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ORIGINAL ARTICLE

Effects of standardization-based coordination mechanisms in project performance

Efeitos dos mecanismos de coordenação baseados em padronização no desempenho de projetos

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Abstract: Among the coordination mechanisms present in an organization defined by Mintzberg, there are the mechanisms based on standardization of processes, employee skills and outputs. This study intends to investigate, through an exploratory and quantitative approach, the relationship between standardization-based coordination mechanisms, considered essential for project objectives accomplishment, and project performance. In addition, it is proposed to investigate whether project size, project manager power, technical system complexity and external environment stability affect the relationship between standardization mechanisms and project performance. In order to test the proposed model, the structural equation modeling technique was used in an empirical research with 216 professionals that have already worked on projects. The results showed that work processes standardization has a significant effect on the performance of projects and that their effectiveness is greater in smaller projects, when the project manager has power of action, when the external environment is stable and the technical system is not complex. This study also showed evidence that the proper use of standardization-based coordination mechanisms may have its effects enhanced when contingency factors are considered.

Keywords: Standardization-based coordination mechanisms; Contingency factors; Project performance.

Resumo: Dentre os mecanismos de coordenação presentes em uma organização definidos por Mintzberg, estão os mecanismos baseados na padronização de processos, de habilidades e das saídas ou resultados. Este estudo propõe-se a investigar, por meio de uma abordagem exploratória e quantitativa, a relação entre os mecanismos de coordenação baseados em padronização, considerados essenciais para o cumprimento dos objetivos do projeto e o desempenho de projetos. Adicionalmente propõe-se investigar se o tamanho do projeto, o poder do gerente do projeto, a complexidade do sistema técnico e a estabilidade do ambiente externo alteram a relação entre mecanismos de padronização e desempenho do projeto. Para testar o modelo estrutural proposto foi utilizada a técnica de modelagem de equações estruturais em uma pesquisa empírica com 216 profissionais que atuam em projetos. Os resultados mostraram que a padronização de processos de trabalho tem efeito significativo no desempenho dos projetos e

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que sua efetividade é maior em projetos menores, quando o gerente de projetos tem maior poder de ação, quando o ambiente externo é estável e o sistema técnico pouco complexo. Este estudo ainda mostrou evidências de que o uso adequado dos mecanismos de coordenação baseados em padronização pode ter seus efeitos potencializados se forem levados em consideração os fatores contingenciais.

Palavras-chave: Mecanismos de coordenação baseados em padronização; Fatores Contingenciais; Desempenho de Projetos.

1 Introduction

Organizations operationalize their strategies through projects. Recent researches (Burke & Morley, 2016; Anantatmula, 2015) identify an expansion of academic interest in projects and project management in all types of organizations. Meantime, there is evidence that project failures, in terms of unmet objectives and extrapolation of costs and deadlines, are still a challenge (Anantatmula, 2015).

Despite several developed studies (Bakker et al., 2016; Burke & Morley, 2016; Khoshtale, 2016) on project management, there is still no consensus on the ways to achieve success in projects. Information from the Pulse of the Profession report shows that organizations wasted 12% of their investment in projects in 2018 due to failure to meet the programmed objectives (PMI, 2017).

Project management is a critical competence in implementing projects and achieving success (Kerzner, 2017). A considerable body of knowledge about project management has been developed and applied over the past decades led by international associations (British Standards Institution [BSI]; Project Management Institute [PMI]; Association for Project Management [APM]). This knowledge is disseminated as project management methodologies and reaches a global scope (PMI, 2017; InformationWeek, 2014).

When analyzing the bodies of knowledge present in the main project management methodologies (BSI, 2017; PMI, 2017; APM, 2017), there is a common understanding that it is only possible to achieve excellence in project management from the implementation of standardized processes (Kerzner, 2017) and homogenization of skills through certification programs (PMI, 2017). This situation is configured as the use of standardization as a coordination mechanism in projects.

This study appropriates the Organizational Design Theory proposed by Mintzberg for choosing the most appropriate mechanisms for the best possible performance. This theory explores the ways in which organizations delineate their coordination mechanisms, influenced by external factors called contingencies (Mintzberg, 2015). The external factors that influence coordination mechanisms are: age and size, which have an effect on the formalization of organizational behavior; the technical system, associated to the control of operational work; the environment, related to the external context; and power, linked to the external control of the project. This study aims to analyze the coordination mechanisms based on standardization and their relationship with the project's performance.

From the assumptions that organizations delineate their coordination mechanisms in pursuit of their objectives (Mintzberg, 2015), the questions in this study were derived:

(1) Which coordination mechanisms based on standardization have an effect on project performance?

(2) Which contingency factors affect the relationship between standardization mechanisms and project performance?

In order to answer these questions, a bibliographical review was carried out aiming to understand, from Mintzberg's point of view, the outline of the project's standardization mechanisms and their relationship with performance. A hypothetical structural model was proposed and empirically tested through a survey of professionals working on projects.

This study intends to contribute to the scientific community and to the organizations by relying on theories of organizations to analyze the context of projects. By identifying the aspects that influence the performance of projects, it helps managers to improve project results.

2 Theoretical framework

2.1 Projects and project management

Projects are exclusive ventures that have a well-defined objective, consume resources and operate under the pressure of deadlines, cost and quality constraints. Project management can be defined as planning, programming and controlling a series of activities and integrated tasks in order to achieve the pre-established objectives (Kerzner, 2017). Most organizations have incorporated project management, mainly because it is a systematic approach to managing projects and the ability to generate consistent results (Golini et al., 2015). Project management can improve the collaboration and productivity of project teams through standardized systems that are supported by the best market practices.

2.2 The paradox of standardization and flexibility in project management

Standardization is the basis of methodologies and project management good practices (Hällgren et al., 2012). The institutions responsible for disseminating project management models have implemented in their bodies of knowledge the systematization of standardized processes with the assumption of increasing the projects effectiveness (Kerzner, 2017). There is evidence that standardization using project management methodologies is generally accepted as an instrument to improve project management practices (Hermano & Martín-Cruz, 2018).

In contrast to this line of thought, some authors understand that standardization is only part of what can be applied to improve project management and argue that greater flexibility and adaptability is necessary in order to achieve expected results in projects. A level of flexibility and adaptability can provide greater resilience to project management (Shenhar, 2001).

There is no consensus on the level of standardization and flexibility required in the management of a project. Shenhar (2001) argues that each project is unique and has specific characteristics that make it difficult to generalize techniques, good practices and standardization in its management.

In the field of organizational structure and strategy, Swamidass & Newell (1987) found a positive relationship between uncertainty and flexibility and between flexibility and performance. However, Pagell & Krause (1999) found no evidence that higher levels of flexibility are linked to higher levels of performance.

Beach et al. (2000) argue that flexibility is a competitive response to uncertainty and increasingly complex environments. However, investments in flexibility are expensive and may negatively affect performance. Likewise, in environments of low uncertainty an increase in flexibility can also lead to decreased performance. Although flexibility is a response to uncertainty in the environment, there is no consensus that more flexibility leads to better performance.

Therefore, the choices between standardization and flexibility are still topics to be explored by research, including research related to projects.

2.3 Standardization-based coordination mechanisms

The Organizational Design Theory approach argues that an organization needs to develop a cohesive set of relationships between planning and structure according to existing (contingency) conditions in order to become effective. An alignment between strategies, structure and action is necessary for the expected results to be achieved (Mintzberg, 2015).

Mintzberg (2015, p. 12) defines the structure as the total sum of the ways in which work is divided into different tasks and how coordination is performed between these tasks. Therefore, the structure is related to the division of labor and its coordination mechanisms. Structures have three basic functions: produce organizational results (be effective), regulate or minimize individual influences on the organization and serve as scenarios where decisions are made and tasks are performed.

Organizations adapt their structures and processes according to their strategies and objectives. The adjustment process is dynamic, managing internal interdependencies and seeking alignment with the external environment at the same time (Miles et al., 1978). There are five task coordination mechanisms proposed by Mintzberg (2015): mutual adjustment, direct supervision, standardization of work processes, standardization of outputs and standardization of employee skills.

This study focuses on the three mechanisms that involve standardization and aim to perform 'automatic' coordination based on previously established standards, known and followed by all executors without the need for direct monitoring.

The standardization of work processes is usually adopted in projects in unstable, but not very complex environments. As, for example, in organizations that work in civil construction, where engineering departments design and prescribe the standardized methods of work used in the execution of projects, in the preparation of detailed instructions, in the purchase of components, in the compilation of technical drawings, among others. The standardization of work processes is only possible in the parts of the project where there is a recurrence of activities. Such as, for example, a support team specially developed to accommodate the routine work of the operational core of the project: for example, provision of housing facilities, bathrooms, canteens and shelters on site (van Donk & Molloy, 2008).

The standardization of project outputs arises in situations where multiple projects are necessary for an objective to be achieved. When the project result depends on another project result, the results need to be standardized in order to integrate and form the final result (Mintzberg, 2015). Standardizing the project outputs facilitates the integration of the various parts that are being built, avoiding rework and ensuring the harmonization of the total project result. This type of standardization may be found, for example, in engineering offices and consulting companies that deal with large programs that involve several projects (van Donk & Molloy, 2008).

The standardization of employee skills is mainly applied to projects whose experience and knowledge of the team, their specialties and specificities, have a significant impact on the results of the project and its success. As for example in the creation of new products or services. In this type of project, knowledge, training and education are the main parameters in the selection of the professional. In this context, the professional knows what needs to be done according to their experience and skills. The tendency of professionals is to work according to their own discipline. On the other hand, putting excessive control mechanisms into operation can be counterproductive. Controlling the work of professionals can encourage performance-oriented behaviors or trigger a bureaucratic environment hostile to innovation (van Donk & Molloy, 2008).

2.4 Contingency factors

The tasks coordination may be determined and changed through a series of parameters, called by Mintzberg (2015) as design parameters, which are related to the organization's decision-making system. Several contingent factors influence the choice of design parameters, and are therefore important in the choices that lead to the organization's configuration. The choice and the appropriate adjustment of the design parameters lead to efficiency in the structure design and to the improvement of organizational performance (Mintzberg, 2015).

Among the contingent factors related to the design parameters are the age and size of the organization. The life span of the organization and its size influence the formalization of organizational behavior, the size of individual units and the way its structure is designed. These factors also influence the way in which coordination mechanisms are established (Mintzberg, 2015).

The technical system is another contingent factor that relates to complexity, regulation, automation of the technical system, control of operational work and formalization. In the context of projects, complexity is related to the type of technology involved in the project. Projects involving new technologies and highly complex innovations, such as military and aerospace projects, projects to create new services and new products have a complexity inherent to their role in exploring concepts and situations not yet experienced, unlike traditional projects such as infrastructure and civil construction, which tend to carry out regular activities known to the project team (Shenhar et al., 2001).

The environment is another contingent factor that involves the external context of the organization, including the market, political climate, economic conditions, among others. At this point, it is important to note that, in this study, the external environment to the project is represented by the main organization (which the project is bound) on the first plane and the external environment to the main organization on the second plane (Bakker et al., 2016).

Power is a contingent factor related to the organization's external control (Mintzberg, 2015). In the context of projects, the power of the project manager is strongly influenced by project external factors. Depending on how the main organization is structured, the reflections on the project may be stronger or weaker. When the main organization has a pure functional configuration, project managers tend to have little power over team members. In this type of configuration, the project manager tends to be an expert allocated to the project for a limited time and authority (PMI, 2017). Projects may still be immersed in main organizations whose structure is presented in a matrix format. The matrix structure reflects a mixture between a pure

functional structure and a project-oriented structure. In matrix structures, the project manager power is more balanced than the functional manager. The stronger the matrix structure, greater the project manager power. In main organizations with a designed structure, the project manager has ample power over team members while they are allocated exclusively to the project (PMI, 2017).

In this way, contingency factors are important elements in the design of coordination mechanisms. The choices made in the project configuration structure in order to seek adjustment to the contingent factors, can influence project effectiveness and performance.

2.5 Project performance

Several scholars recognize the complexity of evaluating project performance. The project performance can have different meanings depending on who is evaluating (Toor & Ogunlana, 2010) and when the evaluation is carried out (Cleland & Ireland, 2006).

There are several definitions for the project performance, the majority being a variation of the standard: budget, deadlines and scope, so called “Iron Triangle” (Toor & Ogunlana, 2010; Ebbesen & Hope, 2013) or “Triple Restriction” (PMI, 2017; Rugenyi, 2016). The budget, deadlines and scope indicators are not sufficient to assess the project performance (Toor & Ogunlana, 2010; Ebbesen & Hope, 2013; Kerzner, 2016). Shenhar et al. (2001). Performance should be seen as a multidimensional concept designed to align project efforts with the organization's short and long terms objectives.

Pinto & Slevin (1988) presented a project performance model composed of internal and external indicators. The internal ones are budget, deadlines and features. The external ones are efficiency in resource use and customer satisfaction. Lim & Mohamed (1999) consider that the project performance depend on the perspective. There are two points of view: the stakeholders macro point of view (utility and operation) and the project team micro point of view (scope, time, cost, quality).

As there is no consensus on how to assess project performance, several authors propose different indicators and scales (Anantatmula, 2015). Table 1 shows the result of a bibliographic review carried out to consolidate studies involving project performance. Offers a consolidated view of the indicators present in the scientific literature related to projects.

Table 1. Project Performance Indicators.

Indicador	Referências
Scope	Agarwal & Rathod (2006); PMI (2017); Procaccino & Verner (2006); Toor & Ogunlana (2010); Wallace et al. (2004); Wateridge (1998)
Time	Agarwal & Rathod (2006); Kerzner (2017); Belassi & Tukel (1996); Lim & Mohamed (1999); PMI (2017); Procaccino & Verner (2006); Toor & Ogunlana (2010); Wateridge (1998)
Cost	Agarwal & Rathod (2006); Belassi & Tukel (1996); Kerzner (2017); Lim & Mohamed (1999); PMI (2017); Procaccino & Verner (2006); Toor & Ogunlana (2010)
Quality	Agarwal & Rathod (2006); Belassi & Tukel (1996); Kerzner (2016); Lim & Mohamed (1999); PMI (2017); Procaccino & Verner (2006); Toor & Ogunlana (2010); Wallace et al. (2004); Wateridge (1998)

Table 1. Continued…

Indicador	Referências
Efficiency (in the use of resources)	Kerzner (2016); Lim & Mohamed (1999); Toor & Ogunlana (2010); Wateridge (1998)
Stakeholders' satisfaction/expectations	Kerzner (2017); Lim & Mohamed (1999); Savolainen et al. (2012); Toor & Ogunlana (2010); Wallace et al. (2004); Wateridge (1998)

3 Methodological procedures

This research is exploratory with a quantitative approach. The following sections detail the methodological path beginning with the hypotheses and the structural model.

3.1 Structural model and research hypotheses

Based on the theoretical review addressed in this study, Figure 1 depicts the proposed conceptual model to be empirically tested. The model presents the three coordination mechanisms based on standardization and their relationship to project performance (PP). The mechanisms are of three types: standardization of outputs (SO), standardization of work processes (SW) and standardization of employee skills (SS). The model also presents the moderation of contingency factors in the relationships between the coordination mechanisms and the project performance. The hypotheses to be tested on these relationships. The contingent factors considered are the project size, the manager power, the project environment and the technical system. Their moderating effects will be tested individually.

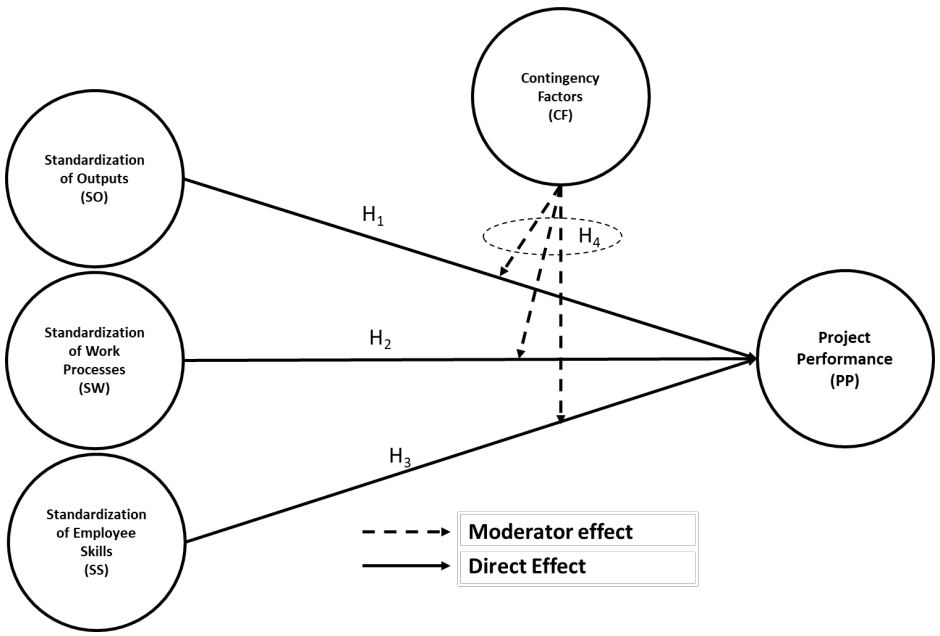

Figure 1. Structural Model.

Considering that the project structure is configured in order to achieve the results in the best possible way, it is possible to suppose that the coordination mechanisms

based on standardization positively impact the project performance, a finding that leads to the following hypotheses, according to Table 2:

Table 2. Hypothesis about coordination mechanisms.

Code	Hypothesis
H1	The standardization of results positively impacts the performance of projects.
H2	The standardization of work processes positively impacts the performance of projects.
H3	The standardization of skills positively impacts the performance of projects.

The structure adjustment occurs due to the design parameters modification influenced by contingent factors (Mintzberg, 2015). Among the contingency factors cited by Mintzberg (2015), the age factor does not make sense for the reality of the projects, since these are temporary and closed when reaching their objectives or when realizing that these objectives cannot be achieved (van Donk & Molloy, 2008; PMI, 2017). Based on these assumptions, contingency factors are assumed to have an effect on the relationship between standards-based coordination mechanisms and project performance. This assumption leads to the following hypotheses, according to Table 3.

Table 3. Hypotheses about moderation.

H4 - Contingency factors have a moderating effect between coordination mechanisms based on standardization and project performance	
H4.1	The size of the project has a moderating effect on the relationship between coordination mechanisms based on standardization and the performance of the project.
H4.2	The power of the project manager has a moderating effect on the relationship between coordination mechanisms based on standardization and project performance.
H4.3	The environment has a moderating effect on the relationship between coordination mechanisms based on standardization and project performance.
H4.4	The technical system has a moderating effect on the relationship between coordination mechanisms based on standardization and project performance.

Hypotheses in this study demand a specific data processing technique. The analysis procedure is based on the multivariate technique known as PLS-SEM - Partial Least Squares Structural Equation Modeling. The use of PLS-SEM is recommended in situations where the theory is poorly developed (Sarstedt et al., 2014). The hypotheses will then be investigated through the causal relationships between the model variables using the statistical procedure PLS-SEM (Hair et al., 2017).

In applying the PLS-SEM technique, the script proposed by Hair et al. (2017), which involves defining the structural model, specifying and validating the measurement models, collecting and examining data, estimating the path model, verifying the results of the reflective and formative models and finally analyzing the results of the structural model.

3.2 Data collection

The electronic questionnaire was sent to professionals who work in project teams and participate in a group of professionals on the Linkedin website (www.linkedin.com) called Project Management Community. At the time of data collection, the group had 371,895 members from all parts of the world, with a close relationship with projects. This choice aimed to ensure that professionals who use different methods of project management in different applications are reached, avoiding bias in sampling.

The sample was collected in a probabilistic manner using a random draw mechanism. In the draw, three random number generators generated three numbers between 0 and 1. These numbers were multiplied by 26 so that they were between 0 and 25 (number of letters of the alphabet), 0 being equivalent to the letter A and 25, equivalent to letter Z. The resulting number determined the three letters of the alphabet that were concatenated into a single text. Examples: CAR, RTG, EGH.

The choice of three letters was to enable a return with a lower number of professionals by the website's search engine. This text was used as a research source in the Linkedin search tool, returning a number of professionals who had exactly the combination of letters in any part of the name. Within this group, an additional random number was generated to choose the chosen professional to receive the survey. To make it possible to send a large volume of messages, a special account was used.

In total, 1,200 messages were sent, of which 216 returned replies representing an 18% return percentage. The sample size meets the minimum requirements proposed by Hair et al. (2017): at least 10 times the largest number of indicators associated with a model construct. The project performance construct has six indicators, which indicates a minimum need for 60 observations.

Responses were obtained from professionals from various regions of the world including Europe, Africa, South America and North America. Most of the respondents (76%) are male, 48.1% of the total respondents have the highest degree of specialization, 15.9% complete master's degree and 27.9% complete higher education. Most respondents (30.8%) are information technology professionals, 16.3% are project managers, 14.4% senior managers and 12% are part of the company's staff. The project segments are divided into: 33.7% software development, 25.5% information technology infrastructure, 6.3% civil construction, 4.3% services sector. The projects analyzed by the respondents involved less than 10 people in 48.1% of the cases, between 11 to 50 in 36.1% of the cases and between 101 and 1,000 in 7.7% of the cases.

3.3 Measurement scales

A seven-point Likert scale was used, with “7” indicating “strongly agree” and “1” indicating “strongly disagree” with the exception of the **Size** construct, which used a two-point scale being 1) up to 50 people and (2) more 50 people.

The variables referring to contingency factors are detailed in Table 4. The project's Technical System was measured by the scale created by Jaworski & Kohli (1993). The project Environment used a scale created by Gordon & Narayanan (1984). Size was measured using the scale proposed by Ika et al. (2012). The Project Manager Power used a scale validated by van Der Vegt et al. (2010).

Table 4. Contingency Factors Scale.

Name	Description	Question
CF_T	Technical system	The technological sophistication of products / services in this project is changing rapidly.
		It is very difficult to forecast where the technology in our project will be in the next 2 to 3 years.
		Technological change provides big opportunities in your project.
		Many new product / services ideas have been made possible by technological advances in our project.
CF_S	Size	How many people did work on your project?
CF_E	Environment	Change occurs in organizational management during the project.
		Corporate politics with effect occurs during the project.
		The organizational environment was unstable
		The organization was in an undergoing restructuring
CF_P	Project Manager Power	I was dependent for materials, means, information from other organization areas in order to carry out my work adequately.

Note: Based on van Der Vegt et al. (2010), Ika et al. (2012), Jaworski & Kohli (1993) and Gordon & Narayanan (1984).

The Project Performance construct is formative and used the scales proposed and validated by Wallace et al. (2004) and Ling et al. (2009) (Table 5).

Table 5. Project Performance Scale.

Name	Description	Question
PP_S	Scope	The client perceive that the Project meets intended requirements
PP_T	Time	The Project was completed within schedule
PP_Q	Quality	The overall quality of the Project deliveries is high
PP_CS	Customer satisfaction	The Project deliveries met the client expectation
PP_C	Cost	The Project was completed within budget
PP_E	Efficiency in the use of resources	There was quality in the project's resource planning

Note: Based on Wallace et al. (2004) and Ling et al. (2009).

The scale on Standardization-based Coordination Mechanisms is reflective and used the scale validated by Drago (1998), in which respondents were asked to identify the structural characteristics using a seven-point Likert scale in which 1 indicates little agreement. and 7 means strong agreement (Table 6).

Table 6. Scale Coordination Mechanisms Based on Standardization.

Name	Description	Question
CM_SO	Standardization of Outputs	Standardization of output was the primary coordinating mechanism in project
		Communications in the project was regulated along formal lines
CM_SW	Standardization of Work Processes	Standardization of tasks was a primary coordinating mechanism in project
		Decision-making in the project was guided by standard procedures

Table 6. Continued…

Name	Description	Question
		Decision-making in the project was guided by action-planning (planned activities)
CM_SS	Standardization of Skills	Standardization of skills was a primary coordinating mechanism in the project
		Employees skills were an important resource for the project

Note: Based on Drago (1998).

3.4 Measurement model validation

The proposed model was investigated using the SmartPLS software. The structural equation modeling technique is recommended when you want to simultaneously analyze multiple variables and test hypotheses about the relationship of these variables (Hair et al., 2017).

The reflective construct **Standardization of Work Processes** showed a composite reliability of 0.631, being the lowest among all constructs, but still satisfactory according to Hair et al. (2017) who states that a construct is considered one-dimensional when this index is greater than 0.6. Convergent validity was assessed by assessing the weight of the factor loads. All indicators had loads with higher weights linked to their original constructs and all had indicators above 0.708, which according to Hair et al. (2017) must be maintained in the model. Convergent validity was assessed using the extracted average variance - AVE. The **Standardization of Employee Skills** construct (0.622) had the lowest stroke, but met the convergent validity criteria that, according to Hair et al. (2017, p. 103) must be above 0.50. Table 7 presents the results.

Table 7. Validation of Reflective Constructs

Construct	Indicator	Loads	Convergin g Validity	Composite Reliability	HTMT Fornell-Larcker Cross Loads
		>0.6	> 0.5	entre 0.6 e 0.9	
Standardization of Work Processes	CM_SW_01	0.821	0.649	0.631	ok
	CM_SW_02	0.812			
	CM_SW_03	0.865			
Standardization of Skills	CM_SS_01	0.813	0.622	0.659	ok
	CM_SS_02	0.799			
Standardization of Output	CM_SO_01	0.729	0.694	0.774	ok
	CM_SO_02	0.845			

The discriminant validity of the reflective constructs was assessed based on the analysis of cross-loads and the Fornell-Larcker and Heterotrait-Monotrait criteria (Hair et al., 2017), with the discriminant validity criteria being met. Based on these results, all reflective indicators of the constructs were maintained.

For the **Project Performance** formative construct, collinearity statistics were checked as indicated by Hair et al. (2017), in which he argues that the VIF - Variance Inflation Factor that must be below 5. All indicators presented a VIF value below 5.0, with the PP_S indicator being the highest value: 4,584, among them.

The **Contingency Factors** were transformed into categorical variables before the moderation analysis following the following criterion: the averages of the indicators (for

those with more than one indicator) were calculated and these were separated into two groups, being: group 1 with average equal or below 4.5 and group 2 with an average above 4.5. For the Manager Power construct, group 1 indicates a lot of power and group 2 little power, in Technical System group 1 indicates little complex system and group 2, very complex system and finally the construct Environment group 1 represents stable environment and group 2 unstable environment.

After validating the measurement model, an analysis of the structural model was carried out, which will be detailed in the next section.

3.5 Analysis of the structural model and results

After analyzing the measurement models, the structural model was analyzed. The significance of the path coefficients was validated using the Bootstrapping technique with 5,000 interactions (Hair et al., 2017). The path coefficients of the **Standardization of Output** and **Standardization of Employee Skills** constructs were not significant, as shown in Table 7. The other constructs presented significant coefficients at 5%, allowing the assessment of the proposed hypotheses, as shown in Table 8.

Table 8. Path Coefficients.

Path	Coefficients	p-Value
SO → PP	0.128	0.175
SW→ PP	0.355	0.002
SS → PP	0.234	0.127

The R^2 coefficient of determination of the **Project Performance** construct was 0.356, indicating that 35.6% of the variance of the project performance construct can be attributed to coordination mechanisms based on standardization. Figure 2 illustrates the results obtained after analyzing the model.

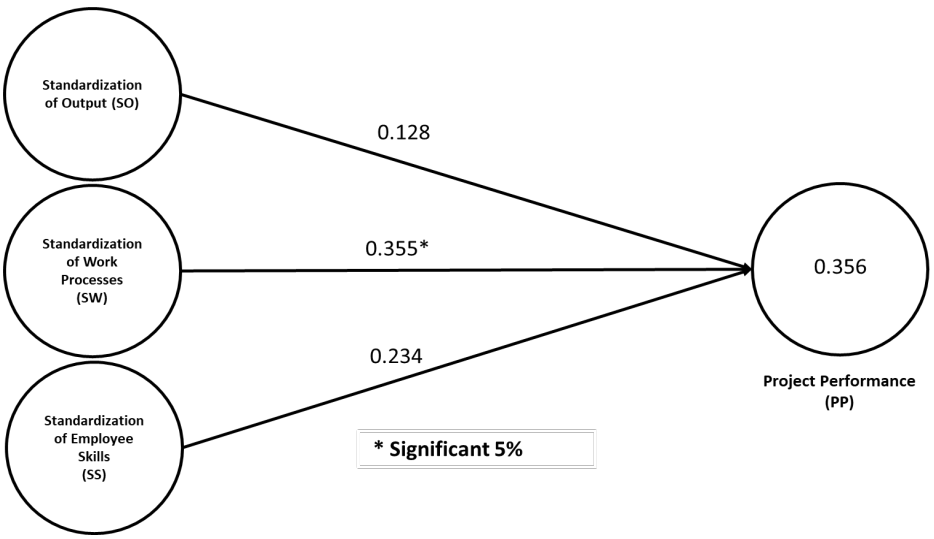

Figure 2. Path Coefficients.

Table 9 consolidates the evaluations of the main Hypotheses of this study.

Table 9. Hypothesis evaluation.

	Hypothesis	Results
H1	The standardization of results positively impacts the performance of projects.	Not supported
H2	The standardization of work processes positively impacts the performance of projects.	Supported
H3	The standardization of skills positively impacts the performance of projects	Not supported

The relationship between the **Standardization of Work Processes** (H_2) was significant and positive, so the hypothesis was supported. As the path coefficients of the Outputs and **Employee Skills Standardization** were not significant, Hypotheses H_1 and H_3 were not supported.

The structural model was then reduced to just one **Coordination Mechanism** and was again analyzed and presented the result illustrated by Table 10 and Figure 2. The R^2 determination coefficient of the Project Performance construct was 0.314.

Table 10. Path coefficients.

Path	Coefficients	p-Value
SW → PP	0.563	0.000

3.6 Analysis of moderation and results

The moderation analysis was performed separately for each of the **Contingency Factors**. All contingency factors were significant, with variations in the path coefficients, as shown in Table 11.

Table 11. Path Coefficients – Moderation.

Moderator	Path	Coefficient Group 1	Coefficient Group 2	p-Value
Size	SW → PP	0.588	0.579	0.000
Environment	SW → PP	0.682	0.540	0.000
Manager power	SW → PP	0.721	0.517	0.000
Technical system	SW → PP	0.651	0.514	0.000

Based on the results presented, all moderation hypotheses were supported, as shown in Table 12:

Table 12. Evaluation of Moderation Hypotheses.

	Hypothesis	Results
H4.1	The size of the project has a moderating effect on the relationship between coordination mechanisms and project performance.	Supported
H4.2	The power of the project manager has a moderating effect on the relationship between coordination mechanisms and project performance.	Supported

Table 12. Continued…

	Hypothesis	Results
H4.3	The environment has a moderating effect on the relationship between coordination mechanisms and project performance.	Supported
H4.4	The technical system has a moderating effect on the relationship between coordination mechanisms and project performance.	Supported

3.7 Analysis and discussions

The results indicate that the **Coordination Mechanisms** significantly influence the **Project Performance**. The determination coefficient of 0.314 indicates that 31.4% of the performance can be attributed to these mechanisms. This result is expected because there are other factors besides the coordination mechanisms that are proven to have an effect on project performance (Khoshtale, 2016; Petro & Gardiner, 2015). The specialized literature related to projects argue that projects work with mechanisms based on planning and ad-hoc actions (Kerzner, 2017; Mintzberg, 2015). The use of standardization is more common in traditional organizations as a way to improve their results and achieve their goals (Mintzberg, 2015), however the results show that standardization is also applied in projects and can also bring positive results in their performance.

The H_1 hypothesis was rejected indicating that the **Standardization of Outputs** has no effect on the **Project Performance**. The **Standardization of Outputs** in projects is linked to the previous definition of deliverables in projects that depend on other projects (PMI, 2017). The sample may not contain a sufficient number of projects of this type, which may explain the rejection of this hypothesis.

The H_3 hypothesis was not supported, giving evidence that the **Standardization of Employee Skills** also has no effect on **Projects Performance**. The **Standardization of Employee Skills** usually appears in new product development projects in which professionals bring their experience and knowledge to the project and are trained to not need direct supervision or other coordination mechanisms (van Donk & Molloy, 2008). The fact that the sample does not have a sufficient number of research and development (R&D) projects may be the explanation for this mechanism not being significant.

The hypothesis H_2 was supported, therefore there is evidence that the **Standardization of Work Processes** has a positive effect on **Project Performance**. This indicates that process standardization is a common practice in projects and that it contributes to its effectiveness for its performance. The determination coefficient of 0.314 shows evidence of the importance of this mechanism and of how investments in processes standardization can contribute to an effective improvement in performance and, consequently, in the results of the project.

In the moderation analysis, none of the hypotheses was not supported. These results provide evidence that **Contingency Factors** have an effect on the relationship between Standardization-based Coordination Mechanisms and the Project Performance. Despite project management methodologies advocating standardization as a way to seek effectiveness in project management (Kerzner, 2017), they do not take into account that contingency factors have significant influence and can enhance the performance of projects, as stated by Mintzberg (2015) when addressing traditional organizations.

In Hypothesis $H_{4.1}$ related to **Size**, the path coefficient between **Work Process Standardization** and **Project Performance** ranged from 0.588 in Group 1

representing small projects to 0.579 in Group 2 representing larger projects. This variation shows that the standardization of work processes in larger projects has a smaller effect on the projects performance, indicating a difference in the results when this mechanism is applied. This result points to a better effectiveness of the standardization of processes in smaller projects. This result contrasts with what defends Mintzberg (2015) in traditional organizations. According to him, when organizations get bigger, they tend to use more the mechanisms of standardization as a way to achieve their goals. These results can be explained by the fact that larger projects require a greater number of interfaces between different professionals. As the projects are temporary ventures with ephemeral teams (Moura & Diniz, 2016), there may not be enough time for a process's standardization to reach everyone uniformly. The results show that this strategy brings better results when applied to smaller projects.

The Hypothesis $H_{4.2}$ related to the Project Manager's **Power**, the path coefficient between the **Standardization of Work** processes and **Project Performance** ranged from 0.721 in Group 1, which represents a lot of power to 0.517 in Group 2, which represents little power. This variation shows that the standardization of work processes is more effective when the project manager has greater power. It is noticed that when the manager has a lot of power, he has more control over the actions that affect the direction of the project and this contributes to the standardization of processes to work better. This result is aligned with the PMI (2017), which argues that in companies, the designed structures facilitate the performance of the project manager.

In Hypothesis $H_{4.3}$ related to the **Environment** of the projects, the path coefficient between the **Standardization of Work Processes** and **Project Performance** varied from 0.651 in Group 1, which represents a stable environment to 0.514 in Group 2, which represents an unstable environment. This variation indicates that when the project is immersed in a more stable environment, the processes standardization has better results. Influences of the environment such as market, political climate, economic conditions, among others, can reduce the effectiveness of using standardization mechanism and consequently its positive effect on performance. The result in projects is similar to other studies that analyze the influence of the external environment on the performance of traditional organizations (Tsou & Hsu, 2015; Eruemegbe, 2015).

Finally, Hypothesis $H_{4.4}$ related to the **Technical System** of Projects, the path coefficient between the **Standardization of Work** Processes and **Project Performance** ranged from 0.682 in Group 1 which represents little complex system to 0.540 in Group 2 which represents system very complex. This result shows evidence that less complex projects are more adaptable to the standardization of work processes. Thus, it can be inferred that the greater the complexity of the projects, the less relevant the application of standardization will be. The explanation for this may lie in the fact that more complex projects tend to be involved in greater uncertainties regarding their scope, objective and even the methods applied. In this situation, standardization tends to be less effective, since the steps to complete the project in advance are not precisely known (Ramasesh & Browning, 2014).

4 Final considerations

This study achieved its initial objectives by answering the questions: which coordination mechanisms based on standardization, used in projects, have an effect

on project performance? and which contingency factors affect the relationship between standardization mechanisms and project performance? Only the mechanism Standardization of Work Processes has an effect on Project Performance, according to the results of this study, and all four contingent factors: Size, Environment, Power and Technical System have an effect on the relationship between Standardization-based Coordination Mechanisms and Project Performance.

The Standardization of Skills and Standardization of Results did not show significant results that would indicate their effect on the Project Performance. The Standardization of Work Processes has a relevant effect on the project performance, which reinforces the need for investments in this coordination mechanism. According to the results, these mechanisms have their effect amplified in smaller projects, in which the project manager has greater power of action, where the external environment is stable and the technical system is less complex.

This study also showed evidence that the use of the Standardization-based Coordination Mechanisms can have their effects on project performance enhanced if Contingency Factors are taken into account.

This article makes theoretical contributions to the academy by analyzing and demonstrating empirical evidence on the use of coordination mechanisms outside the traditional organizational context, in addition to appropriating organizational theories and using them as a reference in project analysis. As a practical contribution, the results can be a guide in choosing the coordination mechanisms in a project that will increase their chances of success.

A limitation of this study is related to the sample used in the analyzes, although it was collected at random (probabilistic), it presented a greater number of respondents from projects related to information technology, which can cause a bias in the results. Therefore, the results presented are limited to the studied group and cannot be generalized. Future works can be proposed, using the model and scales of this study, but in a population of projects aimed at research and development and large projects to verify the effectiveness of the other coordination mechanisms based on standardization in these projects. Other works may add other coordination mechanisms besides those based on standardization, such as direct supervision, to assess whether these have a relevant effect on the performance of projects.

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