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ORIGINAL ARTICLE

Maturity of project teams and the accuracy of the delivered projects in achieving goals

Maturidade de equipes de projetos e a precisão no atingimento de metas dos projetos entregues

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Abstract: The objective of this study is to assess the association of project teams maturity with the accuracy of delivered projects in achieving project goals of a contracting manufacture company. This is a qualitative and quantitative empirical study with an explanatory approach. Eighteen project teams, comprising 122 professionals and 71 completed projects, were studied, aiming to correlate the maturity of teams with the accuracy of the performance of delivered projects. Evidence of a positive association between team maturity and the accuracy in achieving deadline and conformity goals was found. The importance of project team maturity as it relates to achieving pre-established performance targets was revealed. In addition to developing an original metric to measure maturity, this study uses the degree of achievement of goals - not simply linear gains in cost, conformity and time - as a project performance metric. Future studies should focus assertively on the goal achievement metric used here rather than on the diffuse search for vague performance maximization.

Keywords: Project team maturity; Project management; Performance.

Resumo: O objetivo deste estudo é avaliar a-associação da maturidade com a precisão no alcance das metas dos projetos. Trata-se de um estudo empírico qualitativo e quantitativo, com abordagem explicativa e exploratória. Foram estudadas 18 equipes de projeto, compostas por 122 profissionais e 71 projetos concluídos, com o objetivo de correlacionar a maturidade das equipes com a precisão do desempenho dos projetos entregues. Foram encontradas evidências de uma associação positiva entre a maturidade da equipe e a precisão no cumprimento das metas de prazo e conformidade. Foi revelada a importância da maturidade da equipe do projeto no que se refere ao alcance de metas de desempenho pré-estabelecidas. Além de desenvolver uma métrica original para medir a maturidade, este estudo usa o grau de alcance das metas - não apenas ganhos lineares em custo, conformidade e tempo - como uma métrica de desempenho do projeto. Estudos futuros devem se concentrar assertivamente na métrica de alcance de metas usada aqui, em vez de buscar a difusa ou vaga maximização do desempenho.

Palavras-chave: Maturidade de equipes de projetos; Gestão de projetos; Desempenho.

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1 Introduction

In addition to their routine activities, manufacturing companies rely on *projects*, especially to upgrade their production infrastructure and processes.

Given the greater degree of uncertainty that characterizes projects, when compared with routine activities, references to failures in project management and delivery are abundant (Prado, 2008; Archibald & Voropaev, 2003). As a consequence, it seems that manufacturing companies lack project teams with increasingly higher levels of maturity (Andersen & Jessen, 2003; Souza et al., 2010), as it is expected that more mature teams will deliver more ”satisfactory” projects (Crawford, 2006). The present study adopts the perspective of the contracting manufacturing firm, therefore satisfactory projects should be understood as projects as close as possible to their previously established performance goals. In other words, satisfactory projects are accurate projects.

Kerzner (2006) argues that projects conducted by low-maturity teams can result in a succession of failures causing these teams learn, through slow and hard processes, from their own mistakes. Thus, to cross a given threshold of maturity in project management with greater agility and less waste of financial and personal resources, project teams should adhere to certain methodologies and to “good practices” in project management and implementation (Prado, 2010).

There are several project management maturity models available in the specialized literature and applied in management activity. The best known include CMM (*Capability Maturity Model*), CMMI (*Capability Maturity Model Integrated*), MMGP (*Maturity Model Project Management*), OPM3 (*Organizational Project Management*), PMMM (*Project Management Maturity Model*) and P3M3 (*Programme and Project Management Maturity Model*). All these models are aligned with prescriptions of PMBoK (Project Management Body of Knowledge)

However, although maturity is highly recommended in the literature and in management practice, the potential gains resulting from higher levels of maturity acquired by project teams are not very clear. Objectively speaking, there is not much information regarding the association of project team maturity with projects delivery (Berssaneti & Carvalho, 2015). There is only preliminary evidence that higher maturity levels are linked to improvements in project goal achievement (Carvalho et al., 2015; Miklosik, 2015; Badewi, 2016; Santos & Martins, 2008).

In this context, it is legitimate to question what would be, at the time of delivery, considered “adequate” or “satisfactory” projects, from the standpoint of the contracting party, which in the case of the present study is a manufacturing company. Although there is a multiplicity of indicators to assess whether a given project falls within this desirable situation for the contracting party, the fact is that project performance indicators, in practice, traditionally fall in only three basic categories (the “iron triangle”): technical conformity (quality); deadline; and cost (Papke-Shields et al., 2010; Taherdoost & Keshavarzsaleh, 2016).

Another point that should not be disregarded concerns the optimization, from the perspective of the client, of the performance indicators for the projects delivered to them. It is worth determining what would be “optimal” indicators for a project’s client. Satisfaction with technical requirements is seen as necessary, but a level of technical quality above the required level may not be appropriate due to possible cost increases. The delivery of projects on time has always been pursued, but early deliveries may compromise other ongoing activities in the manufacturing industry. Finally, it is highly desirable for the costs of delivered projects to be the lowest possible; however, projects that systematically cost less than provided for in the budget bring about inconveniences related to the anticipated commitment of excess funds, which could be used for other activities in the manufacturing

company, possibly with higher opportunity costs. Most authors, however, focus on the maximization of performance indicators (e.g. Wheelwright & Clark, 1992), and not on achieving precise targets or goals (i.e. not more and not less than what is desired). Even the authors who focus or mention goal achievement in project management, do not indicate that an overachievement could be undesirable (e.g. Lai et al., 2018; Detzen et al., 2018; Albert et al., 2018; Eyiah-Botwe et al., 2016).

Thus, for a contracting manufacturing company, "optimal" projects could be those that match, with the greatest possible accuracy, the expectations of the company. For the present study, it is also expected that from the perspective of the project team, whether from project-based firms or manufacturing firms, it is equally legitimate to assume that "optimal" projects are those with the highest possible *accuracy* of results, which would stimulate more standardized work practices with a greater degree of certainty. The operational definition of accuracy for a given project will be explored further with more rigor, but at this point a research question should be addressed first: Is there a relationship between project team maturity and the accuracy, in achieving stated goals, of delivered projects?

To answer this research question, an analytic model is presented with the following structure: antecedent factors in the form of a maturity construct which embodies, besides traditional PMBoK variables, other variables based on a broad view about project success; and consequent factors in the form of an accuracy construct whose variables are accuracy proxies normally used by manufacturing firms which contract projects. The correlation between these two constructs is studied. The focus of the study is on project teams that have a traditional structure and procedures, such as defined on the PMBOK guide, and not on agile project management (Fernandez & Fernandez, 2008).

Thus, the objective of this study is to assess the maturity of project teams working for a manufacturing company and to associate maturity with the accuracy of delivered projects in achieving the company's stated project goals.

It is assumed that this issue has strong empirical interest, since multinational companies, when deciding their budgets for contracted infrastructure and process improvement projects, are seeking to (a) avoid lack of resources, in the case of undersized projects and (b) avoid unnecessary *ex-ante* allocation of resources, in the case of oversized projects.

This study was conducted in the state of Bahia and included project teams (contracted teams and company teams) that provide services to a large multinational company from the food sector.

It is hoped that this study will contribute to improving the understanding of the relationship between the maturity of project teams working for manufacturing companies and the accuracy in achieving the stated goals of projects.

2 Theoretical framework

This section is divided into five topics: project performance indicators; accuracy in projects; maturity in projects; relationship between maturity and performance in projects; additional factors impacting performance; and the proposed hypotheses.

2.1 Project performance indicators

Due to the very nature of the singularity of projects, the characterization of the performance of a given project may vary from project to project, which makes it

challenging to universally define a set of indicators or criteria for project monitoring and evaluation (Müller & Turner, 2007; Westerveld, 2003).

Over the years, several studies have been conducted in an attempt to create sets of *midpoint* (practices) and *endpoint* (results) indicators for project activity (dashboards, frameworks), many of which vary by the type of contract, type of business, nationality and focus of evaluation of the project (Lipovetsky et al., 1997; Lim & Mohamed, 1999; Chan & Chan, 2004; Shenhar & Dvir, 2007; Toor & Ogunlana, 2010; Müller & Jugdev, 2012).

Notably, it is important to clearly separate the indicators of project execution activity, as mentioned above, into *midpoint* and *endpoint* indicators. The former are instruments used for project managers, focus on the activity as a process, and aim for project monitoring and the appropriate course corrections (Botelho, 2002; Caldeira, 2012). In contrast, the latter are especially useful for the contracting company and function as elements of evaluation of the delivered project. Only the *endpoint* indicators, i.e., the performance indicators of the delivered projects, are relevant to this study.

Thus, “adequate” projects would imply costs close to the initial budget, project deadlines achieved, and delivery aligned with the scope of the project agreed upon. These triple constraints (the “iron triangle”), although classic, have been criticized by scholars and professionals in the field, who question that other indicators can complement and make the evaluation of project delivery more holistic and complete (PMI, 2013a; Anantatmula & Rad, 2013; Berssaneti & Carvalho, 2015).

Despite criticism, the triple requirement remains an essential marker of the result of a project (Papke-Shields et al., 2010; Taherdoost & Keshavarzsaleh, 2016) and will be adopted in this study as a reference for the evaluation of delivered projects.

Table 1 summarizes the most used *endpoint* indicators for the evaluation of project delivery found in the reviewed literature for each of the three dimensions evaluated (De Wit, 1988; Pinto & Mantel, 1990; Munns & Bjeirmi, 1996; Shenhar et al., 2001; Bryde, 2003; Fortune & White, 2006; Kerzner, 2006; Yang & Peng, 2008; Davis, 2014; Badewi, 2016). The formulas were developed by the authors.

Table 1. Summary of the main endpoint indicators of the Triple Constraints for project delivery.

Dimension	Indicator	Formula	Unit
Cost	Cost Variation	Final Cost - Planned Cost	R$
	Cost Index	Final Cost / Planned Cost	%
	Cost Accuracy	(Budget - |Final Cost - Budget|) / Budget	%
Conformity	Conformity Variation	Deliveries Made Without Rework - Planned Deliveries	number
	Conformity Index	Deliveries Made Without Rework/Planned Deliveries	%
	Conformity Accuracy	(Planed Deliveries - |Deliveries Made Without Rework - Planned Deliveries|) / Planned Deliveries	%
Deadline	Deadline Variation	Total Time - Planned Time	Time unit
	Deadline Index	Total Duration / Planned Duration	%
	Deadline Accuracy	(Planned Time - |Total Time - Planned Time|) / Planned Time	%

Source: Authors.

2.2 The accuracy of delivered projects

"Optimal" projects are those that match, with the highest possible accuracy, the expectations of the contracting party (Bakker et al., 2010). In the present study, project delivery will be evaluated using triple constraints (cost, conformity and deadline) based on the respective accuracy indicators, calculated according to Table 1. One can conclude that for each of the three dimensions, accuracy can be expressed, in general, by the following percentage (Equation 1):

$$\left(planned\ value\ -\ |error|\right)\ /\ planned\ value \tag{1}$$

Here, "error" is the difference between actual value and planned value. As the error can take positive or negative values, its modulus is used to calculation.

2.3 Maturity of the organization delivering the project

Maturity is a subjective concept derived from the execution of a set of processes that, throughout their development, lead an organism to a state of equilibrium and of completeness in the attainment of its objective/purpose (Golse et al., 2005).

In the project environment, maturity can be understood as a dynamic and evolving state in which the responsible team is fully able to execute its projects with a certain level of excellence, aware of the need for constant criticism of the *status quo* of the current management so as to become, in addition to apt, increasingly better (Andersen & Jessen, 2003; Crawford, 2006; Prado, 2010; Kerzner, 2011). The expression "becoming better" translates into the widespread idea that adherence to certain methodologies, driven by gradual maturation in project management, is responsible for this improvement (Prado & Archibald, 2014b; Berssaneti & Carvalho, 2015; Aubry, 2015).

In general, project maturity models help organizations understand, through appropriate evaluations, how effective and efficient a project team is, encouraging an optimizing role in the organizational environment, according to certain policies, methodologies and good practices of project execution. These models have proven advantageous because they allow the normative description of good practices, the reflection on the *status quo* regarding maturity models, and the use of models as guides for benchmarking project environments (Grant & Pennypacker, 2006; Nenni et al., 2014).

There are numerous maturity models in project management, with many of them based on the *CMM*, for the evaluation of project teams, based on adherence to prescribed practices, tools and methods (Kerzner, 2001; Ibbs & Kwak, 2000; Grant & Pennypacker, 2006). Although maturity models have strong similarity between them, there is no unanimous reference for a universal measurement of the maturity of organizations that undertake projects. The literature reports a wide variety of models: Abd-Karim et al. (2014) and Souza & Gomes (2015), for example, describe, together, 27 models that have been proposed to guide project teams regarding the development of maturity in the advancement of their activities.

Over the years, some of these models have been refined, providing basic information and broad guidelines for the formulation of an organizational maturity plan, as in the case of the Project Management Institute's OPM3 model and the MMGP

model. Both of these models derive from the PMBOK (Prado, 2010) and have similar approaches. They have a wide reach and are amply disseminated in the project management environment in Brazil (Tiossi & Gasparato, 2017). Even though the project management environments are most often understood as organizations, a project team can also be considered a work environment for project execution (Thamhain, 2004). Therefore, for the purposes of this study, these two maturity models, together with a few other relevant factors related to project management that were also collected based on the bibliographic review, constitute the basic material for the elaboration of the construct used in the empirical research for measuring the maturity of teams.

2.3.1 OPM3 model: project management maturity model (OPM3) of the Project Management Institute - **PMI (2013b)**

OPM3, proposed by the PMI, assesses how well an organization conducts project management and execution, according to “best practices”, reflecting, therefore, its maturity. OPM3 evaluates the current situation to generate a development plan for the entire organization so as to enable more effective project execution (Grant & Pennypacker, 2006).

The evaluation takes place over four stages of maturity: standardize measure, control and continuously improve.

The gradual maturation proposed by OPM3 is implemented in five-stage cycles: 1) acquire knowledge and prepare for assessment; 2) perform assessment; 3) manage improvement: plan for improvement; 4) manage improvement: implement improvements; and 5) manage improvement: repeat the process.

In the evaluation of organizational competencies, the measurement performed using the OPM3 model provides numerical indicators for each of the four stages of maturity, expressed as the percentage of adherence to each stage (standardize, measure, control and improve).

2.3.2 MMGP model: project management maturity model developed by Darci **Prado (2010)**

With great similarity to OPM3, the MMGP model has been applied in project management maturity mapping studies in Brazil, with the participation of companies from various sectors and in different business areas, since 2005, with support from PMI chapters and the International Project Management Association (IPMA) (Prado & Oliveira, 2014a).

The MMGP model classifies maturity into five distinct levels: 1 (initial), 2 (known), 3 (standardized), 4 (managed) and 5 (optimized).

The maturity suggested by the aforementioned authors extends to seven organizational dimensions: project management competence; technical and contextual competencies; behavioral competencies; methodologies; computerization; organizational structure; and alignment with business strategies.

In the MMGP model, maturity levels are linked to evolution in the respective dimensions, as shown in Table 2, where the dimensions of “competencies” are grouped.

Table 2. Evolution in the dimensions of maturity of the MMGP.

Maturity Dimension	Maturity Level				
	1. (Initial)	2. (Known)	3. (Standardized)	4. (Managed)	5. (Optimized)
Competencies	Sparse	Basic	Basic	Advanced	Advanced
Methodology	None	Isolated attempts	Implemented and Standardized	Improved	Stabilized
Computerization	Isolated attempts	Isolated attempts	Implemented	Improved	Stabilized
Organizational structure	None	None	Implemented	Improved	Stabilized
Alignment with strategies	None	None	None	Aligned	Aligned

Source: Prado (2010).

2.4 Relationship between maturity and results of delivered projects

Efforts to implement increasingly higher maturity levels in project environments are justified by the premise that by leveraging management and execution maturity, there will be improvement in project goal achievement (Carvalho et al., 2015; Miklosik, 2015; Badewi, 2016; Santos & Martins, 2008).

The difficulties in defining this relationship lie in clearly associating the gains in achieving goals with the maturity of the project team because several other circumstantial factors could be involved (Santos, 2009; Lappe & Spang, 2014; Joslin & Müller, 2015). The impact of maturity is more easily identified in aspects internal to the organization (*midpoint* indicators), whose reflection can be transcribed into excellence in the execution of internal activities (Santos, 2009; Moraes & Kruglianskas, 2010).

Despite this difficulty, Prado & Archibald (2014b) have conducted surveys since 2008 in Brazil that associate maturity levels (MMGP) with the results of delivered projects. They found that maturity is associated with better results, in terms of reduction in delays, of cost overruns and of percent scope completion.

As already mentioned, this present study has a different focus, analyzing the **accuracy** of the results, i.e., observing, with the same interest, (a) delayed or early project delivery; (b) project cost overruns or savings; and (c) all nonconformities (including positive ones) related to the scope of the project.

2.5 Additional factors impacting project results

In addition to the influence of the maturity models prescribed by the standards on project results, this study also conducted a broad literature review in search of other factors that could equally influence these results. Knowing that the literature records the existence of isolated factors considered important for achieving high performance of delivered projects (Rockart et al., 1982; Boynton & Zmud, 1984), the authors proposed developing a maturity construct that considered, in addition to the traditional standards, the aforementioned factors. The literature review retrieved total of 188 records of factors that impact the results of projects, presented in publications cited in 13 studies reviewed. Table 3 presents a compilation of the review, resulting in 20 additional factors which impact performance.

Table 3. Impact factors for project results.

Authors	Factor
Morlhon et al. (2014)	Mapping of stakeholders
Taherdoost & Keshavarzsaleh (2016)	Transparency
Alias et al. (2014); Fortune & White (2006)	Appropriate budget
Kerzner (2001); Silveira et al. (2013)	Recognition
Fortune & White (2006); Silva (2009); Anantatmula & Rad (2013)	Clear definition of project goals
Fortune & White (2006); Ram et al. (2013); Silveira et al. (2013)	Leadership
Pinto & Slevin (1987); Fortune & White (2006); Davis (2014); Alias et al. (2014)	Realistic schedule
Kerzner (2001); Fortune & White (2006); Taherdoost & Keshavarzsaleh (2016)	Risk management
Kerzner (2001); Fortune & White (2006); Silveira et al. (2013); Alias et al. (2014)	Effective monitoring/control
Fortune & White (2006); Silva (2009); Pasian (2014)	Recording of involved parties and responsibilities
Fortune & White (2006); Silva (2009); Ram et al. (2013); Morlhon et al.(2014)	Strategic alignment
Silva (2009); Silveira et al. (2013); Ram et al. (2013); Pasian (2014)	Organizational culture of project support
Pinto & Slevin (1987); Kerzner (2001); Anantatmula & Rad (2013); Davis (2014); Morlhon et al. (2014); Taherdoost & Keshavarzsaleh (2016)	Clear deliveries
Pinto & Slevin (1987); Silva (2009); Anantatmula & Rad (2013); Davis (2014); Morlhon et al. (2014); Taherdoost & Keshavarzsaleh (2016)	Clear requirements
Kerzner (2001); Silveira et al. (2013); Anantatmula and Rad (2013); Davis (2014); Morlhon et al. (2014); Pasian (2014); Alias et al. (2014)	Commitment and cooperation
Pinto & Slevin (1987); Kerzner (2001); Fortune & White (2006); Silva (2009); Silveira et al. (2013); Morlhon et al. (2014); Pasian (2014); Taherdoost & Keshavarzsaleh (2016)	Technological resources according to activity
Pinto and Slevin (1987); Kerzner (2001); Fortune & White (2006); Silveira et al. (2013); Anantatmula & Rad (2013); Morlhon et al. (2014); Pasian (2014); Taherdoost & Keshavarzsaleh (2016)	Change management
Pinto & Slevin, (1987); Kerzner (2001); Silva (2009); Silveira et al. (2013); Anantatmula & Rad (2013); Ram et al. (2013); Davis (2014); Alias et al. (2014); Taherdoost & Keshavarzsaleh (2016)	Steering committee
Pinto & Slevin (1987); Kerzner (2001); Fortune & White (2006); Silva (2009); Anantatmula & Rad (2013); Ram et al. (2013); Davis (2014); Morlhon et al. (2014); Alias et al. (2014); Taherdoost & Keshavarzsaleh (2016)	Communication
Pinto & Slevin (1987); Kerzner (2001); Fortune & White (2006); Silva (2009); Silveira et al. (2013); Ram et al. (2013); Morlhon et al. (2014); Pasian (2014); Alias et al. (2014); Taherdoost & Keshavarzsaleh (2016)	Team capacity according to activities

Source: Authors.

2.6 Hypotheses

As was mentioned, there is vast evidence that the maturity of teams has a positive effect on project performance and/or on the excellence in the execution of project activities (Andersen & Jessen, 2003; Crawford, 2006; Prado, 2010; Kerzner, 2011; Prado & Archibald, 2014b; Berssaneti & Carvalho, 2015; Aubry, 2015; Santos, 2009; Moraes & Kruglianskas, 2010). More specifically, there is preliminary evidence that higher maturity levels are linked to improvements in project goal achievement (Carvalho et al., 2015; Miklosik, 2015; Badewi, 2016; Santos & Martins, 2008). Therefore, the following hypotheses are proposed:

H1 - Team maturity is positively associated with cost accuracy;

H2 - Team maturity is positively associated with deadline accuracy; and

H3 - Team maturity is positively associated with conformity accuracy.

The diagram in Figure 1 illustrates the association between maturity and the three ways of expressing the accuracy of delivered projects.

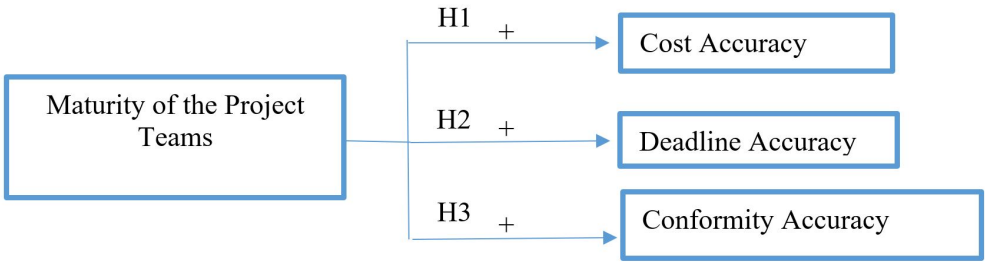

Figure 1. Diagram of the association between maturity and accuracy. Source: Authors.

3 Research methods and techniques

This is an empirical, qualitative and quantitative study of an exploratory nature. The methods and techniques are described below.

3.1 Study design

As already mentioned, the general objective of this study is to determine the relationship between the maturity of project teams and the accuracy of projects delivered by them, in terms of achieving the company's stated project goals. To achieve this objective, the design showed on Figure 2 was followed.

This study was conducted in the state of Bahia, with the participation of 18 project teams belonging to companies that provide project services to a large multinational company in the food sector with a branch office in that state. Thus, all the studied projects were executed for that company.

Constructs development, instrument development, sampling and data processing are described below to facilitate understanding of the results presented in the next section.

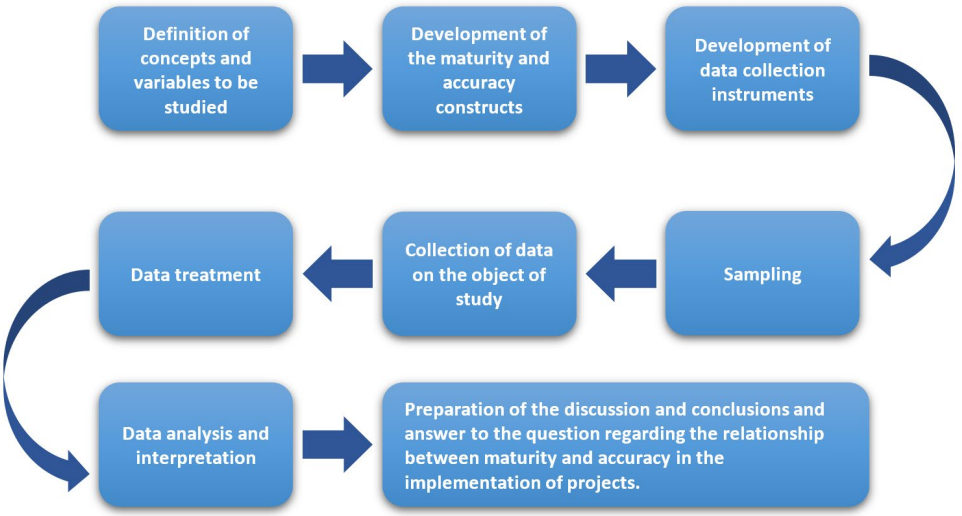

Figure 2. Design. Source: Authors.

3.2 Maturity construct

The maturity construct of project teams was developed from two elements of the literature on the topic: (a) traditionally prescribed maturity standards and (b) additional factors that affect the maturity of project environments.

In total, the construct has 60 maturity variables, of which 40 variables were adapted from project management maturity models based on the PMI standards (MMGP and OPM3). The other 20 variables in the construct were collected from other impact factors reported in the literature (Table 3). Figure 3 shows a schematic of the maturity construct used.

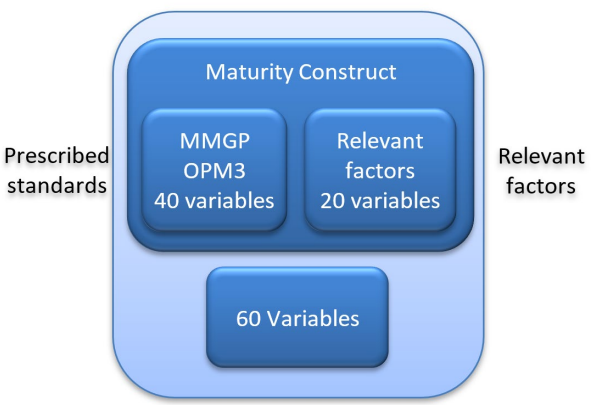

Figure 3. Maturity construct. Source: Authors.

3.3 Accuracy construct

The accuracy construct evaluates the results of the delivered projects, comparing the final results with the initial planning, through three results indicators: conformity (scope/quality); deadline (time); and cost (see diagram in Figure 4).

Figure 4. Accuracy construct. Source: Authors.

For each project team, conformity accuracy was calculated based on the number of planned deliveries and the number of deliveries made without rework. Deadline accuracy was calculated from the planned time for the project and the effective delivery time. Finally, cost accuracy was calculated based on the predicted budget and the final cost of the project.

3.4 Research instruments

For each project team that delivered projects to the investigated multinational company, maturity was evaluated by the team members themselves through a structured questionnaire containing 60 questions (which can be found, in its original language, in the Appendix 1), each of which corresponded to the respective variable of the maturity construct. The response to each maturity requirement or prescription was expressed in a 5-position ordinal scale, with the following scores:

a) always observed: 100 points;

b) observed most of the time: 75 points;

c) observed sometimes: 50 points;

d) rarely observed: 25 points; and

e) not observed: 0 points.

Before being sent to the project teams members, this instrument was pre-tested by four PhD-level researchers who work in a research institute and university center located in the state of Bahia. The objective of this pre-test was to determine the average time taken to answer the questionnaire and to perform a semantic validation. This validation aimed to verify, by means of interviews conducted after the questionnaires were administered, the level of understanding and acceptance of the terms, the relevance of the items in the instrument, the existence of any difficulties and the possible need for adaptation (Fuzissaki et al., 2016).

The questionnaire was sent to each member of each team, with the recommendation that each member provide feedback on the maturity of their respective team.

In turn, the data for the calculation of performance accuracy were obtained from the multinational company that ordered the projects, based on records of the initial planning and data regarding final project delivery, which were separated by project team.

3.5 Sampling

Eighteen project teams participated in the study, with activities in the following disciplines: enterprise management, executive projects, equipment supply, civil construction, mechanical assembly, electrical installation and automation. As a whole, these 18 teams employed 122 project professionals and delivered to the multinational company 71 projects over a two-year period. As the multinational company had some ascendancy over the teams (due to its client status) and because the company had an interest in the research and monitored the responses, all 122 questionnaires were completed, with numbers of respondents distributed as follows:

Team 1 - 7; **Team 2** - 6; **Team 3** - 5; **Team 4** - 8; **Team 5** - 10; **Team 6** - 6; **Team 7** - 4; **Team 8** - 10; **Team 9** - 5; **Team 10** - 8; **Team 11** - 6; **Team 12** - 5; **Team 13** - 10; **Team 14** - 9; **Team 15** - 5; **Team 16** - 7; **Team 17** - 6; and **Team 18** - 5.

3.6 Data treatment

The maturity effectively measured by each respondent was expressed as the percentage of the sum of the score he/she assigned to the team relative to the maximum sum of scores for that construct (6,000 points).

The maturity of each team was calculated as the mean of the maturities assigned by each individual member using the following Formula 2:

$$Overall\ Maturity = \frac{Sum\ of\ the\ scores\ of\ the\ 60\ variables}{6000} x100(\%) \quad (2)$$

The indicators that evaluated the accuracy of the projects when finalized, with respect to cost, deadline and conformity (scope and quality), were calculated, for each team, as the mean of the accuracy of the team projects, where each indicator was calculated according to the expressions shown in Table 4 (which is an excerpt from Table 1).

Table 4. Accuracy indicators.

Cost accuracy	(Planned budget- |Final cost – Planned budget|) / Planned budget	%
Deadline accuracy	(Planned time - |Actual time - Planned time|) / Planned time	%
Conformity accuracy	(Planed deliveries - |Deliveries made without rework - Planned deliveries|) / Planned deliveries	%

Source: Authors.

These indicators assess the degree of agreement between final project delivery and the planning performed at the beginning, thus assessing the predictability of project delivery at the end, according to what was planned.

Finally, to calculate the association between maturity and accuracy, Spearman's correlation, a nonparametric coefficient that does not require normality of the sample data and allows the analysis of continuous and ordinal variables (Lehman, 2005), was used to confirm the three proposed hypotheses. Since the objective was to determine the strength of the relationship between maturity and accuracy, and not to predict causality (in theory, creating better targets could be a result of more mature teams), a

regression approach was not chosen. A key benefit of a correlation approach is that it is a more clear and concise summary of the relationship between a couple of variables than the one that is found with regression, without the need of meeting a few of the assumptions of the latter method (Kutner et al., 2005).

4 Results and discussion of the research

This section presents the results, analyses and discussion of the research.

4.1 Maturity calculations

Table 5 shows the calculated values for the global maturity of the teams (G), expressed as the percentage of the maturity construct used as reference.

Table 5. Calculated values of project team maturity (%).

Project Team	G
1	**52.00**
2	**61.00**
3	**60.00**
4	**56.67**
5	**61.00**
6	**46.00**
7	**88.00**
8	**74.00**
9	**62.00**
10	**58.00**
11	**76.00**
12	**28.00**
13	**40.00**
14	**70.00**
15	**74.00**
16	**20.00**
17	**88.00**
18	**56.00**

Source: Authors.

Figure 5 shows how the maturity values measured are distributed in the overall sample of the 18 teams. There are two teams in the lower end of the maturity range (0 to 30%) as well as in the 81% to 90% range. There are no teams in the 91% to 100% range. The maturity range between 51% and 60% has the highest number of teams (5 teams). Nine teams (50% of the sample) have maturities that do not exceed 60%. To a certain extent, these results are similar to those reported by Miklosik (2015), in which half (50%) of the project teams evaluated by that researcher had maturities of up to 50% relative to the reference standard used in that study.

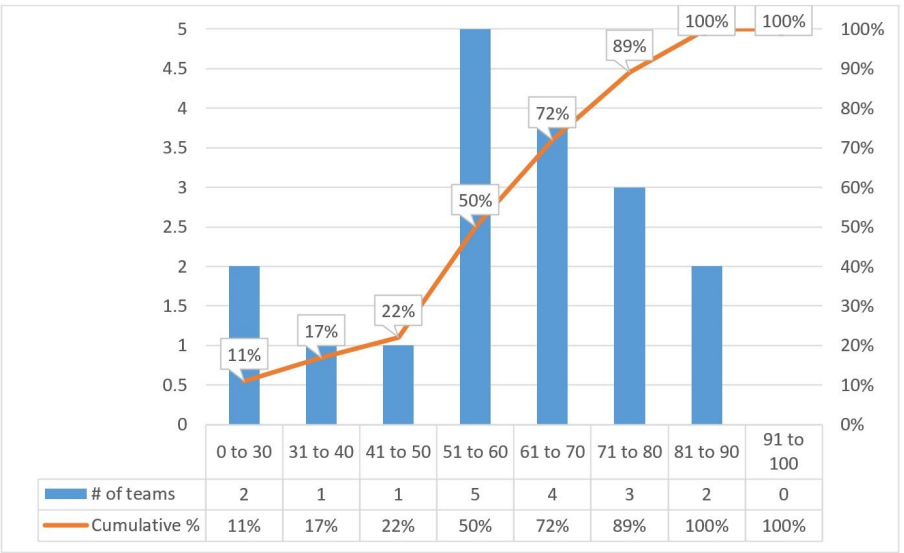

Figure 5. Distribution of maturity for the teams. Source: Authors.

4.2 Accuracy calculations

Through the expressions shown in Table 4, the mean accuracy of the results of the projects delivered by each team were calculated for each of the three types of results (cost, deadline and conformity), as shown in Table 6. For the referred delivery accuracy calculations, secondary data provided by the multinational company investigated were used.

Table 6. Calculated accuracy of delivered projects (%).

Team	Cost %	Deadline %	Conformity %
1	95.54	95.25	93.73
2	94.95	88.19	87.50
3	94.67	77.96	80.87
4	89.04	87.50	87.08
5	92.32	92.36	98.00
6	95.24	90.07	87.55
7	92.54	95.83	100.00
8	95.73	88.48	92.72
9	93.80	88.89	88.57
10	91.88	82.78	88.15
11	95.34	88.89	96.67
12	93.39	75.00	75.07
13	95.05	94.38	91.88
14	95.89	94.17	94.25
15	97.28	94.91	91.32
16	96.62	72.02	92.68
17	87.24	95.83	97.37
18	92.92	82.50	100.00

Source: Authors.

4.3 Association between maturity and accuracy and hypothesis testing

Before proceeding to the tests of the three proposed hypotheses, associations were "visualized" through descriptive statistics, regardless of the significance of the association.

Table 7 shows the teams and their maturity values in ascending order and the respective accuracy values. In general, the best maturity results seem to be associated with the best accuracy results. These results can be visualized in Figures 6, 7 and 8, which show the increasing maturity trend line and the respective trend lines for deadline, conformity and cost. Notably, the deadline and conformity accuracy trend lines characterize a positive graphical association with maturity; the same cannot be said of the association with cost.

Table 7. Maturity × Accuracy.

Team	Maturity	Accuracy		
		Cost	Deadline	Conformity
16	20.00	96.62	72.02	92.68
12	28.00	93.39	75.00	75.07
13	40.00	95.05	94.38	91.88
6	46.00	95.24	90.07	87.55
1	52.00	95.54	95.25	93.73
18	56.00	92.92	82.50	100.00
4	56.57	89.04	87.50	87.08
10	58.00	91.88	82.78	88.15
3	60.00	94.67	77.96	80.87
2	61.00	94.95	88.19	87.50
5	61.00	92.32	92.36	98.00
9	62.00	93.80	88.89	88.57
14	70.00	95.89	94.17	94.25
15	74.00	97.28	94.91	91.32
8	74.00	95.73	88.48	92.72
11	76.00	95.34	88.89	96.67
17	88.00	87.24	95.83	97.37
7	88.00	92.54	95.83	100.00

Source: Authors.

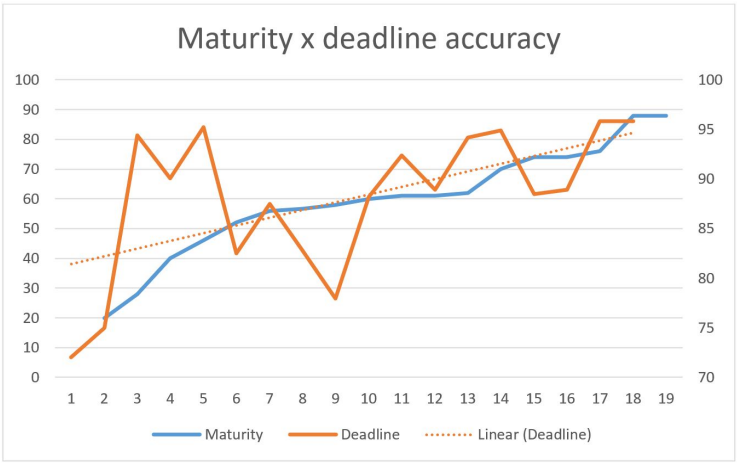

Figure 6. Maturity × deadline accuracy. Source: Authors.

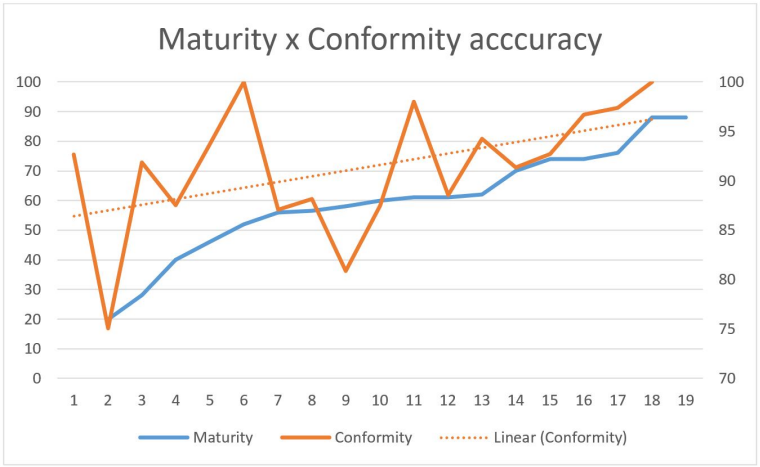

Figure 7. Maturity × conformity accuracy. Source: Authors.

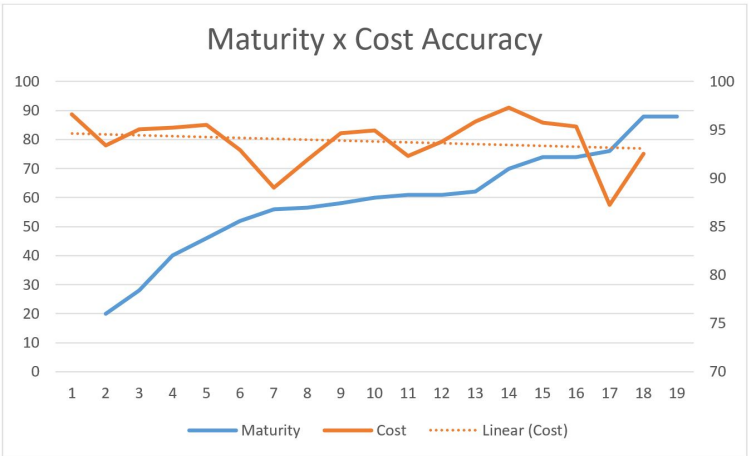

Figure 8. Maturity × Cost accuracy. Source: Authors.

Using SPSS V.21, the data were analyzed using Spearman's correlation test, whose degree of correlation was classified according to Table 8; the results are shown in Table 9.

Table 8. Degree of Spearman's correlation.

Spearman's correlation rho	Interpretation
0.0 to 0.3	Weak correlation
0.3 to 0.6	Moderate correlation
0.6 to 0.9	Strong correlation
0.9 to 1.0	Very strong correlation

Source: Callegari-Jacques (2009).

Table 9. Spearman's correlation test: maturity vs. cost, deadline, and scope.

Correlations	Spearman's rho	P-Value
Maturity × cost	-0.093	0.714
Maturity × deadline	0.538	0.021*
Maturity × conformity	0.450	0.061**

*The correlation is significant at the 0.05 level. **The correlation is significant at the 0.1 level. Source: Authors.

Therefore, there is evidence supporting hypotheses 2 and 3; hypothesis 3 was confirmed for a lower significance level of 0.1. Considering their degree of correlation, the correlations were considered to be moderate (rho below 0.6) in both cases. These results add to the evidence, in the literure, that the maturity of teams has a positive effect on project performance and/or on the excellence in the execution of project activities (Andersen & Jessen, 2003; Crawford, 2006; Prado, 2010; Kerzner, 2011; Prado & Archibald, 2014b; Berssaneti & Carvalho, 2015; Aubry, 2015; Santos, 2009; Moraes & Kruglianskas, 2010). More specifically, it contributes to the literature focused on studying the effect of higher maturity levels on improvements in project goal achievement (Carvalho et al., 2015; Miklosik, 2015; Badewi, 2016; Santos & Martins, 2008).

5 Conclusions and discussions

In response to the central purpose of this study, which is to better understand the nature of the relationship between the maturity of the project teams investigated and the accuracy in achieving the stated goals, the following conclusions can be stated:

a) Among the associations found, the strongest was between maturity and the accuracy of project delivery on time, confirming the results reported by Carvalho et al. (2015), according to which, in Brazil, typically more effort is devoted to meeting project deadlines than to other results. Hypothesis H2, which predicted that the greater the team maturity is, the greater the accuracy in meeting the deadlines established, is confirmed;

b) A moderate association between the maturity of the teams studied and accuracy regarding scope/quality conformity was also identified, which is an indicator linked to delivering projects that are defect-free and compliant with the agreed upon goals. Although this correlation is weaker than the correlation with deadline, hypothesis H3 is also considered to have been confirmed. Descriptive studies by Badewi (2016),

Prado & Archibald (2014b), Lopes (2009) and Ram et al. (2013) indicate that greater team maturity contributes to delivering projects with less need for rework;

c) However, no correlation was found between the maturity of the project teams working for the multinational company and the accuracy of the delivered projects with respect to the budgeted costs (hypothesis H1). A similar result was also found in the study by Santos (2009), not specifically with respect to accuracy but, in general, with regard to the association between maturity and intentions to reduce project cost targets. It is likely that factors other than maturity, not investigated by the authors of this study, exert an influence on costs.

Finally, this study provides an additional relevant contribution because the results of projects, per se, were not analyzed, but instead the accuracy in achieving those goals was analyzed and measured with a new metric, a perspective that has rarely been addressed or adopted in the specialized literature. Exceptions include Ilieş et al. (2010), Ika (2009), Carvalho et al. (2015), Miklosik (2015), Badewi (2016), and Santos & Martins (2008), however these studies did not present or develop a metric. It is expected that future studies in other manufacturing companies will corroborate and validate, with greater depth and breadth, the results obtained here.

One of the limitations of this study is that it cannot attribute causality in the relationship between performance in terms of accuracy in achieving goals and the maturity of teams. In theory, creating better targets could be a result of more mature teams, and this would be an alternative explanation for the results. Moreover, studies with larger samples, collecting data from a vast number of companies, would be important to add external validity to the results presented here. Additionally, there are many other possible factors influencing the success of projects besides the maturity of teams; for instance, external, environmental factors can play a significant role in this regard. This constitutes another limitation of the study, and may be addressed in future studies by means of a multivariate approach.

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Appendix 1. Maturity Measurement Questionnaire and Performance Factors.

ORGANIZATIONAL PERFORMANCE FACTORS: Represent the characteristics of the environment in which projects are conducted.

N.	FATORES DO AMBIENTE ORGANIZACIONAL	Percebido Sempre	Percebido na maioria das vezes	Percebido as vezes	Pouco Percebido	Não percebido
1	Está claro quem são os colaboradores e clientes do projeto					
2	Há clareza na responsabilidade dos envolvidos com projeto					
3	Existe grupo para tomada de decisões críticas					
4	Transparência no nos envolvidos com projeto (Gestor, Colaboradores e Clientes)					
5	Reconhecimento justo					
6	Há compromisso e cooperação de todos					
7	Boa Comunicação					
8	Liderança contribui para realização do projeto					
9	A organização apoia grupo de projetos					
10	Definição clara do objetivo do projeto					
11	Está claro como o projeto contribui para a organização					
12	Clareza em quais as entregas do projeto					
13	Clareza em como as entregas do projeto são avaliadas					
14	Cronograma factível					
15	Orçamento atingível					
16	Plano para reagir aos riscos					
17	Clareza como realizar mudanças no projeto					
18	Monitoramento e controle do projeto que auxilia realização das atividades					
19	Equipe treinada para realização projeto					
20	Ferramentas disponibilizadas para realizar atividade					

PROJECT TEAM MATURITY: Regarding the initial stages of the project:

MATURIDADE DO TIME DE PROJETO		Mais desenvolvido		(Conhecimento)		Menos Desenvolvido
Em relação as etapas INICIAIS do projeto:		Capacidade de aperfeiçoar; de inovar	Capacitado / Em uso	Percebido Iniciativas	Conhecido / Treinado	Desconhecido / Não percebido
21	Conhecimento da missão, visão e valores da organização / empresa; Compreensão das estratégias da organizações / negócios.					
22	Padronização do modo de organização, sistemas informatizados podem auxiliar o gerenciamento dos projetos: - Informações de projetos anteriores; - Organização de informações a serem geradas pelo projeto.					
23	Documentação padrão para gestão dos projetos; Padrões disponíveis na organização, ou de mercado PMBOK, IPMA, Prince2, etc...					
24	Interação entre Gestão dos Projetos e Demais Áreas da Organização (Escritório de Projetos, Comitês, Patrocinadores, Clientes, Colaboradores, Comunidade, Orgãos fiscalizadores, Sociedades, etc.).					
25	Mapeamento dos envolvidos no projeto (internos e externos à organização: - Equipe Gestora; - Colaboradores; - Clientes; - Beneficiados pelo projeto; - Prejudicados pelo projeto.					
26	Planejamento de desempenho de projetos e entregas (padrões disponíveis na organização ou de mercado): - Definição das entregas do projeto; - Definição dos parâmetros de aceite para cada entrega do projeto.					
27	Listagem de conhecimentos técnicos por função junto ao projeto, de modo a atender demandas específicas de cada projeto (produto, processo, aos negócios, à estratégia da organização, seus clientes, etc.).					

Continued...

MATURIDADE DO TIME DE PROJETO		Mais desenvolvido		(Conhecimento)		Menos Desenvolvido
Em relação as etapas INICIAIS do projeto:		Capacidade de aperfeiçoar; de inovar	Capacitado / Em uso	Percebido Iniciativas	Conhecido / Treinado	Desconhecido / Não percebido
28	Mapeamento de características críticas de entorno ao projeto: - Características ambientais; - Sensibilidade política; - Limitação de fornecedores ou recursos internos; - Riscos de danos a imagem; - Etc...					
29	Gerenciamento de mudança (Custo, Tempo e Escopo/Qualidade): - Implementado; - Realizado de forma criteriosa.					
30	Construção de propostas para atendimento de entregas e parâmetros de aceite do projeto.					

PROJECT TEAM MATURITY: Regarding project PLANNING:

MATURIDADE DO TIME DE PROJETO		Mais desenvolvido		(Conhecimento)		Menos Desenvolvido
Em relação as etapas INICIAIS do projeto:		Capacidade de aperfeiçoar; de inovar	Capacitado / Em uso	Percebido Iniciativas	Conhecido / Treinado	Desconhecido / Não percebido
31	Conhecimento da missão, visão e valores da organização / empresa; Compreensão das estratégias da organizações / negócios.					
32	Padronização do modo de organização, sistemas informatizados podem auxiliar o gerenciamento dos projetos: - Informações de projetos anteriores; - Organização de informações a serem geradas pelo projeto.					
33	Documentação padrão para gestão dos projetos; Padrões disponíveis na organização, ou de mercado PMBOK, IPMA, Prince2, etc...					
34	Interação entre Gestão dos Projetos e Demais Áreas da Organização (Escritório de Projetos, Comitês, Patrocinadores, Clientes, Colaboradores, Comunidade, Orgãos fiscalizadores, Sociedades, etc.).					

Continued...

MATURIDADE DO TIME DE PROJETO		Mais desenvolvido		(Conhecimento)		Menos Desenvolvido
Em relação as etapas INICIAIS do projeto:		Capacidade de aperfeiçoar; de inovar	Capacitado / Em uso	Percebido Iniciativas	Conhecido / Treinado	Desconhecido / Não percebido
35	Mapeamento dos envolvidos no projeto (internos e externos à organização: - Equipe Gestora; - Colaboradores; - Clientes; - Beneficiados pelo projeto; - Prejudicados pelo projeto.					
36	Planejamento de desempenho de projetos e entregas (padrões disponíveis na organização ou de mercado): - Definição das entregas do projeto; - Definição dos parâmetros de aceite para cada entrega do projeto.					
37	Listagem de conhecimentos técnicos por função junto ao projeto, de modo a atender demandas específicas de cada projeto (produto, processo, aos negócios, à estratégia da organização, seus clientes, etc.).					
38	Mapeamento de características críticas de entorno ao projeto: - Características ambientais; - Sensibilidade política; - Limitação de fornecedores ou recursos internos; - Riscos de danos a imagem; - Etc...					
39	Gerenciamento de mudança (Custo, Tempo e Escopo/Qualidade): - Implementado; - Realizado de forma criteriosa.					
40	Construção de propostas para atendimento de entregas e parâmetros de aceite do projeto.					

PROJECT TEAM MATURITY: In relation to EXECUTION and CONTROL:

Em relação ao EXECUÇÃO e CONTROLE:		Capacidade de aperfeiçoar; de inovar	Capacitado / Em uso	Percebido Iniciativas	Conhecido / Treinado	Desconhecido / Não percebido
41	Revalidações das entregas do projeto, formalização das: - Entregas do projeto; - Parâmetros de aceite para cada entrega do projeto.					
42	Desenvolvimento, avaliação e aceite das informações e documentos do projeto para armazenamento, evitando acúmulo para final: - Banco de dados para futuros projetos; - Disponibilidade de dados aos envolvidos no projeto.					
43	Estimulo para capacitação e obtenção de certificação em Gestão de Projeto (PMP, IPMA, PRINCE2, etc.) pelos Gerentes de Projetos e elementos de Gerenciamento de Projetos.					
44	Monitoramento dos envolvidos no projeto (avaliação de posição de favorável ou contrário ao projeto e plano de gestão de conflitos): - Equipe Gestora; - Colaboradores; - Clientes; - Beneficiados pelo projeto; - Prejudicados pelo projeto.					
45	Recursos de pessoas e tecnologia adequados por demanda e disponibilizados no momento correto de modo a atender entregas do projeto.					
46	Estruturação de aceites parcial (quando possíveis) das entregas do projeto, evitando acúmulo para final.					
47	Avaliações Capacitação/Desenvolvimento das habilidades comportamentais, como: - Inteligência Emocional; - Pensamento Sistêmico; - Prontidão Cognitiva; - Etc...					

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Em relação ao EXECUÇÃO e CONTROLE:		Capacidade de aperfeiçoar; de inovar	Capacitado / Em uso	Percebido Iniciativas	Conhecido / Treinado	Desconhecido / Não percebido
48	Gestão da Qualidade; - Mapeamento dos pontos críticos de avaliação - Monitoramento das métricas de avaliação - Monitoramento de variações em: Custo, Tempo e Escopo/Qualidade					
49	Registro formal de lições aprendidas durante projetos.					
50	Revalidações estruturadas de Plano do Negócio (viabilidade do projeto); Avaliação: - Mapeamento de pontos sensíveis do negócio - Monitoramento de resultados/benefícios do projeto; - Alinhamento do projeto com com metas Estratégicas. - Revalidações de Plano de negócio					

PROJECT TEAM MATURITY: In relation to CLOSURE:

Em relação a ENCERRAMENTO:		Capacidade de aperfeiçoar; de inovar	Capacitado / Em uso	Percebido Iniciativas	Conhecido / Treinado	Desconhecido / Não percebido
51	Encontros formais para compartilhar experiências do projeto(pontos positivos e à melhorar), crítica e propostas de mudanças são debatidas para: - Métodos; - Ferramentas; - Técnicas; - Etc...					
52	Há sistema informatizado (software, internet, intranet, Excel, etc...), auxiliando a gestão dos projetos, cujo sistema aborda Ciclo de Vida do Projeto, desde a ideia inicial até a entrega do produto do projeto para uso.					
53	Para auxiliar projetos futuros, disponibilização de informações dos projetos quanto à: - Avaliação dos Resultados Obtidos; - Dados do Gerenciamento; - Lições Aprendidas; - Melhores Práticas; - Etc...					

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	Em relação a ENCERRAMENTO:	Capacidade de aperfeiçoar; de inovar	Capacitado / Em uso	Percebido Iniciativas	Conhecido / Treinado	Desconhecido / Não percebido
54	Formalização de entrega do projeto ao cliente.					
55	Estimulo à interação entre Projeto, demais partes da Organização e Cliente, de forma a facilitar desenvolvimento e entrega do projeto e suas metas/objetivos do negócio.					
56	Evento de encerramento de projeto: - Reconhecimentos; - Compartilhamento de aprendizados;					
57	Avaliação de ganhos, ou oportunidades de ganho, ao negócio decorrente de: - Estrutura organizacional de apoio a projetos; - Metodologias de gestão; - Técnicas, ferramentas, documentação padronizados; - Sistema informatizado; - Capacitação em relações interpessoais; - Composição de equipes por Conhecimentos + Experiência + Atitude; - Etc...					
58	Validação final de Plano do Negócio (viabilidade do projeto); - Resultados/benefícios do projeto; - Alinhamento do projeto com com metas Estratégicas.					
59	Avaliação (pontos positivos e à melhorar), realizada pelas Demais Áreas da organização (Escritório de Projetos, Comitês, Patrocinadores, Clientes, Colaboradores, Comunidade, Orgãos fiscalizadores, Sociedades, etc.) em relação a interação junto ao time de projeto.					
60	Avaliação e fomento a sustentabilidade de representantes da equipe de projeto (técnica, gestora, compreensão do negócio, interpessoal,...)					