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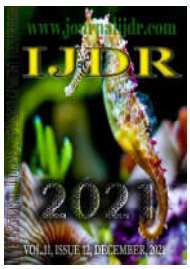

RESEARCH ARTICLE OPEN ACCESS

AN EXPEDITED MODEL TO APPRAISE PROJECT MANAGEMENT OFFICE VALUE

***Dr. Jair Azevedo Júnior, Dr. Antônio Carlos de Oliveira Barroso and Dr. Carlos Anisio Monteiro**

IPEN USP - Av. Prof. Lineu Prestes, 2242 - Butantã, São Paulo – SP

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****Corresponding author:***
Dr. Jair Azevedo Júnior,

ABSTRACT

This study presents the development of a practical model to evaluate the perception of Project Management Office value as seen by project managers. Questions compiled through literature review and interaction with project managers are presented first. An exploratory factor analysis was used to define the best grouping of the items within factors that could be interpretable under the reviewed literature. To evaluate the efficacy of the proposed model, we performed a confirmatory analysis using the Partial Least Square variant of the Structural Equation Modeling. The model demonstrated good convergent validity, very good discriminant validity, and reliability. In addition, the values of its determination and path coefficients were well above the classically recommended values and were also statistically significant. Within the limitations of the tests we done thus far, it appears that a practical, robust, and potentially functional predictive model was achieved.

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INTRODUCTION

Many international companies are typically project-based organizations (PBOs), and organize work into projects as common practice. PBOs use projects as a thorough and effective way to combine resources, knowledge, and leadership to accomplish targeted results, thereby ensuring investment returns. Projects are temporary, but their benefits – in terms of new knowledge and organizational learning – go beyond their strict scope and should be incorporated into the organization's culture. Project management has evolved as a field of great interest and has been characterized as a discipline in itself. As a result, several international journals were created to share updated knowledge on the subject. Hakamian (2016) listed 24 different journals on the subject from 10 different countries, although a stricter appraisal of the publications' scopes would reduce the list to 14. This is still, however, a striking number for this relatively new field. Due to the rapid progress in this field, professional organizations such as the Project Management Institute (PMI), have emerged. These organizations have a remarkable influence in the field through initiatives such as collecting, appraising, and distributing best practices. The Project management Body of Knowledge that is used worldwide is recognized by both of ANSI and ISO. The advantages of sound project management practices are well documented, but project failure rates remain high. This suggests that the continued exploration of new process models and organization structures to nurture strong project performance is needed. An area that can be improved upon in this field is the project management office (PMO) (Dai and Wells, 2004). Arumugam et al. (2013) – referring to the IT project management landscape – state that while PMOs have become the norm in many PBOs, it is not an accepted rule. Among the challenges PMOs face, one that stands out is the struggle to justify the PMO's value within a company. We used action research and adopted mixed methods of data collection (qualitative and quantitative) in a case study within a large government organization. Five senior members of the IT PMO and five senior business unit managers from this organization participated through questionnaires, group discussions, and workshops. We focused on their perceptions and expectations of what PMOs are doing and what they should do. Recently, PMOs and its influence on project and portfolio management have been addressed intending to show evidence of the effectiveness of PMOs in the potential roles they are designed to play. Since this is a many-faceted question depending on the focus of the appraisal, diverse answers can be offered. We will mention some of the articles that are of interest to our research further in this study. Regarding cross project learning and continuous improvement, Julian (2008) used two focus groups to demonstrate that PMO leaders facilitate cross-project improvement by embedding accumulated knowledge from project experiences into project management routines utilized in projects across multiple disciplines. They used a framework from communities of practice (CoPs), in which a PMO leader is viewed as embedded within a constellation of practices, and

the project teams as constituted by members from multiple CoPs. Pemsel and Wiewiora (2013) contributed to the topic of knowledge sharing by researching evidence to determine whether the knowledge brokering role of PMOs are meeting the needs of project managers (PMs). They did qualitative research framing the issue through a cross-case analysis of seven organizations. Hobbs et al (2008) addressed the creation and reconfiguration of PMOs in the context of organizational innovation related to rethinking project management. Their studies were aimed at better understanding PMOs and of the dynamic relationship between project management and the organizational context. Of special interest for this study is the work of Unger et al. (2012), which addressed the role of project portfolio management offices (PPMOs) and their impact on the execution and success of a project. They conceived a model in which the roles (coordination, control, and supporting) was proven to have a positive effect on the project portfolio management (PPM) quality, which acts as a mediator to success. For the first three factors, they proposed nine manifest variables and through a factor analysis grouped them as follows: Five under the first factor (coordination), two under the second (control), and two under the third (supporting). Both loadings and cross-loadings were good. PPM quality and PPM success were based on previous models which included six dimensions and eighteen items altogether. To attain this comprehensive model, they gathered 278 fully completed questionnaires from different industries and countries. Numerically, the explanatory power of the model was mediocre, but it resulted in insightful qualitative information on which roles have significant influence across the perceived dimensions of PPM quality and success.

A large survey by Hobbs and Aubry (2007) on 500 of organizations revealed that there is a large variability in the roles, function, structures, and legitimacy of PMOs across organizations. Additionally, their perceived value and their life spans vary significantly. The study also raised the issue of whether PMOs are indeed sustainable in some organizational contexts. Recently, Van der Linde & Steyn (2016) observed that the mandates and functions of PMOs are somehow tailored by the hosting company, and as a result, there is no agreed method to determine the value of PMOs in general. Additionally, PMOs keep evolving as the needs of the organization or industry change and new principles and methodologies are developed. Consequently, a PMO must change and adapt continually to the organization's needs to remain valuable. Their work presented a case study comparison of the project environment based on two different time slices – before and after the establishment of a PMO. The hosting company was a South African mining industry company (not a project-based organization) whose core business is operations. Projects are therefore executed only to support, improve, or expand their operations. The authors used a conceptual model and methods of qualitative research which included interviewing, observing, and analyzing archived data. Interviews consisted of a set of five research questions. They concluded that the PMO studied had an unmistakable effect on the organization as several systems and methodologies were put in place. Even though the PMO is perceived to add overall value to the organization, the authors noted that it had not reached its true potential in the organization yet. A somewhat unique analysis was undertaken by Ko et al. (2015). They proposed a Data Envelopment Analysis (DEA) Model to compare the efficiency of forty-nine PMOs. In the DEA framework, each PMO was presented as a Decision-Making Unit (DMU). Five PMO functions were used as input factors, and four project outcomes were selected as output factors. The five input functions were practice management, infrastructure management, resource integration, technical support, and business alignment. The output factors were time compliance, cost compliance, requirement sufficiency, and project performance. Data was collected via questionnaires of which the items reflected measurable facets of each factor. They then used the DEA method to identify the efficiency frontiers of the DMUs. The others were then evaluated in terms of the difference in the frontiers, which gives an indication of where improvements are desired. This study was conceived to be applied in a PMO environment of Enterprise Resource Planning (ERP) projects within a PBO whose core business deals mainly with these kind of projects. We focus on the perception of PMOs' value as seen by project managers. We simultaneously wanted a broad view with various insights for our study, but also wanted the resultant questionnaire to be short enough to encourage a good return rate. In first semester of 2017, with the support of PMI Southern Germany, we conducted a survey on 105 project managers of different ages involved in ERP implementation to determine the importance of PMO in large projects and which features of the PMO are most valuable.

OBJECTIVE AND METHODOLOGY

As stated in the abstract, the main objective of this research is to develop a model to assess the perceived value of PMOs in ERP projects from a Project Manager perspective. We opted for an exploratory research method, which uses a set of questions designed to capture a variety of perception facets without the use of an "a priori" conceptual model. Questions were compiled through literature review and interaction with project managers. All items are related to aspects of relevant PMO functions, but we avoided stating the items and causing inductive reasoning. The questionnaire consists of two demographic information requests and fifteen content statements to which respondents should state their agreement on using a five-point Likert-based scale, ranging from total disagreement to complete agreement. We used a ten-person pilot group for a semantic validation of the questionnaire. This group was chosen based on their similar background and experience to the target group. This process was iterated as needed, until ambiguities were removed. One hundred and five people received the questionnaire, and we had a return rate around 94%. After data cleaning and outlier detection, 84 fully completed questionnaires remained.

Exploratory factor analysis – EFA: We used a principal component analysis (PCA) with varimax rotation to extract the main factors. This analysis identifies the number of factors that represent the correlation pattern of the variables (Hair Jr et al., 2010). It showed the optimum number to be five, with which we were able to explain 66% of variance. Table 1 shows the loadings and cross-loadings of the observable variables. All the variables' respective (in factor) loadings shows good values well above the cross-loadings.

Table 1. EFA results using PCA and varimax

Observed Variables	Factors				
	F1	F2	F3	F4	F5
Q03	0.886	0.032	-0.031	0.073	0.003
Q10	0.780	-0.034	0.052	0.078	-0.003
Q09	0.519	0.179	0.326	0.219	0.313
Q11	0.475	0.208	0.408	-0.172	0.432
Q06	-0.092	0.731	-0.365	0.275	0.140
Q17	0.087	0.722	0.295	0.072	-0.044
Q12	0.412	0.523	0.221	0.306	0.059
Q05	-0.080	0.518	0.320	-0.242	0.395
Q14	0.244	-0.043	0.753	0.190	0.106
Q15	-0.075	0.298	0.708	0.174	-0.046
Q13	-0.070	0.011	0.345	0.760	0.029
Q08	0.204	0.129	-0.024	0.736	0.072
Q16	0.171	0.487	0.140	0.574	-0.083
Q04	-0.095	-0.142	0.048	0.019	0.820
Q07	0.287	0.268	-0.059	0.119	0.756

After observing that the best grouping was five factors, we aim to interpret these factors as latent variables of the model. If done successfully, we can suggest a reflective construct with 6 latent variables (LV) and 15 indicators. The focal LV being the PMO value perception, and the five factors being manifestations of the focal LV, which will manifest themselves through the 15 statements. Coordination, Supporting, and Controlling have been established in most previous literature as being main functions of PMOs (Hobbs and Aubry, 2010; PMI 2013; Van der Linde & Steyn 2016; Unger et al., 2012). Unger et al. (2012) are especially emphatic and named them as "The three roles of a project portfolio management office…". Below, we will illustrate that all the question items can be placed under these three functions, as well as 2 additional functions determined by this

study. From the EFA, factor one collected items Q3, Q9, Q10, and Q11, (descriptions in Appendix A). These question items refer to resource management, definition of roles and responsibilities, resource allocation and optimization, and seeking alternatives to reduce risk. These can all be seen as manifestations of the Coordination function of the PMO. Factor three collected items Q14 and Q15, which refers to better understanding of priorities and the facilitation of interaction between and among programs, projects, and organization. These two items can be seen as manifestations of the Supporting function. Items Q8, Q13, and Q16, which refer to better control of time and cost, PMO as a critical success factor for program objective and clients' satisfaction, and increasing quality of deliverables were grouped under factor four. All of these items can be seen as manifestations of the Controlling function. Factor four was so identified. Factor five, collected items Q4 and Q7, which respectively refer to knowledge sharing among multi-projects/programs within the organization and correct information to support critical decisions in multi-projects/programs. Factor 5 was identified as having an Information & Knowledge Sharing role. This role is similar to what was emphasized by Julian (2008) – "How PMO leaders facilitate cross-project learning …" and Pemsel & Wiewiora (2013) – "PMO is a knowledge broker in project-based organizations". Finally, factor two encompassed items Q5, Q6, Q12, and Q17. They refer to communication effectiveness, trustable information to stakeholders and sponsors, increased programs/multi-projects productivity, and trustable and better estimation of cost, schedule, and risk matrix. These items manifest as a Trustability and Transparency role of the PMO. Such a cross-cutting role has been noted as key condition for the communication, control, and supporting roles proposed by Unger et al. (2012). Webster & Wong (2008) discussed the importance of trust in naturally occurring project teams. Finally, Hartman (2000) emphasized the need to discuss and further study the role of trust in project management. Therefore, it is no surprise that our EFA has brought to the foreground this role.

RESEARCH PROCESS

After reviewing the EFA, we propose the model and check if the attributes stated in the objectives were met.

Model proposition and confirmation: From the information gathered in the EFA, we can propose a reflective conceptual model to assess the perceived value of the PMO which is shown in Figure 1. The top latent variable PMO value is perceived by the project managers through five roles: Coordination, Supporting, Controlling, Information and Knowledge sharing, and Trustability and Transparency. These roles constitutes the conceptual model. These roles are latent variables by themselves, which can be quantitatively evaluated through their indicators Q3 to Q17, referring to what has been discussed in section 2.1.

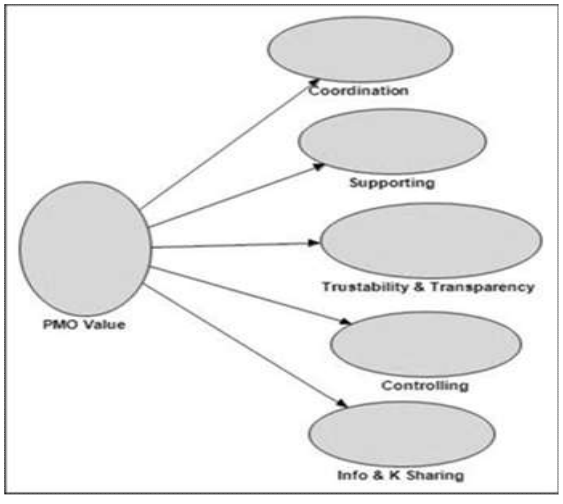

Figure 1. A reflective model to assess PMO value

The quantification of the dependent latent variables constitutes the measuring model. Both models evaluated together can provide an assessment of the PMO value.

Measuring model assessment: To evaluate the efficacy of the proposed model, we performed a confirmatory analysis using the Partial Least Square variant of the Structural Equation Modeling (PLS-SEM). PLS-SEM is a technique using multiple interlinked regression models, fitting the coefficients in a way that maximizes the explained variance of the data. It is widely used in different areas of research (Hair et al., 2011; Henseler et al., 2009). We chose this technique due to its ability to solve coupled regression models simultaneously, incorporating the indicators and the first order latent variables (roles) together with the top regression of the focal latent variable (PMO value) (Pavlou and Chai, 2002). Another reason for using this technique is because it is a robust technique that can be used even when a large quantity of data is not available (Henseler et al., 2009). To evaluate how useful the model is, we have verified both its convergent and discriminant validity as well as its reliability. Convergent validity evaluates whether the indicators of a given construct or latent variable (LV) converge, as they should share a sizable proportion of common variance (Hair Jr et al., 2010). According to same authors, the proposed criteria are loadings ≥ 0.5, but loadings ≥ 0.7 is preferable. Furthermore, the average extracted variance (AVE) should be ≥ 0.5. When these criteria are met, it means that the given construct accurately measures what it was designed for. Discriminant validity complements convergent validity by assuring that the construct has substantial exclusivity towards its underlying concept, and that it does not mix with the other concepts (Hulland, 1999). To evaluate this, we used two criteria. The first was proposed by Fornell & Larcker (1981), and states that the square root of the AVE of each construct must be greater than any inter-construct correlation. The second, proposed by Hair et al. (2011), relies on the observation of cross-loadings, where the loadings of the indicators in its own factor should dominate over the cross-loadings. Referring to the EFA done in section 2.1, if the factor groupings were properly done, this criterium should be met without any problems. We controlled this regardless, since the presence of significant cross-loadings can affect the discriminant validity of the model (Hair Jr et al., 2010). The reliability of the model was checked with the most common method – Cronbach's alpha (Hair et al., 2012; Henseler et al., 2009) – but also by checking the composite reliability, which is perhaps a more robust criterium (Chin et al., 1996; Hair Jr et al., 2010; Hair et al., 2011; Henseler et al, 2009). For both criteria, the values should be ≥ 0.7 (Hair Jr et al., 2010). To run the calculations described above and in the next sections, we used SmartPLS software, v. 3.2.6 (Ringle et al., 2015). Tables 2 and 3 show that our model was suitably successful in the tests described above.

Structural model assessment: Structurally, the model is defined by the causal relations connecting its latent variables, as depicted in the conceptual model (figure 1). With the measuring model validated, we can assess the structural model to check if hypothetical formulated relations are empirically acceptable (Pavlou and Chai, 2002). Essentially, we want to assess the explanatory power of the model. To do so, we must calculate the determination (R2) and path coefficients of the model. Then – based on their respective magnitude and statistical relevance – for the desired size effect, we can decide on how "good" or efficient the model is (Tenenhaus et al., 2005). Values of R2 above 0.2 are considered acceptable for social and behavioral sciences (Hair Jr. et al., 2014). The statistical significance of the model was calculated using a bootstrapping technique to supply Student t-values. Results are shown in figure 2. We observe that all R2 values are well above 0.2, two are above 0.7, two are above 0.5, and one near 0.5. This means that our model potentially excels in predictive efficiency. The complete results of the bootstrapping calculations for 300 samples with replacements are not shown, since the graph is very similar to figure 2, with the coefficients replaced by the Student t-test scores. It is enough to mention that all t-values were above 4.9, which is compatible with p-value well below 0.001, which is statistically significant (Hair Jr et al, 2010; Hair-Jr et al, 2014; Wong, 2013).

Table 2. Values obtained for convergent and discriminant validity and reliability

	#1	#2	#3	#4	#5
1. Controlling	(0.780)				
2. Coordination	0.477	(0.758)			
3. Info & K Sharing	0.376	0.495	(0.860)		
4. Supporting	0.533	0.484	0.324	(0.856)	
5. Trustability & Transparency	0.590	0.512	0.510	0.505	(0.703)
AVE	0.608	0.574	0.740	0.732	0.494
Composite Reliability	0.823	0.843	0.850	0.845	0.795
Cronbach's Alpha	0.678	0.752	0.657	0.635	0.655

Square root values of the AVE are shown within parenthesis on the diagonal.

Table 3. Cross-loadings values for the discriminant validity assessment

Constructs	Ind.	#1	#2	#3	#4	#5
1. Controlling	Q08	0.750	0.396	0.304	0.274	0.398
	Q13	0.786	0.347	0.284	0.520	0.444
	Q16	0.802	0.376	0.293	0.442	0.531
2. Coordination	Q03	0.338	0.805	0.293	0.322	0.352
	Q09	0.461	0.768	0.468	0.414	0.452
	Q10	0.326	0.764	0.287	0.277	0.333
	Q11	0.301	0.689	0.426	0.437	0.396
3. Info & K Sharing	Q04	0.230	0.329	0.806	0.242	0.307
	Q07	0.393	0.500	0.911	0.308	0.538
4. Supporting	Q14	0.438	0.465	0.272	0.849	0.358
	Q15	0.474	0.366	0.281	0.862	0.504
5. Trustability & Transparency	Q05	0.251	0.377	0.483	0.370	0.657
	Q06	0.453	0.229	0.435	0.239	0.640
	Q12	0.513	0.455	0.316	0.383	0.719
	Q17	0.430	0.356	0.223	0.415	0.786

Loadings were highly significant: $p < 0.001$

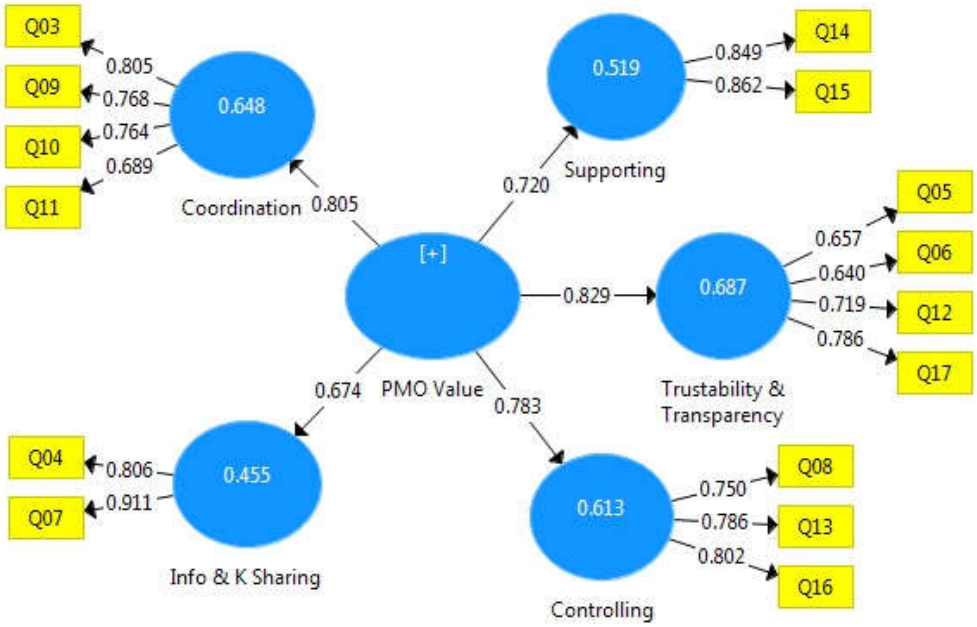

Figure 2. The overall model with determination and path coefficients (all with $p < 0.001$) – extracted with *Smart PLS3 software*

We noted this information in the title of figure 2. Therefore, we have satisfactory results and statistically they are very significant.

Using the model : Although the focus of our research was on the perception of PMO value as seen by project managers, we can use the model to investigate how the sample manifested its opinion. The items were all stated in the positive, and the interval grading scale ranges from 1 – total disagreement to 5 – complete agreement. Therefore, perceptions below 3 are negative and above 3 are positive. The multi-regression model shown in figure 2 can now be applied to determine the best estimates of the LVs and therefore the PMO value perception, as assessed by the respondents.

To do so, we developed a short script in R language, (R Core Team, 2013). The script considers 6 multiple regressions, 5 for the first order LVs, and one for the focal LV (PMO_value). Results are shown in Table 4 and Figure 3.

As we can see, the LVs Coordination, Controlling, and Trustability & Transparency got scores over 4, which are in the very-good range. The LVs Info & K_sharing and Supporting scored over 3.9, and the top LV PMO_value scored 4.03. It is apparent that the overall perception of PMO_value for the organization under this study is proving to be high.

Table 4. Model results for the survey

Names	Regressed VLs	PMO coefficients
Controlling	4.03	0.78
Coordinating	4.26	0.80
Info & K_sharing	3.91	0.67
Supporting	3.92	0.72
Trustability & Transparency	4.03	0.83
PMO_value	4.04	.....

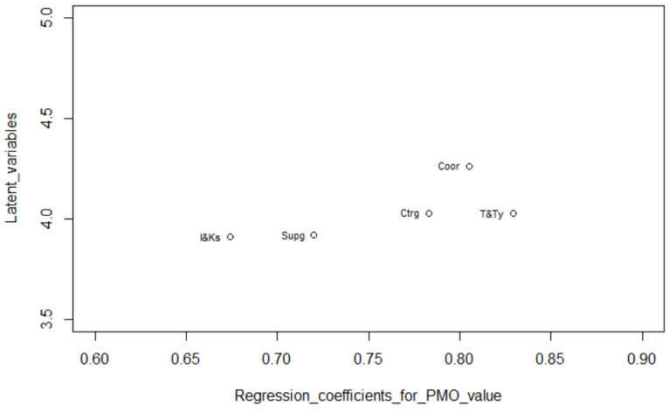

Figure 3. Estimation of the VLs and their relevance for the focal question

Figure 3 puts this evaluation into context, as we can see that all 3 more relevant LVs (coefficients ≥ 0.78) received good evaluations. The results shown in Figure 3 indicates which areas can be improved by an organization to develop PMO functions and get a better payoff in terms of PMO value perception.

CONCLUSIONS

We have developed an expedite model to assess the value of PMOs that has the following necessary attributes:

- It is theoretically sound because (a) it was constructed based on a thorough review of updated literature, (b) it has good convergent validity, very good discriminant validity, and it is reliable;
- It has sound predictive potential demonstrated through very good determination and path coefficients, which are also statistically significant;
- It is practical, since the data questionnaire was short and relevant, and can therefore be used annually by the organizations as "thermometer" of value perception of PMOs.

Limitations and further research: Despite great results, we used a sample size that is far below the ideal size. In fact, 84 is just slightly above the most condescending rule of thumb which recommends sample sizes of 5 to 10 observations per estimated parameter (Bentler & Chou, 1987; Bollen, 1989). In the case of this study, this translates as 75 to 150. Therefore, it is advisable to have it deployed in wider population and gathering a sample well above one hundred to repeat the validation. Lastly, we would like to expand the measuring level to a seven-point scalar scale. This would render more discrimination to the users of the model.

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Appendix A

Variables	Description
Q1	What is your age?
Q2	How many years of experience in project management do you have?
Q3	It assures Resource Management in the project with all competencies necessary for the multi-project or program.
For the next items, a 5-point scale was applied: 1= completely disagree to 5 completely agree. In your perception PMO is or assures Qi (i=3, …, 17)	
Q4	Responsible for knowledge sharing among multi project / Program into the organization.
Q5	Communication Effectives across the program or multi-project.
Q6	More trustability in information about program or multi-project status that will be presented to stakeholders and sponsors.
Q7	Correct information to support in critical decisions on programs / multi-project.
Q8	Better control of cost and time.
Q9	Better definition of roles and responsibilities.
Q10	Better resource allocation and optimization among multi-project and program.
Q11	Responsibility to see alternatives to reduce the risk in multi-project or program.
Q12	Increase program or multi-project productivity.
Q13	PMO is a factor critical of success to achieve the objective of program and client´s satisfaction.
Q14	Better understanding of priorities.
Q15	Facilitate interaction between program and multi-project and organization.
Q16	Increase quality in the deliverables of the program or multi-project.
Q17	The estimation is most trustable and better (cost, schedule, and risk matrix).

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