ORIGINAL
ARTICLE

Performance indicators system for a metallurgical project portfolio management

Sistemática de indicadores de performance para a gestão de um portfólio de projetos metalúrgicos

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Abstract: This work aims to report the implementation of a set of indicators applied to a project portfolio control, highlighting the solutions found to manage the practical problems common to these issues. We conducted a study based on the research-action method to establish and test the indicators. Our results indicate the need for integrated systems of indicators control to investigate the deviations or trends by different sources. The adoption of more than one analysis source demonstrated positive results for the efficient management of the project portfolio. Moreover, we verified the need to observe the real team skills and their experience in establishing indicators metrics. Once the team know-how is improved, the company would hardly relinquish its past experiences. Also, the results obtained indicate the need to maintain systematic feedback of the actions taken so that the team might be aware of the outcomes of the indicators' applications.

Keywords: Project portfolio; Project portfolio management; Performance indicators; Project portfolio control.

Resumo: Este artigo tem como objetivo relatar a implantação de um conjunto de indicadores aplicados ao controle de um portfólio de projeto, ressaltando as soluções encontradas para tratar os problemas práticos comuns a este tipo de aplicação. Para isto, foi realizado um estudo baseado no método de pesquisa-ação, em que os indicadores foram levantados e testados na prática. Os resultados obtidos apontam para a necessidade de sistemáticas integradas de controle de indicadores que permitam a observação dos desvios ou tendências por meio de fontes distintas. O uso de mais de uma fonte de análise revelou resultados positivos para o controle eficiente da carteira de projetos. Foi também verificada a necessidade da observação da capacidade real da equipe e de sua experiência no estabelecimento das métricas dos indicadores. Quanto maior o aproveitamento da experiência da equipe, menos a empresa se abdica de vivências passadas. Além disso, os resultados obtidos indicam a necessidade de

manter uma sistemática de *feedback* das ações tomadas, de forma que a equipe possa ter conhecimento dos resultados reais da aplicação dos indicadores.

Palavras-chave: Portfólio de projetos; Gestão de portfólio de projetos; Indicadores de desempenho; Controle de portfólio de projetos.

1 Introduction

Portfolio management has been widely studied, considering the importance of projects for the maintenance and growth of organizational activities. Selecting suitable projects consists of a more effective strategy to meet the objectives of the organizations (Hadjinicolaou & Dumrak, 2017). Recent observations emphasize that the consistent management of the project portfolio is relevant for the long-term permanence of organizations in the market, which contributes to highlighting the importance of studying project portfolio management in the current scenario (Young et al., 2011; Hadjinicolaou & Dumrak, 2017; Wang & Thiele, 2017).

Portfolio management is an issue commonly addressed in the literature associated with other topics such as project management offices (Unger et al., 2012; Feitosa et al., 2016), maturity models (Killen & Hunt, 2013; Nikkhou et al., 2016), innovation (Meifort, 2016; Jugend et al., 2016), among others. Organizations shall have a clear and consistent management process (Cooper et al., 1999) to benefit from the positive outcomes of portfolio management, in which their objectives can be categorized and measured using Key Performance Indicators (KPIs).

The application of performance indicators aims at setting metrics to manage precisely the organization focusing on improvements (Gunasekaran et al., 2001). Concerning portfolio management, there are some particularities related to the use of KPIs. To guaranteeing the KPIs' effectiveness, isolated analysis of the project performance is not enough since there is a relationship of mutual influence between these KPIs that can directly affect the goals of the organization (Sanchez & Robert, 2010).

Although this is a real problem, it is possible to observe that the research on the application of KPIs has focused efforts on the definition of metrics for the project selection within a portfolio (Debnath et al., 2017; Costantino et al., 2015). Although it is essential for the organization, this attention is given at the expense of a view aimed at maintaining and directing the performance of the project portfolio over time. The monitoring and control of the portfolio performance are essential to achieve the objectives in an organization and is relevant since it allows taking corrective actions and implementing timely strategic changes (Alexandrova, 2017).

When referring to the project literature, we verified designs for more general KPIs in indicator models as in Sanchez & Robert (2010) or applications disassociated from practical cases as in ICB 4.0 (IPMA, 2015). It is possible to observe a need for elaborating feasible studies that demonstrate the implementation of on-site portfolio indicators to present attention points, specific needs, successful practices, and negative factors throughout their application.

Considering that, this study aims to report the application of a portfolio control method based on the structured application of a set of KPIs as tools for improving the management of the project portfolio of a company in the metallurgical sector, herein named CG Company. Furthermore, this work highlights the outcomes and insights obtained through the analysis of the implemented indicators to answer the following question: how can the use of integrated indicators influence the company portfolio

management? It is important to emphasize that this method of structuring KPIs was developed exclusively for the application in this work, regarding the context of the company assessed. This evaluation was performed using the action-research methodology, and the portfolio used as the object of the study is responsible for transacting about 40 million dollars annually.

2 Literature review

The need by the organizations to develop strategic planning to optimize the goals and achieve their objectives must include a project portfolio (Martinsuo & Geraldi, 2020). A portfolio consists of a set of projects managed under a common budget to achieve the organizational objectives for which it is intended. The portfolio must be carried out by the integrated management of its projects, thus allowing to measure the decisions taken and expand its benefits (Killen, 2017). Portfolio management will be addressed in more detail in the next topic.

2.1 Project portfolio management

Project portfolio management (PPM) corresponds to a set of management activities that are related to the initial choice, selection, arrangement, allocation, and reallocation of resources for projects according to their priorities (Blichfeldt & Eskerod, 2008), thus reducing operating costs and defining performance strategies (Feitosa et al., 2016). Therefore, PPM is related to the strategic choices of a company and can result in substantial changes to the organization (Clegg et al., 2018; Martinsuo & Geraldi, 2020). Companies must adapt their project portfolio to strategic business objectives to maximize shareholder value and balance resource allocation and risks (Barbosa & Rodrigues, 2020).

The choice for the number of projects to assign these resources is essential for the successful management of project portfolios. As the number of projects in a portfolio increases, ensuring effective and efficient performance becomes even more relevant (Teller et al., 2012) considering the increasing complexity of management. This feature makes portfolio management closely connected to other areas of project management, such as risk management (Costantino et al., 2015) and stakeholder management (Beringer et al., 2012).

The structuring of the portfolio also named portfolio selection or project selection (Meskendahl, 2010), consists of performing recurrent and strategic activities that evaluate projects and outline portfolios as desired. This happens due to the careful selection of projects through the observation of current and new organizational proposals so that the objectives are met without exceeding available resources or violating other restrictions (Costantino et al., 2015). The structuring of the project portfolio is positively related to its success (Meskendahl, 2010).

Another crucial factor related to the maintenance of the portfolio is the management of resources following the prioritization of projects. This happens because, within the organization, several projects demand the same resources (Engwall & Jerbrant, 2003), including material, human, or financial resources. Resource management aligned with a business strategy is positively related to portfolio performance, enabling the organization to join new markets and balancing the portfolio (Killen et al., 2008). This alignment happens by targeting the portfolio, understood as the set of coordination

activities among the multiple projects that shall consider the complexity of the relationships involved. The focus of the guidance is on the establishment of the distribution or redistribution of resources, based on monitoring the progress of individual projects towards the goals and objectives set (Unger et al., 2012).

For ensuring that the process of portfolio management occurs efficiently, a broadly adopted practice is the development of Project Management Offices (PMOs) in organizations (Feitosa et al., 2016). PMOs have emerged as a means to develop skills in project management (Unger et al., 2012), with roles related to the centralization of information related to project progress, coordination of communications, support and guidance of project managers, development of management methodologies, practices, and standards (Feitosa et al., 2016).

Among the main variations of PMOs found in organizations, a significant subset is the Project Portfolio Management Offices (PPMOs), responsible for jointly managing multiple projects and programs in a portfolio. The tasks of PPMOs are derived from the requirements of the main stakeholders in the organization, their high potential for conflict, and the need to assign managerial responsibilities. These tasks vary according to the sort of project set that comprises the portfolio (Unger et al., 2012).

The implementation of the performance indicators to control the project portfolio is among the most important assignments of the PMO and, consequently, the PPMO regarding the establishment of management standards. The implementation of the performance indicators to control the project portfolio is among the most important assignments of the PMO and, consequently, the PPMO regarding the establishment of management standards. This analysis includes verifying the most suitable indicators for use and their detail level (Amer & Elayoty, 2018).

2.2 Project portfolio performance indicators

Key performance indicators or KPIs, when applied to portfolios, comprise means of verifying whether the set of projects meet the desired standards. These standards shall be monitored by the portfolio manager to keep their characteristics under control, such as time, cost, risks, among others (Silva et al., 2017). The measures obtained by these indicators determine whether the chosen strategies are viable or not, since, without a clear objective to establish improvements or reduce deviations, the achievement of goals may be impaired (Gunasekaran et al., 2001).

For achieving these goals, most of the authors associated with project management emphasize the importance of evaluating cost, time, and quality to measure aspects related to the project performance (Ahadzie et al., 2008; Kaliba et al., 2009; Ahsan & Gunawan, 2010). However, this classic approach only addresses economic factors while neglecting other important aspects of the projects. Therefore, it is necessary to evaluate additional elements related to efficiency in project management, such as meeting organizational goals, the long-term benefits, the relationship between the success of the project and the work team group, the risks involved, among others (Shenhar & Dvir, 2007; Silva et al., 2017). These measures shall guarantee an efficient project evaluation system that includes the particularities of the project, the adequacy of its purposes, and the related changes (Ngacho & Das, 2014).

The application of indicators for portfolio management shall consider that no single measure can precisely demonstrate the organizational performance (Allen et al., 2014). This means that there is no point in controlling project indicators in an isolated or non-integrated way, requiring the means to understand the meaning of a project

performance when it is interconnected to several others and the objectives of the organization (Sanchez & Robert, 2010). For this purpose, some companies use dashboards to support the portfolio manager by grouping the indicators in an integrated way, allowing interactive analyses and maximizing the opportunities of the projects (Shahandashti et al., 2018; Silva et al., 2017).

Another crucial issue is that KPIs should not only measure the outcomes of project performance (Almahmoud et al., 2012) since it is limited for the decision making (Bassioni et al., 2004; Ma et al., 2020). On the other hand, they shall enable proactive action by project managers to the detriment of reactive actions (Almahmoud et al., 2012). This is possible because one of the most relevant benefits in applying indicators for portfolio management is related to the increase of the ability to verify trends. The application of indicators acts as a support to the decision-making process, which allows to understand in advance the project course within a portfolio and react quickly, prioritizing the most urgent and significant problems (Colla et al., 2020; Sanchez & Robert, 2010).

3 Method

The action-research method was used with a focus on the development of a system to monitor and control the CG Company portfolio, based on the structured application of different KPIs proposed empirically. According to McKay & Marshall (2001), the action-research method consists of a juxtaposition of action and research, that is, practice and theory. In this method, the research and field activities are merged into a single process in which the actors involved and the researchers elucidate the reality in which they are introduced, identifying mutual problems, jointly seeking and experimenting solutions in real situations. (Costa et al., 2014). The working group established for this study was composed of researchers, PMO members of the organization, and specialists depending on the needs.

Concerning the nature of the study, a qualitative approach was applied to evaluate the phenomenon from an integrated overview. The phenomenon was studied in an interpretive manner, from the perspective of the people involved in it, considering all aspects relevant to its understanding through data collection and analysis (Areljung, 2018; Peercy & Troyan, 2017).

Access to the research was a request of the organization, aiming to improve its portfolio management process. The procedures for data collection were based on two designs: document collection and direct observation. Among the documents collected, we highlight the records of department meetings, charts of indicators previously used, and operational procedures in the project area. The direct observation, which consists of observing the environmental conditions or behavior of the parties through formal or informal activities (Yin, 2005), was carried out during visits to the workplace and meetings according to the action-research method. There were 29 observation sessions from March to December 2018.

For the organization of the action-research process, six stages were planned and accomplished for the development of the works, demonstrated in Figure 1. These stages will be better described in the following topics.
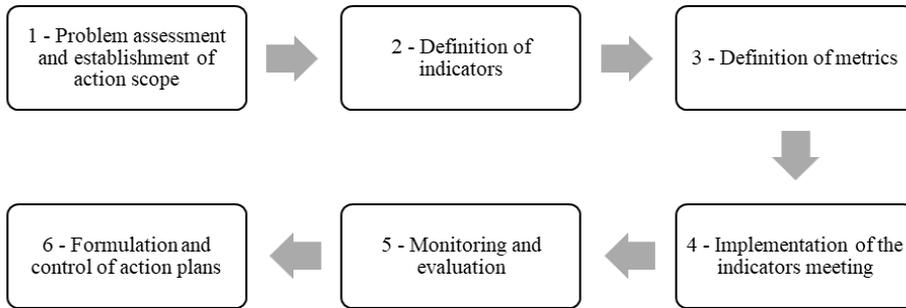
Figure 1. Stages of development. Elaborated by the authors.

The study represents part of a demand by the CG Company to set up an improvement project for the management of its portfolio. CG is a consolidated company in the metallurgical market, with about ten manufacturing plants in three Brazilian states. Project management is conducted locally by the plants, whereas portfolio management is centralized in one of them, where the research was conducted.

The need for demand was based on the opportunity to improve the control of projects by the CG Company. These needs included the budgeting and cost estimate control, as well as the organization of internal processes, including issues such as the initiation, definition, and management of scope, time, costs, among others. In the first meetings held with the PMO of the organization and top management, a Work Breakdown Structure (WBS) was drawn up. This WBS supported the establishment of the scope of action demanded by the CG Company, which enabled to organize an action plan through work packages, as shown in Figure 2.
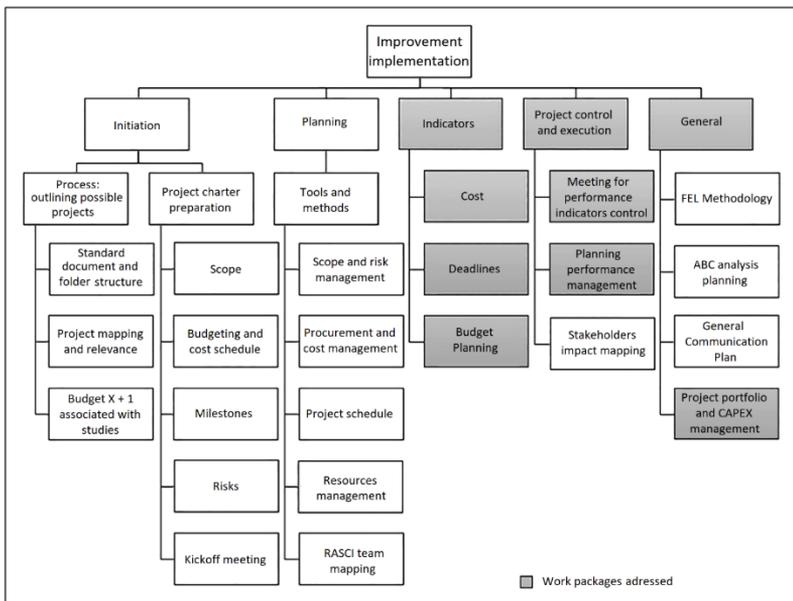

Figure 2. Work Breakdown Structure. Source: elaborated based on data from the field research.

Although the WBS presented various work packages that guided the works in action research, only packages related to the implementation of the indicators were addressed to delimit the topic chosen. These work packages are highlighted in gray in Figure 2.

4.1 Root cause analysis and scope definition

In the first meetings held after the WBS definition, the working group decided to develop an indicator control system that would allow the organization to act directly on its project portfolio. The indicators were chosen based on the need of the organization to properly examine the issues related to the project costs since they were controlled by various means and not regularly. The performance by indicators would provide standardized measures for monitoring the projects and reducing deviations found. For this purpose, we retook some indicators already used by the organization and designed new ones, including those that would ensure a greater focus on the performance of project managers regarding assertiveness and compliance with budgets.

A monthly meeting chaired by the PMO was also scheduled to disseminate these indicators, with the presence of top management and those responsible for the execution of the projects. The frequency of the meetings was chosen to ensure that the project teams were not overloaded and provide enough time for the project coordinators and specialists to take the arranged actions. At first, the scope of the meeting was to establish better control of the project portfolio to improve the coordinators' assertiveness about costs and to find risky deviations in the goals. Although improving cost assertiveness may seem a simple issue, it was observed that it is usually linked to a series of difficult-to-do matters such as scope changes, deadline changes due to scheduling mistakes, internal or supplier delays, communication problems, among others. In addition to the points discussed, the monthly meetings improved communication among the teams, reinforced the portfolio management strategies established by the company, better integrated the teams, and disseminated a more systematic project management pattern across the organization.

4.2 Definition of indicators and metrics

The second step to implement the improvement project was the establishment of indicators to meet the needs of the project portfolio controlling. After a thorough analysis of the demands, ten indicators were developed, in which six focused on general control of the portfolio and four on the specific performance of the project coordinators (Chart 1). Although some of these indicators are referenced in the literature, they were elaborated according to empirical evidence with an observation of the context and the real needs of the organization. The authors mentioned in the chart contributed with relevant discussions on the topic.

An outstanding view of the coordinators' performance occurred since, during the meetings held by the working group, a gap was verified regarding the feedback on their performance. The lack of feedback, therefore, could consolidate practices risky to the project portfolio by the coordinators and stimulate their lack of interest in the outcomes of their work.

Chart 1. List of the indicators used.

Performance Focus	Indicator	Measure	Description	Source
Whole portfolio	Estimated and actual costs indicator (EACI)	Difference between estimated and actual cost	Difference between the monthly total estimated cost and the monthly actual total cost the of whole project portfolio.	Silva et al. (2017); Suk et al. (2012)
	Absolute Deviation Indicator (ADI)	Total error in cost estimates	Sum of the monthly deviations modules from the cost estimates. It enables the quantification of the total error of the estimates without the negative and positive errors suppressing each other.	Kishore et al. (2011); Suk et al. (2012)
	Adherence Indicator (AI)	Percentage of cost deviation	It measures the percentage of portfolio costs as planned.	Silva et al. (2017); Kishore et al. (2011)
	Project status Indicator (PSI)	Project progress status	It is possible to know, of the total projects of the year, the number of projects that are in progress, postponed, concluded, and canceled.	Silva et al. (2017)
	Ongoing Procurement Indicator (OPI)	Procurement performance	It monitors the percentage of requests and procurement orders with the expected and overdue deadlines.	Minnullina (2017); Abolbashari et al. (2018)
	Deadline Indicator (DI)	Schedule performance	It assesses the percentage of projects that are overdue greater than the target of the deadline performance.	Silva et al. (2017)
Coordinators	Project distribution Indicator (PDI)	Coordinator's participation in the portfolio	It shows the distribution of projects and costs among the coordinators.	On-site demand verification
	Estimated and actual costs Indicator (EACI)	Difference between estimated and actual cost per coordinator	Difference between the total estimated cost in the month and the actual total cost in the month per coordinator.	Silva et al. (2017); Suk et al. (2012)
	Absolute Deviation Indicator (ADI)	Total error in cost estimates per coordinator	Sum of the monthly deviations modules from the cost estimates per coordinator. It enables the quantification of the total error of the estimates without the negative and positive errors suppressing each other.	Kishore et al. (2011); Suk et al. (2012)
	Adherence Indicator (AI)	Percentage of cost deviation per coordinator	It measures the percentage of costs according to the planning of each project coordinator.	Silva et al. (2017); Kishore et al. (2012)

Source: Elaborated by the authors.

The Estimated and Actual Costs Indicator was applied to check the cost deviations related to the comparison between the sum of the estimates of all project costs with the costs observed in the month, as shown in Equation 1.

$$EACI = Monthly\ Estimated\ Costs - Monthly\ Actual\ Costs \qquad (1)$$

This indicator identified the difficulties in achieving the annual estimated budget by monthly evaluating the performance of the portfolio's expenses. Although significant, this indicator alone does not provide a full assessment of the deviations since they can be suppressed. This happens because the negative deviations (cost performance values below the planned values) can be added to the positive ones (actual costs above the planned values) to suppress the total error of the estimates, impairing the management of corrective measures. Thus, another indicator used to improve the analysis was the Absolute Deviation Indicator that enables the assessment of the total error, regardless of whether it is negative or positive since it does not consider the differences in signs to sum the error. The Absolute Deviation indicator is calculated in Equation 2.

$$ADI = \left| Negative\ Deviations\ Sum \right| + \left| Positive\ Deviations\ Sum \right| \qquad (2)$$

Figure 3 shows an example of the analysis of these two indicators and the relationship between them. In August, although the EACI was R$ 3.36 million, the ADI was R$ 6.87 million, thus showing a greater hidden error in the estimates.
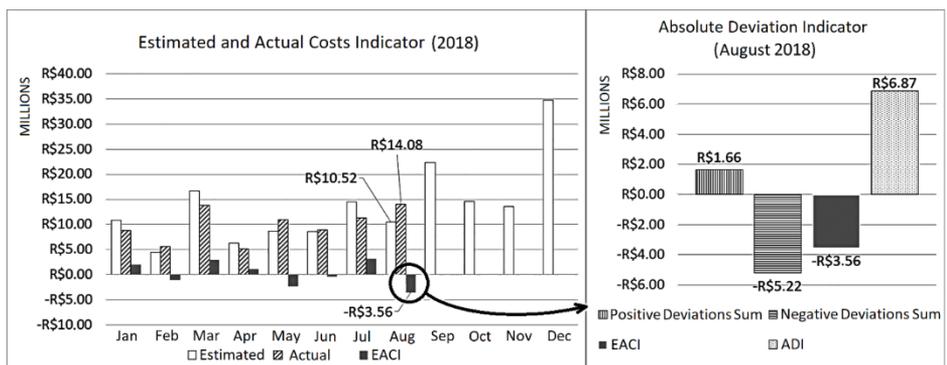

Figure 3. Analysis of indicators. Source: elaborated based on data from the field research.

In addition to these two indicators, the Adherence Indicator was adopted to measure the accuracy percentage of estimates for the subsequent months, as shown in Equation 3. The AI is related to the need to understand the performance of portfolio management both in percentage and relative terms.

$$AI = \frac{Monthly\ Cctual\ Costs}{Monthly\ Estimated\ Costs} \qquad (3)$$

These three indicators are used for portfolio measurements considering the total costs and arranged to allow an analysis per coordinator to verify individual performance and tracking problems. Figure 4 shows an example of the arrangement of the Adherence Indicator at the project coordination level.
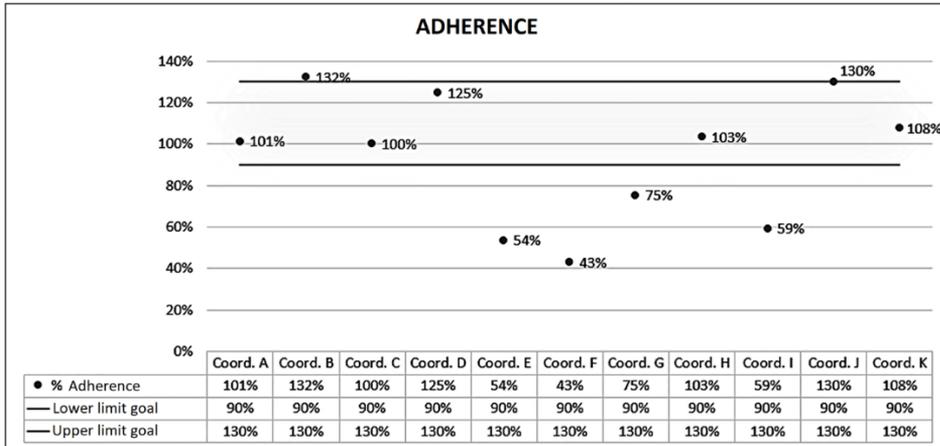

ADHERENCE

	Coord. A	Coord. B	Coord. C	Coord. D	Coord. E	Coord. F	Coord. G	Coord. H	Coord. I	Coord. J	Coord. K
● % Adherence	101%	132%	100%	125%	54%	43%	75%	103%	59%	130%	108%
— Lower limit goal	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%	90%
— Upper limit goal	130%	130%	130%	130%	130%	130%	130%	130%	130%	130%	130%

Figure 4. Adherence Indicator Arrangement. Source: elaborated based on data from the field research.

The PSI monitors the progress of the portfolio performance to control the ongoing, postponed, completed, or canceled projects. The importance of this indicator is related to the high number of projects that are under custody of the team, representing a portfolio of more than 700 projects. By controlling the status of projects, it is possible to keep the workforce activities constant or balanced, or even prepare for periods of higher or lower intensity. The analysis of this indicator is performed along with the PDI, responsible for demonstrating the distribution of the project capacity per coordinator.

The OPI and DI were established due to their influence on the schedule control and as a result of the project budget. They are calculated using Equations 4 and 5, respectively.

$$IAC = \sum \frac{Requests\ and\ Procurement\ orders\ on\ time}{Total\ Requests\ and\ Procurement\ orders} \qquad (4)$$

$$IP = \sum \frac{Overdue\ projects}{Total\ projects} \qquad (5)$$

In the OPI, we observed cases prior to the application of the indicators that demonstrate striking delays in the procedures for carrying out the project procurement, characterizing a greater need for control. Regarding the DI, it is a KPI previously applied to the organization and which has been resumed since its analysis benefits the budget control and the project performance. Both indicators aim to meet the need to control deadlines, a parameter related to the variations in the schedules.

The metrics used to define the goals of the indicators were defined by three factors: the first and most important factor is the achievement of the objectives of the organization. The second one is associated with the experience of the working group,

in which some members already took part in previous works to implement performance indicators. The third factor is related to the service skills of the team, and for this purpose, future adjustments to the goals were necessary. An example was the AI, in which the variation target was planned in a decreasing way according to the quarter of analysis (Figure 5).
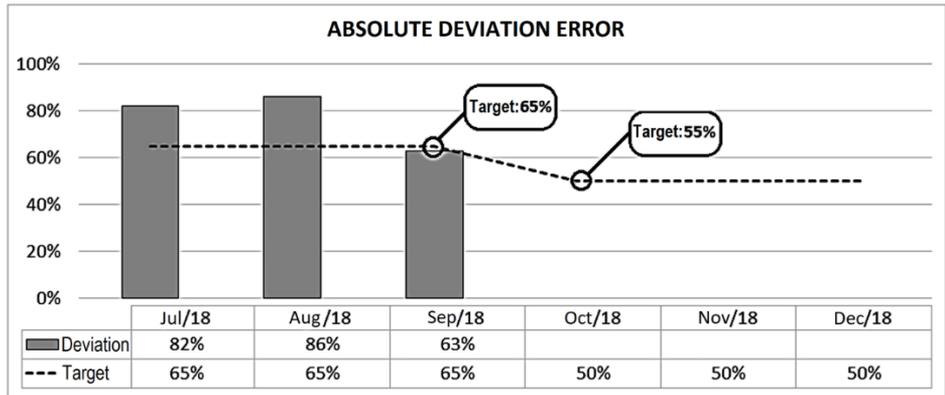

ABSOLUTE DEVIATION ERROR

	Jul/18	Aug/18	Sep/18	Oct/18	Nov/18	Dec/18
Deviation	82%	86%	63%			
Target	65%	65%	65%	50%	50%	50%

Figure 5. Variation target of the Adherence Indicator. Source: elaborated based on data from the field research.

These three factors to define the goals of the indicators were aligned with the strategies of the organization. This scenario highlights the importance of assessing aspects such as the organizational goals, the long-term benefits of the project, and the relationship between the project's success and the work team.

4.3 Implementation of the indicators meeting

Initially, the indicators meeting was held along with the general meeting of the project department, and it was later split into a specific meeting, considering the importance of the issues addressed and the relevance within the organization. The indicators were then disclosed in this meeting to increase the participation of the general manager of the area and the coordinators in the management of the KPIs.

The meeting performance was planned in three stages: demonstration of the actions taken and their consequences after the meeting in the previous month, presentation of the general and specific indicators of the project managers, and establishment of actions related to the deviations found. Although the planning was agreed in this way, it took a while for the dynamics to be accepted by the team and also to establish this flow. We believe that issues related to organizational culture, including individual issues and flaws in the dynamics, have had a negative influence. The persistence in implementing this dynamic occurred because several factors that lead to deviation were not properly addressed after the meetings. These factors were exposed again in consecutive meetings, without the implementation of effective actions.

4.4 Monitoring, analysis, and formulation of action plans

During the monitoring and analysis of the indicators, we recognized several factors as causing deviations. Due to the limitations of this work, we will highlight only the two main factors: the difficulty in carrying out equipment import flows and exchange rate variations during the project performance. Both aspects were verified in the analysis and deployment of the EACI, ADI, and AI, considering the arguments of the coordinators for the deviations observed.

Concerning the imports, the criticality of the process occurred mainly related to the high values in a small number of procurement orders (Figure 6). This means that the delays in imports tended to have a more considerable financial impact than other issues. Furthermore, the resources shared for import tasks were time-consuming in the process. This problem is worsened since the complexity of carrying out an import is greater than that of a national procurement because it includes differentiated negotiation issues, customs and logistics problems, besides cultural and language barriers. Moreover, when these imports involve high-tech products such as industrial equipment, they are regulated by the respective governments, making the process even more laborious (Barbalho et al., 2014). Also, it is essential to check the ineffective communication processes between the PMO and the department responsible for imports, considering the high number of routines performed in both departments.

STATUS OF PROCUREMENT ORDERS IN JULY 2018

Type	Purchase Request Qnt	Value	ORD. Qnt	Value
Importação	17	2,743,059	232	82,080,090
Serviço	61	11,085,991	380	7,204,656
Material	195	1,525,089	604	6,805,030
Total	273	15,354,139	1216	96,089,776

Figure 6. Procurement progress indicator. Source: elaborated based on data from the field research.

The exchange rate variations pose a substantial risk to the project budget maintenance (Song & Hao, 2020) due to the large number of equipment manufactured abroad, whose budgets undergo a broad variation between the budgeting period and the procurement period. The unpredictability of the exchange rate throughout 2018 represented a critical factor for portfolio management. In 2018, a total exchange variation of 28% was recorded by the organization between the highest and lowest rate month.

After checking these issues, we formulated an action plan to act on the major causes of the problems. For the imports, the action plan was based on the difficulties related to the information procedures that can be explained by the use of spreadsheets as the only source of routine communication, the lack of periodicity in the verification of data by PMO and procurement, and the resources shared. Thus, a follow-up plan was drawn up based on bi-monthly meetings to monitor the progress of the most relevant procurements and improve communication between both departments. This meeting was organized considering the analysis of integrated control, with the effective participation of both departments. For the exchange rate variations, although they are

an external factor, some measures were listed, such as continuous monitoring of their impacts on the budget to adapt the project portfolio according to exchange rate fluctuations and feedbacks for the area responsible for validating the estimates.

5 Results

The implementation of a methodology for the systematic control of the portfolio at CG Company to the detriment of the control methods used provided a contrast in the organization overview of its project portfolio. The multi-objective analysis by Silva et al. (2017) as a means to define optimized solutions in projects, proposed alternatives for better analyzing the data collected, considering the different objectives of the projects. It was possible due to the use of indicators with complementary functions to evaluate the problems in a relative and absolute way, as proposed by Suk et al. (2012). This can be seen, for example, in the three cost indicators, EACI, ADI, and AI. These indicators provided insights into the error due to the difference in the estimated and actual cost values, the absolute error over the budgeted values, and the percentage error.

A better understanding of the risks of the estimates might explain the progress related to the assessment standard used (Kishore et al., 2011). This happens because the budget estimate errors of the teams became evident, the risks more apparent, and this greater visibility of risks was not limited to costs but also included the sharing of resources.

The distribution of resources, considered to be a deficit at CG Company, is one of the main goals of portfolio management. Suitable allocation of people must take place in line with the organization's purposes to reflect its operating strategies (Alexandrova, 2017). Therefore, the projects shall have their situation defined so that they are addressed to a responsible resource. This verification was proposed by PSI and PDI, respectively, representing an agreement of the proposed method with authors who value the alignment between the portfolio and the organizational strategic objectives (Cooper et al., 1999; Alexandrova, 2017; Hadjinicolaou & Dumrak, 2017). Notwithstanding, the OPI and DI follow the same rationale, in which the schedule control is one of the main factors that impact the project portfolio (Suk et al., 2012).

An important issue to highlight is related to the effectiveness of team participation, which is vital to the success of portfolio management (Hermano & Martín-Cruz, 2016). Greater participation was achieved through the involvement of the team in the development of controlling metrics, joining the coordinators or managers and the organizational outcomes. For this purpose, the metrics were established in agreement with Shenhar & Dvir (2007), based on their contribution to the company outcome and not restricted only to their ability to reach deadline or cost targets.

6 Discussion

Considering the application of the method for portfolio control and its practical implications that resulted in significant improvements in the management processes, it is possible to assure that the goals were achieved. The research enabled the investigation and application of a functional set of integrated indicators as feedback to the organization scenario. These indicators were monitored and acted on systematic problems such as those related to imports and exchange rate variability. Both factors considerably influenced the performance of the project portfolio.

During the implementation of the indicators, we verified some empirical contributions from the portfolio managers and managers of organizations, such as the relevance of establishing an integrated system for controlling the project portfolio. This integration, demonstrated in the indicators addressed, is essential since it is difficult for a deviation or a trend of deviation to be well analyzed and tracked through an isolated observation. The complementary verification of the indicators is incorporated into the team's experiences and the history of the projects to better guide the necessary actions.

Another contribution is in the necessary attention for the establishment of the appropriate goals, in which the observations showed that they should not consider only the objectives of the organization but, it is also crucial to understand the real capacity of the team and the observation of their experience. This makes the goals reflect not only the direction of the organization but also the experience of past projects that should not be neglected.

Finally, we verified the need to establish a process to ensure the systematization of the performance of action plans. Also, the feedback on the implementation of the measures in the meetings acts as a control measure and supports the work team in seeing real outcomes from the KPIs application. This implies an increased commitment to controlling the portfolio and the company's outcomes.

This study revealed some limitations. The implementation of the indicators was restricted to the features and the context in which the company is inserted, thus limiting their application in different contexts. Another significant limitation involves the nature of the indicators, which were partly restricted by the data collection systems of the organization that are based on cost, deadline, resources, and procurements.

For future research, field studies are necessary to complement the set of integrated indicators proposed here and their scope for the management of project portfolios. These field studies may focus on project control methodologies that were not addressed in this work, such as risk control applied to project portfolios or even issues related to the influence of external stakeholders on the performance of the project portfolio.

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