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Identification of variables that impact project success in Brazilian companies

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Abstract

This research aims to analyze the relation between project management maturity and the project success. Moreover, the moderating effect of top management support and the assignment of a dedicated project manager were analyzed. The methodological research approach was a survey of 336 professionals in the field of project management conducted in Brazilian organizations. The results show that project management maturity is significantly related to all vertices of the iron triangle (time, cost and technical performance) dimensions of success. However, it is not related to the customer satisfaction dimension. The two moderate variables, top management support and dedicated project manager, have significant impact on the time success dimension but not on customer satisfaction. It suggests focus on efficiency aspects rather than effectiveness aspects.

Keywords: Project management; Project success; Critical success factors; Maturity models

1. Introduction

Projects in current business environments are considered not only solutions to technical problems but also a way to improve business and to implement changes (Andersen and Jessen, 2002).

Project management is designed to ensure the success of a project, which, according to Jha and Iyer (2006), is a subjective concept that depends on the perspective of the individual who is evaluating that success (Carvalho, 2014).

Traditionally, compliance with cost, schedule, and quality/performance (meeting specific requirements of the project) has been used as a criterion to measure project success (Barclay and Osei-Bryson, 2010; Meredith and Mantel, 2000; Pinto and Slevin, 1987). These dimensions, known as the "*iron triangle*", though often criticized, are still considered the gold standard for measuring project success (Papke-Shields et al., 2010). Accordingly, a focus on these factors suggests that project management is expected to be more concerned with organizational efficiency than with organizational effectiveness.

To better understand the causes of project failure, researchers explored a number of project management dimensions, including how projects are conducted and the internal and external contexts in which projects are executed (Papke-Shields et al., 2010). Over the last three decades, many authors have used different lines of research to identify the variables or conditions that lead to successful projects. Among these lines of research, the greatest number of publications is related to critical success factors (Fortune and White, 2006) and project management maturity models (Berssaneti et al., 2012; Jiang et al., 2004). The current business environment shares the general assumption that the adoption of project management methodologies driven by international bodies of knowledge (BOKs) and the achievement of maturity in this field result in improvement of both organizational performance and project performance.

Although businesses have been engaged in project management for more than half a century, its contribution to performance is still not acknowledged outside the group of professionals who believe in project management (Aubry and Hobbs, 2010). Some

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empirical studies support the general view (Besner and Hobbs, 2013; Chou and Yang, 2012; Hong et al., 2011; Kerzner, 2006) and highlight the challenges associated with the implementation of project management methodologies (Ala-Risku and Kärkkäinen, 2006). However, scholars argue that the contribution of project management methodologies to enhancing performance is a controversial subject that requires in-depth research (Aubry and Hobbs, 2010).

There is a lack of empirical and structured researches (Grant and Pennypacker, 2006) to address the relationship between project management and performance. There is the need to move on the predominant exploratory qualitative research to confirmatory quantitative approaches. This paper aims to fill the research gaps and to answer the research question "*what are the variables that influence project success*?". This study analyzes the relationship between organizational maturity in project management and project success. Moreover, the relationships between two critical success factors (top management support and dedicated project manager) and the success of executed projects are also analyzed. A quantitative research approach was applied, using a survey-based research, involving 336 project management professionals from companies in different sectors of the Brazilian economy.

This paper is divided into five sections. Section 2 presents a synthesis of the theoretical discussions regarding project success, critical success factors (CSFs) and maturity. Section 3 presents the methodological approach used in the field research. Section 4 presents an analysis of the results, and Section 5 presents the conclusions and limitations of the study.

2. Literature review

This section aims to present a review of the pertinent and relevant literature related to the research topic. The concepts used in this study, which include project success, critical success factors, and maturity models in project management, are first presented.

2.1. Project success

The goal of project management is to ensure the success of the project. However, companies face new challenges when adopting project management methodologies, for example, in construction projects, as suggested by Ala-Risku and Kärkkäinen (2006), or in information systems (IS) projects, as suggested by Barclay and Osei-Bryson (2010).

Furthermore, success, as a subjective term, is dependent on the perspective of those who are measuring it (Jha and Iyer, 2006). According to Barclay and Osei-Bryson (2010), a key challenge in IS projects often includes the lack of clearly defined objectives and the mismatched stakeholders' expectations (project sponsor, external consultant, staff and executive management). Moreover, the success criteria can vary from project to project as they are dependent on the context and on the perspectives of the various construction stakeholders (client, consultants, and contractors), according to Toor and Ogunlana (2010). Corroborating this assumption, some authors, such as Chou and Yang (2012) and de Vries (2009), who have applied the stakeholder salience theory and identified a strong influence based on the interests of various stakeholders, recommend the use of stakeholder analysis.

Factors such as time, cost, and quality are traditionally used as criteria for measuring project success (Pinto and Slevin, 1987; Mullaly, 2006; Papke-Shields et al., 2010). These criteria comprise the "*iron triangle*" (Meredith and Mantel, 2000; Pinto and Slevin, 1987) in which a project is considered a success when the cost is very close to the initial budget planned, the estimated schedule is met, and all deliveries meet the requirements established by all parties involved in the project. However, there is no consensus regarding the success criteria among researchers (Jha and Iyer, 2006) because there are many variables that can affect success, such as the context of the internal organization and the external environment in which a project is performed, and can influence both the outcome and the success of a project (Papke-Shields et al., 2010). In addition, over the years, the three criteria (time, cost, quality), often called the basic or traditional criteria, have been criticized because they seem inadequate. Some authors consider them excessive, while others consider them incomplete (Yu et al., 2005). Accordingly, several efforts have been made to overcome the inadequacies. These attempts can be grouped into two different approaches: (1) adding more dimensions to the traditional criteria (iron triangle), exploring the variables that can impact success; and (2) reducing various criteria to a single evaluation criterion, the financial criterion (Yu et al., 2005). The second approach considers that time and quality are project cost variables (Yu et al., 2005). This study is aligned with approach 01, exploring variables that impact project success.

With respect to the context of an IS project, Barclay and Osei-Bryson (2010) adopted the following performance evaluation criteria as objectives: develop quality reputation, maximize revenue, maximize staff competences, maximize efficiency, and maximize record keeping. Jugdev et al. (2007) highlight the relationship between project management and the capability of the firm based on the VRIO (valuable, rare, inimitable, organizational) framework from the research based view.

The literature review suggests that project management is expected to be more concerned with efficiency than with effectiveness. However, Rauniar and Rawski (2012) argue that the failure to strategically manage important projects can limit the competitive growth of a business.

Because of the complexity of the project success concept discussed above and the lack of consensus among authors in the field, the traditional dimensions of the "iron triangle", albeit criticized, are still considered central to the measurement of project success (Papke-Shields et al., 2010). Agarwal and Rathod (2006) stated that cost, time and quality (functionality) are still important criteria for evaluating the performance of software projects from the professional's point of view, and these criteria have been used in several studies, both alone and in combination with other measures.

The present research used the basic dimensions, denoted as efficiency by Shenhar and Dvir (2007). Project performance was evaluated according to the planned budget, the schedule, the technical specifications (product/service requirements), and

the ability to meet the customer service requirements. Note that the quality dimension was subdivided into two criteria: meeting technical specifications and meeting customer demands. Projects were considered successful when all four dependent variables of the conceptual model proposed and stated above as basic dimensions were met. Partial success was considered when only one, two, or three of the basic dimensions were met.

2.2. Critical success factors — CSFs

Milosevic and Patanakul (2005), from a project management perspective, define the CSFs as characteristics, conditions, or variables that can have a significant impact on the success of a project when sustained, maintained and managed appropriately.

Over the past few decades, a question that has motivated and guided researchers around the world is related to the factors that lead to the success of projects developed and implemented by organizations. These researchers have attempted to define and to identify the critical success factors (CSFs) in project management; in other words, what factors contribute to the success of projects in organizations. As the search for CSFs in project management has been intensified since the 1980s, researchers in project management have attempted to answer the following question "*what are the critical factors that "really" lead to successful projects*?" (Cooke-Davies, 2002).

Many authors have published lists of factors, sometimes relating them to specific problem areas and activities, sometimes highlighting their applicability to all projects types, and in some cases, changing the concept and referring to them as "Critical Failure Factors" (Fortune and White, 2006).

Fortune and White (2006) have conducted an extensive literature review regarding critical success factors (CSF) for projects and have also raised criticism about this approach. Their study was based on a review of 63 publications that focused on CSFs. They used a variety of databases and examined empirical and theoretical studies on successful and unsuccessful projects. As a result of their systematic literature review, Fortune and White (2006) presented a list of twenty-seven critical factors, in which the most cited was *top management support*, cited by 39 references (62%). In any organization, top management is primarily responsible for providing the necessary support and resources required for the project (Rauniar and Rawski, 2012). A lack of engagement by the top management and a lack of attention from the organization during the early stage of the project are linked to poor performance (Sosa et al., 2007).

Zwikael (2008) suggested that effective executive involvement can significantly improve project success. However, the literature does not provide organizations with a clear list of effective top management support practices to facilitate or to achieve this type of support. As a result of his research, Zwikael (2008) identified a short list of critical processes and best practices that most contribute to effective top management support and, hence, to project success.

According to de Vries (2009), in most companies, severe project delays were caused by political processes and conflicts. Thus, being aware of this potential situation can help the top management avoid unnecessary delays and negative effects related to the project.

The above discussion suggests the following hypothesis:

- H01
  There exists a relationship between top management support and the performance (success) of executed projects.

Another critical success factor often cited in the literature corresponds to the existence of a dedicated project manager (Fortune and White, 2006; Pinto and Mantel, 1990; Pinto and Slevin, 1987). Archibald (1976), for example, considers the project manager the link responsible for integrating the entire project. Nguyen et al. (2004) identified five critical success factors, among which are included a competent project manager and the availability of resources. The leadership literature states that the project manager provides the team with the proper direction and goals, provides motivational support, and helps to resolve any interpersonal and organizational issues (Rauniar and Rawski, 2012). In another research, Qureshi et al. (2009) posited that project management leadership has a significant impact on project management performance.

The above discussion leads us to propose the following hypothesis:

- H02
  There exists a relationship between the presence of a dedicated project manager and the performance (success) of executed projects.

In conclusion, in this research, the two critical success factors highlighted by the literature are used in the conceptual model (see Fig. 1), as follows: (a) top management support; and (b) a project manager dedicated to the project. These two critical success factors were selected based on the feasibility of verification and checking by survey respondents and because they are most often cited in the literature related to CSFs.

2.3. Project management maturity models

It is difficult to imagine that organizations have a "collective brain", but one can find organizations' knowledge and experience in their operating procedures, descriptions of work processes, job descriptions, scripts, routines, and databases of knowledge regarding products and projects (Gareis and Huemann, 2000).

Project management maturity of a company is a measure of its efficiency in completing the project (Kerzner, 2001). Organizational maturity in project activity is not necessarily related to the passage of time but to the nature of the business and the market forces (Dinsmore, 1998). Project management maturity identifies the level of maturity of an organization based on the use of specific project management practices (Ibbs and Kwak, 2000).

During the 1990s, a large number of project management maturity models emerged, many of which had common characteristics such as a focus on evaluating and improving the ability to manage projects. Such project management maturity

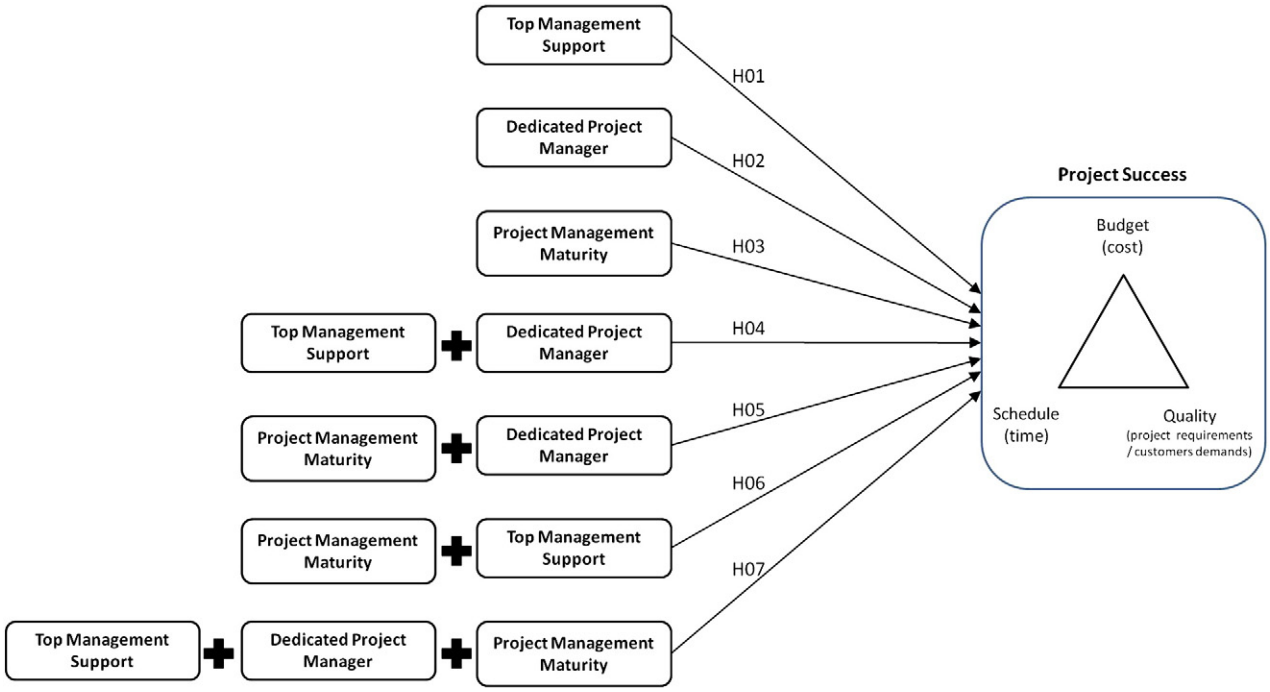

Fig. 1. Research main objectives.

models were influenced by the study of Humphrey (1989), who, while studying the process of IT project development, identified levels of project management maturity based mainly on the attitudes found in business management. Paulk et al. (1995) identified the characteristics that differentiate immature organizations, which typically use *ad hoc* procedures, from mature organizations, which incorporate a disciplined use of project management methodologies.

The emergence of project management maturity models is a recent phenomenon, which dates back approximately a decade and a half. The literature has focused its attention on the methods used to conduct a maturity assessment based on the potential value of project management maturity models (Grant and Pennypacker, 2006). The first model, developed by the Software Engineering Institute (SEI), measured the quality of the software development process and was called the SEI Capability Maturity Model (SW-CMM) (Paulk et al., 1991). The SW-CMM, developed after 1986, was in response to the needs of the U.S. Department of Defense, which sought to evaluate its software suppliers (Paulk et al., 1995).

The SEI Capability Maturity Model has been applied by many organizations (Grant and Pennypacker, 2006). Billions of dollars are estimated to be spent on research related to software process improvement based on this model. There is a growing research base that supports a link between high levels of maturity and optimized organizational performance. Accordingly, the SEI Capability Maturity Model is an attractive starting point for developing project management maturity models (Grant and Pennypacker, 2006).

As a result, this model has evolved into a more comprehensive model called the CMMI (Capability Maturity Model Integration), which can be applied by companies in any business sector and is therefore not limited only to IT organizations. Both models, based on concepts of maturity levels or stages and on structural requirements for key process areas, execute a series of practices, both specific and general, that are inherent to each of the five maturity Levels: (1) initial, (2) managed, (3) defined, (4) quantitatively managed, and (5) optimized. The project management method model currently used as a reference for evaluation is the CMMI v1.2 (CMMI-DEV) (SEI, 2006).

The wide dissemination of the CMM and CMMI models has motivated empirical studies on the effectiveness of the adoption of the models. A survey conducted by Jiang et al. (2004) indicated that there is a significant relationship between the project performance and maturity level of software development. In their study, the authors concluded that the adoption of the CMM, as specified in key areas for software process improvement (SPI), has a positive relationship with project performance, as has already been observed with respect to the performance of processes and products (Jiang et al., 2004).

In the last two decades, several other specific project management maturity models have been developed that describe and measure project management competence. Most of them are based on The Guide of the Project Management Body of Knowledge (PMBOK) from PMI (Duncan, 1996, cited in Gareis and Huemann, 2000). Among the project management maturity models proposed, two models can be highlighted, the Organizational Project Management Maturity Model (OPM3) (Project Management Institute, 2008) and the Kerzner Project Management Maturity Model (PMMM) (Kerzner, 2001). In addition, some lesser known maturity models were proposed by Dinsmore (1998) and Gareis and Huemann (2000).

In May 1998, the Project Management Institute (PMI) launched the Organizational Project Management Maturity

Model (OPM3). This program was established to develop a maturity model certified according to PMI standards (Grant and Pennypacker, 2006). Additionally, the OPM3 program helps organizations develop the ability to support macro company processes in managing all projects and relating these projects to corporate strategy. The OPM3 program includes a glossary of terms, outputs indicating that project management results in success, contingency variables, and descriptions of the model steps (Project Management Institute, 2008).

Originally, the OPM3 assessment questionnaire consisted of 151 questions. In 2008, the model was updated with the publication of its second edition, and the number of questions was reduced to 125 questions. The major change that occurred between the first and the second editions is that the latter also evaluated the organizational enabler criteria (structural, cultural, technological, and human resources) and analyzed the life cycle phases in the context of project, program and portfolio.

The Project Management Maturity Model (PMMM) is composed of five levels: Level 1 — Common Language; Level 2 — Common Processes; Level 3 — Singular Methodology; Level 4 — Benchmarking; and Level 5 — Continuous Improvement. As in Software Engineering Institute models, each level represents a different degree of project management maturity. Maturity Level 2, for example, represents the transition from immaturity (Levels 1 and 2) to maturity (Level 3) (Kerzner, 2001). According to Carvalho et al. (2008), despite the similar structure, the CMM and PMMM have different focuses, as the CMM is more specific to the software engineering context, and different terminology, which could lead to misunderstandings when both models are being implemented in the same organization.

Level 2 represents the transition from immaturity to maturity. The PMMM Level 2 has the following main characteristics: recognition of benefits from project management, organizational support at all levels, recognition of the need for processes/methodologies, recognition of the need for cost control, and development of a project management training curriculum. The PMMM Level 2 can be deployed in five life cycle phases as follows: (1) embryonic, (2) executive management acceptance; (3) line management acceptance, (4) growth, and (5) maturity (Kerzner, 2001).

The assessment of maturity is based on a specific questionnaire for each level. Level 2 of the PMMM has a questionnaire that consists of 20 questions (four questions for each life cycle phase), thus providing an overview of the life cycle profile (Kerzner, 2001). To achieve maturity, that is, to move to Level 3, a company must score six or more in all life cycle phases of Level 2 (to be more fully explained in the next section). At this point, the company can be considered mature (Kerzner, 2001).

Although companies with more mature project management practices could be expected to have better project performances, the findings are, in fact, conflicting (Yazici, 2009). In recent decades, some studies have been published which evaluated the relationship between project management maturity and project success. However, there is limited evidence on the existence of a relationship between maturity and success, and to date, this relationship has not been confirmed (Grant and Pennypacker, 2006; Jugdev and Thomas, 2002; Thomas and Mullaly, 2007). Accordingly, these studies demonstrate the need for further research regarding the relationship between project management maturity and project success.

Dion (1993) mentioned that organizations that adopt the CMM model tend to demonstrate higher quality software development, a faster development cycle and greater productivity. In a sample of 61 companies, Herbsleb and Goldenson (1996) found evidence that process maturity of software development is associated with better organizational performance.

Jiang et al. (2004) sought to verify the existence of a positive relationship between process maturity of software development and project performance through an evaluation of research (survey) answered by one hundred and four participants. This study has identified a statistically significant relationship between project success and maturity levels of software development.

Another recent study was published by Berssaneti et al. (2012). In this research, a survey with fifty-one professionals from the Brazilian Information Technology sector, the results showed a positive impact between PMMM Level 2 and meeting stakeholders' demands.

The previous discussion suggests the following hypothesis:

- H03
  There exists a relationship between organizational maturity in project management and the performance (success) of executed projects.

2.3.1. Comparative analysis of the maturity models

Table 1 summarizes the three main maturity models presented in this section, which could be used for the evaluation of organizations in terms of project management maturity. In addition to the models' features, Table 1 also presents their advantages and limitations.

For assessing project management maturity, the Kerzner maturity model was selected. The PMMM, Maturity Level 2 — Common Processes, mark the transition within an organization, from immaturity stages (Levels 1 and 2) to maturity (Levels 3, 4 and 5), according to Kerzner (2001). The Kerzner maturity model was chosen for the following reasons:

- Small survey that is easy to apply, consisting of 20 closed questions with a Likert scale (ranging from strongly disagree (−3) to totally agree (+3));
- The instrument has been validated and published by Kerzner (2001) and is already recognized in the academic area;
- Issues and forms of data analysis are public domain;
- Allows researchers to evaluate the organization and not part of it; and
- Provides a clear vision and positioning of the current state of the company.

2.4. Research conceptual model

For answering the research question, a set of hypotheses arose as a result of the theoretical discussion. Three variables that can

Table 1
Comparison between maturity models.

Maturity model	Model features	Advantages	Disadvantages
CMMI	Developed by the Software Engineering Institute (SEI)	Rating form and requirements (practices) are public domain	Only some parts (areas or departments) of the organization are evaluated
	Structured in five levels. Organization is classified into one of five levels of maturity	CMMI v1.2 (CMMI-DEV) is used as the benchmark evaluation, which allows the identification of gaps with respect to the model and preparation of action plans	The evaluation is difficult to implement because on-site checking of the model requirements (practices) is required
PMMM	Developed by Kerzner	System with easy application in the form of a questionnaire, and data analyses are public domain	Measures only the current level of maturity in project management organization and does not indicate what the next steps to be performed are to reach the next level
	Structured in five levels. Organization is evaluated and classified into one of five levels of maturity	Evaluates the organization and not parts of it	
	It presents one questionnaire for each maturity level, containing a total of 183 questions	The organization is classified into one of the five maturity levels, providing a clear view of the current state	
OPM3	Maturity Model Project Management Institute (PMI)	Measures the level of maturity in projects, program and portfolio management	Form of data analysis and grouping of answers are outside public domain
	Total of 125 questions	System with fast implementation, containing binary responses (yes/no)	PMI is the owner of this evaluation and charges for its application
	Results of the maturity assessment are presented in percentages from 0% to 100%	Results in line with current concepts of project management and action plans generated automatically by the tool	Technical questionnaire must be answered by professionals familiar with the language

impact project success were considered: top management support, dedicated project manager and organizational project management maturity. The main effect of these three variables was analyzed, besides the effect of the interaction among them. Project success, the dependent variable, is considered according to the iron triangle perspective. Fig. 1 shows the research conceptual model and hypotheses.

The research hypotheses are the following:

H01. There exists a relationship between top management support and the performance (success) of executed projects.

H02. There exists a relationship between the presence of a dedicated project manager and the performance (success) of executed projects.

H03. There exists a relationship between organizational maturity in project management and the performance (success) of executed projects.

H04. There exists a combination of the variables of top management support and a dedicated project manager that explains the success of executed projects.

H05. There exists a combination of the variables of organizational maturity in project management and a dedicated project manager that explains the success of executed projects.

H06. There exists a combination of the variables of organizational maturity in project management and top management support that explains the success of executed projects.

H07. There exists a combination of the variables of top management support, a dedicated project manager, and organizational maturity in project management that explains the success of executed projects.

3. Research methods

While seeking the variables that affect or influence the success of projects carried out by Brazilian companies, this research proposal benefited from a quantitative approach through a survey assessment.

3.1. Unit of analysis selection

The unit of analysis is the project. Table 2 presents the main characteristics of the projects surveyed. The sample is composed of people who have responded to the questionnaire on behalf of their companies. Each respondent corresponds to a project analyzed in this research. To obtain a sample of individuals who possess a working knowledge on the subject and who are able to properly respond to the survey, the sample is non probabilistic but was rather biased to the purpose at hand; in other words, a convenience sampling. These individuals are part of institutes and associations dedicated to studying project management, are students of a graduate executive program in a Brazilian public university or are professionals from companies selected based on the fact that these companies operate in environments that are typically project-oriented, such as engineering and construction companies, the transformation industry, consulting services and information technology companies (IT).

A total of 488 questionnaires were collected; however, 152 of them were invalidated because they had incomplete information. With respect to the sample size, we improve the demographic

Table 2
Project demographics.

	Project budget (1000 Real)	Project duration (months)	Team size (number of members)
Mean	47,475.98	14.62	39
Median	1200.00	10.50	10
Max	2,000,000.00	72.00	2000
Min	30.00	1.00	3
Standard deviation	211,085.61	13.83	145.18

characterization and better explain the sample parameters adopted. We obtained an effective return of 336 questionnaires, a sample that is larger than that calculated by the software G*Power 3.0 (Faul et al., 2007) when considering the level of statistical significance (α) at 5% and the level of power required at 80% (Hair et al., 2005), which results in a sample of 153 respondents.

Out of the remaining 336, only 14 were collected without the supervision of the researchers; in other words, they were sent to the respondents through email. It is worth noting that more than 3000 emails with the questionnaire were sent.

Among the 336 valid questionnaires, 171 (50.9%) were from people who have project management functions (Table 3) in addition to other duties, such as execution, resource allocation, monitoring or project selection for the company's portfolio.

3.2. Research instrument

The research instruments were designed based on the literature review, deployed into 4 sections as follows:

1. Section 1 addresses the characterization of the interviewee and is composed of the questions relating to the following: participation in projects (yes or no) and responsibility in projects. It also addresses the characterization of the company, with questions such as the number of employees, revenue estimates, number of ongoing projects, percentage of employees dedicated to projects both in full-time and part-time schedules, and project categorization.
2. Section 2 addresses the evaluation of organizational maturity in project management using Kerzner's (2001) PMMM Level 2 assessment — life cycle phases. The evaluation of the life cycle (maturity Level 2) represents the transition, within an organization, from immaturity (Levels 1 and 2) to maturity (Levels 3, 4 and 5). Kerzner (2001) proposes the assessment composed of 20 questions (four questions for each life cycle phase). High scores (six or greater) in the sum of the four questions in the phase assessment indicate that maturity has been achieved in that specific life cycle phase. For a company to be eligible for maturity Level 3, it is necessary to have high scores (six or greater) in all five life cycle phases. In this case, the company may be considered mature.
3. Section 3 addresses observation and attention to critical success factors. Interviewees were requested to answer questions based on their last concluded project. They were then asked about the existence of an exclusively dedicated project manager (yes or no) and if the estimated resources of the project were made available (yes or no) by the top management.
4. Section 4 addresses the analysis of the project performance. Interviewees were requested to respond to questions based on their latest concluded project. Accordingly, an analysis based on the perspective of interviewees is presented with respect to the success or failure of the project. Although this may be considered biased information, it is a good alternative to correlate Sections 2 and 3 with Section 4, that is, to draw a relationship between critical success factors and project management maturity. In the questionnaire, we opted for an evaluation of project performance based on four criteria (known as basic or traditional) with yes or no alternatives.

Table 3
Function of respondents in projects.

Function	Absolute frequency	Relative frequency
Project execution	219	65.18%
Project monitoring	196	58.33%
Project management	171	50.89%
Allocation of resources	82	24.40%
Project prioritization (portfolio execution)	78	23.21%
Project selection for portfolio	35	10.42%

A pre-test was performed to evaluate the research instrument with academics and practitioners.

3.3. Conceptual model

In the present research, there are four dependent variables, all of which were analyzed separately. Tables 4 and 5 identify the dependent, independent and/or moderating variables of the conceptual model.

A moderating variable is a factor, phenomenon or property that also impacts the dependent variable, but to a lesser extent, thus influencing the relationship between the independent and the dependent variables (Marconi and Lakatos, 2003). The two critical success factors selected are the two possible moderating variables used to evaluate their influence on generating lower costs, meeting deadlines and improving the quality of the projects. Therefore, these two CSFs were considered independent variables for verifying hypotheses H01, H02 and H04, while they were considered moderating variables for verifying hypotheses H05, H06 and H07.

To verify hypotheses H01, H02 and H03, chi-squared independency tests were performed using as a benchmark a

Table 4
Evaluation of project success — dependent variables.

Dependent variable
D1 — Compliance with project budget (cost)
D2 — Compliance with original project timetable (schedule)
D3 — Delivery of product/service requirements as planned
D4 — Customer service requirements (needs)

Table 5
Input variables of the conceptual model.

Input variable	Variable category	Construct
V01 — Top management support	Independent and/or moderating	Critical success factor
V02 — Dedicated project manager	Independent and/or moderating	
V03 — Project management maturity	Independent	Project management maturity models

p-value lower than or equal to 0.05 (descriptive level) of the maximum likelihood test, from Minitab v.16.

To verify hypotheses H04, H05, H06 and H07, binary logistic regressions were tested also using as a benchmark a p-value lower than or equal to 0.05. The binary logistic regression analysis applied in this study corresponds to a multivariate statistical technique used for explaining a dependent variable with binary outcomes (success or failure). According to Hosmer and Lemeshow (2001), the logistic equation corresponds to a probability distribution restricted between 0 and 1, as seen in Eq. (3.1):

$$P(\text{success}) = \frac{1}{1 + e^{-\alpha}} \tag{3.1}$$

where

α $\beta 0 + \beta 1X1 + \beta 2X2 + \ldots + \beta iXi$;
βi constants;
Xi independent or moderating variables.

4. Results

According to Fig. 2, from the 336 valid questionnaires, it was determined that the majority of respondents work in organizations that belong to the following industries: transformation industry (machinery, equipment, automobiles and auto parts); information and communication industry (information technology and telecommunications); construction; financial activities; technical, scientific and professional activities (engineering services); and transport, storage and mailing services.

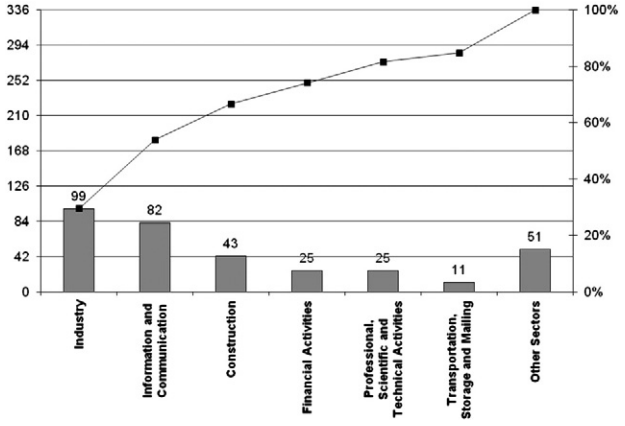

Fig. 2. Sample characterization by sector.

Table 6
Results per PMMM life cycle phase.

Life cycle PMMM Level 2	Companies with a score equal to or greater than 6	Mean	Standard deviation	Median
Embryonic	98	1.62	5.67	2.00
Executive management acceptance	59	0.61	5.24	1.00
Line management acceptance	71	1.28	4.86	2.00
Growth	72	0.66	5.40	1.00
Maturity	58	−0.74	5.88	−1.00

For evaluating which organizations can be classified as mature with respect to project management, the data from the project management maturity (Level 2) questionnaire were verified for each of the five stages of the Level 2 life cycle of the PMMM. Table 6 presents, for each one of the five stages, the number of companies with scores equal to or greater than six, from the perspective of the survey participants.

When analyzing Table 6, in which a given company can have a score equal to or above six in one of the stages of Level 2 of the PMMM, great variability of the data can be observed. We note that out of the 336 questionnaires, the stage with the largest number of companies equal to or above a score of six was the embryonic stage, which totaled 98 companies (28.6%). Following the embryonic stage were the growth and line management acceptance stages, with 72 companies (21.4%) and 71 companies (21.1%), respectively. In the executive management acceptance stage, there were 59 companies (17.6%), while in the maturity stage of the life cycle, 58 organizations had scores of six or above, for 17.3% of the total. However, among the 336 respondents of the survey, only 32 (or 9.5%) evaluated their companies with scores equal to or above six in all stages of the life cycle, the case necessary for a company to be considered mature (Kerzner, 2001). The results have shown that there is a great opportunity to improve project management practices in the evaluated companies, given that less than 10% of the sample has evaluated their company as meeting the requirements necessary to be assessed as mature with respect to project management. This result corroborates those obtained by Yazici (2009) and Berssaneti et al. (2012), who have also found that only a small portion of their samples qualify as mature regarding their project management practices.

To verify the hypotheses in the research, the hypotheses have been broken into four sub-hypotheses that aim to verify the relationship between the input variables of the conceptual model and each of the four dependent variables in the model. Table 7 presents the first three hypotheses and sums up their verification by means of the chi-squared independency test in which hypotheses are confirmed at the 5% significance level. When there is no statistically significant difference, the hypotheses are rejected.

Based on the results in Table 7, we can infer that H01b and H01c are true. Hence, there is a relationship between top management support and meeting the project timetable and also

Table 7
Specific hypotheses deployed from hypotheses H01, H02 and H03.

Hypothesis		a — budget (cost)	b — schedule (time)	c — project requirements	d — customer demands
H01	Chi-square test	Fail to support	**Support**	**Support**	Fail to support
	χ^2	1.147	**8.39**	**4.796**	3.187
	p-Value	0.284	**0.004**	**0.029**	0.074
H02	Chi-square test	Fail to support	**Support**	Fail to support	Fail to support
	χ^2	0.966	**4.161**	1.775	0.000
	p-Value	0.326	**0.041**	0.183	0.983
H03	Chi-square test	**Support**	**Support**	**Support**	Fail to support
	χ^2	**6.326**	**5.296**	**6.392**	0.435
	p-Value	**0.012**	**0.021**	**0.011**	0.509

between top management support and product/service requirement delivery. These results support the critical success factor most often cited in the literature — top management support (Fortune and White, 2006).

H02 is also partially true as a relationship between the existence of a dedicated project manager and meeting the timeline was found. The result indicates the importance of a dedicated project manager in meeting timelines, thus contributing to studies such as Archibald (1976), Nguyen et al. (2004) and Qureshi et al. (2009).

With respect to hypothesis H03, three sub-hypotheses were confirmed. The presence of project management maturity — Level 2 of the PMMM (Kerzner, 2001) — has been statistically significant for all variables except dependent variable D4 (meeting customer demand). This result corroborates the findings of Berssaneti et al. (2012), who conducted a similar study on the technology sector in which they identified a statistically significant relationship between project management maturity and meeting stakeholders' demands. The result also supports the studies by Jiang et al. (2004), Ibbs and Kwak (2000), Jugdev and Thomas (2002), Grant and Pennypacker (2006), Mullaly (2006), Thomas and Mullaly (2007) and Yazici (2009), which confirm the hypothesis that project management maturity is positively related to improved project performance. Furthermore, according to H04, H05, H06 and H07, the presence of more than one variable, when present and combined, provides an explanation for the success of the projects. To perform the binary logistic regression analysis, these hypotheses have been further broken down into four specific hypotheses. Table 8 presents the results with respect to a p-value at the 5% significance level. At this level, only hypothesis H06 was partially confirmed, thus resulting in a regression equation for variable D3 — product/service requirements delivery as planned.

In Table 9, we present the β coefficients of Eq. (3.1), their standard deviation, their significance level — p-value – and "Odds Ratio Exp(B)", which allows us to determine how the probability of a given event increases in the presence of a single variable when compared to its non-existence. The descriptive level (significance level), a single p-value lower than or equal to the adopted level of significance (α) indicates that the observance of a given result would be less likely if H0 (null hypothesis) were true; hence, we reject H0 (p-value ≤ α).

When analyzing data from Table 9, we find that, at the 5% significance level, there is enough evidence to conclude that

Table 8
Specific hypotheses deployed from hypotheses **H04**, **H05**, **H06** and **H07**.

Hypothesis		a — budget (cost)	b — schedule (time)	c — Project requirements	d — Customer Demands
H04	Binary logistic regression	Fail to support	Fail to support	Fail to support	Fail to support
	Constant	p-Value = 0.004	p-Value = 0.361	p-Value = 0.022	p-Value = 0.001
	Top management support	p-Value = 0.327	p-Value = 0.007	p-Value = 0.038	p-Value = 0.067
	Project manager	p-Value = 0.382	p-Value = 0.087	p-Value = 0.283	p-Value = 0.837
H05	Binary logistic Regression	Fail to support	Fail to support	Fail to support	Fail to support
	Constant	p-Value = 0.000	p-Value = 0.245	p-Value = 0.000	p-Value = 0.000
	Maturity	p-Value = 0.045	p-Value = 0.049	p-Value = 0.047	p-Value = 0.521
	Project manager	p-Value = 0.432	p-Value = 0.067	p-Value = 0.265	p-Value = 0.964
H06	Binary logistic regression	Fail to support	Fail to support	**Support**	Fail to support
	Constant	p-Value = 0.000	p-Value = 0.715	**p-Value = 0.004**	p-Value = 0.000
	Maturity	p-Value = 0.043	p-Value = 0.045	**p-Value = 0.046**	p-Value = 0.584
	Top management Support	p-Value = 0.330	p-Value = 0.005	**p-Value = 0.035**	p-Value = 0.074
H07	Binary logistic regression	Fail to support	Fail to support	Fail to support	Fail to support
	Constant	p-Value = 0.006	p-Value = 0.300	p-Value = 0.033	p-Value = 0.001
	Maturity	p-Value = 0.047	p-Value = 0.059	p-Value = 0.052	p-Value = 0.57
	Project manager	p-Value = 0.490	p-Value = 0.126	p-Value = 0.379	p-Value = 0.797
	Top management support	p-Value = 0.370	p-Value = 0.009	p-Value = 0.047	p-Value = 0.071

Table 9
Input variables of the model.

Dependent variable	Independent variable	Coefficient	Standard error	p-Value	Odds Ratio Exp(B)
D3 — delivery of the product/service requirements of the project as planned.	Constant	$\beta_0 = 0.724260$	0.248697	0.004	
	V03 — project management maturity	$\beta_3 = 1.48368$	0.744685	0.046	4.41
	V01 — top management support	$\beta_1 = 0.621888$	0.295039	0.035	1.86

variables V03 and V01 influence the delivery of product/service requirements as planned. Therefore, they should be included in the model. We then obtain Eq. (4.1):

$$P(D3) = \frac{1}{1 + e^{-(0.724260 + 1.48368V03 + 0.621888V01)}}. \quad (4.1)$$

By substituting values in Eq. (4.1), that is, V03 = 1 (presence of variable) and V01 = 1 (presence of variable), the probability that the project delivers product/service requirements as planned is 94.43% at a significance level of 5%.

Independent variable V03 and moderating variable V01 positively influence the probability that product/service requirement delivery as planned will be met. In the presence of variable V03 (project management maturity), the probability of product/service requirement delivery as planned increases by 4.41 times (Odds Ratio Exp(B)), and in the presence of moderating variable V01 (top management support), it increases by 1.86 times (Odds Ratio Exp(B)).

5. Conclusions

The research hypotheses presented herein provides a means for correlating the organizational project management maturity with project success, as well as two critical success factors (top management support and the presence of a dedicated project manager). However, the impact is not significant in all dimensions of project success.

This paper contributes to the current literature in two ways. First, the top management support (V01) and the existence of a dedicated project manager (V02) partially explained the success of the projects. Only indicators of success related to technical performance and meeting deadlines had a significant impact with respect to top management support, the most mentioned critical success factors in the literature (Fortune and White, 2006). With respect to the relationship between a dedicated project manager and project success, the success factor was limited to the deadline indicator. Second, it was possible to determine that project management maturity (variable V03) explains the success in executed projects, considering the iron triangle: time, cost and quality. However, the expanded view of quality that further involves customer satisfaction has not been confirmed. This makes it possible to infer that companies classified as mature, according to the PMMM criteria (Kerzner, 2001), demonstrate superior performance over those companies that are classified as immature. This result corroborates the findings of some authors regarding project management maturity and further complements these studies. However, this result may imply that the methods and techniques adopted in project management prioritize efficiency aspects (iron triangle) rather than effectiveness aspects (customer satisfaction), which may represent an important implication for practical application in organizations and thus constitute a future research agenda.

There were no explanatory variables or equations that would lead to the overall success of a project. In other words, there was no compliance among the four success indicators used in the proposed conceptual model. It is worth noting that the indicator customer satisfaction was not related to the three independent variables investigated. Meeting deadlines was the only success indicator used in the study that was affected by all input variables. Furthermore, project management maturity was more important to determine project success than were the other variables of the conceptual model.

The presence of both the independent variable V03 (project management maturity) and the moderating variable V01 (top management support) positively influences the success of projects regarding technical performance, and accordingly, the probability of success is 94.43%. In the presence of project management maturity, the chance of delivering the product/service requirements of the project as planned increases by 4.41 times, while with top management support, it increases only by 1.86 times.

An implication for practice is that companies have spent time and money on project management and this study shows evidence that their organizational efforts have borne fruit, once the maturity is positive and significantly related with all vertices of the iron triangle.

Some methodological choices may limit the generalization of the research findings. The first of the limitations is associated with responses based on the perception of respondents, which can be a source of bias. The second refers to the use of a non-probabilistic sample, which may introduce bias into the analysis and the sample might not represent the population as a whole. Another limitation can be associated with the fact that all the respondents were from companies of a single country. In Brazil, the organizations and practitioners adhere to the internationally recognized methodology of project management, and the country ranks first among Latin American countries in terms of its number of project management professional (PMP) certifications. Considering the Brazilian context, that is, the execution of large sports facility construction projects for the Summer Olympics 2016 and the FIFA World Cup 2014, the infrastructure projects pertaining to the growth acceleration program (PAC in Portuguese) and the projects related to the Brazilian petrochemical industry, the controls to meet the goals of these projects may be momentarily exaggerated and as a consequence, influence the research results. However, a sample with

a high number of elements (n = 336) can help mitigate this issue and the results found can provides generalizable insights.

The scope of the research and the conceptual model is limited, with few independent or moderating variables. In addition, the consolidated models presented in this study concern the prediction of project success rather than failure. This limitation is also observed in the theory of critical success factors in projects, whereby the discussion of success is more present than the discussion on failure. Finally, because of its focus on the theme, as alerted by Aubry and Hobbs (2010), this study contributes to the literature, which seems to be driven by the belief that organizations will adopt project management only if such adoption can be shown to generate value.

For future studies, the suggestion is to increase the sample for a better statistical generalization, including cross country and cross sector analysis. Moreover, can be done an analysis of the project success during the whole project life cycle and not just after the project end. Other moderating and control variables should be explored in the future, such as the project complexity, sector, project life cycle phases and company size. Finally, this study also demonstrates that the time vertices of iron triangle are more sensitive to the studied variables than the others. Thus, it is important to investigate if there are tradeoffs among the project success dimensions, because this study demonstrates that the studied variables impact each success dimension in different ways.

Conflict of interest

There is no conflict of interest.

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