ARTICLE IN PRESS
JPMA-01765; No of Pages 14

Available online at www.sciencedirect.com
ScienceDirect

International Journal of Project Management xx (2015) xxx–xxx

International Journal of Project Management
www.elsevier.com/locate/ijproman

Project management and its effects on project success: Cross-country and cross-industry comparisons

Marly Monteiro de Carvalho *, Leandro Alves Patah, Diógenes de Souza Bido

Production Engineering Department, Polytechnic School University of São Paulo, São Paulo, Brazil

Received 11 April 2014; received in revised form 1 April 2015; accepted 14 April 2015

Abstract

This study aims to investigate the effects of project management (PM) on project success under the parameters of scheduling, cost, and margins. We adopt a contingency approach that evaluates the complexity of the project, according to 4 categories, the effect of industry sector and countries. The methodological approach involved a longitudinal field survey in 3 countries (Argentina, Brazil, and Chile) with business units from 10 different industries over a 3-year period, and data from a total of 1387 projects were analyzed. Structural equation modeling was used to test the research hypotheses. The results show a significant and positive relationship between the response variable schedule with PM enablers and project management efforts in training and capabilities development. Project complexity has a significant effect on 2 aspects of project success: margin and schedule. Both cross-country and cross-industry analyses show a significant explanatory effect.

Keywords: Project management; Performance; Success; Contingency approach; Project management maturity; Project complexity

1. Introduction

Studies conducted over the last decade have aimed to analyze project success based on a variety of dimensions (Belout and Gauvreau, 2004; Besner and Hobbs, 2006; Bizan, 2003; Dvir et al., 2003; Gray, 2001; Kendra and Taplin, 2004; Lipovetsky, 2005; Raz et al., 2002; Repiso et al., 2007). This interest is associated with the increasing efforts (and resources) that companies are expending to implement project management (PM). However, PM remains a challenge because many projects have failed, as evidenced by several studies (Buchanan, 2008; Dai and Wells, 2004; The Standish Group International, 2009; White and Fortune, 2002).

Methods and techniques have been developed and encapsulated in bodies of knowledge by institutes and professional PM associations (IPMA, 2006; PMI, 2013). However, empirical studies highlight the challenges associated with implementing PM methodologies (Ala-Risku and Kärkkäinen, 2006; Besner and Hobbs, 2013; Chou and Yang, 2012; Hong et al., 2011). This occurs because internal and external contexts can affect PM (Papke-Shields et al., 2010).

On the one hand, some studies try to show the relationship between PM maturity and project success. The core thesis in the studies is that companies that expend efforts and resources to develop PM and to expand their PM capabilities demonstrate better performance in their projects. However, the evidence for that thesis is limited and inconclusive (Grant and Pennypacker, 2006a, 2006b; Ibbs and Kwak, 2000a, 2000b; Jiang et al., 2004; Jugdev et al., 2002; Mullay, 2006; Thomas and Mullaly, 2007; Yazici, 2009).

On the other hand, executives seek evidence that their PM efforts are both effective and producing expected results. Thus, from the project performer organization perspective the existence of a positive relation between the organizational efforts into improving project management and project success is critical to sustaining these efforts.

There remains a gap in the literature with respect to understanding the relationship between PM and project success

* Corresponding author at: Av. Prof. Almeida Prado, trav 2, n 128, 05508-900 São Paulo/SP, Brazil.
E-mail address: marlymc@usp.br (M.M. Carvalho).

http://dx.doi.org/10.1016/j.ijproman.2015.04.004
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(Aubry and Hobbs, 2010; Ika, 2009; Thomas and Mullaly, 2008). Further, Besner and Hobbs (2013) suggest that maturity and competence have a diverse, complex and intertwining relationship with project success, which should be studied more thoroughly. The literature continues to lack a broader empirical basis (Grant and Pennypacker, 2006a, 2006b).

This study aims to contribute to filling the research gap, evaluating both the relationship between PM training efforts and project results and the relationship between PM context and project results. PM contexts involve developing and using PM practices and methodology, along with providing organizational and administrative support. The methodological approach involved a longitudinal study, combining quantitative and qualitative strategies.

This article is divided into 5 sections. Section 2 summarizes the theoretical framework. The methodological approach is presented in Section 3. Section 4 presents and discusses the results. Finally, Section 5 concludes and provides recommendations for future studies.

2. Literature review

2.1. Project success

Project success has been the target of fruitful discussions in the project management literature (Carvalho and Rabechini Junior, 2015) that reveals the social and political contextualization of performance in project management (Sage et al., 2014).

The traditional view of project success is associated with fulfilling time, cost and quality objectives (the iron triangle). Financial criteria have been used to measure project performance, including economic return and cost/benefit analyses (Archer and Ghasemzadeh, 1999) and profits (Shenhar and Dvir, 2007; Thomas et al., 2002). Another way to evaluate the benefits of PM is to analyze the margins of a company's ongoing projects (Patah and Carvalho, 2007). The most-often utilized project performance metrics are those related to obtaining the initially planned schedule and cost values at the end of the project (Gray, 2001; Katz and Allen, 1985; Larson and Gobeli, 1989; Ling, 2004; White and Fortune, 2002), in which—as expected—there is a consensus on the financial issues involved (Archer and Ghasemzadeh, 1999; Patah and Carvalho, 2007; Thomas et al., 2002).

However, various studies have investigated new dimensions of project success (Carvalho and Rabechini Junior, 2015; Samset, 1998; Shenhar and Dvir, 2007; Barber, 2004; Ika, 2009; Jugdev and Muller, 2005). There seems to be no simple definition for this construct, once it may be measured differently in different types of projects, from different perspectives, at different stages, and in absolute or relative terms (Samset, 1998).

It is a multidimensional construct (Carvalho and Rabechini Junior, 2015; Samset, 1998; Shenhar and Dvir, 2007) and different stakeholder groups have their own perceptions of project success (Chou and Yang, 2012; Davis, 2014, Toor and Ogunlana, 2010; de Vries, 2009). Samset (1998) explores five success criteria: efficiency (related to the iron triangle), effectiveness, impact of the project on society, relevance to real needs and priorities in society, and sustainability, which relates to the project effects on the future. Shenhar and Dvir (2007) propose five slightly different dimensions of success: project efficiency, impact on the customer, impact on the team, business and direct success, and preparation for the future. For Carvalho and Rabechini Junior (2015), there is also a sustainability dimension, but it relates to the impact of the project on social and environmental aspects, more aligned with the current triple bottom line literature.

The distinction between the success of project management and that of its product/service is also an important issue in the literature of project success emphasized by several authors (Barclay and Osei-Bryson, 2010, Carvalho and Rabechini Junior, 2015; Cooke-Davies, 2002, Pinto and Slevin, 1988, Shenhar and Dvir, 2007).

2.2. Project management and success

A systematic PM consists of methods, toolkits and models. It can be viewed as the sequential application of structured processes for the purpose of institutionalizing standardized practices. Using a well-structured and well-implemented approach, capabilities can be stored and transferred over time, space and context. Additionally, PM can make organizations less vulnerable to the loss of tacit knowledge stored in individual memories (Ibert, 2004).

According to Carvalho et al. (2003), maturity models meet these needs because they systematize project methods, tool packages and methodologies, proposing a continuous improvement model to manage the change between an organization's initial and desired statuses. In general, maturity models involve structuring managerial processes and the key areas in which the capabilities and practices to be developed—and the key performance indicators—are grouped. The models may be structured according to proficiency levels, processes or domains by analyzing their repeatability and continuous improvement.

Maturity models assume that organizations' knowledge and experience can be translated into procedures, roadmaps, routines and databases, which leads to the configuration of a "collective brain" (Gareis and Huemann, 2000).

There are several maturity models, most of which have been proposed by consulting companies (Foti, 2002). Although most of the models in the PM area have been created over the last two decades, several maturity models already exist, such as the Capability Maturity Model (CMM) and Capability Maturity Model Integration (CMMI) (SEI, 2006), the Project Management Process Maturity Model (Ibbs and Kwak, 2000), the Project Management Maturity Model (Kerzner, 2001), the Organizational Project Management Maturity Model (PMI, 2008) and the PM Competence Model (Gareis and Huemann, 2000).

When companies adopt systematic PM, they assume that increased PM maturity will generate better project performance. However, the empirical results of this assumption are not yet

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conclusive (Yazici, 2009). Studies on maturity models implementation in the information technology (IT) industry, specially related to the CMM and CMMI models, have concluded that these models tend to develop higher quality software, a faster development cycle, higher productivity (Dion, 1993), better organizational performance (Hersleb, 1996) and increased project success (Jiang et al., 2004). In their study, Jiang et al. (2004) also conclude that project success is only significant beyond CMM Level 3.

In a cross-sector study in the USA, Yazici (2009) concludes that organizational performance is associated with PM maturity but also that the latter influences organizational performance when combined with organizational culture. Besner and Hobbs (2012, 2013) corroborate this finding and suggest that there are different relationships among maturity, competency and project success. According to Ghoddousi and Amini (2011)), among large construction companies in Iran, only those with high maturity levels have been able to win contracts for international projects.

In general, maturity models are strongly grounded in the bodies of knowledge (BoKs) of PM associations and institutes. In the models, BoKs are a reference for management process groups, knowledge areas, and tools and practices, including the Project Management Body of Knowledge (PMBoK) (PMI, 2013) and the ICB Competence Baseline (IPMA, 2006).

Chou and Yang (2012) analyze the impact of the PMBoK guide on project performance, customer satisfaction and project success in the civil construction industry in Taiwan and conclude that it is convenient to adopt PMBoK practices in this industry. Similarly, McHugh and Hogan (2011) present the reasons to adopt an internationally recognized PM methodology, as follows: the guarantee that the organization is employing what are considered to be best practices; external customers' requirements for using a recognized methodology; assistance in external recruitment and the availability of training; and support to the methodology. Conversely, Sanchez-Losado (2012) opposes the PMBoK guide and Lean Thinking in the context of construction projects by arguing that projects with a particular level of uncertainty cannot be managed exclusively through PMBoK but must incorporate aspects of Lean Thinking in a way that makes both methods compatible.

Some studies have tried to understand the impact of the implementation of these PM standards (Besner and Hobbs, 2012, 2013; Chou and Yang, 2012; McHugh and Hogan, 2011) and suggest a relationship between PM and success. Other studies investigate the impact of the adoption of PM practices on performance (Besner and Hobbs, 2012, 2013; Chou and Yang, 2012; McHugh and Hogan, 2011), and all of the referenced studies are based on the structure of the PMBoK, fourth edition (PMI, 2008).

In determining PM context, we consider both PM areas, as suggested by the BoKs, and organizational enablers, as suggested by the maturity models. Therefore, the following hypothesis is established:

H1. The context of PM is positively associated with project success.

2.3. Project management skills and success

Besner and Hobbs (2012) observe that the PMBoK guide seems to emphasize certain practices over others. The BoKs highlight hard skills, stressing the need for documentation, measurement and control of a project during its life cycle. However, Carvalho (2014) highlights the importance of soft skills in PM, especially related to communication and stakeholders' management and skills. Jugdev et al. (2007) corroborate and highlight the relationship between PM and a firm's capability based on the resource-based view.

Sage et al. (2014) suggest that in project management, failure is often assumed to be an evidence of deficient management, and thus, a problem that can be overcome by better management. However, the managerial BoKs and maturity models discussed previously focus mainly on hard skills. Thus, more effort should be put into the soft side because, for implementing projects successfully, it is necessary to combine both hard and soft skills (Soderlund and Maylor, 2012), considering organizational and behavioral issues such as the support and commitment of middle and top management, training and careers in PM. Accordingly, efforts in PM maturity are important and must be combined with an understanding of the manager and project team's cultural orientations and skills.

Project manager is a critical success factor (CSF) in a project (Archibald, 2003), providing direction, goals, motivational support and assistance in resolving interpersonal and organizational issues (Rauniar and Rawski, 2012). Other authors corroborate and include training and education issues as key factors in PM (Cooke-Davies, 2002; Dai and Wells, 2004; Takey and Carvalho, 2015). Plaza and Rohlf (2008) go further and suggest that the choice of a training strategy has a significant impact on project cost performance whereas Hong et al. (2011) emphasize the impact of learning and knowledge sharing on performance. For McHugh and Hogan (2011), training on international BoKs supports PM methodology.

According to Czuchry and Yasin (2003), effective executive knowhow exerts influence on the 3 modes (decisional, critical skills and technical) of a project life cycle. Technical know-how includes the importance of applying PM skills that are well documented in the PMBoK.

In the IT context, Nfuka and Rusu (2011) highlight both training and attracting, besides retaining competitive IT leadership and professionals as critical. For Ali and Kidd (2013), one of the top-ranking CSFs for configuration management professionals is certification and training in that area. It might be relevant to note that the same CSFs—training in PM methods and Project Management Professional (PMP) certification—hold top rankings in the PM context.

Thus, to assess whether organizational efforts in PM training improve performance, we established the following hypothesis:

H2. Efforts in PM training are positively associated with project success.

The conceptual model and research hypotheses are shown in Fig. 1.

Due to the complex nature of interdependencies between the independent construct *context of PM* and *the efforts in PM training* with the dependent construct project success, the choice of control variables represented a particularly important part of the research model (see Fig. 1). In the research models, it was control for effects for country-specific, sector-specific factors, and project complexity, while relying on a limited number of control variables. It is important to highlight that the model is designed from the project performer organizations point of view, i.e., the organization that is investing resources in PM.

The first control variable is the national business environment (country variable). More attention for cross-country analysis has been given in studies related to international development (ID) projects (Ahsan and Gunawan, 2010; Prasad et al., 2013) and suggests that cultural issues of the host country should be considered, including aspects related to projects being more susceptible to political corruption (Khang and Moe, 2008). Prasad et al. (2013) propose a framework that considers the characteristics of the external environment such as infrastructure, stakeholder variance, and flexibility and autonomy. Some studies focus more on the impact of culture (Chevrier, 2003) on international projects than on the impact of the stage of PM methodology development in particular countries. However, as Ahsan and Gunawan (2010) suggest, ID projects are different from traditional business projects, and make traditional project management tools in the developed world less appropriate.

Zwikael et al. (2005) identify differences in project management style between the Japanese and the Israeli, considering the nine knowledge areas of PMBoK third edition (the fifth edition considers 10 knowledge areas, PMI, 2013). The results reveal significant cultural differences between the two countries. In Israel, project managers are more focused on performing "Scope" and "Time", while in Japan they focus on "Communications" and "Cost". Zwikael and Ahn (2011) also identify that the levels of perceived risk vary significantly in three countries, once it is higher in New Zealand, as compared to lower levels in Israel and Japan.

More recently, Chou et al. (2013) focus on construction engineering projects and try to identify cross-country (Taiwan, Indonesia, and Vietnam) similarities and differences considering the contribution of the Project Management Body of Knowledge (PMBOK) to success. Empirical data obtained in a cross-country comparison suggest modified models for Taiwan, Indonesia, and Vietnam. Just 7 (20%) of the PMBOK techniques/tools/skills (TTSs) were common in the three studied countries, namely: product analysis, alternatives identification, control charts, risk data quality analysis, procurement negotiations, procurement performance reviews and meeting quality requirement. The highest project success index (PSI) values were obtained for project risk management (PRM) in Taiwan, project human resource management (PHRM) in Indonesia, and project procurement management (PPM) in Vietnam. Le-Hoai et al. (2008) also study Vietnam construction industry and point out the five most important causes of delay and cost overruns, and compare it with other countries and identify that the results are more similar to developing economies.

These studies suggest the contextual variable of national business environment (country variable) is relevant. This expected homogeneity within a country such as culture and PM externalities allowed us to perform an analysis controlling effects per country and thus, the following hypothesis is proposed:

H3a. The national business environment significantly influences project success.

The second control variable is the effect across industries (Carvalho and Rabechini Junior, 2015; Ibbs and Kwak, 2000a, 2000b; Pennypacker and Grant, 2003; Raz et al., 2002; Zwikael

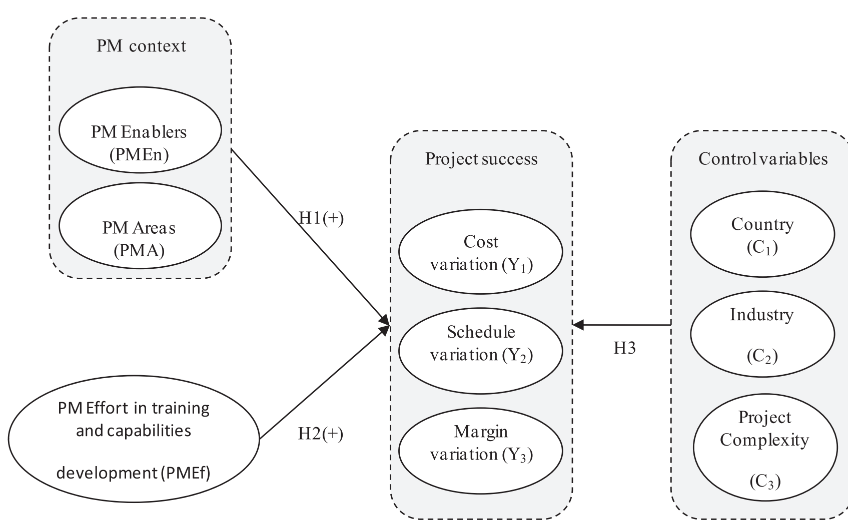

Fig. 1. Conceptual model and hypotheses. Note: To simplify the understanding of the model, some arrows were not shown. For example, there are six arrows at the H1(+) position (going from the two dimensions of "PM context" to the three dimensions of "Project success", there are three arrows at the H2(+) position, etc.

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and Ahn, 2011). These studies have come up with controversial findings. Although some studies (Raz et al., 2002; Zwikael and Ahn, 2011) have found significant effect of industries, other studies (Carvalho and Rabechini Junior, 2015; Pennypacker and Grant, 2003; Ibbs and Kwak, 2000a, 2000b; Pennypacker and Grant, 2003) were statistically inconclusive. Zwikael and Ahn (2011) identify that the level of project risk varies significantly across seven industries, in which engineering and construction projects have the highest levels of perceived risk, while projects in the service industry have the lowest. Carvalho and Rabechini Junior (2015) study the moderate effect of industry on risk project management and on success, but the results show no significant effect of industries. In the studies on project management maturity (Grant and Pennypacker, 2006a, 2006b; Ibbs and Kwak, 2000a, 2000b; Pennypacker and Grant, 2003), the sector does not seem to be statistically significant. This previous discussion on the industry contingent variable suggests the following hypothesis:

H3b. The industrial sector significantly influences project success.

Finally, various studies pointed out the relevance of analyzing the effect of project complexity on PM research. The contingent effect of complexity has evolved in prior decades, influenced by Shenhar and Dvir's research (Shenhar, 2001; Shenhar and Dvir, 1996; Shenhar et al., 2002) that proposes the Diamond model, which includes four dimensions—novelty, complexity, technology and stage—. Various authors argue that a project complexity influences its performance (Cleland and Ireland, 2006; Cooke-Davies, 2002; Crawford et al., 2004; Larson and Gobeli, 1989; Schwalbe, 2007; White and Fortune, 2002). Besner and Hobbs (2012, 2013) reinforce the influence of the variable project type both on adopting the practices and on the results. The last control variable previously pointed out in this section as relevant suggests the following hypothesis:

H3c. Project complexity interferes significantly with project success.

3. Research methods

The methodological approach involved a longitudinal field survey conducted in the Southern Common Market business units of a multinational organization in Argentina, Brazil, and Chile over a 3-year period. A total of 60% of the gross sales of the studied company come from projects, and there is a high rate of product innovation. The company has analyzed eight different business groups, finding that those groups represented almost 45 billion Euros worldwide; this finding demonstrates the importance to the company of an effective PM system. The company operates in different segments of the economy, including manufacturing, components, safety, maintenance, oil and gas, energy, healthcare, telecommunications, IT, and transportation. The company sells customized solutions to its customers. The selection of this research approach was guided by the need for a deeper analysis of the PM methodology implementation processes in organizations that allow for temporal analysis and access to project data. As Thomas and Mullaly (2008) suggest, it is difficult to obtain various types of information from most organizations; thus, key aspects of the study include access to company information, along with the company's willingness to participate in the study, and allow access to project values, project performance data, and audit data related to PM methodology in its business units.

The company's PM program is systemized by an organizational matrix based on the best practices of BoKs, customized to the company's context. The implementation guide, which is in its 4th edition, contains 60 best practices divided into 12 modules. The guide, which was released in 2001, is a worldwide program for implementing a singular PM methodology.

Within the Southern Common Market, the company operates in Argentina, Chile and Brazil; since 2003, the company's Brazilian operation has been responsible for program implementation. There are 14 different business units in the region that participate in the implementation program. The evolution of the business units within the company's PM program is evaluated by a central audit department. Therefore, this study analyses are based on independent audits, not on the perceptions of people involved in PM.

3.1. Data collection

Several sources of evidence were used in this study; however, three documents were decisive for the sample selection within each business unit and for project analysis: standard sheets, cockpit and project status report. The standard sheets, provided by all business units, contain a list of each unit primary projects, results and periods and provide a general overview of their projects. The cockpit is a consolidated report with a general overview of each business unit, based on the standard sheets report. Project status report is a detailed report containing the project scope, categorization, primary financial data, an analysis based on SWOT (strengths, weaknesses, opportunities and threats) specific to the project, the project primary risks, as well as the opportunities and good practices generated by the project. In addition, the authors participated in monthly workshops conducted in Brazil with representatives of all of the business units that implemented the program along the two years of data collection for this study. The workshops involved evaluations, mapping key processes, discussing the requirements to be implemented by the business units, presentations of the best practices found, follow-up reports, audit results and information exchanges.

The authors analyzed the number of projects per business unit to determine and to establish a valid sample. The availability of the data shown in Table 1 was analyzed for each project selected. As shown in the following section, 1387 valid project samples were obtained.

Due to the scarcity of data and complex nature of interdependencies between PM maturity and success, and PM Skills and success, the choice of control variables represented a particularly important part of the model design. As all business units have been operating for 10 years with the same

Table 1
Project success measurement.

	Cost variation		Schedule variation		Margin variation	
	Relative variation of budget increases, which is measured as the difference in monetary value between the original budget forecasted and the actual final project budget and divided by the original budget. (%)		Relative variation of the increase of the project schedule measured as the difference between the original planned schedule in days and the final schedule divided by the original schedule. (%)		Relative variation of the project margin measured as the difference between the final and the originally forecasted margins, divided by the original margin. (%)	
Mean	9.51%		4.66%		−2.68%	
Standard deviation	47.07%		7.42%		84.4%	
Project performance	Number of projects	%	Number of projects	%	Number of projects	%
Negative	180	12.98	412	29.70	367	26.46
On target	667	48.09	1	0.07	505	36.41
Positive	540	38.93	974	70.23	515	37.13
Total	1387	100	1387	100	1387	100

organizational PM maturity model, this homogeneity allowed us to perform an analysis controlling effects for country-specific and sector-specific factors, while relying on a limited number of control variables.

Thus, from the project performer organization perspective, the existence of a positive relation between the organizational efforts to improve of project management and project success is critical to sustain these efforts.

3.2. Operationalization of the dependent variables

As mentioned before, several studies have attempted to analyze how to measure project success (Belout and Gauvreau, 2004; Berssaneti and Carvalho, 2015; Besner and Hobbs, 2006; Bizan, 2003; Carvalho and Rabechini Junior, 2015; Dvir et al., 2003; Gray, 2001; Kendra and Taplin, 2004; Lipovetsky et al., 2005; Raz et al., 2002; Repiso et al., 2007; Samset, 1998; Shenhar and Dvir, 2007). Thus, project success can be operationalized through operational and strategic performance indicators from different dimensions. Because of the lack of consensus in defining project success concept and the quantitative approach of this research method, the traditional dimension of project efficiency was adopted. Moreover, this research is designed from the project performer organization perspective. Although it represents just part of the project success discussion, it is still considered central to the measurement of project success (Papke-Shields et al., 2010; Berssaneti and Carvalho, 2015). This study focuses on the efficiency dimension also because data on other dimensions were not available in a systemized and documented fashion. The reports concern on cost, schedule, and margins apply the same measurement methodology across the distinctive business units studied. However, for customer satisfaction measurement, the business units employ different methodologies that could not be compared. As all the selected projects were accepted without legal issues by the project client, we could neutralize the effect of this potential success dimension. Table 1 presents project success measures—including project descriptions and project units—and distribution according to a project performance in those measures.

The variations were defined such that an increase in the indicator designated a higher degree of success, as shown in Eqs. (1) and (2).

$$\textit{Cost variation} = \textit{budget} - \textit{actual budget} \tag{1}$$

(+) ➔ budget > actual ➔ the amount spent was lower than planned ➔ *higher* project success
(−) ➔ budget < actual ➔ the amount spent was higher than planned ➔ *lower* project success

$$\textit{Magin variation} = \frac{\textit{final} - \textit{forecasted}}{\textit{forecasted}} \tag{2}$$

(+) ➔ budget < actual ➔ the amount earned was higher than planned ➔ *higher* project success
(−) ➔ budget > actual ➔ the amount earned was lower than planned ➔ *lower* project success

As all subsidiaries have been operating for 15 years or more prior to the observation period; the subsidiary age was deemed irrelevant. Subsidiaries have also exhibited homogeneity with respect to the product portfolio, brand and high-level pricing strategy (allowing a modest degree of discretion for individual client negotiations).

3.3. Operationalization of the independent variables

To analyze the intensity of use of PM methods in the business units, the central audit report evaluated 11 variables of the worldwide program guidelines on a scale of 0% to 100%. The modules addressed different aspects of PM maturity and methodology using the consolidated areas of the BoKs. Thus, two latent variables relating to PM maturity and PM methodology were created, called PM enablers and PM areas, respectively (see Table 2). The construct of PM enablers was modeled as a formative latent variable (Jarvis et al., 2003), whereas PM areas were designed as first-order reflective because they are designed

Table 2
Measurement of the use of project management methods.

	Variables	Description	Unit
PM enablers	PM processes roles	• Definition of the business unit's processes, establishing the main benchmarks of project and documents	0 to 100%
	PM web portal	• Creation of a portal with easy to access and to obtain information, to exchange project management information and best practices	0 to 100%
	Benchmarking and implementation status	• Management of the information transfer processes and program implementation in the other areas of the organization	1 to 100%
	PM assessment	• Self-evaluation of project management in the company using a standard tool for all the business units	2 to 100%
	Small project	• Analysis of the requirements and recommendations applicable to the management of small projects	3 to 100%
PM areas	Contract mgt	• Management of the project contract, from the pre-sale until... (missing text)	4 to 100%
	People mgt	• Management of the project team from the career definition and team stimulus to the implementation of system of goals and incentives for results achieved	5 to 100%
	Quality mgt	• Project quality management	6 to 100%
	Knowledge mgt	• Knowledge Management about project management	7 to 100%
	Procurement Mgt	• Project-related acquisitions management	8 to 100%
	Project Control	• Project control, both financial and technical	9 to 100%

Mean standard deviation		
PM methodology*	77.18%	3.29%
PM training budget**	238,609.00	270,344,00
Number of the PMPs**	7	1.16

Notes: *Extracted from central audit department. **Extracted from PMO data system (in Real$).

as parts of a whole, as suggested in the main BoKs. Table 2 presents the variables of both PM enablers and PM areas, including their descriptions and units of measurement.

The effort put into PM training and capability development was measured using 2 indicators. First, the financial value in Brazilian currency (R$) of the investment in PM training at all available levels (basic, intermediate and advanced) of the business unit. Second, the number of project managers in the business unit responsible for leading the project that are PMP-certified, which is an internationally recognized certification given by the PMI to project managers. Table 2 also presents statistics related to these latent variables. For confidentiality purposes, only a summary of these data is presented.

3.4. Operationalization of the control variables

Within the company, projects are classified into 4 categories according to the system proposed in the worldwide program guidelines. The projects are evaluated according to four criteria that are unfolded into variables, as shown in Table 3.

Based on the analysis of the projects according to all of the criteria presented in Table 3, projects are classified into four categories of complexity. Each category has variable scoring from specific minimum to maximum, and the total project complexity score is the sum of all the variables (see Table 3). The maximum score that a project can achieve is 1360. Each project is classified, according to its score, into four categories from A to D. Category A groups projects with scores higher than 1000 points. Categories B, C and D group projects from 500 to 999, 60 to 499 and 0 to 59 points, respectively.

Project distribution according to complexity categories is also shown in Table 3. To use this variable in the model estimation, the variable was re-coded from 1 to 4, and the highest score (4) was attributed to the most complex projects (A). These data were obtained from the Latin America PMO data system.

The nominal variables (country and industry) were operationalized as dummy variables, consistent with Falk and Miller (1992). Therefore, a value equal to 1 was attributed to the projects that belonged to the same category and 0 to all the other categories, as detailed in Table 4.

3.4.1 . Data analysis

The data were analyzed according to their frequency distribution, descriptive statistics and bivariate analyses (cross-tables and correlations), and the full model was evaluated using partial least squares path modeling (PLS-PM). PLS-PM was considered the most adequate method for various reasons. First, it was possible to incorporate nominal variables into the structural model, as was the case for the country and industry control variables. Second, it was possible to incorporate variables measured by formative indicators, as was the case for the PM enablers and the control variables. Finally, it depended neither on the normality of the variables (as was the case of LISREL) nor on the normality of the residuals because the significance probabilities were estimated by bootstrap (Henseler et al., 2009; Tenenhaus et al., 2005).

The significances were estimated by bootstrap directly on the SmartPLS software, using 1000 resamplings (Tenenhaus et al., 2005).

Table 3
Criteria and variables adopted by the company to categorize projects.

Criteria	Variables	Unit
Financial	– Financial volume; – Percentage value of the estimated risks; – Sales margin of the project; and – Percentage value of investment in research and development or engineering for the project.	1–340
Contractual	– Contractual position of the company in the project; – Number of external partners contractually associated; – Internal partners of the company; and – Degree of the relationship with the customer.	1–340
Technical complexity	– Clarity of the definition of the product or scope of the project and – Need for a new technological development.	1–340
Organizational considerations	– Type of project (supply, system or turn-key); – Contractual complexity; – Strategic significance of the project for the company; and – Strategic relevance for the customer.	1–340

Category	Score	Value used in the structural research model	Number of Projects	%
A	1000 to 1360	4	209	15.07
B	500 to 999	3	547	39.44
C	60 to 499	2	598	43.11
D	0 to 59	1	33	2.38
		Total	1387	100

4. Results

4.1. Demographics

We obtained 1387 valid samples of projects in the following 10 industries: energy (713), health care (218), manufacturing (152), transportation (105), IT (82), telecommunications (43), components (37), maintenance (18), safety (13) and oil and gas (6). Therefore, more than half of the sample was from the energy industry (51.4%).

The sample was predominantly composed of projects developed in Brazil (823 projects, or 59.3%), followed by Argentina (294) and Chile (270).

Regarding the project complexity control variable, the sample was composed of predominantly type C (598, or 43.1%) and B (547, or 39.4%) projects, contributing 82.5% of the total. Therefore, the extremes—type A projects of high complexity (209) and type D projects of low complexity (33)—were the minority.

4.2. Evaluation of the measuring model

4.2.1. Constructs measured with a single indicator

Cost variations, schedule variations, margin variations and complexity were measured with only one indicator. Thus, they cannot be interpreted as latent variables but as the indicator

Table 4
Industry and country categories coded by formative dummy formative indicators.

Industry category	D1	D3	D4	D5	D6	D7	D7	D9	D10	n	%
Components	1	0	0	0	0	0	0	0	0	37	3%
Energy	0	0	0	0	0	0	0	0	0	713	51%
Manufacturing Industry	0	1	0	0	0	0	0	0	0	152	11%
Maintenance	0	0	1	0	0	0	0	0	0	18	1%
Health care	0	0	0	1	0	0	0	0	0	218	16%
Oil and gas	0	0	0	0	1	0	0	0	0	6	0%
Safety	0	0	0	0	0	1	0	0	0	13	1%
Information technology	0	0	0	0	0	0	1	0	0	82	6%
Telecommunications	0	0	0	0	0	0	0	1	0	43	3%
Transportation	0	0	0	0	0	0	0	0	1	105	8%

Country category	D_arg	D_chi	n	%
Argentina	1	0	294	21%
Brazil	0	0	823	59%
Chile	0	1	270	19%

Note: Any category might be used as a reference (Falk and Miller, 1992), we chose the industry category energy and country category Brazil because it is the category with the highest numbers of projects.

Please cite this article as: M.M. Carvalho, et al., 2015. Project management and its effects on project success: Cross-country and cross-industry comparisons, Int. J. Proj. Manag. http://dx.doi.org/10.1016/j.ijproman.2015.04.004

Table 5
Loading factor.

Reflective indicators	Y_1	Y_2	Y_3	M_1	PMEf	PMA	T Statistics	P value
Y_1—Cost variation	1.000	−0.231	0.018	0.059	−0.062	−0.033	–	–
Y_2—Schedule variation	−0.231	1.000	0.090	−0.160	0.234	0.163	–	–
Y_3—Margin variation	0.018	0.090	1.000	−0.124	0.051	−0.019	–	–
M_1—Coplexity	0.059	−0.160	−0.124	1.000	−0.307	−0.102	–	–
PMEf1—Investments in training	−0.037	0.195	0.054	−0.292	0.992	0.041	846.7	0.000
PMEf2—Number of PMPs	−0.079	0.260	0.047	−0.314	0.996	0.086	2711.4	0.000
PMA_1—Contract mgt	−0.012	0.077	−0.005	−0.082	−0.012	0.884	30.4	0.000
PMA_2—Knowledge mgt	−0.023	0.151	−0.010	−0.155	0.116	0.900	41.4	0.000
PMA_3—Quality mgt	−0.034	0.106	0.014	−0.058	−0.047	0.633	7.3	0.000
PMA_4—Project control	−0.030	0.141	−0.045	−0.013	0.091	0.685	9.3	0.000
PMA_5—Procurement mgt						Note 1		
PMA_6—People mgt						Note 1		

Source: Data from this study.
Note 1: Item removed from the measurement model because of low loading factor.

itself. Evaluation of convergent validity and reliability was performed for the cases in which multiple reflective indicators were used; therefore, that evaluation was not performed for these 4 constructs.

4.2.2. Constructs measured by multiple reflective indicators

PM efforts in training and PM areas show loading factors that are significant ($p < 0.001$) and higher than 0.6 (Table 5), which result in an Average Variance Extracted (AVE) of 0.99 and 0.62; this is much higher than the recommended minimum value of 0.5. There is convergent validity for these two latent variables with reflective indicators; the Cronbach's alpha is higher than 0.75, the composite reliability is higher than 0.82 for both constructs (Chin and Newsted, 1999; Henseler et al., 2009; Tenenhaus et al., 2005).

Discriminant validity was evaluated in two ways—at the indicator level and at the latent variable level. In the first case, Table 5 shows that the indicators have loading factors for their respective constructs that are higher than in any other latent variable. In the second case, Table 6 shows that for all the latent variables, the square root of the AVE is higher than the correlation among them (Henseler et al., 2009; Tenenhaus et al., 2005), which confirms discriminant validity.

Table 6
Correlation matrix between the latent variables (n = 1387).

Construct	Y_1	Y_2	Y_3	M_1	PMEf	PMA	PMEn
Y_1-Cost	1						
Y_2-Schedule	−0.231	1					
Y_3-Margin	0.018	0.090	1				
M_1-Complexity	0.059	−0.160	−0.124	1			
PMEf-PM Efforts	−0.062	0.234	0.051	−0.307	0.994		
PMA-PM areas	−0.033	0.163	−0.019	−0.102	0.067	0.784	
PMEn-PM Enablers	−0.029	0.166	−0.021	0.085	−0.013	0.591	(Note2)

Note 1: The numbers in the diagonal contains the AVE square root. and all values higher than |0.08| are significant at the 1% level.
Note 2: Values higher than |0.08| are significant at the 1% level.

4.2.3. Constructs measured by multiple formative indicators

For the control variables (country and industry), each category was coded as a dummy variable, which was later modeled as a formative indicator (Falk and Miller, 1992). In these cases, there was no evaluation of validity and reliability because correlation among the formative indicators was neither necessary nor desired. Table 7 presents the outer weight for all formative indicators.

For the control variables, content validity is considered adequate because all of the relevant categories are represented in the model estimation (see Fig. 1).

PM enablers are the third construct related to formative modeling. It was assumed that the construct was defined by its five indicators.

4.3. Evaluation of the structural model: hypothesis testing

The project success was operationalized as three complementary variables (evaluating different dimensions of success). The correlations were analyzed to evaluate the possibility of modeling success as a latent variable, showing that these variables have very low correlations (see Table 6), which means that it is not feasible to model success as a reflective latent variable (Henseler et al., 2009; Mackenzie et al., 2005; Tenenhaus et al., 2005). Furthermore, modeling success as a formative latent variable would hinder the interpretation of the results with outer weights that are positive, negative or equal to 0. Therefore, we decided to evaluate each project success indicator separately (see Fig. 1).

The structural model tested on the SmartPLS 2.0.M3 software contained all of the relationships shown in Fig. 1; however, to present the results more clearly than in the figure with all of the estimated coefficients and arrows, we decided to split the figure into three tables, one for each project success indicator.

In addition, we opted to test four versions of the structural model to evaluate the increase of R2 from the model with the control variables (Models 1 to 3 in Table 8) to the full model (Model 4 in Table 8).

Table 7
Outer weights.

Formative indicators	PMEn PM enablers	Country	Industry	T statistics	P value (Note 2)
$PMEn_1$_PM assessment	0.442			1.63	0.1035
$PMEn_2$_PM web portal	0.276			1.80	0.0727
$PMEn_3$_Processes roles	1.224			4.71	0.0000
$PMEn_4$_PM benchmarking	−0.351			1.47	0.1413
$PMEn_5$_PM small projects	0.336			1.32	0.1884
D_Argentina		1.032		101.7	0.0000
D_Brazil		(Note 1)			
D_Chile		0.331		3.64	0.0003
D1—Components			1.000	1.10	0.2697
D2—Energy			(Note 1)		
D3—Manufacturing industry			1.002	4.24	0.0000
D4—Maintenance			1.003	1.05	0.2940
D5—Health care			1.004	7.75	0.0000
D6—Oil and gas			1.005	0.94	0.3471
D7—Safety			1.006	2.95	0.0033
D8—Information technology			1.007	16.44	0.0000
D9—Telecommunications			1.008	0.88	0.3800
D10—Transportation			1.009	11.14	0.0000

Note 1: Item represents the reference category (see Tables 5 and 6).
Note 2: For formative indicators, the outer weights and their significance probabilities are not interpretable when there is multicollinearity among them; nevertheless, the structural coefficients are not biased.

Table 8
Cost, schedule and margin variation as dependents variables.

Dependent variable		Independent variable	Hypothesis		Path coefficient	Standard error	T statistics	P value	R^2	Adjusted R^2
Cost	Model 1	Country			0.154	0.026	5.9	0.0000	2.4%	2.4%
	Model 2	Industry			0.244	0.040	6.1	0.0000	6.0%	6.0%
	Model 3	Country			0.092	0.026	3.5	0.0005		
		Industry			0.218	0.038	5.7	0.0000	6.7%	6.6%
	Model 4	PM Enablers	H1a′	x	−0.004	0.029	0.1	0.8926		
		PM Areas	H1b′	x	0.001	0.018	0.0	0.9609		
		PM Efforts	H2′	x	0.034	0.022	1.6	0.1151		
		Country	H3a′	v	0.102	0.035	2.9	0.0035	7.2%	6.8%
		Industry	H3b′	v	0.222	0.039	5.7	0.0000		
		Complexity	H3c′	v	0.076	0.023	3.3	0.0009		
Schedule	Model 1	Country			−0.322	0.027	11.8	0.0000	10.3%	10.3%
	Model 2	Industry			−0.535	0.023	23.1	0.0000	28.6%	28.6%
	Model 3	Country			−0.183	0.030	6.2	0.0000		
		Industry			−0.482	0.026	18.8	0.0000	31.7%	31.6%
	Model 4	PM Enablers	H1a′	v	0.101	0.039	2.6	0.0092		
		PM Areas	H1b′	x	0.045	0.028	1.6	0.1129		
		PM Efforts	H2″	v	0.079	0.022	3.7	0.0003		
		Country	H3a″	v	−0.106	0.027	4.0	0.0001	36.8%	36.5%
		Industry	H3b″	v	−0.496	0.026	19.0	0.0000		
		Complexity	H3c″	v	−0.161	0.024	6.8	0.0000		
Margin	Model 1	Country			0.044	0.042	1.04	0.2974	0.2%	0.2%
	Model 2	Industry			0.015	0.052	0.29	0.7733	0.0%	0.0%
	Model 3	Country			0.043	0.029	1.49	0.1375		
		Industry			0.003	0.029	0.09	0.9246	0.2%	0.0%
	Model 4	PM Enablers	H1a‴	x	0.021	0.028	0.7	0.4566		
		PM Areas	H1b‴	x	−0.033	0.026	1.3	0.2084		
		PM Efforts	H2‴	x	0.054	0.029	1.8	0.0693		
		Country	H3a‴	v	0.077	0.037	2.1	0.0369	2.1%	1.6%
		Industry	H3b‴	x	−0.008	0.030	0.3	0.7951		
		Complexity	H3c‴	v	−0.118	0.039	3.0	0.0026		

Note: The model was estimated using the SmartPLS 2.0.M3 software (Ringle et al., 2005).

Please cite this article as: M.M. Carvalho, et al., 2015. Project management and its effects on project success: Cross-country and cross-industry comparisons, Int. J. Proj. Manag. http://dx.doi.org/10.1016/j.ijproman.2015.04.004

Table 8 shows that the control variables (country H3a′ and industry H3b′) explain most of the variance of the cost variation (6.6%). The increase in R^2 is only 0.2% from Model 3 to Model 4, indicating that although complexity (H3c′) has a statistically significant coefficient, its contribution to explaining cost is indeed negligible (Hair, 2005), once the increase in R^2 is only 0.2%.

Table 8 shows that the control variables (country and industry) explain most of the variance of the schedule variation (31.6%). In Model 4, besides the control variables (country and industry), three others are shown to have significant coefficients, which are PM enablers (H1a″), PM efforts (H2″) and complexity (H3c″), but these improve the explanation of the schedule variance only by 5%.

The third project success indicator is margin variation, and once again, the predictor variables show low predictive power (see Table 8), indicating that its contribution to explaining margin is only 1.6%. Of all the predictor variables, only country (H3a‴), complexity (H3c‴) and PM Efforts (H2″) have a significant coefficient.

5. Discussion

Table 8 summarizes the findings by describing the significant impact of the national environments (Brazil, Chile and Argentina), project complexity and industries on all of the project performance measures investigated. Our study indicates that all of the contingent variables have a significant relation with all of the performance measures studied, but the effect magnitude is not the same.

The findings confirm the descriptions in the literature highlighting the impact of complexity (Cleland and Ireland, 2006; Cooke-Davies, 2002; Shenhar, 2001; Shenhar and Dvir, 1996; Shenhar et al., 2002; White and Fortune, 2002) and industry sectors on project performance (Patterson et al., 1999; Raz et al., 2002). However, the findings add to the literature in two primary ways. First, the current literature poorly explores whether the national environment (Brazil, Chile and Argentina) has a strong impact on project performance. Second, the schedule performance measure makes more sense for these contingent variables than for the other performance measures, considering their effect on performance.

Several empirical data suggest significant differences across the three studied countries. First, the cross-country comparison suggests modified project complexity profile for Argentina, Brazil and Chile, because significant differences between project proportions among the four complexity levels were found (using chi-square test, with p-value = 0000). The highest proportion of complex projects (level 4 class A) were obtained in Chile (56%).

Second, the cross-country comparison also suggests modified project success profile for Argentina, Brazil and Chile, because significant differences between medians in the three success indicators applied were found (using Mood median test). The highest project cost success index values were obtained in Argentina (p-value = 0.000), schedule success index value in Brazil (p-value = 0.000), and margin success index value also in Argentina (p-value = 0.000).

Finally, the cross-country comparison also suggests different degree of PM methodology implementation and investments in Argentina, Brazil and Chile. The highest average number of PMP by project was obtained in Brazil (p-value = 0,000); similarly, the degree of PM methodology and investments in Brazil is higher than in the other two studied countries.

Our study shows that the country control variable explains a significant amount of the effect on performance. In this sense, our study reinforces the difficulty in explaining the project success variable as suggested by Sage et al. (2014). The country control variable can combine several factors, including a specific PM environment such as the availability of skilled PM professionals, the presence of PM professional associations and the presence of world-class companies in the PM area, but also economic and political issues among other factors with a high explanatory effect. Considering the three Latin American countries studied, Brazil has a leading role in the PM area because it has the most chapters of the main associations (PMI and IPMA), and has more than 15,000 PMPs (Carneiro, 2014), which together demonstrate the interest in developing PM methodology in that country, as corroborated by our empirical data.

Similar analysis was performed for cross-sector comparison; however, just on the degree of PM methodology were significant differences found across sectors. The highest the degree of PM methodology was obtained in the Telecommunications sector (p-value = 0.004). We designed distinctive models that considered the three performance measures studied. The schedule model is affected by PM variables. Both PM enablers (that relates to PM maturity) and PM efforts in training have a positive significant impact on schedule performance. It is interesting to note that PM areas do not show a significant impact on any project performance measure. These two variables relate more to the soft side of PM that involves managing stakeholders' roles, individual skills and capabilities and the notion of project ecology (Grabher, 2004). Most PM approaches have disregarded the soft side of PM (Sharma and Gupta, 2012; Soderlund and Maylor, 2012) in favor of focusing on the hard side, characterized in our study as the PM areas variable.

Although much effort from professional associations, companies and scholars has resulted in the consolidation of the discipline of PM over time, that effort continues to show weak results. There are several implications for practice. The absence of effect of the PM areas variable with respect to the three performance measures studied is consistent with Ahlemann et al. (2013), who suggest that the prescriptive characteristics of PM approaches lead to numerous problems, such as non-acceptance in practice, limited effectiveness and ambiguous application scenarios.

The cost and margin models are not affected by PM variables. The lack of impact of these variables naturally leads to questions about the way PM is implemented in organizations, and we remain far from a definitive explanation. The issue of PM implementation may be partially explained by the research of Jiang et al. (2004) on maturity, which the results suggest that tangible results are only perceived beyond a certain degree of maturity (CMM Level 3). Moreover, it is necessary to invest more time and effort in the soft side (Soderlund and Maylor, 2012) and to conduct further research.

The limitations of the present research lie in the nature of the research methodology. This study was developed in Latin America, which means that there are some biases that make it difficult to generalize the study conclusions to developed countries. Nevertheless, the large sample of more than 1000 projects in different sectors and countries offers important insights for further research and creates a basis for comparison with other countries. Moreover, the results pointed out the importance of cross-countries and cross-sector analysis to better understand the variables that can moderate the relation between project management and success.

6. Conclusions

This paper explored three research hypotheses. The research hypotheses related to contingent approach are validated for all performance measures. The study shows that national environment plays a key role in project performance, with an increased effect on performance in the country (Brazil) where PM methodology is at a more developed stage (as compared to Chile and Argentina) with respect to several aspects, such as PM associations, certified professionals and regulations. This effect is poorly addressed in the current PM literature, and further research is needed for an in-depth understanding of how this variable impacts performance. The effects of complexity and industry sectors confirm recent streams of PM literature.

The research hypotheses related to PM enablers, PM efforts in training and capabilities development and PM areas still show weak effects on performance, except for the schedule success indicator. The PM enablers and PM efforts in training stand out and reinforce the importance of the soft side of PM.

This paper provides new contributions to the current literature in two ways: it provides an understanding of the effect of PM enablers and PM efforts on project performance and it provides an understanding of the contingent effect of national business environments.

Conflict of interest

None.

Acknowledgments

The authors gratefully acknowledge the financial support of the Brazilian research funding agencies CNPq (National Council for Scientific and Technological Development, 311293/2013-1) and FAPESP (São Paulo Research Foundation, 2012/10117-0).

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Please cite this article as: M.M. Carvalho, et al., 2015. Project management and its effects on project success: Cross-country and cross-industry comparisons, Int. J. Proj. Manag. http://dx.doi.org/10.1016/j.ijproman.2015.04.004

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