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PERFORMANCE MEASUREMENT IN PROJECT MANAGEMENT

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Resumen:

En este artículo se analiza la medición del desempeño en Dirección de proyectos. El trabajo estudia la literatura actual, la aproximación de los cuerpos de conocimiento, y la perspectiva del sector público Colombiano. La metodología utilizada ha empleado estrategias cualitativas y cuantitativas. Por medio de la observación de un caso de estudio se ha recolectado información sobre los indicadores usualmente aplicados en un contexto en particular, para evaluar la gestión del desempeño de los proyectos. Una brecha entre la teoría y la práctica es analizada a través del estudio de indicadores y herramientas. Se conceptualizan los factores que pueden ser usados para medir el desempeño en la gestión de un proyecto lo cual representa la visión de la literatura y cuerpos de conocimiento.

Con respecto a la medición del desempeño se encuentra un consenso general sobre la aplicación de técnicas. En la literatura existen diversas propuestas de las cuales se ha extraído un grupo de categorías que pueden ser usadas como un marco simplificado que soporte la elección de indicadores por parte de los directores. La importancia de la evaluación del desempeño de los proyectos ha sido validada como un factor global para el éxito de los mismos. Se ha encontrado una brecha y desafíos futuros para mejorar las condiciones del contexto descrito. Se pretende promover el uso de indicadores en esta práctica, y el desarrollo y aplicación de herramientas metodológicas que mejoren los resultados de la ejecución de proyectos.

Palabras Claves: Dirección de proyectos, indicadores clave de desempeño, sector público, Colombia.

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MEDIÇÃO DO DESEMPENHO DA GESTÃO DE PROJETOS

Resumo:

Neste artigo analisa-se a medição do desempenho em direção de projetos. O trabalho estuda a literatura atual, a aproximação dos corpos de conhecimento, e a perspectiva do sector público Colombiano. As estratégias utilizadas para a metodologia da pesquisa foram quantitativas e qualitativas. Por meio da observação de um estudo de caso recolheu-se informação sobre os indicadores usualmente aplicados num contexto em particular, para avaliar a gestão do desempenho dos projetos. Uma brecha entre a teoria e a prática é analisada através do estudo de indicadores e ferramentas. Se conceitualizam os fatores que podem ser usados para medir o desempenho na gestão de um projeto o qual representa a visão da literatura e corpos de conhecimento.

Com respeito à medida do desempenho encontra-se um consenso geral sobre a aplicação de técnicas. Na literatura existem diversas propostas das quais se extraiu um grupo de categorias que podem ser usadas como um marco simplificado que suporte a eleição de indicadores por parte dos diretores. A importância da avaliação do desempenho dos projetos tem sido validada como um fator global para o sucesso dos mesmos. Encontrou-se uma brecha e desafios futuros para melhorar as condições do contexto descrito. Pretende-se promover o uso de indicadores nesta prática, e o desenvolvimento e aplicação de ferramentas metodológicas.

Palavras-chave: Direção de projetos, indicadores chave de desempenho, setor público, Colômbia.

PERFORMANCE MEASUREMENT IN PROJECT MANAGEMENT.

Abstract:

Purpose — This paper analyses performance measures in the project management. The paper studies the current literature, the bodies of knowledge approach, and the perspective of the public sector. Design/methodology/approach – The methodology has used qualitative and quantitative strategies. Through general observation in a case study, information is collected on indicators that are usually used in a particular environment, in order to evaluate the management and project performance. Gaps between theory and practice have been analyzed through the study of the indicators and tools used. Factors that can be used to measure performance in the management of a project are conceptualized, which in turn represents the overview of the literature and bodies of knowledge.

Findings – With respect to performance measurement, guidelines provide a general consensus on the application and techniques to use. In the literature there are several proposals, from which have extracted a set of categories that can be used as a simplified framework to support managers in choosing and developing indicators.

The importance of the evaluation of project performance has been validated as a global factor for its success. Have been found gaps and future challenges to improve the conditions of the case study. Aim is to promote the usefulness of the indicators, and in turn, the development and application of methodological tools that improve the outcomes in the implementation of projects.

Originality/value – It is suggested that the methodology could be used in similar studies to relate the success factors in a project to it's performance and outcome.

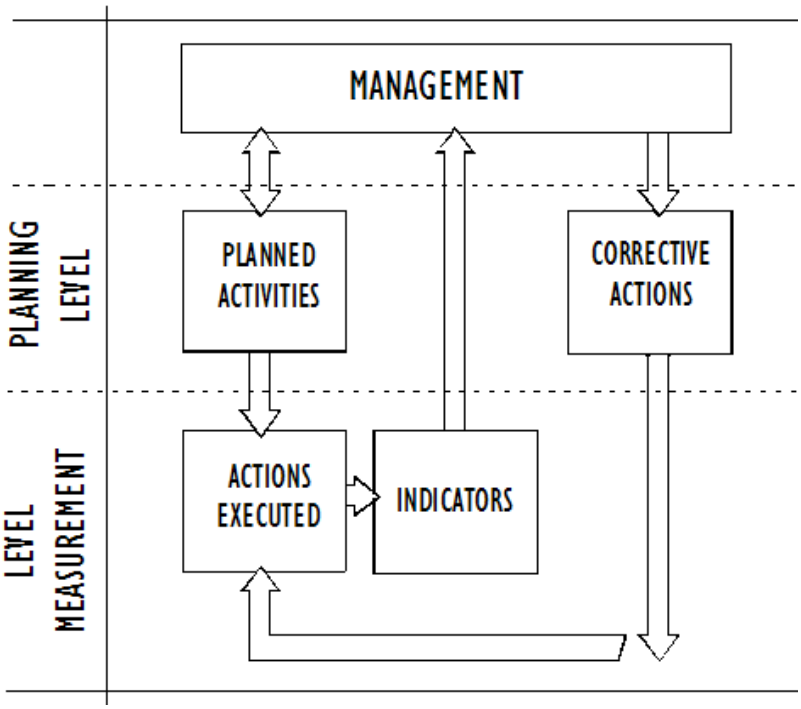
Keywords: Project management, key performance indicators, public sector, Colombia.

1.Introduction

Performance management is defined as the way organizations achieve their goals, usually accomplished with the activities carried out by individuals who are part of it (Flapper et al., 1996). Also, performance management involves setting goals, managing to get and compare the achievements with the expected results (Poister, 2010). Knowing the performance capability provides information to guide the planning and control process at organizational level, which is why their appropriate measurement increases its value. Performance measure is the process of quantifying action, within which the measurement corresponds to the process of quantification and action is what leads to results (Neely et al., 2005). According to Neely (1997) and others, performance measure is a method of data collection that can be used to inform and to benefit those who are responsible for the decision making.
In this paper it is understood that metric is a quantitative measure of the level at which a process has a certain attribute or measurable property; and, in turn, a measure is the number assigned to that attribute, as a result of the implementation of a measurement process. It is understood that an indicator is the metric or set of metrics that provide knowledge about aspects of a project, helping to interpret the measurable concepts

Performance measure is an issue that is often discussed but rarely defined (Neely et al., 2005), and quantified by measures that are usually implemented through metrics or indicators.
According to Flapper et al (1996) the indicators are important within an organization since they asses what should be measured and the control limits within which the performance should be. The level of performance that an organization reaches is based on the efficiency and effectiveness of the actions taken (Neely et al., 2005). The efficiency is based on the relationship between production and inputs, with a focus on process productivity measures and resource utilization, while the effectiveness is based on the idea of appropriate outputs of the process (Radnor and Barnes, 2007). Then, the management capacity in an organization is related to planned actions to accomplish their objectives and the actions executed after assessing the performance of the plan (efficiency and effectiveness) (see Figure 1).

Figure 1 Role of performance evaluation in management.



As shown in Figure 1, the management capacity in an organization is related to the actions planned to achieve its objectives and evaluation of the actions that are actually executed. For this, you can use a measurement process using indicators which will enable to establish corrective actions to be taken to maintain the efficiency and effectiveness of organizational activities.

This article focuses on aspects related to the quantitative evaluation of project performance during their execution. In projects, the control process ensures that the objectives can be achieved through measuring progress and taking corrective actions when necessary (Kwak and Ibbs, 2002).

As in other management disciplines that use performance measures such as operations management, quality management and strategic management; since 1980 a discussion has been established in the field of project management on the performance evaluation and its impact on the success of such management (D. J. Bryde, 2005). For the discipline, performance evaluation is based on measuring and monitoring the performance criteria of the projects (Barclay and Osei-Bryson, 2010), and traditionally, also the performance of projects has been dependent on time, cost and quality (Pillai et al., 2002) (Wi and Jung, 2010), and on the ability to successfully complete them if these requirements are met. Projects must meet budget, schedule, safety, and quality goals to be regarded as a success (Bayraktar et al., 2011). In construction projects, for example, the importance of measuring performance is critical in the process of control, since it allows to monitor the performance to achieve the ultimate objectives (Haponava and Al-Jibouri, 2008), and to estimate a performance score using a framework based on monitoring performance indicators (Yuan et al., 2011).

Although there is divergence of opinions on what constitutes "the success of the project" (Prabhakar, 2008), it is considered appropriate to highlight the difference exposed by Baccarini (1999) and de Wit (1988), for which it must be distinguished between project success, as measured by the achievement of the objectives of the final product, and project management success, usually measured in terms of time, cost and quality. In this regard Cooke-Davies (2002) states that a difference should be made between the success criteria (the measures by which success or failure of a project will be judged) and success factors (inputs to the system of management that lead directly or indirectly to the success of the project). Although the literature commonly referred to cost, time and quality as the criteria for project success, it has also been suggested the need to consider new approaches (Agarwal and Rathod, 2006).

In project management, assessment and analysis of success factors can establish the efficiency and effectiveness of the implementation process. Figure 2 synthesizes the debate on a vision in which the approach to evaluate the project execution is structured from this two perspectives: management (success factors) and outcomes (success criteria). Critical success factors are recognized as a key element for that project to achieve its goals (Meng et al., 2011), for example, it has been recognised that human capital is a key success factor of particular interest in projects because of teams influence (Chinowsky et al., 2011). Three important elements are seen on each approach: measuring success, performance assessment, and measurement process factors.

The interest part of the study is the focus on exploring all those criteria and metrics to evaluate the process management so that its outcome can be useful in guiding the projects implementation. Thus, the approach is to analyze the way used to reach the final outcome of a project.

Figure 2 : Project management success and performance.

MANAGEMENT APPROACH	ELEMENTS	OUTCOME APPROACH
Key success factor	⇦ SUCCESS ⇨	Success criteria
Procces	⇦ PERFORMANCE ⇨	Product
f(t,c,q) + other factors	⇦ MEASUREMENT ⇨	f(t,c,q) + other criteria

f(t,c,q) = function(time, cost, quality)

Project performance can be measured through Key Performance Indicators (KPI) (Luu et al., 2008). Project management performance systems are defined as the set of indicators used to quantify the efficiency and effectiveness of actions (Marques et al., 2011). Overall, project management performance is the establishment of performance targets, the choice of a strategy to improve through critical success factors (CSF), and the implementation of a measurement process with KPIs (Toor y Ogunlana, 2008). Some studies show that it is impossible to generate a universal list of factors, since they vary from one project to another (Jha y Iyer, 2007; Marques et al., 2011); and others like Van Der Westhuizen & Fitzgerald (2005) propose, for example, to include new dimensions different from traditional ones like management quality process and meeting stakeholders expectations, to have a fuller picture of the project.

This article aims to analyze and categorize the orientation of the performance measurement phenomenon in the discipline of project management. It also aims to contribute to a simplified framework for analyzing the performance in project management, elaborated from the bodies of knowledge, standards and literature. It is expected to contribute with fresh qualitative categories, to help under-trained project managers in developing countries to develop performance indicators that evaluate the implementation of their projects.

Articles on the topic and relevant research contributions have been studied. Guidelines for choosing performance indicators are provided with the classification of a set of metric categories found in literature. In addition, through the illustration of the application of project performance indicators in public sector in Colombia, expected to contribute to its adaptation in a specific environment, and to improve situations as described through the proposed framework.

2. Methodology

The question that want to respond to with this research is: What qualitative performance categories can be used to evaluate the management of a project, facilitating the manager's work?

The methodology has used qualitative and quantitative strategies. Two interesting aspects have been revised in the literature: (1) bodies of knowledge and standards in project management, (2) scientific journals that publish contributions in this issue, such as: International Journal of Project Management, Project Management Journal, Journal of Management in Engineering, International Journal of Productivity and Performance Management, Expert Systems with Applications, among others. To carry out searches combinations of key words have been used, like "project", "measurement", "performance", "management", "indicators". Once the search is carried out, the phenomenon of performance measurement in project management is contextualized. In addition, It has carried out an interpretive work of international standards and bodies of knowledge (BOK's) most representative of Project Management. With this descriptive approach has been established on the one hand, good practices, and on the other, gaps, as well as the research needs. Once the literature is reviewed, a general framework was developed and simplified by a table structure that characterizes the major factors in the literature, from which performance indicators for projects can be developed and applied. With the analysis of the case study empirical evidence was collected on the application of indicators in a real context, which helped verify which categories are usually applied in project management of the public sector

3. Bodies of knowledge and standards.

The Project Management Institute (PMI) determined in its body of knowledge that the performance report (or reports of performance) is the instrument that summarizes the status of activities being carried out to achieve the expected work on the project schedule (Project Management Institute - PMBOK®, 2008). These reports support the direction and management project execution, and should be made to collect and distribute the status and the measure of the progress, including information regarding: the status of deliverables (change request, corrective actions, preventive actions, defects repair), estimates at completion (percentage of work physically completed), and the achieved value of technical measures (starting and ending dates of scheduled activities) (Project Management Institute - PMBOK®, 2008).

The International Competence Baseline (ICB), body of knowledge of International Project Management Association (IPMA), considers progress and performance measure as a technical area called "report control", included as part of the implementation, management execution and project closure (International Project Management Association - IPMA, 2006) (Asociación Española de Ingeniería de Proyectos - AEIPRO, 2009). This measurement according to the ICB is based on comparison of goals, plans and contracts planned for the project, against the progress and the actual performance as a measure for taking corrective actions. Monitoring the status of performance on specific dates and the issuance of reports to communicate the situation to those involved, are some of ICB procedures to implement its application in the project development.

According to the ISO-10006, which provides guidelines for quality in project management, information on the project performance should be recorded as part of a factual approach to decision-making (The International Organization Standardization (ISO), 2003). Also, the norm indicates that to assess the status of the project a performance evaluation should be carried out, analyzing the state of progress regarding the management plan and defining the performance indicators and the way to

measure them. The study also presents techniques of checkup and measurement, such as the use of a project management log book and an earned value analysis.
The Association for Project Management (APM) states in its body of knowledge that a professional project manager should monitor the project, the baseline plan and the key performance indicators (Association for Project Management - APM, 2006). According to APM the key performance indicators are measures for evaluating the success of the project that are established in the beginning, and provide the basis for making decisions during the course of the project. For their estimation, APM recommends the comparison of the actual performance with the plans and the implementation of the Earned Value technique, with the concept of representing the physical work done in terms of accumulated financial value.

Methods such as PRINCE2 (Projects in a Controlled Environment) (Office of Government Commerce - OCG-UK, 2009), which is also considered as a standard in project management in the United Kingdom, attaches importance to the communication of project performance as an activity to carry out during the completion of each phase and at the end of the project. This process is presented through the comparison of the performance of planned goals, tolerance levels, time, cost, scope, benefits and risks. Furthermore additional information on the performance appropriate for decision-making is included like planned and completed activities, pending products to be delivered, incomplete work, current risks and project forecast. The method includes the earned value technique and progress of the project approach.

A general consensus can be observed that in all bodies of knowledge and standards in project management the performance is regarded as an aspect related to the executing process. There are some differences regarding the parameters for its measurement and few metrics for its application. Table 1 summarizes the concepts of performance, the parameters for their study and recommended techniques or tools. It shows how the concept is argued by comparing planned against executed, with some differences in the parameters that are included for this comparison.

Table 1. Performance approach in project management standards.

STANDARD	PROCESS	PARAMETERS	TECHNIQUES
PMI-PMBOK	Comparison of the work plan with executing project	Scope (Deliverables)	Earned Value Management
		Schedule (dates achieved))	KPI
		Cost (% work completed)	
IPMA-ICB	Comparison of progress with planning	Objectives	Earned Value Management
		Plans	
		Contracts	
APM-APMBOK	Comparison of actual performance versus plan	Actual work on financial data	Earned Value Management
ISO-10006	Situation analysis of progress with the plan of management	Progress	Earned Value Management
		Contracts	KPI
PRINCE	Comparison of performance with planned goals	Time, cost, scope, risks	Earned Value Management
		Benefits	
		Products to be delivered, work not completed	

When making a comparison of standards with respect to performance measures, one can see that although there is agreement on the design, the parameters referred to are different in most cases. There are very important elements such as the evaluation of cost function in respect to work completed, progress analysis, scope, and milestones actually achieved.

Guidelines on implementation of specific metrics for evaluating performance in project management are scarce, except for performance indicators of earned value management technique suggested in all bodies of knowledge and standards. Therefore has been reviewed the literature related to metrics that have been used to estimate the performance, on both generic projects and specific types of project and / or sector.

4. Literature review and categorization.

This section is intended to make a revision of contributions made from year 2000 on implementation of performance measurement systems, or indicators, for project management processes, formulating a structure that combines the contributions studied in categories. Most discussed applications have been implemented in construction and technology sectors, perhaps the two areas that show more progress in project management. Other contributions are found in areas of public development projects, oil and manufacturing in smaller amounts, as well as some proposed generic models.

In general, most indicators are organized based on the so-called golden triangle (cost, time and quality) (Wi and Jung, 2010). From this triple set of metrics, the number is further extended to additional categories generated according to sector, project type or author's interests. In the case of Ling (2004), Sohail and Baldwin (2004), Jha and Iyer (2007), Cho et al (2009), they propose traditional categories or some additional ones, as summarized below. Time, cost and quality have long been the success criteria used to evaluate the performance of a construction project (Chan et al., 2002).

Ling (2004) adopts a set of 11 metrics taken from previous studies which have examined the criteria for design-building projects of the U.S. public sector. He investigated the factors affecting the performance and success in projects, stating that measuring the success of projects can be improved through the search of success in product and success of the process. Ling classified the metrics in four categories: cost (unit cost, cost growth, intensity), time (construction speed, delivery speed, schedule growth), quality (turnover quality, system quality, equipment quality), and, owner (owner´s administrative burden, owner´s satisfaction).

Sohail and Baldwin (2004), based on data from 800 projects undertaken in developing countries, compiled a total of 67 performance indicators to be used in micro-projects, grouping into four categories indicators: time, cost, quality, and, inter-organizational co-operation and partnership.

According to Jha and Iyer (2007), there are no universal criteria to measure the success of the projects, and suggests that they could be grouped into two broad categories: objective assessment criteria (which are tangible and measurable such as cost, quality, safety and disputes), and subjective evaluation criteria (intangible such as customer satisfaction, contractor satisfaction; and project management team satisfaction). Through surveys of construction project managers in India, they incorporate suggestions from previous research and propose a set of critical factors (commitment, coordination and competition) that affect the project performance. Therefore, the categories considered are: Schedule, cost, quality, disputes.

Cho et al. (2009) developed a model to explain the relationship between performance and the characteristics of construction projects, identifying the influence of these latter on the projects performance. Indicators identified through literature review were categorized into two areas: costs (cost of the contract, final cost and increased cost), time (growth and programming).

Other proposals found in the literature make contributions from several categories different than traditional, including other performance measures for project management. It is considered important

to review these contributions, since all the factors that can be collected from them will form the proposed structure with the development of this work.

Dey (2000) identifies some procedures applied in actions for planning, monitoring and control of projects, which include as performance measure, work packages plans, time and resources, and index results of earned value analysis. The author's proposal seeks to determine the resources required to complete projects faster and support its execution activities.

Stewart (2001), applying the Balanced Scorecard technique, suggests that the minimum measures of a project combine four areas: financial, customer, project/ internal business, and growth/ innovation. He also recommends that when using the body of knowledge of the Project Management Institute (PMBOK) as a guideline for measuring performance, an indicator for each of the outputs of the process groups that make up its structure must be designed.

Sanchez and Perez (2002), have studied the use of techniques and indicators of efficiency in research and development in the Spanish industry, in order to generate contributions to help the managers of such initiatives. Although in their proposal they suggest specific indicators to this type of project, there are also some general indicators that can be applied in other settings or industries, with categories such as time (total development, deviations, partial), network (communication, coordination), cost (development and deviations) and customer satisfaction.

Bryde (2003), proposes a performance model with six criteria to evaluate the management of projects, based on the EFQM model for quality management. The author concludes through a survey that the criteria for evaluating performance are related to seven factors: leadership, staff, strategy, resources, management processes and key performance indicators. The latter (KPI) are defined as the ability to develop measurement methods of delivery, benefits, stakeholders and organizational aspects.

Westerveld (2003), has developed a model of success criteria (outcomes) and success factors (organizational) for six organizational areas that can be applied in several stages and situations of assessment and management of projects. The model of Westerveld, based on the literature, has identified six organizational areas of critical success factors: leadership and team, strategy, stakeholder management, resources, contracting and project management (scheduling, budget, organization, quality, information and risks). The areas that have been identified in the study can be used as categories of performance evaluation in project management processes.

Cheung and others (2004), have developed a web-based environment to monitor performance in construction projects. The system includes eight categories of measurement: people, cost, time (deadline), quality, safety and health, environment (around), client satisfaction and communication. The effectiveness has been evaluated in a case study in Hong Kong, using sets of indicators for each category, which have been adapted from construction public reports. The system has been useful to identify omissions in the management of projects and to find solutions in the shortest possible time.
Bryde and Wright (2007) conducted a study on project management practices in the social housing sector in the UK, with which they prepared a profile of performance factors for projects with five significant themes: managing efficiency, customer and project team orientation, stakeholder orientation, control and flexibility.

Barclay (2008) researches and develops a multi-dimensional performance assessment method called "Project Performance Scorecard (PPS)". The method provides a framework of six dimensions to assess projects. These are: Project process, the benefit, the innovation and learning, use quality, and stakeholder perspective. The research study is based on literature of performance and the basis of the project should be considered in three interconnected aspects: the project success, the project management success and product success. Using the technique Balanced Scorecard (BSC) an approach is presented for measuring organizational performance from four perspectives: financial, customers, business processes and learning.
Luu et al. (2008), used the approach from the benchmarking with the competition (benchmarking) to improve the measurement system of projects performance in Vietnam, by identifying areas or categories and sub-indicators for construction projects. The classification was established by reference

to the contractor's point of view, with the following metrics: cost, time, customer satisfaction in services and products, quality, project team performance, change management, materials management and safety work management.

Barclay and Osei-Bryson (2010) had designed a model for strengthening competences of decision in the analysis of processes in information systems projects. Through the use of a performance system that has been developed based on performance criteria review of the literature, the implementation is classified into four themes: project management and project team, customers and other stakeholders, product or service, and preparation for the future. The model called "Project Performance Development Framework - PPDF" addresses the perception of performance across different values and different measures of traditional systems, ranking into four criteria: project, product, design and project management, project and product.

Toor and Ongulana (2010) say that gradually the project performance measure is moving away from traditional measures (such as cost, time and quality) to a combination of quantitative and qualitative measure. Through analysis of the literature in construction projects, they tried to capture the vision of the project leaders about different key performance indicators (quantitative and qualitative) in public development projects. The authors propose a framework of indicators in nine areas: time, budget, specifications, safety, efficiency, effectiveness, defects free and in accordance with the stakeholders' expectations.

Lauras (2010) et al present a performance measurement system that applies indicators in each of the tasks resulting from the work structure division (WBS) of the project, on topics of efficiency (measures whether the resources were well used to achieve the goals), effectiveness (measures whether the results of the activity meet the objectives) and relevance (measures whether the means are fit for purpose). For each task the indicators are defined by taking the nine knowledge areas of PMI, and for each one of its elements one efficiency indicator is assigned (usage rate), an indicator of effectiveness (achievement of progress) and one of relevance (re-estimation of the final). Under the proposal, each task will get a number of indicators equivalent to the product of areas of knowledge and performance criteria (areas * criteria). The alternative is interesting because it clearly defines the criteria for choosing the indicator. However, the number of measurements could be extended in many complex projects and tasks.

In software development projects, metrics are commonly used to measure project performance and progress. In this regard work such as the Presedo et al. (2010) have identified a set of metrics and indicators to monitor the management of projects, which are grouped into the following categories: effort, cost, time, staff hours, changes and errors.

Cao and Hoffman (2011) worked on the design of a system for evaluation of project performance for a manufacturing and technology company, in which they carried out a first stage of metrics selection through result categorization of a survey. The indicators chosen were: project duration (working days to complete the project), effort (work content of the project), project staff (number of people in the project), priority (urgency of the project), number of engineers (number of functional area during the project) and technical complexity (technical difficulty and uncertainty of project).

Bernroider and Ivanov (2011) highlighted the importance of managing the monitoring of progress of projects through their life cycle. In their study they evaluated a group of metrics proposed by a method for IT projects. They conclude that the metrics are seen as useful for management control of projects and are used very little in practice. The metrics of the study focused on categories of budget, time, stakeholders, project managers and use of standards.

Table 2 shows a summary of the review discussed in this paragraph, in which all the performance criteria referred to in the literature have been classified, seeking thereby the formation of a single instrument to categorize all the proposals that have been found.

Table 2. Approaches to performance in project management literature

PROJECT TYPE	CATEGORY	AUTHOR
Construction	Cost, Time, Quality, Safety, Health, environment, Costumer satisfaction and Communication	Cheung & Cheung, 2004
Construction	Cost, Time, Quality, Owner	Ling, 2004, Chan et al 2002
Construction	Cost, Schedule	Cho & Hyun, 2009
Construction	Working team, Continuous improvement, Time, Budget, Specifications, Resources/Efficiency, Effectiveness, Safety, Defects, Stakeholders, Conflicts	Toor & Ogunlana, 2010
Construction	Schedule, Cost, Quality, Arguments	Jha & Iyer, 2007
Construction	Stakeholders, Time, Cost, Monitoring of standards, Implementation, Training	Bernroider & Ivanov, 2011
Construction	Cost, Time, Customer satisfaction, SGC implementation, Project Team, Change management, Materials management, Safety management	Luu, Kim, & Huynh, 2008
Developing	Time, Cost, Quality, Organization	Sohail & Baldwin, 2004
General	Staff, Leadership, Policy and strategy, partnerships and resources, Project life cycle management processes, Indicators.	Bryde, 2003
General	Nine areas of PMBOK	Lauras, Marques, & Gourc, 2010
Generic	Time, Budget, Costs, Meeting objectives, Customer satisfaction, Benefits, Resources management, Change management statistics, Quality	Stewart, 2001
Generic	Leadership and team (tasks and responsibilities), Policy and strategy (objectives/goals), Stakeholder management, Resources, Contracting, Scheduling, Budget, Organization, Quality, Information, Risks	Westerveld, 2003
IT	Budget, Indicators of earned value management, team project, Time of task completion, customer, cost	Barclay & Osei-Bryson,2010
IT	Time, Cost, Scope, Successful implementation, Stakeholder, Learning and innovation, Benefit, Quality, Use.	Barclay, 2008
Research and development	Profitability, Time, Communication, Coordination, Cost, Customer interaction, Diffusion, Strategy	Sánchez & Pérez, 2002
Manufacturing and technology	Time, Effort, staff, Urgency/priority, Difficulty and uncertainty	Cao & Hoffman, 2011
Organization	Time, Cost, Quality	Wi & Jung, 2010
Petroleum	Scope (work packages), Time, Resource plans	Dey, 2000
Software	Effort, Cost, mistakes, Scope, Risks, Changes	Presedo, Dolado & Aguirregoitia, 2010
Vivienda social	Cost, Duration, Suppliers, Customer satisfaction Project team orientation, Progress against schedule	Bryde & Wright, 2007

Table 2 shows that many types of categories are similar although they are assigned with synonymous terms, which has enabled to group them into the same category. By contrast other metrics represent a different proposal that sets new categories, in some cases unique. Following the same approach and going from the particular to general, all types of metrics have been classified according to their type, affinity and synonymy. Once all the metrics have been cataloged into groups based on their affinity, a unique name is assigned for each category. The result is a qualitative list of categories for guidance on performance measurement in projects, which has been developed from the research and interpretation of literature, unifying all approaches in one global element.

Table 3 presents all the categories obtained, sorted by the frequency they are mentioned in the literature studied.

Table 3. Categories of measuring performance in project management literature

#	CATEGORY
1	Time
2	Cost
3	Quality
4	Customer satisfaction
5	Organization - Management
6	Staff
7	Efficiency
8	Scope
9	Communication
10	Changes
11	Effort
12	Profitability / Benefits
13	Contracts / procurement
14	Risks
15	Safety and Health
16	Conflicts / Arguments
17	Environment
18	Urgency
19	Commitment
20	Successful implementation
21	Relevance / reassessment
22	Diffusion

The results obtained may be useful as an assessment of those systems using metrics to evaluate the results of their project management. Therefore the applicability of the list of categories obtained has been assessed, compared to the metric system used in the case study by using preliminary compilation of a case study of public project management in Colombia, which will be presented in the next section.

5. Case study: public sector in Colombia

This section is intended to examine the indicator system operation in the public project management in Colombia. It intends to find preliminary evidence so that the synthesis obtained by the revision of body of knowledge and standards can be useful to evaluate project management. The following section describes the foundation for the case study, the process operation and some of the indicator categories that comprise it.

One of the reasons why public managers must measure performance is to know the programs, people, or projects in which to spend the money of the citizens (Behn, 2003). The execution of a public project must be clear in regard to the work to be done and its monitoring to reduce the likelihood of facing higher costs, lower yields, and little accountability (Kassel, 2008).

Project management in the public investment system in Colombia has a normative framework and methodological components so that their institutions (at a national or regional level) carry out their projects with funds from the national budget, provincial or local, equity, foreign credit or cooperation resources. The institution responsible for coordinating actions is the National Planning Department (NPD[1]), which carries out the process by using methodologies, computing tools and procedures. These have been designed and developed over several decades to strengthen the administration of public investment in the country.

According to a national decree "all investment projects that are to be eventually financed or co-financed with resources from the General Budget of the Nation, must be registered with the Bank of National Investment Projects (BNIP) (Colombia - Decree 841 - 1990 1990), which is a tool that allows to centralize all projects eligible for funding. The NPD has established methodologies and manuals for the operation of BNIP, and coordinates a national network of banks for projects (regional, departmental, municipal and district) that serves as support for the planning processes, budgeting, monitoring, control and evaluation of projects and results of public investment (National Planning Department, 2006a).

Methodologies designed by the NPD to manage projects are: adjusted general methodology (AGM) (National Planning Department, 2006b); monitoring methodology (National Planning Department, 2004b); ex post evaluation of programs and investment projects (National Planning Department, 2004a); and adjusted general methodology (MGA) manual for the identification, preparation and evaluation of programs or mother projects (National Planning Department, 2005a). The AGM is the guideline for the formulation, evaluation and project scheduling, and is complemented with a tool that records information through templates and spreadsheets. This tool summarizes project information in formats that facilitate the transmission of information for their registration in BNIP. In the methodology, indicators must be recorded for monitoring the execution of projects, and the information that has been planned is compared with the actual work that is recorded in the monitoring stage.

The project monitoring methodology has been proposed to control activities in the execution of projects, and is composed of manuals, procedures and formats. The project organizations are

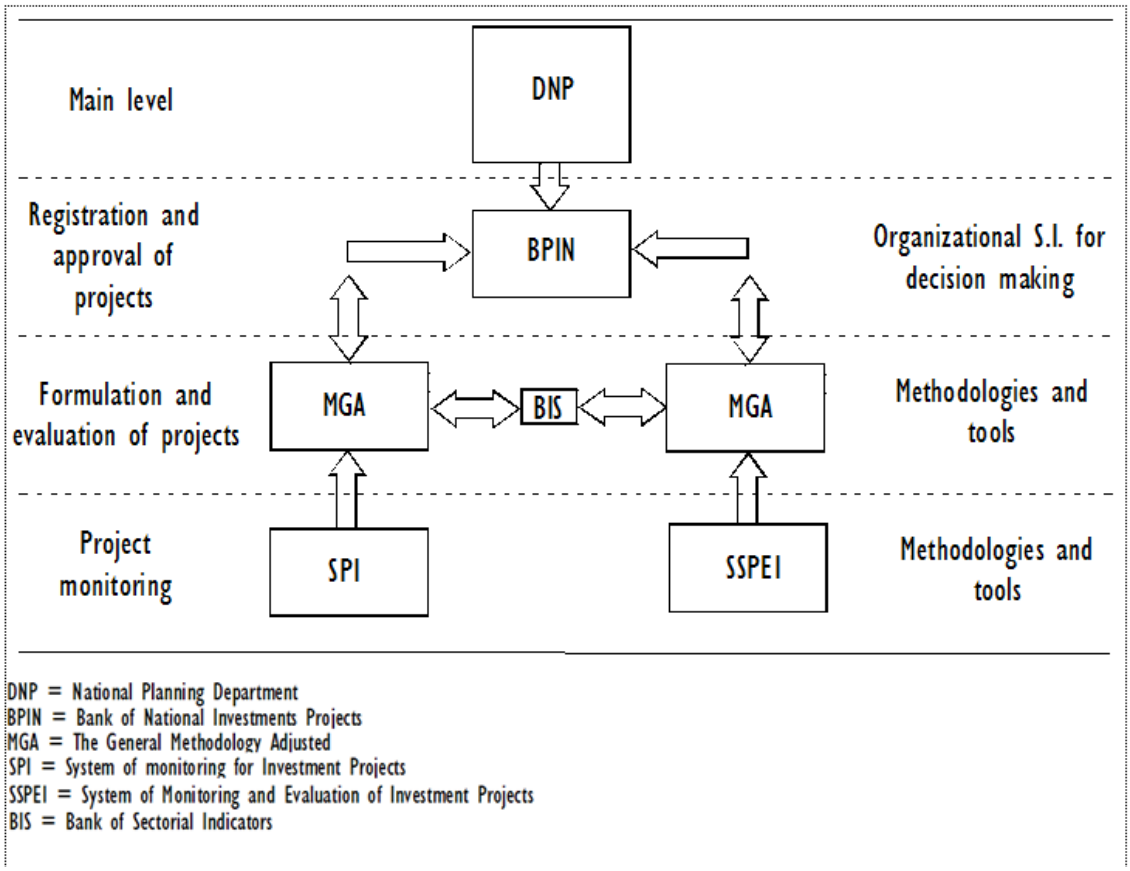
[1] See www.dnp.gov.co

responsible for their execution, and must submit regular monitoring reports that are centralized in the NPD. The monitoring and evaluation system for investment projects (MESIP) (National Planning Department, 2005b) must be used at territorial level, and the monitoring system for projects (MSP)[2], at national level. At territorial level, for example, project managers must submit reports to the planning offices of municipalities and departments, as these provide the information necessary for the operation of the monitoring and evaluation system for investment projects (MESIP). Figure 3 shows a schematic diagram with the interactions between the entities, methodologies and tools in the case of Colombia.

One strategy for monitoring the implementation of projects is based on the comparison of those goals and indicators that have been registered when programming projects with the AGM tool. With the information reported regularly in "MSP" and "MESIP" by using the indicators, the degree of progress is defined between the activities executed and those planned. These indicators are chosen from a database called Sectoral Indicators Bank (SIB), which contains about 2400 indicators classified in three categories: product, management and impact, from which those that evaluate project performance are chosen (or new are proposed).

The method used by the NPD in Colombia, with group management metrics to evaluate the project, is considered a convenient tool for the context in which this is applied since it requires a fast and accurate verification of the efficiency in the execution of investments. It is worth examining the contents to compare the result of the analysis of metrics and categories of body of knowledge, standards and literature.

Figure 3: Interactions in the public projects management in Colombia (Adapted from information published on DNP



[2] See http://spi.dnp.gov.co/

To carry out the preliminary analysis of the indicator system, it has been compared with the information reported in the MSP tool for a sample of 146 investment projects in 16 different sectors (social action, agriculture, environment, housing, development, commerce, industry, tourism, culture, sport, recreation, education, mines, energy, planning and transport), registered to be executed at different period intervals between 2003 and 2018. The indicators recorded in each of the three categories (product, management, and impact) have been analyzed for each project, with emphasis on the indicator that verifies the project management.

No similarity was found between the indicators used by all projects in any of their types (management, product or impact). In the case of the performance indicators it can be concluded that neither general guidelines nor permanent metric groups are available for all the projects. Each formulator and project director includes the indicator that is considered convenient to measure the progress, since the only case when the indicators are repeated is when the project is registered by the same person.

Once the MSP database is analyzed, from 607 indicators in the category of "management" and taking as parameter the categories obtained in the review of standards and literature, about 3% refer to project management measures. Topics of existing indicators are: compliance with budget execution, scheduling the project (meeting deadlines, progress in resource scheduling), ratio of planned costs against implemented, project execution time, total amount of resources and executed budget against allocated. Table 4 shows those indicators of 'SIB' classified in the typology of management that have some similarity with the categories established as a result of the review. It can be appreciated that indicators collected would be placed in the categories of time and cost (see Table 3).

Table 4. Indicators of "BIS" useful for project management (Source: BIS – DNP)

INDICATOR NAME
Compliance with budget execution
Scheduling the project.
Monitoring scheduling project
Monitoring scheduling of project's investment
Index of executed budget against planned
Execution of the project according to schedule
Unit Cost scheduled against execution cost
Execution time of the project
Production rate of activities
Rate of implementation of activities
Percentage of projects with a monitoring actions
Budget execution against definitive appropriation
Progress in time of the project.
Partial amount of resources executed
Total amount of resources executed.
Budget executed against allocated.

Performance indicators have been explored in projects that belong to the same sector, with the aim to find metrics that are repeated in more than one of them. Those that appear more than once have been compared with the categories established in the review of standards and literature. When applying the three types of indicators, in general, all projects report management and product indicators. Only thirteen (13) projects out of the hundred and forty six (146) did not report such management indicators (approximately 9%).

Impact indicators are not included in any of the projects in the sample. By analysing the indicator's use for each sector (for the two types of indicators: management and product) it can be concluded that there is no agreement about a guideline to evaluate the management and performance.

Although the frequency of repetition is low, the results are shown below (sector - indicator): contracts signed with operators (social action); projects co-financed (agriculture); signed inter-administrative agreements (environment, housing and development - commerce, industry and tourism); managed cooperation resources (culture, sport and recreation); announcements (education); administrative acts issued for the allocation and distribution of resources (mines and energy); percentage of resource allocation agreements issued within the established time (Planning); assigned contracts, signed agreements (transport).

Below other "SIB" indicators a match is shown with one of the categories that could be used to carry out project performance evaluation: percentage of implementation progress, performed monitoring reports, committees carried out for Project coordination and supervision, action plan progress, percentage of construction progress, presented reports.

It is considered, in general, that the indicators used for monitoring the projects do not take into account all the elements that should be incorporated to visualize the state of their management. The indicators identified can be classified into one or two categories (contracts, scope time) of those established in the review of standards and literature; however with the outcome of their reports it is not possible to have more evidence to qualify the project management. The indicators are not shared across sectors and none of those recorded as management indicators of the SIB database are used. Those that are registered between the items of "management" are focused to measure the percentage of the product that has been completed in the time unit.

When comparing the types of indicators that have been used in the case study and the metrics obtained as a result of the review of the literature, it is considered that a group of fixed metrics could be incorporated into the Colombian system for all the projects to maintain control management of the projects with higher degree of standardization. The tool generated with the standards and review of literature, presented in the first part of this paper, contains a group of categories that can guide those responsible for project management on the metrics they can use to have useful information to carry out their work.

6. Conclusion

Although guidelines for project management cannot agree on the meaning of project performance and a tool for assessing management process through indicators, numerous proposals for performance measure systems have been developed for various types of projects and sectors. The development of an overall performance measure may be useful to indicate whether management made by directors includes all groups of qualitative categories needed to improve the chances of success in their projects.

The categories that have been established from the literature review and that have been presented in the first part of this communication constitute a substantial input so that in subsequent research and in real application frameworks the usefulness of the tool is validated and new contributions are produced to manage project implementation.

In the categories of performance for project management synthesized from the literature review, the traditional measures (time, cost and quality) are the most cited in all types of projects and sectors included in the study. However, there is a new set of metrics that are related to significant aspects of the project staff, with whom performance can be intervened, such as disputes, commitment, communication and efforts levels. The above categories may represent a group of success factors with direct bearing on performance, and should be incorporated to the measurement systems.

Other measures that stand out in the above categories are related to the changes, effort, and project organization. It is considered that these aspects represent controllable features in the process management, with which they can improve the control capability and the outcome of the project.

The Public Investment System of Colombia presents a major advance towards the consolidation of public sector projects, and with that in mind, it could complement the current tools with inputs to improve the management and work of people who represent the NPD in national and regional institutions. Tools such as MSP and MESIP are expected to follow up on projects from a material, financial and contractual point of view; and the progress made with them could be beneficial if other groups of indicator categories are incorporated into the project management assessment. Thus, the use of techniques such as earned value management is considered, which is suggested in all the body of knowledge and standards of project management.

According to the characteristics of the execution of public investment projects in Colombia and the work of those responsible for its management, the basis of information from SIB should be broaden towards a performance measure with fixed management indicators for all projects. In addition, indicators could include measures in all categories set out in the present paper to establish a full assessment of project management. The incorporation of measurement metrics should even be incorporated in the conditions of tenders, as a tool of control of contractors and executors.

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