VII SINGEP
Simpósio Internacional de Gestão de Projetos, Inovação e Sustentabilidade
International Symposium on Project Management, Innovation and Sustainability
ISSN: 2317-8302

UNDERSTANDING THE INFLUENCE OF PROJECT RISK MANAGEMENT ON INFORMATION TECHNOLOGY PROJECT SUCCESS: A MULTIDIMENSIONAL ANALYSIS

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ISSN: 2317-8302

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Resumo

Diversos estudos foram realizados para melhor compreender as principais causas de falhas de projetos e como enfrentá-los na área da tecnologia da informação (TI). O gerenciamento de riscos do projeto (PRM) foi reconhecido como um fator crítico de sucesso para suportar o atingimento do sucesso de projetos. Apesar dos benefícios conhecidos do PRM, seu uso efetivo tem sido discutido em estudos que buscam as razões para o desengajamento dos gerentes de projeto em adotar as melhores práticas de PRM durante o ciclo de vida de um projeto. O objetivo principal deste trabalho foi analisar como o PRM influencia o sucesso do projeto em projetos de TI. Diferentemente de outros estudos, este considerou muitas dimensões dos dois construtos PRM e sucesso do projeto. Uma abordagem quantitativa foi realizada para coletar dados de 156 profissionais em todo o mundo, de vários países e empresas. Este estudo contribuiu para a teoria mostrando que o PRM influencia positivamente o sucesso do projeto, mas ocorre apenas para duas das cinco dimensões do PRM, a saber cultura de gestão de risco e planejamento de resposta ao risco, em relação a quatro das cinco dimensões do sucesso do projeto, a saber eficiência do projeto, impacto no cliente, impacto na equipe do projeto e sucesso nos negócios.

Palavras-chave: sistema de informação, tecnologia da informação, gerenciamento de risco do projeto, sucesso do projeto, abordagem multidimensional

Abstract

Several studies have been carried out to better understand the main causes for project failures and how to tackle them in the information technology (IT) field, and project risk management (PRM) has been recognized as a critical success factor to support the achievement of project success. Despite the known benefits of PRM, its effective usage have been discussed in studies looking for the reasons due to project managers disengagement from adopting best practices of PRM through the overall project life cycle. The main objective of this work was to analysis how PRM influences project success in IT projects. Differently from other studies, this one took into consideration many dimensions of the both constructs PRM and project success. A quantitative approach was carried-out to gather data from 156 practitioners worldwide from several countries and companies. This study contributed to theory by showing that PRM influences positively the project success, but it occurs only for two out of five dimensions of PRM, namely risk management culture and risk response planning, in relation to four out of five dimensions of project success, namely project efficiency, impact on the customer, impact on the project team and business success.

Keywords: information system, information technology, project risk management, project success, multidimensional approach.

1 Introduction

One relevant knowledge area in the project management field is project risk management (PRM), which is recognized as a critical success factor to support the achievement of project goals and with has given much attention in the last years (Aven, 2016; Lehtiranta, 2014; Sanchez, Benoit, Bourgault, & Pellerin, 2009; Zhang, 2011; Persson, Mathiassen, Boeg, Madsen, & Steinson, 2009). In the Project Management Institute (PMI) Pulse of Profession 2017 survey, 27% of 3,234 project management practitioners said that undefined opportunities and risks was one of top three primary causes for projects failures, considering the projects started in the past 12 months (Project Management Institute, 2017b). Several best practices have also been proposed for risk management that may support project managers on their journeys, such as the PMI PMBOK® guide or Practice Standard for Project Risk Management, AXELOS PRINCE2® or Management of Risk (M_o_R) and ISO 31000:2009 Risk Management - Principles and guidelines.

Both, academic literature and best practices commonly cite four sequential and cyclic process of PRM process, namely risk identification, risk analysis, risk response planning, and risk monitoring and control. Several studies have been given attention for each one of these processes, such for to identify contextual risk factors (Aloini, Dulmin, & Mininno, 2007a), propose risk checklists and risk ontologies (Salmeron & Lopez, 2010), investigate the risk perceptions of different roles over risk identification (S. Liu, Zhang, Keil, & Chen, 2010), assess the interdependency between risks (Kwan & Leung, 2011), prioritize risks (Samadi, Nazari-Shirkouhi, & Keramati, 2014), identify avoidance and mitigation strategies (Hung, Hsu, Su, & Huang, 2014), propose models and frameworks to identify risks (Ohtaka & Fukazawa, 2010), access risks (Büyüközkan & Ruan, 2010), plan responses to risks (Dey, Clegg, & Cheffi, 2013), and monitor risks and their behavior over the software development life cycle (SDLC) in information technology (IT) projects (Yu, Chen, Klein, & Jiang, 2013).

Despite the known benefits brought with PRM, its effective usage have been discussed in some studies looking for the reasons due to project managers disengage from adopting best practices of PRM over the project life cycle (Kutsch, Denyer, Hall, & Lee-Kelley, 2013). Some reasons have been appointed, such as resources, costs and time constraints, fear to exposure issues and lack of control to stakeholders, unclear benefits of the PRM outcomes, and so on. Looking at the main four processes previously cited, risk identification and risk analysis were the main ones followed by project managers with rare effective application of risk response planning, and monitoring and control (Bannerman, 2008; Kutsch, Browning, & Hall, 2014; Kutsch et al., 2013; Kutsch & Hall, 2009, 2010; Kutsch & Maylor, 2011; Taylor, Artman, & Woelfer, 2012; Wickboldt et al., 2011).

The main objective of this work is to analyze how the PRM processes influences project success in IT projects. Differently of the other studies found in the literature, this work takes into consideration the many dimensions of the both constructs, PRM and project success in order to confirm, review and make practical recommendations to guarantee the effective use of PRM best practices once they have been recognized as critical success factor to support the achievement of business objectives. Therefore, this study proposes the following research question, "*Do project risk management influence project success in IT projects?*" with eyes on both, the multi dimensions of PRM and project success. This will provide insights of the influence of common processes of PRM on common dimensions of project success, namely project efficiency, impact on the customer, impact on the project team, business success, and preparing for the future.

2 Literature Review

In the last 40 years, several studies have been conducted to investigate the concepts, ontologies, models, methods, and frameworks related to PRM in different fields and IT have developed significant contributions to that. Recent systematic reviews, for instance, were proposed to discuss conceptual/theoretical issues (Aven, 2016; Zhang, 2011) and practical issues on risk management (Lehtiranta, 2014; Persson et al., 2009; Sanchez et al., 2009). These studies reinforce the relevance of this field of study, showing that there are much more opportunities for new research questions, at least, in the IT context.

PRM has an important function in managing software projects, but risk management theory needs to evolve on practical requirements to deal with the uncertainties challenged by software projects bridging the gap between the practice and academic prescriptions of risk management (Bannerman, 2008; Wickboldt et al., 2011). This is also in line with recent studies inquiring the effective application of PRM by project managers (Kutsch & Hall, 2009, 2010; Kutsch et al., 2013, 2014; de Bakker, Boonstra, & Wortmann, 2010, 2011, 2012; Wickboldt et al., 2011; Zwikael & Ahn, 2011). Several reasons have been presented why project managers disengaged from PRM best practice standards in IT projects (Kutsch & Hall, 2009, 2010; Kutsch et al., 2013, 2014). It opens new doors to better understand the influence of PRM processes on project success and to develop theoretical and practical alternatives to enhance the usage of PRM.

2.1 Project Risk Management

On top of the four sequential and cyclic proceses of PRM, organizations should have a clear set of internal policies and key principles for PRM to be shared among internal and external stakeholders, such as, employees, partners, suppliers and customers. They should state the company's tolerance to risk, how to identify, analyze, response to and monitors risks, what are the main tools for registering, reporting, communicating, and following risks. These embrace the so-called risk management culture and risk management process formalization.

Risk identification aims to identify and categorize risks that if materialized could impact the business objectives. Several studies were performed to identify contextual risk factors (Aloini et al., 2007a; Büyüközkan & Ruan, 2010; Chua, 2009; Reed & Knight, 2010; Sharma & Gupta, 2012; Sharma, Sengupta, & Gupta, 2011; Wallace, Keil, & Rai, 2004a), propose risk checklists and risk ontologies (Chao Peng & Baptista Nunes, 2009a, 2009b; Salmeron & Lopez, 2010), recommend frameworks to identify and manage risks (Dey et al., 2013; Holzmann & Spiegler, 2011; Ohtaka & Fukazawa, 2010; Vrhovec, Hovelja, Vavpotič, & Krisper, 2015; Yu et al., 2013; Yu, Chen, Klein, & Jiang, 2015) and investigate the risk perceptions of different roles over risk identification (Keil, Li, Mathiassen, & Zheng, 2008; S. Liu et al., 2010; Sharma et al., 2011). **Risk analysis** aims to assess risks, individually and collectively, by qualitative and/or quantitative methods and prioritize them according to the business appetize to risks. Many studies suggested frameworks to assess risks and support decision making (Büyüközkan & Ruan, 2010; Costa, Barros, & Travassos, 2007; Salmeron & Lopez, 2010), assess the interdependency between risks (Büyüközkan & Ruan, 2010; Hu, Zhang, Ngai, Cai, & Liu, 2013; Kwan & Leung, 2011), assess the risks interdependencies in ERP projects (Lopez & Salmeron, 2014; Ojiako, Papadopoulos, Thumborisuthi, & Fan Yang, 2012) and prioritize risks (Huang & Han, 2008; Samadi et al., 2014) for different perspectives and using different methods, tools, frameworks and approaches.

Risk response planning aims to select the best strategy and action plans to address risks. Risks can be tackled proactively, before the risk materialization (ex-ante) or reactively, afterwards (post-ante) and the risk response can target the risk causes or the risk consequences

(Teller, 2013). Several studies have been deployed to identify avoidance and mitigation strategies and their effectiveness and efficiency tackling key risks (Chua, 2009; Gefen, Wyss, & Lichtenstein, 2008; Hu et al., 2013; Hung et al., 2014; Li et al., 2008; J. Y.-C. Liu & Yuliani, 2016; S. Liu, 2016) and propose models and frameworks to implement the mitigation actions (Alhawari, Karadsheh, Nehari Talet, & Mansour, 2012; Dey et al., 2013; Hu et al., 2013; Persson et al., 2009). These studies contribute to the PRM field due to their practical recommendations in other to protect and maximize the chance of business success. **Risk monitoring and control** aims to monitor and control the mitigations actions and reassess known risks as well new risks emerging over the project life cycle. Some studies have been proposed frameworks to analyze and monitor risks looking their behavior over the SDLC in IT projects (Dey, Kinch, & Ogunlana, 2007; Hwang, Hsiao, Chen, & Chern, 2016; Yu et al., 2013). They provide insights on the key risks in each project phase and/or software development phase. These recent studies reinforce the relevance of this process for the project success, as old risks change and new risks arise during the project development affecting each phase of the project in different ways but they do not show empirically the effect of this process to the project success.

A well-established **risk management culture** is essential for the properly deployment of an effective risk management process (Sanchez et al., 2009). It implies an open, honesty and transparent communication by risk responsible to all project stakeholders; the sense of responsibility by risk owners for the risks and their associated response action plans; everybody is responsibility to manage, pro-actively and daily, the risks in their area of responsibility; and employees at all levels of the project are conscious of the necessity of the risk management - high risk awareness (Teller, 2013; Teller, Kock, & Gemünden, 2014). Top management support, project leaders' support and a risk awareness culture is vital, otherwise, PRM process will not likely be implemented properly which in turn could not bring the expected benefit for the project success (Cagliano, Grimaldi, & Rafele, 2015; Yeo & Ren, 2009). An open culture gives the project team the chance to be aware of the current situation as soon as possible avoiding bad surprises in the last minute, and allowing manage risks proactively (Yeo & Ren, 2009). Moreover, an early planning enhance the collaborative culture with the active involvement of the project stakeholders, such as the project team, the support functions, suppliers, partners, and customers, leading to better understand and sense making of the risks that should affect the business objectives (Thamhain, 2013).

A established **risk management process formalization** has been recognized as an key contributor to the project success (Cagliano et al., 2015; Carvalho & Rabechini Junior, 2014; de Bakker et al., 2010; Teller, 2013). A Risk policy should describe the risk definition agreed by one organization, the risk management model covering all interested parts of the organization, the risk organizational structure, and the risk tolerance acceptance by the management. Roles and responsibilities should be clearly defined and documented to guarantee the comprehensive execution of risk management across the organization. For each risk a risk owner should be nominated, being the accountable for it during the risk life cycle (Teller, 2013; Teller & Kock, 2013). The risk management process should be described in detail in a guide, manual or other document of the organization, stating the steps of the process, such as the one described in the previous section, the four sequential and cyclic steps of PRM. Standardized forms for risk management should be created as applied for the common understanding of all stakeholders in a way that everyone in the organization knows how to interpret each contents and the structure of the risk management evaluation. Least, but not least, the risk policy, roles and responsibilities, risk management process and standardized forms should be well-communicated for all members of the organization (Teller, 2013; Teller et al., 2014). On the other hand, some authors highlighted that risk management process can be perceived by project managers, project team and stakeholders as a cumbersome set of activities, enforcing extra work, cost and time (Aloini, Dulmin, & Mininno, 2007b) and under certain circumstances cannot be effective.

2.2 Project Success

Several studies defined project success splitting it into process and product performance which product performance refers to the success of the system developed in terms of reliability, meeting the requirements, user's expectation, and process performance refers to the success of the development process itself in terms of on schedule and within budget (Han & Huang, 2007; S. Liu & Wang, 2014; Wallace, Keil, & Rai, 2004b; Wallace et al., 2004a). Product performance sometimes appears in other studies named as system performance which is the extent to which the project is delivered with reliable outcomes and with satisfying functional requirements embodying the functionality and quality of the system (S. Liu, 2015a, 2015b; S. Liu & Wang, 2014). Likewise, project success can be measured as two dimensions, namely efficiency (on time and within budget) and effectiveness (meeting client specifications, meeting technical specifications, goal achieved, pride and quality achieved) which presents small variations in relation to the previous studies. Similarly, one study evaluate project success as four variables, namely cost overrun, schedule overrun, achievement of project scope target, and customer satisfaction (Zwikael & Ahn, 2011).

Last studies have been defined project success as indicators of scope, quality, customer satisfaction, team satisfaction and sustainability (Carvalho & Rabechini Junior, 2014; Rabechini Junior & Carvalho, 2013; Mir & Pinnington, 2014) structuring project success based on five dimensions proposed by Shenhar (Shenhar & Dvir, 2007), namely project efficiency, impact on the customer, impact on the team, business and direct success and preparation for future. Mir and Pinnington (2014) developed a well-cited study on the influence of project management performance on project success, both been defined as multidimensional constructs. These previous studies considered either a traditional vendor-oriented definition of project success as commonly stated in the literature and a broader view of project success that includes the opinion of stakeholders on various project characteristics, being the broader view at some extend an extension of the traditional view. This study adopted the multidimensional construct proposed by these authors.

2.3 Project Success Impacted by Risks and Risk Management

Several studies were undertaken to investigate the influence of either risks or PRM on project success. Some of them examined the influence of different categories, groups, sources, and dimensions of risk on project success (Han & Huang, 2007; Jun, Qiuzhen, & Qingguo, 2011; S. Liu & Wang, 2014; Mishra, Das, & Murray, 2016; Na, Simpson, Li, Singh, & Kim, 2007; Reed & Knight, 2010; Sharma et al., 2011; Wallace et al., 2004a, 2004b), the influence of PRM on project success (Carvalho & Rabechini Junior, 2014; de Bakker et al., 2010, 2011, 2012; Islam, Mouratidis, & Weippl, 2013; Jun et al., 2011; S. Liu, 2015b, 2015a; Rabechini Junior & Carvalho, 2013; Zwikael & Ahn, 2011), the moderating effects of risk or contingency factors on the relationship between risk or risk management on project success (Carvalho & Rabechini Junior, 2014; Jun et al., 2011; Keil, Rai, & Liu, 2013; S. Liu, 2015b, 2015a; S. Liu & Wang, 2014; Teller & Kock, 2013; Teller et al., 2014; Wallace et al., 2004b; Zwikael & Ahn, 2011), and the influence of portfolio risk management on project portfolio success (Teller, 2013; Teller & Kock, 2013; Teller et al., 2014). Diverse findings were retrieved from these studies to comprehend how risk and risk management affect the project success.

3 Conceptual Model and Hipotheses

The previous cited studies on the influence of risk on project success although are not designed to explicitly lead with PRM dimensions, they are extremely relevant as bases for further studies intended to develop risk management strategies and practices to deal with risks affecting the project success. PRM, as process, is cited briefly in one or another section of these studies, usually in the end of the papers as part of the final remarks. Those studies that aims to understand the effect of PRM on project success bring valuable insights that pave the way for new contributions, such as the meta-analysis developed by de Bakker et al. (2010) which is key for the development of this study due to two main reasons. First, their study covered papers in the literature review (1997-2009) that, with few exceptions, were not covered in this study. Second, their findings show that the effectiveness of the risk management approaches is still unclear, the empirical knowledge up to 2009 is still anecdotal and PRM can be effective only in specific IT project contexts.

On the other hand, recent studies have been inquired the effective application of PRM and arguing that PRM theory should focus on practical requirements to deal with the uncertainties challenged by IT projects bridging the gap between the practice and academic prescriptions (Kutsch & Hall, 2009, 2010; Kutsch et al., 2013, 2014; Wickboldt et al., 2011; Bannerman, 2008). The reasons behind this are diverse, like costs and time constraints, focus on familiar topics, lack of agreements, authority or inspection, avoidance of self-exposure, unclear RM outcomes (Kutsch et al., 2014, 2013; Kutsch & Hall, 2009, 2010; Kutsch & Maylor, 2011). Based upon these recent findings, it is worth to investigate the relationship between PRM and project success from other lenses and it is even more relevant in a context with continuous changings and application of different approaches to manage projects (e.g. agile) in addition to traditional approaches. *Figure 1* shows the conceptual model.

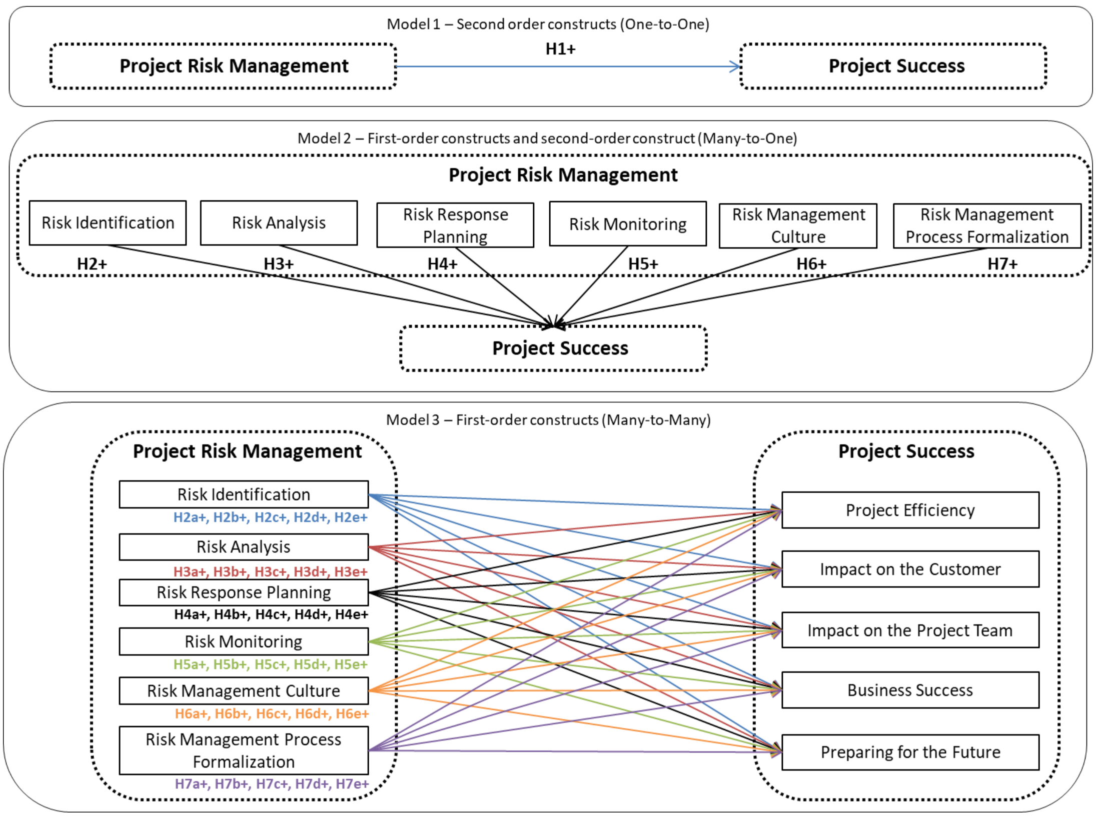

Figure 1. Proposed conceptual model

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4 Methodology

This research selected hypothetical-deductive as research design by the identification of a research gap. A literature review was undertaken by adopting a systematic review approach. Only papers and reviews in English of journals dated from 2007 to 2016 were selected, in accordance to our intent of retrieving the most updated studies. A total of 101 papers achieved these criteria and they compose the literature review of this study.

This study is built upon two second-order constructs, PRM and project success, and both were designed on a multidimensional basis, following the literature review described in the previous sections. PRM is composed by six first-order constructs, namely *risk identification, risk analysis, risk response planning, risk monitoring and control, risk management culture and risk management process formalization,* and projects success is composed by five first-order constructs, namely *project efficiency, impact on the customer, impact on the project team, business success, and preparing for the future*. Each construct and their items were assessed by respondents based on the scales proposed in the referred studies. In total, 44 variables compose the overall proposed conceptual model.

A pre-tested was carried-out over a web-based survey with around 22 senior project management practitioners in IT field to ensure the effectiveness and appropriateness of the questionnaire`s content, the wording, the sequence and the instruction. A web-based survey was conducted over three weeks in February 2018 supported by the online platform SurveyMonkey. A three-wave follow up approach was adopted, thus, soft reminders were sent to all participants and groups after one week interval. Convenience sampling was adopted in this research, therefore, the participants and unit of analysis - *latest completed project* - were chosen by the facility to access them and their availability to answer the online questionnaire. The data collection resulted in a final valid number of 156 respondents for the analysis. This is slightly above the minimum threshold (146) expected. The population covered a wide variety of small to large projects, thereby strengthening the generalizability of the findings.

The reliability and validity of the measurement model were verified for three different groups according to the specific objectives of this study: one-to-one constructs, many-to-one constructs and many-to-many constructs. It was performed by four stepwise analyses for the measurement model: convergent validity, composite reliability, internal consistency and discriminant validity. Partial least squares - structural equation modeling (PLS-SEM) was considered the most suitable data analysis method due to the research objective of identifying many-to-many relationship between PRM dimensions and project success dimensions, the presence of many dependent variables (first-order constructs), and due to the small population, despite the achievement of the minimum sample requirement. The software SmartPLS 3.2.7 was chosen to perform the evaluation of the measurement model and of the structural model.

This research adopted the step-wise recommended by Ringle, Silva, and Bido (2014) and the PLS Algorithm for the evaluation of measurement model and the R^2. The evaluation of the structural model was followed by three stepwise analyses. First, the structural model analysis considered the Pearson coefficient of determination (R Squared or R^2). Second, the analysis evaluated if the correlations are significant ($p \leq 0.05$ or test-t > 1.96) and it was performed by bootstrapping analysis which is a test that relies on random sampling. Lastly, the analysis evaluated the values of two quality indicators, predictive validity (Q^2) - Stone-Geisser indicator and effect size (f^2) - Cohen indicator.

The respondents were very experienced professional with 26.3 years in average of total work experience, 15.4 years in average of PM experience and 10.3 years in average of PRM experience. Most of them, 81.1%, came from large companies, here defined as those

ISSN: 2317-8302

businesses with 300 employees or more. They were requested to answer the questionnaire considering as the unit of analyses the ***latest completed project*** that they were engaged. A set of project characteristics were collected in this survey, namely project environment, type of approach, type of IT project, project duration, project team size, team language, total project net value (without taxes), sourcing orientation, and project margin variation from the target.

5 Results

Second-order constructs: this is related to the relationship between the second-order constructs PRM and project success and, consequently, the hypothesis H1. Following the step-wise recommended by Ringle et al (2014),

Table 1 shows the outcomes of the adjusted model for AVE, composite reliability, R square, R square adjusted and Cronbach's alpha and *Figure 2* shows the path final adjusted model of the second-order constructs.

Table 1. Quality criteria of the second-order constructs (final adjusted model)

Second-order constructs	AVE	Composite Reliability	R Square	R Square Adjusted	Cronbach's Alpha
Project Success	0.503	0.945	0.332	0.328	0.937
Project Risk Management	0.578	0.968			0.965

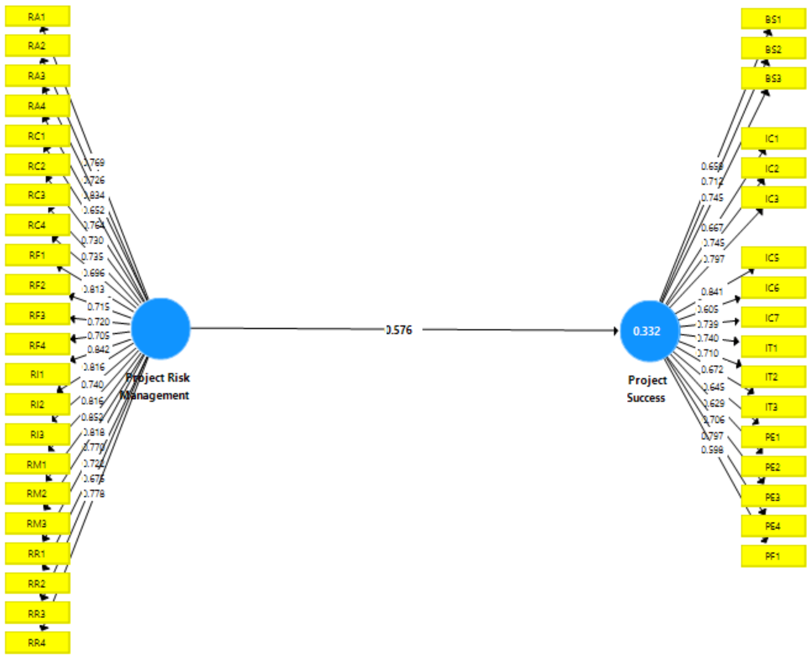

Figure 2. Path model of the second-order constructs (final adjusted model)

First-order vs second-order constructs: this is related to the relationships between the first-order constructs of PRM, concerning the test for relationship of each dimension, and the second-order construct Project Success (PS) and, consequently, to the hypotheses H2, H3, H4, H5, H6 and H7. *Table 2* shows that all values of AVE, composite reliability and Cronbach's alpha (α) are above the recommend threshold, respectively, 0.50, 0.70 and 0.70.

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Moreover, R^2 is above 26% which means a significant effect (Cohen, 1988) on the dependent variables and *Figure 3* shows the final adjusted measurement model.

Table 2. Quality criteria for first-order vs second-order constructs (adjusted model)

First-order constructs vs Second-order construct	AVE	Composite Reliability	R Square	R Square Adjusted	Cronbach's Alpha
Project Success (PS)	0.503	0.945	0.391	0.370	0.937
Risk Analysis (RA)	0.683	0.865	-	-	0.771
Risk Management Culture (RC)	0.697	0.902	-	-	0.855
Risk Monitoring (RM)	0.819	0.931	-	-	0.889
Risk Management Process Formalization (RF)	0.671	0.891	-	-	0.837
Risk Response Planning (RR)	0.672	0.891	-	-	0.837

Figure 3 shows the third draft version of the adjusted measurement model.

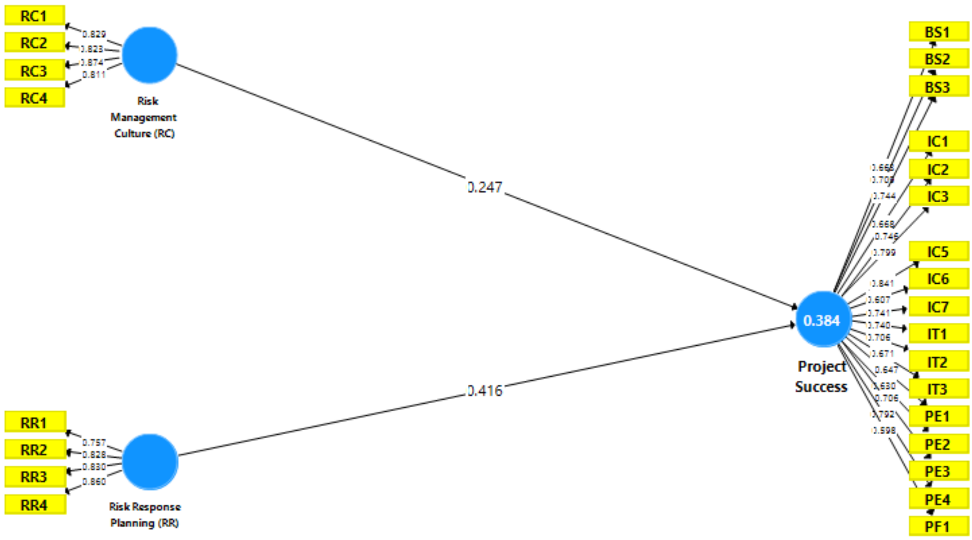

Figure 3. Path model of the first-order vs second-order constructs (final adjusted model)

First-order Constructs: this is related to the relationships between the first-order constructs of PRM and the first-order constructs of Project Success (PS) and, consequently, to the hypotheses H2a, H2b, H2c, H2d, H2e, H3a, H3b, H3c, H3d, H3e, H4a, H4b, H4c, H4d, H4e, H5a, H5b, H5c, H5d, H5e, H6a, H6b, H6c, H6d, H6e, H7a, H7b, H7c, H7d and H7e. *Table 3* shows for the final adjusted model that all values of AVE, composite reliability and Cronbach's alpha (α) are above the recommend threshold. Moreover, almost all R^2 are above 26% and *Figure 4* shows the final adjusted measurement model.

Table 3. Quality criteria of the first-order constructs (final adjusted model)

First-order constructs	AVE	Composite Reliability	R Square	R Square Adjusted	Cronbach's Alpha
Business Success (BS)	0.597	0.855	0.295	0.290	0.774
Impact on the Customer (IC)	0.644	0.915	0.256	0.251	0.888
Impact on the Project Team (IT)	0.759	0.904	0.307	0.302	0.841
Project Efficiency (PE)	0.691	0.899	0.307	0.298	0.854
Risk Management Culture (RC)	0.697	0.902	-	-	0.855
Risk Response Planning (RR)	0.672	0.891	-	-	0.837

ISSN: 2317-8302

Bootstrapping analysis was carried out to evaluated if the correlation is significant (p ≤ 0.05 or test-t > 1.96) for all three models and it shows that all test-t values are bigger than 1.96 and all p-values are lower than 0.05, after several iterations. Based on the outcomes of the previous sections which are summarized in the *Table 4*, eight out of thirty-seven hypotheses were supported in this study, namely H1, H4, H4a, H4b, H4d, H6, H6a and H6c.

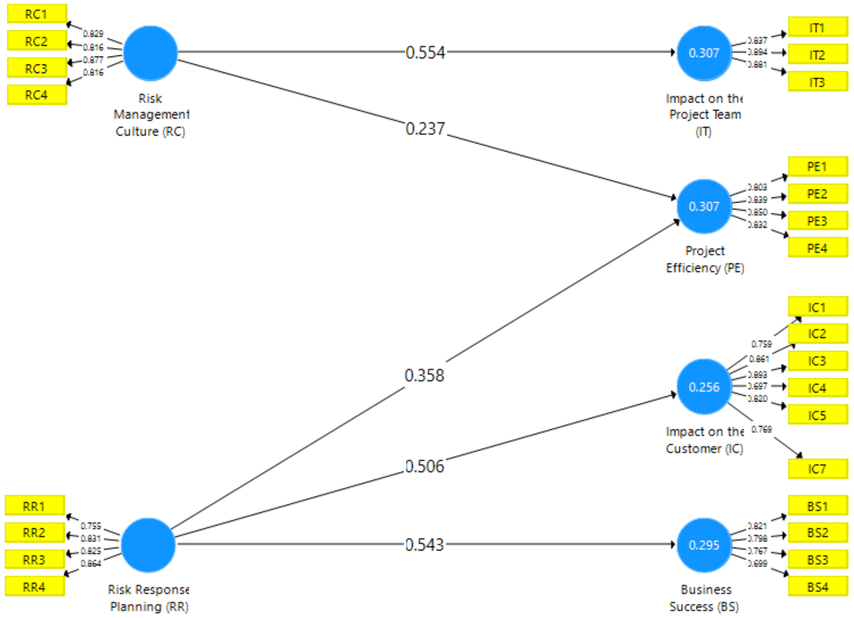

Figure 4. Path model of the first-order constructs (final adjusted model)

Table 4. Path coefficients of the constructs (final adjusted model)

Path coefficients	Original Sample	Sampl e Mean	Standard Deviation	Test-t	P Values
Project Risk Management (PRM) -> Project Success (PS)	0.576	0.592	0.052	11.036	0.000
Risk Management Culture (RC) -> Project Success (PS)	0.247	0.253	0.111	2.224	0.026
Risk Response Planning (RR) -> Project Success (PS)	0.416	0.423	0.101	4.118	0.000
Risk Management Culture (RC) -> Impact on the Project Team (IT)	0.497	0.487	0.134	3.722	0.000
Risk Management Culture (RC) -> Project Efficiency (PE)	0.237	0.238	0.106	2.240	0.025
Risk Response Planning (RR) -> Business Success (BS)	0.543	0.550	0.059	9.162	0.000
Risk Response Planning (RR) -> Impact on the Customer (IC)	0.509	0.518	0.062	8.224	0.000
Risk Response Planning (RR) -> Project Efficiency (PE)	0.357	0.367	0.108	3.323	0.001

6 Analysis and discussion

Identify the relationship between PRM and project success: the hypothesis (H1) was supported by this study. PRM influences positively the project success (H1), it is statistically significant (ρ<0.001) and 33.2% of variance explained by the model in relation to the project success. This result corroborates other studies that found positive relationship between PRM and project success (Carvalho & Rabechini Junior, 2014; Rabechini Junior & Carvalho, 2013; Teller et al., 2014; Zwikael & Ahn, 2011). It reinforces the relevance of PRM for the project success but it's still impossible to identify which PRM components better contribute to this.

***Identify the relationships between PRM dimensions and project* success:** two out of six hypotheses (H2, H3, H4, H5, H6 and H7) were supported by this study (H4 and H6). The

ISSN: 2317-8302

project risk response planning is positively related to the project success (H4), it is statistically significant (ρ<0.001) and 38.4% of variance explained by the model in relation to the project success. It is in line with other studies that showed the importance to define and put in place strategies and action plans to tackle risks which, as consequence, brings a positive result to the project success (Chua, 2009; Gefen et al., 2008; Hu et al., 2013; Hung et al., 2014; Li et al., 2008; J. Y.-C. Liu & Yuliani, 2016; S. Liu, 2016; Sharma & Gupta, 2012). It raises an important warning regarding the disengagement in the early stage of the PRM (Kutsch et al., 2013) showing that to achieve a better benefit in terms of positive project success, risk response planning should be followed properly receiving much more attention. It could mean less effort invested by project managers on early stages and more in further stages. The PRM culture is positively related to the project success (H6), it is statistically significant (ρ<0.05) and 38.4% of variance explained by the model in relation to project success. It is adherent to the vital importance of risk management culture and its impact to the project success as stated by many authors (Sanchez et al., 2009; Teller, 2013; Teller et al., 2014). Furthermore, a well-stablished risk management culture implies the sense of responsibility of risk owner for the response action plans (Teller et al., 2014; Thamhain, 2013; Yeo & Ren, 2009), in line with the result found for risk response planning.

The influence of project risk identification and project risk analysis on project success were not supported by this study, respectively, hypotheses H2 and H3, despite they have being recognized in the literature as the main steps followed by the project managers in PRM (Bannerman, 2008; Kutsch et al., 2014, 2013; Kutsch & Hall, 2009, 2010; Kutsch & Maylor, 2011; Taylor et al., 2012; Wickboldt et al., 2011). Despite that, they have gained more attention (more number of studies) according to the systematic review carried out in this study. This outcome also does not corroborate with the findings of de Bakker (de Bakker et al., 2011, 2012) which showed that risk identification was the most influential risk management activity that have contributed to the project success. It opens space to investigate the effective impact of project identification and project analysis on project success.

The influence of risk management process formalization on project success (H7) was not supported, despite it has been recognized as an key contributor to the project success (de Bakker et al., 2010; Teller, 2013). This may be in line with studies that highlighted that risk management process can be perceived as a cumbersome set of activities and not effective under some conditions (Aloini et al., 2007b; Atkinson, Crawford, & Ward, 2006; de Bakker et al., 2010). The influence of project risk monitoring and control on project success (H5) was not supported by this study. It is not possible to make significant comparisons with other studies due to the lack of them in the systematic review undertaken in this study.

Identify the relationships between PRM dimensions and project success dimensions: Thirty hypotheses were evaluated for risk identification (H2a, H2b, H2c, H2d and H2e), risk analysis (H3a, H3b, H3c, H3d and H3e), risk response planning (H4a, H4b, H4c, H4d and H4e), risk monitoring and control (H5a, H5b, H5c, H5d and H5e), risk management culture (H6a, H6b, H6c, H6d and H6e) and risk management process formalization (H7a, H7b, H7c, H7d and H7e), all related to the influence on project success dimensions.

Five out of thirty hypotheses were supported (H4a, H4b, H4d, H6a and H6c). All of them were statistically significant (ρ<0.001). The project risk response planning is positively related to the project efficiency (H4a) and 30.7% of variance explained by the model. It means that taking many actions aimed to the sources of risk and tackling proactively and/or preventively risks influence positively the achievement of traditional indicators of time and budget, mainly. The project risk response planning is positively related to the impact on the customer (H4b) and 25.9% of variance explained by the model. It means that taking many actions and tackling risks influence positively the customer by meeting their interests. The project risk response planning is positively related to the business success (H4d) and 29.4% of variance explained by the model. It means that taking many actions and tackling risks influence positively the business success by meeting the organization's interests.

The PRM culture is positively related to the project efficiency (H6a) and 30.7% of variance explained by the model. It means that an open communication of risk and risk awareness influence positively the achievement of traditional indicators of time and budget, mainly. The PRM culture is positively related to the impact on the project team (H6c) and 34.4% of variance explained by the model. It means that an open communication of risk and risk awareness influence positively the project team engagement and motivation.

All hypotheses related to the first-order construct Preparing for the Future (PF) (H2e, H3e, H4e, H5e, H6e and H7e) should not be supported by this study once this construct was removed from the model due to low values of AVE and Cronbach's alpha (α). One possible cause could be the diversity of respondents per industry which brings distinct perceptions of future benefits for their respective organizations. Further investigation is necessary to better identify the root causes and propose adjustments of the manifest variables, if applicable. All other hypotheses related to the first-order constructs risk identification, risk analysis, risk monitoring and control and PRM process formalization were not supported by this study.

7 Conclusion

Implications for Theory: This study contributes to theory by showing that PRM influences positively the project success, but this positive effect occurs only per two out of five dimensions of PRM, namely risk management culture and risk response planning, in relation to four out of five dimensions of project success, namely project efficiency, impact on the customer, impact on the project team and business success. While prior studies have tended to examine the influence of PRM as a single construct in regard to project success, the last one designed as a single or multidimensional construct, this is the first study that has investigated PRM in regard to project success, both being designed as multidimensional constructs.

Therefore, our finding is of theoretical significance for PRM field in IT projects because it provides insight into how each dimension of PRM is perceived by experienced project team members in relation to the achievement of the projects goals. It sheds light on the four sequential and cyclic steps of PRM as well as on the risk management culture and risk management process formalization to enhance the discussion of the influence of PRM on project success, sometimes described as positive or as limited, as well as the disengagement of project managers over these steps. Moreover, this study also contributes to the theory developing and validating an instrument for multidimensional PRM not previously available in the literature that could be adapted and used for further investigations.

Implications for Practice: The results of this study show that PRM has a positive effect on project success and the perception of experienced project team members regards to this effect varies in relation to their mindset (e.g. risk awareness) and the activities performed over the PRM process. Project management practitioners should recognize the positive impact of PRM on project success, especially by the dimensions of risk management culture and risk response planning. In particular, risk management culture influence positively the project efficiency and the impact on the project team, and risk response planning influence positively the project efficiency, the impact on the customer and the business success.

Managers should create mechanisms to incentive an open canal of communication between projects team members and stakeholders related to key risks; create an environment that reinforce the importance of PRM in the day by day of the organization, and guarantee the proper ownership of each risk and the accountability of the actions plan to tackle them. Managers should influence people for thinking about risks in their ordinary and extraordinary activities and empower people accordingly to their responsibilities so they could act with some degree of freedom to make decisions and protect the business value.

Project management practitioners should carry out root cause analysis of the sources of risks, develop preventive and proactive actions plan and act to deal with risks materializations. Managers should push the organization to guarantee the proper execution of the actions plans to achieve the business goals. Managers and project management practitioners should invest more effort, energy and time on risk awareness culture and deployment of actions plan instead of on formal process of risk identification, risk analysis, risk management process formalization and risk monitoring. This study is not stating that these steps are not relevant or necessary, but there are a plenty of limitations and challenges already pointed out by the literature, such as resources, costs and time constraints, lack of authority by project managers, unclear benefits of the PRM outcomes that could be properly addressed by practical and effortless activities as perceived by project team.

As with all academic research, this study has some limitations. First, our study is based on limited sample, but still valid for the research purpose. Second, respondents from different countries, organizations type and size may have different perceptions of PRM and project success. For example, one of the causes of the removal of the first-order construct Preparing to the Future (PF) could be related the different perceptions of its measuring items, including the opposite interpretation of its meaning. Third, despite the reliability and validity of the measuring instrument confirmed in this study, the broad coverage of some items for the first-order constructs risk identification and risk analysis may have biased the respondents' perception affecting the final outcome in terms of influence on project success and its dimensions. Fourth, the systematic review narrowed the scope of papers for those related to IT/IS projects so other relevant papers in the PRM field which could be support the objectives of this study were not covered. There are several proposals for future works. First, one could consider the moderating effect of control variables under the relationship between PRM and project success. Second, one broader study could cover only respondents related to the IT supplier side in opposite to the consumer side. Third, new studies should be undertaken to better test and adapted the proposed multidimensional construct for PRM in order to understand why project managers disengage from adopting PRM and propose alternatives to address this issue. Forth, this study could be replicated to other areas, such as construction, government, educational, etc. to verify and compare the results. Fifth, other investigations could evaluate why some of the hypotheses were not confirmed, for instance, why project managers do not perceive risk identification affecting the project success.

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