



# PROJECT MANAGEMENT METHODS FOR PUBLIC INFRASTRUCTURE PROJECTS

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Given the importance of public infrastructure projects to the civil construction and considering the Brazilian context, the aim of this paper is to improve the management efficiency concerning project management methods applied to this kind of construction project. Using a multiple case study approach, the research has examined two large infrastructure projects and identified the critical points to achieve projects' success. One project is from the sanitation sector and the other from the transportation sector, both developed in the Metropolitan Area of Sao Paulo and its surroundings. Public infrastructure projects normally have high levels of technical and management complexities. In recent years in Brazil, infrastructure projects have been showing increasing costs and a growing number of active companies. Moreover, these kinds of projects tend to interfere in the urban and rural areas in the cities, presenting many different influences and interests coming from several stakeholders and, consequently, bringing a high level of management complexity. This paper presents the initial results of the case studies carried out in order to identify guidelines for the application of project management methods in public infrastructure projects. Continually taking into account the context and the specific needs of each project, these guidelines intend to aid structuring, planning and maximizing the results, the final quality of the construction products and contribute with the improvement of project management practices adopted.

*Keywords:* Public projects, Infrastructure construction, Critical points, Management guidelines.

## 1 INTRODUCTION

The purpose of this paper is to examine how project management methods have been applied to infrastructure projects in order to identify guidelines to assist their planning and structuration, to improve the management quality and help achieving the expected results. The identification of guidelines and best practices, highly applicable to the reality of these projects, is supposed to maximize results and the final quality of their products, increasing their performance and their benefits generation. This paper aims to discuss how public infrastructure projects apply project management methods and which results come from this application, or even the lack of this application, and identify guidelines for successful projects.

## 2 RESEARCH METHODOLOGY

A multiple case study approach has been adopted to examine two big projects of infrastructure and to identify the critical points to achieve projects success. Documental analysis and semi-structured interviews have been carried out with professionals directly involved in the

management of these projects. These interviews were based on a previously designed script, which was adapted as the interviews took place.

According to Yin (2015), a case study allows researchers to focus on a "case" and to retain a holistic view of the real world. He further says that the differentiated need of case study research arises from the desire to understand complex social phenomena.

### 3 RESEARCH CONTEXT

In recent years in Brazil, according to the Annual Survey of the Construction Industry prepared by IBGE (2016), infrastructure works have registered increasing amounts of production and active companies in the sector.

Table 1 shows that, in 2014, 10% of active companies accounted for a production value of approximately R\$ 142 billion, which in turn represented 40% of the total value of production in the construction industry. Active companies must manage a gross value of production that has been increasing over time, which shows the need to improve the management of these projects to improve its efficiency in obtaining results. These values also highlight the relevance of infrastructure projects for the Brazilian construction industry.

Table 1. Active companies and gross value of production, from 2007 to 2014 (IBGE 2016).

<b>Year</b>	<b>Active companies</b>	<b>% of active companies</b>	<b>Gross value of production R\$ (x 1.000)</b>	<b>% of value</b>
2007	8.193	15	55.886.302,42	45
2008	7.337	13	74.062.216,36	48
2009	8.114	13	88.658.255,32	47
2010	10.189	13	107.971.289,00	44
2011	9.117	10	114.567.712,00	42
2012	10.345	10	131.718.526,00	41
2013	11.713	10	136.664.205,00	38
2014	11.439	10	142.594.515,00	40

Project Management stands for the application of knowledge, skills, tools and techniques to project activities to meet project's requirements (PMBOK Guide 2013). It is still a multidisciplinary activity, which must be performed - impartially and unbiasedly - by an experienced professional (Melhado 1994). Public projects present several conflicts of interest, such as private agents, public agents, population, environmental, political, public management, regulatory bodies, and suppliers, among others. The large number of stakeholders and agents with different and divergent interests make it difficult to manage this type of project (Brito 2013, Melhado 2005). According to Brito (2013), projects with these characteristics can be called complex projects, as they are less predictable than smaller projects with fewer agents. For Silva (2015), projects with complex characteristics involve large project teams, geographical distribution, the need for rapid delivery of value to the customer and requirements that change over time.

One difficulty of the public sector in Brazil is the submission to the laws, created to guarantee the transparency and the suitability of the public contracts, thus establishing severe restrictions to the evolution of the project management's processes. The main law regulating the contracts of works and services of the public sector in Brazil is the 8,666/93, responsible for splitting the design and construction stages of the public projects. To reinforce this issue of lack of integration of project agents, at the end of July 2016, the president of the Republic, Michel Temer, signed the State Responsibility Law, which allows public works bidding without previous design and detailing.

## 4 CASE STUDY

### 4.1 Description of Projects

Project A relates to the construction and concession of a water sanitation system, approximately 83 km long, for the metropolitan region of São Paulo. It began in mid-2013 and will be completed by early 2018. This project is larger than other projects currently under development in the public sanitation company, which generates the need for intense monitoring, since its results interfere directly the company's results. It goes through some areas of environmental protection, leading to the need for environmental management to minimize the impacts caused. It counts with a management team of six people from the client, the public sanitation company. A consortium was hired to carry out the management and supervision of the works, with approximately 40 people. From this team, seven people carry out directly the management activities. Project A uses as basis for its management a method developed by the public company. This method includes tools and indicators that assist in the analysis and decision-making, that helps guaranteeing the quality and project's results.

Project B is the construction of a 12 km long railway line and three stations that will connect the metropolitan area of São Paulo to an airport. Its activities began in October 2013 and will be completed by the end of 2019. This project has a management team of six people from the client, the public railway company. A consortium was contracted to supervise the works, with approximately 30 people. From this team, two people carry out directly the management activities. Project B uses several tools to carry out its management, which were developed based on best market practices, but with the necessary customizations to meet the needs of this project.

### 4.2 Data Collection and Analysis

Data from the case studies were collected through documentary analysis and interviews. Team members of each project were interviewed to have an overview of the management and the results achieved.

In order to analyze the data collected, the answers were compiled into a digital file and sent back to the interviewees thus they could validate the answers given. This made it possible to guarantee the accuracy and impartiality of the data collected. Then, the data was formatted as a matrix, similar to one presented in Table 2. This matrix enabled the authors to compare and analyze the data of both projects.

The purpose of the analysis is to find the logic of the standard combination (Yin 2015), a technique in which a predicted standard, based on the research questions, is compared to an empirical standard, based on the data collected in the case studies. Complementing this technique, the cross-synthesis of the data was used, in which the organization of the data of the two cases, in a similar format, made the comparative analysis possible.

Taking into account the issues that motivated this research, the analysis of the data collected focused on identifying the answers to the following research questions: 1) what context and complexity of these projects are and their various agents involved; 2) what are the most critical management aspects to their success; 3) what aspects of project management methods can help achieving projects' success. The purpose of the case studies is to identify their context, critical aspects of project management and the use of management methods, continuously with the focus on identifying the results obtained by these projects, taking into account the use or lack of use of knowledge in project management.

So far, it has been observed, as described in item five, that the application of project management methods, whether pre-existing or created as needed during the project development, is necessary for the achievement of its success.

Table 2. Main synthesized collected data.

<b>Project</b>		<b>A</b>	<b>B</b>
<b>Has a Project Management method been systematically adopted?</b>		Yes	No, it is being developed along the project by the professionals involved
<b>Tools</b>	<b>Integration</b>	Applied	Applied
	<b>Scope</b>	Applied	Applied
	<b>Time</b>	Applied with adaptation	Applied
	<b>Costs</b>	No project costs control	No project costs control
	<b>Quality</b>	Applied	Applied
	<b>Human Resources</b>	Not mentioned	Not mentioned
	<b>Communication</b>	Applied	Not mentioned
	<b>Risks</b>	Applied	Applied. Under development
	<b>Procurement</b>	No project procurement control	No project procurement control
	<b>Stakeholders</b>	Applied with difficulties	Not mentioned
<b>Environment</b>	Applied	Not mentioned	
<b>Life Cycle Stages</b>		Existing and in use	Existing and in use
<b>Use of Project Management methods</b>		Application only of the most relevant processes and tools	Application of customized tools led by the coordinator
<b>Experience and knowledge of professionals</b>		There are specialists that help in achieving the results Some specialists are resistant in using the management methods and tools	Values the experience and knowledge of the professionals involved in obtaining the results There are few professionals with knowledge on project management

The research will evolve through the direct observation of the cases, searching for evidences of successful and unsuccessful management decisions, as well as the measurement of deviations from the initial goals defined for each project phase. New data collection and analysis cycles will be made, bringing a more comprehensive and better structured results for this research.

## 5 DISCUSSION

Methods are the set of means arranged conveniently to meet an end and especially to reach a scientific knowledge or to communicate it to the others (Trevisan 1998). According to Ghauri and Gronhaug (2010), methods are rules and procedures, and can be understood as ways of proceeding to solve problems, that is, the strategies and the tools with which is possible to reach a result. The interviews showed the lack of application of management methods and tools leading to problems and difficulties in focusing on the results. Therefore, it emphasizes the real need for the application of management methods.

In Project A, management procedures are based on a mature management method created by the company. On the other hand, Project B's team recognizes the management need but the implementation of a management method is still in progress.

In the case of sanitation and transportation infrastructure projects, the environment management is of paramount relevance, since they are, in general, linear and extensive, impacting on protected areas in more than one town. The teams that are carrying out the projects' management do not control the projects' costs, which have been controlled by higher management levels, leading to lack of transparency as well as weakening the decision-making analysis. There is a triple constraint restriction, made by scope, time and quality, which affects

directly the projects' success since costs are unknown. In both cases, it was emphasized the importance of holding meetings to integrate, analyze and expose the projects' performance, with the participation of all stakeholders involved in decision-making. This proved to be very effective in achieving the results.

Even if communication is critical because of so many agents and stakeholders involved, in both cases there is not an efficient way to control it. Several communication failures were found and much effort has been invested to solve them. It was also demonstrated the importance of carrying out an in-depth risk analysis, in order to anticipate problem solving for all areas, but an efficient tool is missing. The human resources and procurement areas were not considered as critical; the cases showed that these activities are carried out day by day in an operational way.

As clear statements by the interviewees, it was also identified that it is critical for the project management to prioritize the application of few and more relevant processes and tools than a whole project management method. Another critical aspect is the involvement of specialists who have a great technical knowledge about the products or services generated by the project, as well as project management professionals.

From these critical points, the research findings suggested four preliminary guidelines which could be recommended for the management of similar infrastructure projects. **First:** identify relevant processes, areas and tools to the project in case, always with an integrated vision of their needs and context. In construction projects, scope, time, quality, environment and communication are critical and should be very seriously prioritized. **Second:** customize the selected tools to fit its needs and a realistic application. **Third:** hold regular meetings for the presentation of an integrated panorama of the project, with the participation of the stakeholders involved in decision-making. **Fourth:** hire qualified professionals with expertise in project management and in the activities related to the products or services involved, since the combination of the professional's expertise with the use of appropriate management tools is the formula to achieve projects' success. If not possible, an investment in the professionals' qualification will be needed to reduce their resistance to using tools and methods.

### 5.1 Limitation of the Study

Limitations of this study provide opportunities for the development of new research and studies within the project management area. First, this initial study was limited to collect and analyse data from the point of view of the project management and supervision team, leaving out the views of other players, such as designers, construction companies, and regulatory agencies. A study about contractual aspects of the Public-Private Partnerships, would certainly contribute to the evaluation and analysis of the projects' results. Another limitation was the realization of only two case studies. Finally, during the case studies it was identified the opportunity of deepening project management study focusing on environmental management, which would bring many contributions to the theme.

## 6 CONCLUSIONS

This paper brings some initial contributions to other projects of the same kind, taking into account the inherent complexity of big infrastructure projects.

Project management of public infrastructure projects is important for structuring, planning, executing and obtaining results. The application of appropriate methods and tools is strategic and maximizes the achievement of projects success.

Critical points were identified for the achievement of success in this type of projects, according to their context and complexity. The guidelines identified are intended to help the

management of new infrastructure projects. These results will make it possible to improve projects quality, the quality of their products and can contribute to the development of project management area.

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