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The Challenge of Managing Megaprojects

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***Abstract*—*This paper reviews the concepts of project management and megaprojects, emphasizing on how to join these topics and the challenges of managing this kind of project, because the standard methodologies are not specific for megaprojects and, until now, academic researches focus only in the general content of methodologies for megaprojects. So, the objective of this paper is to jointly discuss project management, megaprojects and the challenges of managing this kind of project. First, we review the project management concepts and standards; then we define megaprojects, considering that a narrow definition is not the best alternative and then we present the current discussions about managing megaprojects. As a conclusion, we suggest unfolding the emerging topics for managing megaprojects in specific process, documents, tools and templates, to create a new standard, otherwise project managers will keep unsuccessfully trying to adapt the traditional methodologies to their megaprojects. This work brings a theoretical contribution when reviewing the newest advances in this topic and suggests future researches in the development of a new megaproject methodology.*

I. INTRODUCTION

Project is defined as a temporary endeavor undertaken to create a unique product, service, or result (PMI, 2017). Most of the activities we conduct in our day-to-day life, personally or professionally, can be classified as a project. Some examples of a project would include this paper that I have written, a specific work one has to conclude in his organization to deliver to his customer or a trip with your family in the next summer vacations.

Project management consists in the application of knowledge, skills, tools and techniques to conduct activities to meet project requirements (PMI, 2017). These requirements are set from the project´s customer or even from any stakeholders (anyone with any interest in the project). To properly manage a project, it is necessary to have in hand these tools and techniques and the ability to conduct a group of persons, the team members, into the execution of the project. Of course, before the execution of the project, the team, led by the project manager, needs to plan the whole project.

This is a not a simple activity, as it is possible to imagine. But when we think in megaprojects, the challenge remains even more complex. Flyvbjerg (2014) defines megaprojects as large-scale, complex ventures that typically cost a billion dollars or more, take many years to develop and build, involve multiple public and private stakeholders, are transformational, and impact millions of people. Other authors consider that the economic value is not the most important variable to define a megaproject, like Pollack et al. (2018) that state that a megaproject should be defined by the organizational complexity, ambiguity, ambition, political aspects and risks that are entailed on it. In some industry segments or in some small countries, megaprojects can be well defined by this second definition.

By analyzing the literature on project management and megaprojects, the objective of this paper is to discuss jointly these topics and the challenges of managing this kind of project. This is an important topic because of the volume of global spending in megaprojects annually. Flyvbjerg (2014) estimated it to be USD 6-9 trillion

annually, or 8 percent of total global gross domestic product. If we look in the next following years, the impact is also very high. The McKinsey consultant company estimates that the world needs to spend about USD 57 trillion on infrastructure by 2030 only to enable the predictions of the global GDP growth (Garemo et al., 2018).

II. PROJECT MANAGEMENT

A systematic project management approach consists of methods, toolkits and design models. Thus, project management can be viewed as the sequential application of structured processes that are continuous and repeated and, when used by an organization in a gradual and safe way, permits a business to take steps toward the institutionalization of standardized practices.

Project teams require help to plan and deliver projects, considering the project's entire life cycle, toward both the business and customer satisfaction. In recent years, some standards were created by project management institutes and associations as presented in Table 1.

The most renowned standards of project management are the PMBoK (Project Management Body of Knowledge) and the ICB (International Project Management Association Competence Baseline) (PMI, 2017; IPMA, 2006). Their focus is in the traditional management of projects, despite the European model emphasizes the human aspects of managing a project. The same happens with a not so worldwide well-known standard, the AIPM (Australian Institute of Project Management Professional Competency Standards for Project Management) from Australia (AIPM, 2008). Its structure is very similar to the PMBoK, divided in knowledge areas.

The APM (Association for Project Management) Body of Knowledge, from UK, is the most complete standard, offering not only project related content, but also strategic aspects and project governance content (APM, 2006). But there are also some specific standards, not so comprehensive, used in individual industry segments. The PRINCE2 (Projects in Controlled Environments) is a set of methods for information technology projects developed in the UK from the Office of Government Commerce (OGC, 1996). For construction projects, the Japan Project Management Forum developed the ENAA Model Form-International Contract for Process Plant Construction (ENAA, 1992).

Existing literature (McHugh and Hogan, 2011; Besner and Hobbs, 2013) recognizes the benefits of implementing and using a project management methodology. Besner and Hobbs (2013) analyzed the perceived value and potential contribution of project management practices in their success, starting from the use of different tools and techniques of the same management method. On the other hand, McHugh and Hogan (2011) studied organizations that used their own internally developed methodology. They discovered that, even for these organizations that developed proprietary methodologies, there was a desire within these organizations to implement a universal and internationally recognized project management methodology.

These standardize types of methodology are structured in common process that can be applied to different projects. They suggest tools and templates that must be adapted by each organization that decides to use them. The advantage of using this kind of methodology is that the basis of project management concepts used in the company is the same from other companies and was already tested in other projects. This solution guarantees that best practices will be used within the company. To implement this solution, the first two methodologies, from the six presented in Table 1, are the most indicated. The PMBoK (PMI, 2017) and the ICB (IPMA, 2006) are the most used worldwide in a huge variety of organizations, so their processes have already been tested in lots of projects, making their tools the most stable ones and their suggested best practices, the most applicable ones to different industry segments.

III. MEGAPROJECTS

Defining a megaproject is not a simple task. There is no consensus on a common definition for the characteristics of a project, to classify it as a megaproject (Flyvbjerg, 2014; Misic and Radujkovic, 2015; Li et al., 2018; Pollack et al., 2018). A direct definition, proposed by Flyvbjerg (2014), specify the minimum value of a billion dollars to classify a project as a megaproject. A more structured set of characteristics to define a project as a mega one, includes variables such as complexity, ambiguity, stakeholder's ambition, political aspects and risks, as proposed by Pollack et al. (2018). To include these additional variables besides budget, is a good solution to classify a project as a megaproject. In some specific segments, projects are not so expensive as a construction project, that can achieve a billion dollars budget. But, for sure, they are complex, sometimes involving hundreds and even thousands of team members or more than ten different suppliers, and hard to implement, whit a schedule of several months or even years and with the implementation of a technical solution never used before.

Table 1. Major Associations of Project Management and Their Standards

Institute	Standard	Country of Origin	Methodology Focus	Characteristics	Observations
Project Management Institute (PMI, 2017)	*Project Management Body of Knowledge* (PMBoK)	USA	General management of projects	Set of methods developed for various types of projects, which are therefore generic and structured according to areas of knowledge in a project	These methods are complemented by two additional standards: program and portfolio
International Project Management Association (IPMA, 2006)	ICB—IPMA *Competence Baseline*	European Union	General management of projects	Structured according to skills that must be developed by project participants, divided into: contextual, behavioral and technical	Together with the Australian standard, this method has a much greater degree of depth than other methods related to the human aspects of the project manager
Australian Institute of Project Management (AIPM, 2008)	AIPM—*Professional Competency Standards for Project Management*	Australia	General management of projects	This document, published by the Australian institute of projects, is very similar in structure to the PMBoK and is divided by areas of knowledge	This document focuses more deeply on human skills
Association for Project Management (APM, 2006)	APM *Body of Knowledge*	UK	General management of projects	One of the most complete set of methods, this document provides project-related content, value, office projects and strategic aspects of project management	This is the most comprehensive set of methods
Office of Government Commerce (OGC, 1996)	*Projects in Controlled Environments* (PRINCE2)	UK	Management of information systems projects	Set of methods structured according to project stages and activities to be conducted by the management team	This set of methods is aimed at information technology projects
Japan Project Management Forum (ENAA, 1992)	ENAA *Model Form-International Contract for Process Plant Construction*	Japan	Management of construction projects	The document primarily focuses on the contractual aspects of a project	This set of methods focuses on engineering construction projects

The problem is when these variables are subjective and difficult to define when classifying a project. How one would define if a project scope is sufficient ambiguous or in which sense are the stakeholders enough ambitious to define a project as a megaproject? Trying to answer this question, Li et al. (2018) propose a mixed definition including a budget value variable, like Flyvbjerg (2014), but also additional variables like Pollack et al. (2018). They suggested three groups of variables: the economic value; significance and importance of the project and complexity in terms of technology, organization and environment.

But maybe the more adequate definition of a megaproject comes from Misic and Radujkovic (2015). They advocate that a megaproject should be defined depending on its application area. For them, each industry segment, country, type of project and application area, can have a specific definition to classify a project, as a mega one. In that sense, they present some megaproject´s definition, according to different federal agencies, associations and authors (Table 2).

Table 2. Megaproject Definitions

Author(s)	**Definition**
Flyvbjerg (2014)	Large-scale, complex ventures that typically cost a billion dollars or more, take many years to develop and build, involve multiple public and private stakeholders, are transformational, and impact millions of people.
Misic and Radujkovic (2015)	Definition of a megaproject depending on industry segment, country, type of project and application area.
Li et al. (2018)	Very expensive or very large, where the cost or investment exceeds a determined value in USD or as % of country GDP. Attracts a lot of public attention, carry strong symbolic significance, are closely linked to society, environment, economy and politics. Extremely complex in terms of technology, organization, environment, culture and finance with high degrees of uncertainty, are unique, a one-of-a-kind project.
Pollack et al. (2018)	Should be defined by the organizational complexity, ambiguity, ambition, political aspects and risks that are entailed on it.

Although the increasing literature on project management and megaprojects, with the standards presented (Table 1) and researches conducted (Table 2), which help the advancement in process, tools, techniques and systems; project management success studies, mainly for megaprojects, remains low. Mir and Pinnington (2014) tested the relationship between project management performance and project success for 154 megaprojects in Asia. They created multi-dimensional frameworks to test their hypotheses and suggest that organizations should invest time, money and effort to develop proper project management methods and key performance indicators to manage different types of projects.

This is the same idea suggested by Shenhar (2001), some years ago. He proposed that different types of projects should be managed in different ways. The novelty presented in his paper was to explore the domain of traditional contingency theory in the more modern world of projects. He created a two-dimensional model to classify technical projects into technological uncertainty and system complexity. The benefits of his work were to show for project leadership why and how management should adapt a more project-specific style, offering a collection of insights to improve projects.

As it is possible to verify in Mok et al. (2015), the idea of choosing a specific approach to manage complex and uncertain projects, has been broadly accepted through a large period in the academic research. They analyzed the development of stakeholder management for mega construction projects, reviewing 85 selected articles published from 1997 to 2014, and show the evolution and the increasing of methodologies and process used to manage complex projects.

The discovery from Mok et al. (2015) was already expected, in my opinion. During decades, project managers tried to use the standard process and tools, provided by the general methodologies presented in Table 1, to manage megaprojects and the results obtained show that this is not the best solution. The Standish Group (2018) presents that the rate of megaprojects considered successful (i.e. achieved the planned schedule and cost, and delivered the required scope), was 16% in 1994. This is a very low rate for any kind of project, specially for megaprojects, considering that 84% of these projects, normally projects with a budget higher than a billion dollar, were unsuccessful ones. As the researches were developing new methodologies specific for megaprojects, the managers were using them, and it is also possible to see this initial positive effect on the megaprojects´ results, with a 29% successful rate obtained in 2015 (The Standish Group, 2018).

IV. MANAGING MEGAPROJECTS

One of the main findings in the Flyvbjerg (2014) work was that the conventional way of managing megaprojects has reached a "tension point". Where tradition is challenged, and reform is emerging. Although the successful rate of megaprojects increased a lot in the last 20 years (The Standish Group, 2018), it is still very low, whit more than two in three projects not achieving their goals. Flyvbjerg (2014) is right when he says that it is time to change this game. It is not possible anymore to keep using the traditional tools to manage megaprojects and at the end obtain these unsatisfactory results. According to him it is necessary to build a “new methodology” in order to reach the goals set for this kind of project. The author presents data and examples showing that most megaprojects incurs in over budget and over time when managed using the current methodologies.

Shenhar (2001) was the first one to propose a contingency approach to project management. In his work he suggested to start differentiating the methodologies to manage the projects. Flyvbjerg (2014) agrees with him, although for an even more specific type of project, a megaproject. Both conducted their researches studying some projects and then generalizing their findings. Shenhar (2001) goes beyond, proposing a model for analyzing projects, but again, both authors do not solve the “problem”. They just suggest that it is necessary to use specific methodologies to specific types of projects. For example, in a crisis project, that must be conducted with much urgency, like the care for Hurricane Katrina victims, it is necessary to start the project very soon with a very short time for planning. All the documentation will come further. In a opposite way, in a very complex, risky, long and expensive project, like the construction of the International Space Station (ISS), the methods and tools, will be very carefully followed, before the implementation of project starts.

More recently, Svejvig and Andersen (2015), presented the results of their research in a very provocative way, once they say that it is not only necessary to adapt the standard methodologies to different types of projects. They suggested that is necessary to completely rethink project management to succeed in this “brave new world” we live nowadays, according to them. They studied 74 other papers published in the last 30 years to create a critical look at what is happening in the project management research. They suggest 6 topics that are emerging ones and will dominate project management research in the following years: contextualization, social and political aspects, rethinking practice, complexity and uncertainty, actuality of projects and broader conceptualization. It is possible to see that, at least 4 of them are aligned with what was proposed by Shenhar (2001) and Flyvbjerg (2014).

A broader conceptualization was recently studied by Bisenthal et al. (2018). They suggest more characteristics that justify a different approach to manage megaprojects:

- Reach: the megaproject effects go beyond national borders due to its impacts;

- Duration: the benefits obtained from a megaproject, due to the long duration of them, could also be included in their completion and evaluation;

- Cost: once the costs of megaprojects are high, independently of the defined value, it is necessary large amounts of money to implement them and sometimes loans from international funding agencies, that impose some restrictions on the way in which the project is managed;

- Risks and uncertainties: megaprojects often use new technologies and process that require careful risk analysis and treatment;

- Controversy: these projects are subjected to public and media scrutiny, so success criteria are often fuzzy and misrepresented;

- Legal and regulatory issues: due to its complexity, legal claims and litigation very often occurs, and multiple governance regimes are necessary over the duration of the project;

- Value involved: social, economic and ecological value are high in megaprojects, because of the intense labor force used and impact caused.

The success of using specific approaches to manage megaprojects was studied by Shenhar and Holzmann (2017). The authors applied contingency theory specifically to megaprojects. They studied 500 megaprojects conducted in the past and already concluded, searching for successful projects to compound a final sample to be studied in detail. For this final sample, 14 projects considered successful ones were selected and analyzed in detail searching for characteristics that distinguish them from unsuccessful ones. They propose three major elements: clear strategic vision, total alignment and adapting to complexity. I agree with them, adaptation to complexity is necessary as was possible to see in the prior sections of this paper, but, moreover, to stablish a clear vision for a megaproject is indispensable, once this kind of project consists in a long effort. And without a total alignment between the megaproject and the organizations that are involved with them, it is even not possible, to start a project like this.

V. CONCLUSION

This paper reviewed the concepts of project management and megaprojects, emphasizing on how to create a specific methodology to manage this kind of project, because the standard methodologies are not specific for megaprojects.

Managing complex, uncertain and megaprojects are not a simple task. Independently of what kind of megaproject will be managed (Flyvbjerg, 2014; Misic and Radujkovic, 2015; Li et al., 2018; Pollack et al., 2018), it is necessary to create specific process, tools and techniques (Shenhar, 2001; Mok et al., 2015; Padalkar and Gopinath, 2016), as reviewed in this paper.

Once the traditional standards (ENAA, 1992; OGC, 1996; APM, 2006; IPMA, 2006; AIPM, 2008; PMI, 2017) were created to manage any kind or project, most of them are standard ones, i.e., they are not specific developed to complex or big projects. Organizations and project managers must create new methodologies in order to manage properly their megaprojects (Flyvbjerg, 2014; Svejvig and Andersen, 2015), otherwise their projects goals will not be achieved.

There seems to be an agreement on using specific process to manage complex projects, but what are the content of these methods? Some topics are already being presented (Bisenthal et al., 2018), but it is necessary to detail and specify the tools. The literature review shows that common topics, such as, adaptation to complexity, careful risk analysis and treatment, funding, corporate alignment and strategic vision, are already been discussed in researches and inside the organizations. But the problem remains unsolved. Project managers need specific tools, process and methods to manage their megaprojects. It is necessary to unfold these topics in several detailed documents for each part of a project, with the ultimate goal of creating specific methodologies for megaprojects. Future research should go in this direction.

Otherwise, project managers will remain trying to use the traditional methods to manage their megaprojects, and the results will not be achieved as would be expected, besides the fact that some results are beginning to be revealed (Shenhar and Holzmann, 2017). This is the challenge of managing megaprojects.

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