a good balance in our project portfolio in terms of … new and old application areas. /… new and existing technologies. /… project risks. |         |                    |
| **Preparing for the Future** (3 items, $\alpha = 0.82$, $\lambda = 0.66$) | In our projects, we adequately develop new technologies/skills.  
- Our projects put us a step ahead of our competitors in terms of new products, technologies, and services.  
The projects allow us to help shape the future of our industry. |         |                    |
| **Economic Success** (4 items, $\alpha = 0.84$, $\lambda = 0.62$) | How do you evaluate the success of your company/business area compared to your competitors in terms of … overall business success. / … market share. /… sales growth. /… profitability. |         |                    |
| **Formal Project Risk Management** (4 items, $\alpha = 0.91$) | Please evaluate the following statements with regard to the project level:  
- Responsibilities in risk management are clearly defined.  
- The risk management process is explained in detail in a process description (e.g., manual).  
- We use standardized forms for risk management.  
- As a part of risk management there are extensive regulations regarding content, scope, and the external form of risk documents (workflows). |         |                    |
| **Integration of Risk Management Into Project Portfolio Management** (6 items, $\alpha = 0.87$) | Risk information is integrated in project prioritization.  
- Individual projects are postponed based on risk information.  
- We cancel projects in progress based on risk information.  
- We initiate new projects based on risk information.  
- Resources are redistributed among the projects based on risk information.  
- We check the portfolio assumptions made for validity based on risk information. |         |                    |
| **External Turbulence** (4 items, $\alpha = 0.87$) | The technology used in our industry sector is constantly changing.  
- There are frequent technological breakthroughs in our industry sector.  
- Technological changes open up large opportunities in our sector.  
- Technological developments in our sector tend to be minor (inverted). |         |                    |
| **Portfolio Dynamics** (2 items, $\alpha = 0.83$) | Our project portfolio changes greatly over the course of a year.  
- We often modify the project structure over the course of a year. |         |                    |