The impact analysis of functions of Project Management Office on performance of triple constraint of new-product development projects

Análisis del impacto de las funciones desempeñadas por la Oficina de Gestión de Proyectos en el rendimiento de la restricción triple de proyectos de desarrollo de nuevos productos

Sanderson César Macêdo Barbalho; Gladston Luiz da Silva; José Carlos de Toledo

Departmento de Engenharia de Produção. Faculdade de Tecnologia. Universidade de Brasília. Campus Darcy Ribeiro,Asa Norte, CEP 70904-970, Brasilia, DF, Brazil.
sandersoncesar@unb.br; gladston.ls@gmail.com; toledo@dep.ufscar.br.

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Abstract This paper presents an analysis on a sample of 35 companies that develop new products and have Project Management Offices (PMO) in their organizational structure to support it. These PMOs´ functions were analysed from the point of view of performance indicators related to project´s triple constraints. The data was analysed using Spearman correlation. The results suggest that PMOs are not focused on activities as to provide project success on time, cost or scope. Schedule performance is correlated to functions of monitoring project status and reporting them to senior managers. Cost performance is correlated to benefits management but not to prioritization and portfolio management. No function was correlated at higher levels to prevent scope change. These results suggest that success on triple constraints is more related to activities performed by project managers and team than to the ones performed by PMOs.

Keywords: Project Management Offices; New product development; Project performance; Triple constraint; PMO functions.

Resumen: Este artículo presenta un análisis sobre una muestra de 35 compañías que desarrollan nuevos productos y tienen Oficinas de Gestión de Proyectos (OGP) en su estructura organizacional para apoyarlo .Las funciones de las OGPs fueron analizadas desde el punto de vista de indicadores de desempeño relacionados con restricciones triples del proyecto. Los resultados sugieren que los OGPs no se centran en actividades que pueden proporcionar el éxito del proyecto en tiempo, costo o alcance. El desempeño de la programación está relacionada con las funciones de supervisión del estado de los proyectos y su informe a los altos directivos. El desempeño de los costos se correlaciona con la administración de beneficios, pero no con la priorización y la administración de la cartera. Ninguna función se correlacionó en niveles más altos para evitar el cambio de alcance.Estos resultados indican que el éxito en triples limitaciones están más relacionadas con las actividades realizadas por el gestor del proyecto y su equipo, que a la realizada por las OGPs.

Palabras clave: Oficina de Gestión de Proyectos; Desarrollo de nuevos productos; Desempeño de Proyectos; Restricción triple; Funciones de los PMO.

1. Introduction

Project Management Office (PMO) is a structure providing important support to project managers, especially in the provision of management methodologies and multi-project management. Some pioneer studies (Dai and Wells, 2004; Julian, 2008) show that the awareness of performance on cost, time and quality of projects managed in organizations that have PMO is more positive than in organizations without such structure. In addition, research has shown that a PMO is not a static structure, or one with a fixed set of functions that are independent of the organization where it works. Instead, PMOs are strongly determined by the company's business and by the project performance objectives (Aubry et al., 2010).

In order to advance the understanding of how Project Management Offices are structured in companies that develop new products and their implications for project performance and NPD (New Product Development), one survey was conducted on a non-probabilistic sample of 35 companies that develop new products and which have Project Management Office structures that provide support for them.

This paper focuses on the roles played by the PMOs surveyed and their relation with the indicators of schedule, cost and scope, known as triple constraint, or iron triangle of project performance (HELDMAN, 2011; MULCAHY, 2005; VERZUH, 2015).

Triple constraint is based on the standard proposed in the PMBOK® Guide (PROJECT MANAGEMENT INSTITUTE, 2013a) which suggests the use of the Earned Value Analysis (EVA) method as a way to control project progress. Such a method was developed by NASA to monitor its contracts and incorporates indicators that encompass synergistic management of scope, time, and cost (GAREL, 2013). Through its use, a project succeeds in delivering on contracted scope, on schedule and at planned cost.

There are discussions in the literature about PMO impacts on company performance, such as Spelta and Albertin (2012), Unger, Germünden and Aubry (2012) and Spalek (2013). These studies did not directly address the relationship between functions and performance, nor were they focused on projects of companies that develop new products which is here approached.

The main theoretical frameworks used are shown below. Further on, the research methodology is discussed and finally the collected data and other discussions are presented. Closing, theoretical and practical considerations of the research and perspectives to its further development are described.

2. Project Management Offices in New Product Development

Ulrich and Eppinger (2008) argue that a new product development process is operated throughout different projects. In addition, the life cycle of a product involves a large set of project cycles: a project to constitute product specifications, to technically design it, to certify it thru regulatory agencies, to release it, to remove it from the market etc. Each of these project cycles is different from one another, but they are all linked to one process.

The pioneer study that is currently the main reference as yet in the analysis of new product development (NPD) performance is the work of Clark and Fujimoto (1991), as focused on the automotive industry. The authors treat the performance of product development as a reflection of a company's long-term capabilities, and establish the total quality of the product, the development lead-time and the productivity as NPD key performance criteria. They also state project management offices as a liaison organization throughout different company areas.

Project Management Office (PMO) is characterized as an established organizational structure to facilitate the activities of project management and brings improvements to the organization's management process through portfolio management and project alignment with corporate strategy (Crawford, 2002).

Dai and Wells (2004) compared project management (PM) practices in companies with and without PMO. The authors identified more effective PM practices in companies with PMO, especially in the recording of lessons learned and in the application of PM methodologies and techniques.

Hobbs and Aubry (2007) conducted an extensive analytical study on PMO activities. The presence and degree of importance of 27 different functions and roles of PMOs were analyzed. These functions and roles were grouped by factor analysis generating the following groups: (1) monitoring and controlling activities of project performance; (2) development of skills and project management methodologies; (3) multi-project management; (4) strategic management; and (5) organizational learning. For the authors, monitoring and controlling projects performance are the most important activities within the PMO.

Another widely used PMO typology classification is the one proposed by the Project Management Institute (2013a) that stratifies PMO in: supporting, with role of consulting to projects and low degree of control over them; controllers, which provide support, but demand the adherence to standard methodology of the projects and have a moderate degree of control; and managing, which controls the projects by managing them directly.

Recent studies identified a positive relation among PMO functions and project performance. Spelta and Albertin (2012) state previous research that poses that PMO's main contributions are related to time, cost and quality results of projects. Their research identified portfolio control as the main driver of PMO adoption. Unger, Germünden and Aubry (2012) found PMO's controlling functions as an explanation of the quality of project portfolio management. Spalek (2013), in a research with 259 PMOs, puts forth difficulty in demonstrating their added value, but poses that when the company successfully operates its project management office, the latter positively influences industrial engineering performance specially in long-term planning, and in a multi-project environment, according the maturity of company's PMO.

Some Brazilian researchers' studies focus on new

products development projects under the lenses of project management practices. Jucá Jr, Conforto and Amaral (2010) studied software development companies with a focus on CMMI (Capability Maturity Model Integration) and found that this standard is not appropriate to analyze NPD practices in small businesses. Da Silva et al. (2010) discusses the application of risk management techniques in companies that produce automotive parts. Conforto (2014) discusses agile project management practices in innovative projects.

Few analyzed studies approach PMO as linked to new product development projects. Barbalho et al. (2009) discuss PMO structuration to facilitate the execution of large projects in small companies. Rabechini et al. (2011) analyze the NPD of an automotive company in which PM practices potentiated by PMO were motivated by the need of combating the lack of projects' technical memory. Artto et al. (2011) addresses the potential of PMOs to carry out activities in the front end of innovation projects, especially in the management control of the front end. Barbalho et al. (2014) address the different functions that PMO can assume on new product development projects with very specific activities for this kind of project. Barbalho and Toledo (2014) analyze the transitions in a PMO that manage NPD in a technology-based company, featuring the changes in terms of functions performed by the PMO. Jugend, Barbalho and Silva (2015) address the contributions that PMO can provide to NPD portfolio management.

No survey-kind research about PMOs serving only NPD projects was identified in scientific literature. The investigation here described has in view contributing to the understanding of how main project performance indicators are influenced by the PMO functions more commonly found in innovative companies. In the present work the PMO functions identified in the Hobbs and Aubry (2007) study were added to functions identified in other studies of the literature, such as Pellegrinelli and Garagna (2009) and Barbalho et al. (2014). These functions were compiled in a form and submitted to managers in charge of Brazilian PMOs that provide services for new product development in their companies as mentioned in the next section.

3. Methodology

The research method used was a quantitative survey with descriptive analysis aiming at withdrawing conclusions about the main functions performed by PMOs and their impact on indicators of the development of new products. According to Garcia (1995) a descriptive analysis must be performed in order to understand the variables, and build hypotheses for the use of more sophisticated statistical techniques. In this study, the references of Bussab et al. (2003), and Heiberger and Holland (2004) to plan data gathering and analysis were considered.

Initially the survey was mainly based on the assay of companies that develop new products in the state of São Paulo, but it was extended to other locations sought and featured in social networks. The first version of the questionnaire was personally applied by the researcher to three companies in order to validate and refine the questionnaire used. After this initial step, the questionnaire was consolidated and applied to a set of 35 companies that develop new products in different industrial sectors such as automotive, automation, equipment and capital goods, consumer goods and toiletries. Being applied through Google Docs and disseminated via social networks, there were respondents from many Brazilian states: São Paulo, Paraná, Pernambuco and Federal District.

These responses lead to making statistical analyses and calculating the correlation factors between PMO and NPD performance in cost, schedule and scope as well as analyzing its significance. To that effect, data were downloaded into an MS Excel datasheet, properly treated and uploaded into SAS© package. A Spearman correlation and multiple tests were used, and the results thereof are presented on next section.

4. Results

The surveyed enterprises come from many fields of industry, ranging from energy companies and information technology companies, through automotive corporations and capital goods industries. In spite of this, and because of the methodology used, this research does not bear a potential to demonstrate a multi-industry reality since it was not mandatory to identify the entrepreneurial area of each company, considering that it is not the purpose here to relate functions or performance to types of business. Thus, only a few respondents identified their industrial sector.

Among the characterization variables of which the response was mandatory in the questionnaire it was noted that 69% of the surveyed PMOs were created in the last five years, when the concept of PMO became widely discussed, both in academic events and in congresses dedicated to project management practitioners in Brazil. Forty-three percent of companies have up to 50 employees, and 57% of these PMOs integrate up to five people. From the point of view of the characteristics of the company's development process, it was observed in the sample that 43% are contracted projects,

while 49% are internal platform-type or radical developments, according to the Wheelwright and Clark (1993) classification. Only 8% of the PMOs support product development that can be characterized as incremental.

As to the organizational structure for project execution, considering the classification proposed by the Project Management Institute (2013a), most companies have a matrix organizational structure (51%) and no details of the matrix organization were questioned in a way that would allow us to characterize what format (balanced, light weight or heavyweight) prevailed. The functionally structured and the projectized organizations were quantitatively almost equivalent in the research, with 26% and 23%, respectively.

Although the characterization presented above could lead to interesting analyses of the relationship between the functions of the PMOs in each typology presented and the triple restriction of the projects they support, these would run beyond the scope of this article which considered more appropriate to study the PMO functions versus the performance of projects in a general way.

As a whole the data gathered represents the correlation of project performance and the functions for the PMO effort to support higher hierarchical levels, project managers and their teams, or to directly manage projects and/or programs and/or portfolios.This classification aimed to compose the referenciality of functions of Hoobs and Aubry (2007), Pellegrinelli and Garagna (2009) and Barbalho et al. (2014) to the PMBOK® Guide rating due to the greater familiarity that the project management community (survey respondents) have with the classification and terminology used by the Guide. Table 1 identifies the functions analyzed in this work. The performance variables were: perception of better schedule (X32), cost (X33) or scope (X34) in form to comply to the triple constraint concept.

Table 1 PMO functions as analyzed on this work

Var	Function	Group
X1	Report project status to senior management	I –Support to the Higher Hierarchical Levels*
X2	Provide coaching to senior management	
X3	Participate in strategic planning	
X4	Benefits management	
X5	Recruitment, selection, evaluation and determination of disbursement for PMs	
X6	Networking and environmental monitoring	
X7	Participation in multidepartment committees	
X8	Promote project management inside the company	

X9	Develop and implement a standardized methodology	
X10	Develop PM skills, including training	
X11	Implement and operate information system on projects	
X12	Monitor and control PMO performance	
X13	Provide tools without any specific effort to standardize	
X14	Implement and manage lessons-learned database	
X15	Implement and manage risk database	II –Support to Project Managers and their teams **
X16	Provide coaching for project managers	
X17	Management of engineering changes	
X18	Perform specialized activities for project managers (Ex. Preparation of schedules, etc)	
X19	Management of manufacturing of items for prototypes/deliveries	
X20	Management of purchasing of items for prototype /deliveries	
X21	Provide proactive ways for organizational learning between projects	III – Projects, Programs and Portfolio Management***
X22	Monitor and control project performance	
X23	Coordination between projects	
X24	Develop and maintain a scoreboard of projects	
X25	Manage one or more portfolios	
X26	Identify, select and prioritize new projects	
X27	Manage project documentation files	
X28	Manage one or more programs	
X29	Conduct project audits	
X30	Set resource allocation among projects	
X31	Conduct project evaluation at its end	

* Activities aimed at assisting the company's senior management, commonly related to portfolio definition and management, but also to promoting project management culture in the company. Except for the role of participation in multidepartment committees, which was added to reflect the likely participation of PMOs in committees linked to product development projects (Barbalho et al., 2014), all other functions are in the Hoobs and Aubry (2007) survey.

** Activities in which the PMO directly supports projects, ie, for managers and their teams. Functions added as based on the research literature on PMO for product development: acquisitions management and manufacturing for prototypes, and management of engineering changes (Barbalho et al., 2014). The other activities are featured in Hoobs and Aubry (2007).

*** Project management activities, programs or portfolios that are directly performed by PMOs, according to Hoobs and Aubry (2007) and Pellegrinelli and Garagna (2009).

So, we correlate the answers to PMO functions with those provided for perception of project results. More specifically, the aim would be to identify in each PMO the activities with high levels of effort in it, meaning: very high effort by the PMO (answer "5") or high effort (answer "4"), as those ones less relevant on office operations - very low effort (answer "1") or low (answer "2"). Effort level "3" indicates an intermediate response. The perception of project performance was also answered at five levels.

Due to the ordinal nature of the variables associated with the function and the perception of project performance, the association levels have been checked based on the Spearman correlation coefficient (rs). Regarding the Indicators, represented by the variables X32, X33 and X34, there are significant correlation levels, according to Table2.

Table 2: Spearman correlation levels for PMO functions and performance of triple constraints.

Group	Function	X32	X33	X34
I	X1	0.386**	0.195	0.218
	X2	0.148	0.079	0.014
	X3	-0.019	-0.092	-0.187
	X4	-0.155	0.435***	0.222
	X5	-0.032	0.077	-0.103
	X6	-0.129	0.280*	0.049
	X7	0.309*	0.181	-0.093
	X8	0.093	-0.119	0.009

II	X9	0.079	-0.328*	-0.068
	X10	0.211	-0.075	0.121
	X11	0.173	-0.175	-0.158
	X12	0.326*	0.078	0.071
	X13	0.023	-0.214	-0.025
	X14	0.272	0.350**	0.145
	X15	0.179	0.367**	0.304
	X16	0.023	-0.117	-0.151
	X17	0.226	0.200	-0.070
	X18	0.319*	0.068	0.163
	X19	0.109	0.210	-0.128
	X20	-0.013	0.284*	-0.140
III	X21	0.151	0.122	-0.058
	X22	0.342**	0.168	0.096
	X23	0.330*	0.139	0.166
	X24	0.143	0.172	0.103
	X25	0.287*	-0.091	-0.055
	X26	0.159	-0.090	-0.161
	X27	0.351**	0.104	0.111
	X28	0.384**	0.052	-0.018
	X29	-0.085	-0.036	0.117
	X30	0.100	0.179	-0.017
	X31	0.195	0.125	0.108

* p< 0.10
** p< 0.05
*** p< 0.01

To verify if such results would remain unchanged, once a set of inferences had been reported simultaneously, the correction for multiple tests was performed by applying the Holmmel, Hochberg, and FDR tests.

Hommel's (1988) method is based on Simes' test (SIMES, 1986), where p-value for a joint test of any set of K hypotheses with p-values $p(1) \leq p(2) \leq \ldots \leq p(K)$ is $\min\{(K/1)\, p(1), (K/2)p(2), \ldots, (K/K)\, p(K)\}$. The Hommel-adjusted p-value for test j is the maximum of all such Simes p-values, taken over all joint tests that include j as one of their components.

Hochberg (1988) demonstrates that Holm's step-down adjustments control the family wise error rate even when calculated in step-up fashion. Since the adjusted p-values are uniformly smaller for Hochberg's method than for Holm's method, the Hochberg method is more powerful. However, this improved power comes at the cost of having to make the assumption of independence and uniform distribution under their respective null hypotheses.

FDR method controls the false discovery rate and not the family wise error rate. The method requests adjusted p-values by using the linear step-up method of Benjamini and Hochberg (1995). These p-values do not control the family wise error rate, but they do control the false discovery rate in some cases.

In applying the aforementioned tests, functions were joined by groups and analyzed on SAS© statistical package. Only correlations to X32 and X33 were tested because they have p-values under 0.05 (see Table 2). The rejection of the null hypotheses indicated in Table 2 were almost all rejected and are presented on Table 3.

Table 3: P-Value Adjustment Information for PMO functions and performance of triple constraints correlations

		X32				X33			
Group	Indicator	Raw	Stepdown Bonferroni	Hochberg	FDR	Raw	Stepdown Bonferroni	Hochberg	FDR
I	X1	0.0220	0.1760	0.1760	0.1760	0.2610	10.000	0.6591	0.5964
	X2	0.3957	10.000	0.9137	0.7342	0.6526	10.000	0.6591	0.6591
	X3	0.9137	10.000	0.9137	0.9137	0.5977	10.000	0.6591	0.6591
	X4	0.3735	10.000	0.9137	0.7342	**0.0090**	**0.0720**	**0.0720**	**0.0720**
	X5	0.8564	10.000	0.9137	0.9137	0.6591	10.000	0.6591	0.6591
	X6	0.4589	10.000	0.9137	0.7342	0.1033	0.7231	0.6591	0.4132
	X7	0.0709	0.4963	0.4963	0.2836	0.2982	10.000	0.6591	0.5964
	X8	0.5963	10.000	0.9137	0.7951	0.4974	10.000	0.6591	0.6591
II	X9	0.6522	10.000	0.9401	0.8696	0.0545	0.5450	0.5450	0.2180
	X10	0.2226	10.000	0.9401	0.5342	0.6689	10.000	0.6990	0.6990
	X11	0.3190	10.000	0.9401	0.5469	0.3156	10.000	0.6990	0.4734
	X12	0.0557	0.6684	0.6684	0.3720	0.6557	10.000	0.6990	0.6990
	X13	0.8969	10.000	0.9401	0.9401	0.2168	10.000	0.6990	0.4289
	X14	0.1139	10.000	0.9401	0.4556	0.0395	0.4345	0.4345	0.2180
	X15	0.3027	10.000	0.9401	0.5469	0.0301	0.3612	0.3612	0.2180
	X16	0.8951	10.000	0.9401	0.9401	0.5017	10.000	0.6990	0.6689
	X17	0.1915	10.000	0.9401	0.5342	0.2502	10.000	0.6990	0.4289
	X18	0.0620	0.6820	0.6820	0.3720	0.6990	10.000	0.6990	0.6990
	X19	0.5321	10.000	0.9401	0.7982	0.2262	10.000	0.6990	0.4289
	X20	0.9401	10.000	0.9401	0.9401	0.0988	0.8892	0.6990	0.2964
III	X21	0.3869	10.000	0.6289	0.5022	0.4835	10.000	0.8382	0.7425
	X22	0.0442	0.3978	0.3978	0.1458	0.3335	10.000	0.8382	0.7425
	X23	0.0530	0.4240	0.4240	0.1458	0.4259	10.000	0.8382	0.7425
	X24	0.4109	10.000	0.6289	0.5022	0.3219	10.000	0.8382	0.7425
	X25	0.0944	0.6608	0.6289	0.2077	0.6019	10.000	0.8382	0.7425
	X26	0.3607	10.000	0.6289	0.5022	0.6075	10.000	0.8382	0.7425
	X27	0.0386	0.3860	0.3860	0.1458	0.5522	10.000	0.8382	0.7425
	X28	0.0227	0.2497	0.2497	0.1458	0.7680	10.000	0.8382	0.8382
	X29	0.6289	10.000	0.6289	0.6289	0.8382	10.000	0.8382	0.8382
	X30	0.5672	10.000	0.6289	0.6239	0.3030	10.000	0.8382	0.7425
	X31	0.2621	10.000	0.6289	0.4805	0.4727	10.000	0.8382	0.7425

The combined results of Tables 2 and 3 show that although several functions are correlated with time and cost indicators with p-values below 0.05 and 0.01, but also with the scope indicator used at p-value below 0.10; when Multiple tests are performed only benefit management (X4) remains correlated with the cost performance of the projects in the surveyed PMOs.

Analyses of the joint results presented in Tables 2 and 3 are presented in the following topic.

5. Discussion

According Table 2, there are four functions that are positively correlated with time performance at p-value < 0.05. Reporting projects to senior management (X1) can imply indirectly in performance terms by allowing senior management to observe project deadlines and to act on realigning them. This is a typical activity aligned to portfolio management, an important role of PMOs as stated by scientific literature (UNGER, GERMÜNDEN and AUBRY, 2012; SPELTA and ALBERTIN, 2012).

Project performance monitoring and control (X22) enhances reporting to senior management, but it may also indicate an evidence of the Hawthorne effect - that PMO monitoring makes project managers and project teams more concerned about compliance with deadlines.

The other functions involved in the results of timing performance are linked to functions in which there is direct PMO management on the projects: managing documentation files (X27) and managing programs (X28). Manage documentation files suggests that document management activities, which works in data organization of projects and the possibility of data utilization among different projects, implies the non-committing of the same mistakes, and this tends to reduce deadlines. Manage programs suggests that when projects are grouped and treated as programs of which the challenges are coordinated and its management helps to reach common benefits, the result is a better performance in time, which is reinforced by the results of deadline performance, as shown below.

With a lower significance (p <0.10), the functions of direct project portfolio management (X25), participation in multifunctional committees (X7), coordination among projects (X23), execution of specialized activities for project managers (X18) and monitoring and control of the PMO's own functions (X12) are related to performance in terms of timing.

It is interesting to observe that some function in which the PMO acts directly in the project management itself, such as managing manufacture or acquisitions of items (X19 and X20), manage changes (X17) and risk (X15) or lessons learned databases from the projects (X14), or even operate the projects information system (X11) do not imply improvement on project successes in timing. As time is a key element in project management, this result can suggest that role of the project manager and the role of the team are more closely related to results in time than the functions performed directly by PMOs.

Particularly, the literature reports cases in which activities X19 and X20 occurred in situations when performance had improved on project lead times (BARBALHO et al., 2014). In these cases,the discussed research did not ask respondents if project lead times decreased, but if time performance carried out as due. Maybe another kind of protocol must be used in order to more effectively analyze these issues.

When they are analyzed, the correlations between cost performance and functions, data evidenced an interesting positive correlation with a performance of the PMO in the management of the benefits reached by project for companies´ objectives (X4). This result corroborates one of the elements identified in the analysis of time performance, that is the management of programs. It is known that the heart of the difference between program management and project management is the benefits approach (PELLEGRINELLI, 2011; PROJECT MANAGEMENT INSTITUTE, 2013b), and there are standards in program management (see THE CABINET OFFICE, 2011) that assign functions very close to those proposed in the literature to characterize PMO activities, which can, as a whole, explain the relationships observed here.

It is important to note that the main correlation extracted from the analyses herein carried out with companies that have PMO and develop new products, whose numbers are indicated in tables 2 and 3, is between cost and benefit management suggesting a strong link between these performances and process variables, respectively. Thus, the cost performance improves when if the PMO focuses on the management of the benefits previously defined to be achieved by the projects. On the one hand, this may indicate a vision that is impregnated by the financial vision of the projects, which may result from short-term visions of business performance (KAPLAN and NORTON, 1996; COOPER, KLEINDSMITH, EDGETT, 1998). On the other hand, it may indicate an efficient management of resources, and the achievement of effective results for the company, which is at the heart of the program man-

agement propositions.

Considering a p-value less than 0.05, the data demonstrate that the role of the PMO in the implementation and management of databases on risks (X15) and lessons learned (X14) has a positive correlation with good performance in costs and this suggests the view of avoiding errors of past projects. For p-value below 0.10, there are business monitoring functions (X6), development of standardized methodology (X9) and purchasing management for prototypes (X20).

Following Table 2, the only function performed by PMOs that has an impact on the volume of changes made in projects, which is an indicator that is related to the quality of scope planning, was the implementation of risks databases (X15) with p-value <0.10, it being a function also correlated with cost performance. The data suggest that the participation of the PMO in the consolidation of the history of the risks occurred in the projects that were previously developed by the company can imply in reducing changes in the scope of the projects, one of the main causes of the failure in projects in general (MULCAHY, 2005, HELDMAN , 2011)

Although several of the significances found in table 2 were not confirmed in the tests presented in table 3, it is considered that future surveys with a greater number of participating companies can confirm or refute the correlations found, and confirm or not the discussions presented in this topic. An interesting element to consider in addition is that performance in terms of time and costs can be affected by functions other than PMOs', because of a total of 15 functions with some degree of relation to such variables, none was repeated regarding the two elements of performance. In a way, this data corroborates with the concept of triple constraint, since it suggests that no function of the PMO could contribute to the parallel improvement of these two indicators theoretically in trade-off.

6. Implications and final remarks

The data here presented demonstrates PMO functions can improve project indicators of time, cost and scope. Besides, when analyzing the functions that best correlate the studied indicators, it can be observed that no function is correlated with deadline, costs and scope, at the same time, or even with two of these indicators concurrently at higher significance. This result has two sides: on one hand, it means, for practitioners, that a PMO manager have to increase a specific function without a decrease in the effort in another function if they want to achieve improvements on both - time and cost - indicators. On the other hand, the triple constraint concept aligns with these data, because if a single function could improve performance of more than one indicator, it would means that PMO functions could have effects on changing the more known trade-offs of project management practice: the triple constraint itself.

On the whole, the data related with the indicators of time, cost and volume of changes denotes that the impact of PMO functions on the triple constraint of projects is reduced, with few functions that impact in these indicators with high significance and with no more than a moderate correlation. Data may well suggest the hypothesis that these dimensions of project performance would have a greater sensitivity to the performance of project managers' activities and/or project teams' activities than to PMO functions. Since these last functions tend to work on all the projects characterizing more of a portfolio than a project action, then indicators of time, cost and scope can be more sensitive to the specific activities in each project, according to the PMBOK Guide® (PROJECT MANAGEMENT INSTITUTE, 2013a).

As a PMO tends to work on the aggregation of projects, it maybe that its performance could be more precisely measured by indicators related to organizational project management (OPM) as maturity level, team and project management satisfaction or corporate environment conditions (for reference see Marioka and Carvalho, 2014; and Patah and Carvalho, 2016), or maybe at a portfolio level as portfolio balance, portfolio value, strategy fitness (COOPER and KLEINSCHMIDT, 1995) or portfolio quality (ÜNGER, GEMUNDEN e AUBRY, 2012). In our study herein, PMO functions related to managing benefits can improve cost performance, a result indicating a relation which has not been previously detected by scientific literature.

Of the 31 PMO functions analyzed in this paper, 27 were derived from studies that focused on PMOs that support projects of any typology, and four were added because there were clues in the literature regarding their presence in PMOs that supported product development projects. Of these functions, none were correlated at p-values below 0.01 or 0.05. Only two were among the correlations with a p-value of 10%, namely: participation in committees, related to deadlines; and cost-related procurement management for prototypes. In the first case, the data can indicate that the NDP committees, an eminently multi-functional structure, have prioritized on-time project delivery, attendance of product launch windows and time-to-market. In the second case, it can denote the strong trend of firm horizontalization and product servitization, in which supply networks are more critical than internal manufacturing

for the fulfillment of project objectives implying on procurement costs. Such elements can be the object of future exploratory and descriptive studies.

From a more strategic point of view, it is interesting to observe that the performance of the PMOs related to the programs' themes, especially to the aspect of the benefits were more significant than the portfolio aspects,considering the sample researched as being product developers companies, although portfolio management is a more ubiquitous theme in NPD literature than program issues. It is not common to find product development texts that suggest the program-aggregating approach, although platform-type projects are common, a typical program mindset. This is an element to be explored more deeply in product development projects, given the results identified in the screen survey.

Moreover, as a hypothesis, important issues are revealed in this study: (1) “Which function can a PMO increase if projects are suffering from over-cost?” - results point out that PMO must work on lessons learned in general or for risk management, and benefits management; (2) “Which function can a PMO focus when scope creeping is occurring frequently?” - in this case, no function can help project managers at significance, but one can try to improve the management of risk databases, according to our results; and (3) “Which function can a PMO perform when overtime is common?” - our data suggests that PMO needs to monitor and control project statuses and reporting them to senior managers, as well as working on document management and managing programs. These kinds of questions might help companies to improve their PMO action as a way to contribute for the success of projects and not just for their accomodation in the company´s structure.

This paper presents analyzes of the data collected in a survey of which the objective was to analyze the PMOs’ functions from the point of view of some performance indicators used in NPD projects. The text discusses the most ubiquitous functions considering performance of a project’s triple constraints. Considering that only one from 31 functions of PMO work demonstrated an effective relation to project performance, but other 14 functions were discovered as correlated at lower significance, these ones would need to be better analyzed with a research protocol distinct from this one. Moreover, scope management is the main issue addressed by project managers, because, in general, it denotes the purpose of a project. Integration is the capital role of project managers, but this integrative role is directly related to the feasibility and viability of delivering the product of the project. So, maybe this result points out to that scope management is further away from the PMO sphere of influence than time or cost. This hypothesis can also be better analyzed with a distinctive research protocol, in the future.

Future works can be formatted in order to explore how the function of benefits management can act to bring about this relation with cost performance. It means to determine mechanisms by which this function may result in positive outcomes in order to extract best practices in its execution, including the relation between PMO and program managers activities. Moreover, a more expressive sample, eventually an international one, can be used to explore relations between the functions of PMOs for NPD projects and their performance. A similar study can be done on PMOs for any kind of project, or maybe applied to some specific sectors. A specific study can be formatted to understand the impact of PMO on scope management and scope indicators. Finally, studies can be formatted for understanding the impact of PMO functions on other indicators denoting project success, and also of PMO success from an organizational viewpoint.

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