THE KNOWLEDGE BENCHMARKING PROCESS FRAMEWORK: A NEW BASIS TO ANALYZE MEGAPROJECTS CHALLENGES AND PRACTICES

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Abstract

Megaprojects faced many pathologies and challenges to provide the attended impacts. These pathologies contribute to overshadow the results and outcomes needed by those who promote these kind of projects. So, we need to unsderstand and assess properly the dynamics related to megaprojects. To overcome this situation we present a new way to analyze megaprojects based on a knowledge benchmarking process framework.

Keywords: Megaprojects, Knowledge management, Case study, Evaluation

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1 INTRODUCTION

Megaprojects represent an important issue in terms of development of concrete solutions to develop services and products needed by the society. Today, megaprojects are present in various sectors and geographical. Many issues are in stake concerning megaprojects. Different studies recognize different variations compared to the expected positive impacts and expected results. Variations concern underestimated costs, risks, complexity, time schedule and social, economic and financial impacts. Based on the financial resources requested to carry out megaprojects (at least 1 billion dollar of investment), the underperformance observed drew questions and a need for more investigations.
This article pursues three goals, namely: 1- firstly establish challenges faced by the realization of megaprojects; 2- secondly to identify the limits of current practices observed in megaprojects; 3- thirdly introduce the base of a new approach based on benchmarking-knowledge. With this new approach, it will be possible to build a framework that will help to better understand how to analyze megaprojects and to develop appropriate solutions. In this paper, we discussed challenges face by megaprojects and options to consider based on five sections, namely: 1- context of emerging megaprojects; 2- concept of megaprojects; 3- challenges related to megaprojects: the issue at stake; 4- current solutions and limits; 5- base for a framework centered on knowledge management and benchmarking.

1.1 Background related to megaprojects

Megaprojects have been part of our social, economic, technological and institutional environment for many years, especially since the early 20th century (Altshuler and Luberoff, 2003). The movement has accelerated considerably over the past 40 years (1975-2015). Originally concentrated in the area of constructive infrastructures at first (roads, bridges and building of cities) megaprojects then extended to industrial complexes during the second period of the 20th century. Nowadays, no field of societal activities is spared by megaprojects, so it can be found at the level of major research programs in the fields of health, informatics and telecommunications. We can also think of the development of new products and services such as the electric car, or the development of new means of transport (eg. the hyperloop project). It also includes the development of new drugs or research into degenerative diseases. There is also the organization of major sporting and cultural events that mobilize hundreds of thousands, even millions of people.
In short, megaprojects, although old, are now competing to meet a certain societal demand, marked by specific constraints of different natures. For example, in the face of the announced catastrophe of environmental pollution or greenhouse gases, the transition from fossil to renewable energies is required. This requires the construction of new infrastructure at different levels (transport, production systems, etc.). Such systems must address a range of constraints affecting different aspects (finance, technology, social, etc.) and an increasingly large spectrum of people in such a way that the installation of the mega-project requires ingenuity, creativity and mastery of solutions Innovations. Thus, it must be recognized that mega-projects, regardless of their nature, domain, or origin, are part of a societal framework. However, this societal framework presents a number of issues that make the problems to be resolved more and more complex. Thus, the concentration of people in urban areas requires the construction of the latest generation of infrastructures that must not only respond to facilitating mobility, but also provide information that facilitates decision-making in order to move from one place to another in real time. The challenge is not only to build the structure or the solution itself, but also to integrate sub-systems, which originally are not naturally or structurally integrated.
Moreover, the many structural constraints that characterize the various problems of a societal nature, such as the integration of design, production and exploitation practices based on sustainable development, impose a level of complexity that did not prevail in the projects of a smaller scale. Moreover, we cannot forget the omnipresence of technology in the present social context. It has never appeared so dominant that it has become the cornerstone of solving the contemporary challenges of contemporary societies (Latour, 1987). Thus, societal demands are materialized and resolved on the basis of technological solutions. The extension of technological knowledge and their combination give rise to new fields of knowledge which also contribute to the development of new responses that require extremely large resources, thus contributing to the elaboration and conceptualization of megaprojects. Thus, the drastic increase in knowledge including the one of a technological and scientific nature opens up a vast world of new potentially possible and feasible solutions: this induces, beyond the immense

resources that are required, that megaprojects are no longer the prerogative of a sector, a country or a continent, but something that can be seen more often (Table 1 adapted from Kardes et al. 2013).
For example, in Quebec in the 1950s and 1970s, a megaproject was built in the hydroelectric field, while 30 years later, 3 times more megaproject were built. In the countries of the Persian Gulf and particularly in Dubai in the 1970s, there were no towers of nearly 100 meters in height; 40 years later there are 25 times more, including the highest in the world that culminates at 820 meters of height. And for the year 2019, it is expected that the Sedah tower in Saudi Arabia will culminate at 1000 meters. This observation of the growth of megaprojects which is illustrated in the field of skyscrapers is also found in all the various sectors of activity. It must therefore be noted that megaprojects constitute an object of study of interest in view of its evolution and the place it occupies more and more in the societal space. However, little specific literature is produced on this issue. As an example, on Amazon.com, there are only 4 books devoted to megaprojects. However, there is an important challenge to expand on these different aspects of megaprojects. The purpose of this article is to highlight issues related to the megaproject and to propose a study and analysis approach to better identify the issues and challenges that may lead to a better understanding of the success factors characteristic of megaprojects.

Table 1. Example of megaprojects in various sectors

Project name	Project details
Lockheed Martin F-35 USA	The F-35 is designed to meet the bulk of the needs of the US military. The global supply network includes over 1000 companies worldwide. The initial cost is about $200 billion
Dubai World Central Dubai	The Center is a planned residential, commercial and logistics complex scheme. The initial cost is about $8 billion
Three Gorges Dam China	It's the word,s largest hydroelectric plan with an expected generating capacity of more than 22,000 MWe. The project sets record for number of people displaced (1,4 million), number of cities and towns flooded (13 cities, 140 towns, 1350 villages). The initial cost is about $26 billion
Gautrain South Africa	It's a state-of-the art rapid rail of network in Gauteng. The cost is about $4 billion
Marmaray Tunnel Turkey	The project consists of the construction of an undersea rail tunnel creating a network between Europe and Asia. The initial cost is about $4 billion
Eurofighter Typhoon European Union	The aircraft is Europe's largest military collaborative program in cooperation. The initial costs is about $30 billion

1.2 Megaprojects concept

The megaproject is the subject of different definitions. For Flyvbjerg et al. (2003, p.2), the megaproject is: "a project of a significant interest or political interest because of direct and indirect impacts on the community environment and budgets". For others, the monetary attribute factor is at least 1 billion dollars (Roult and Lefebvre, 2012). For Geller and Lynch (2003), the megaproject recognizes the potential of impacts in the environment and the context in which it is implanted; Thus, they consider that the megaproject refers to "transform landscapes rapidly, intentionally and profoundly in very visible ways and require coordinated applications of capital and state powers" (Geller and Lynch, 2003, p. 15). For Stransman and Wells (1998), the megaproject is recognized by the mobilization of important technological means that it requires for its materialization. In order to make a clear distinction with other types of major projects, Haynes (2002) points out a number of important aspects that distinguished megaprojects from large-scale projects by the multitude of keys. For the Project Management Institute (2008), a megaproject initially has a strategic dimension in terms of spillovers and importance in the mobilization of resources. The magnitude of resources and spin-offs is so great that in the case of some megaprojects the lack of conclusive results can undermine the promoter's organization or simply bankrupt it and contribute to its disappearance (Dumez, 2012). In a sense, a megaproject corresponds to an autonomous organization.
The megaproject thus encompasses both the constraints of a conventional organization and those relating to the operation of a project (constraints of costs, resources, timing, quality and deliverability). For some

other authors (Lethonen, 2014), a megaproject must be seen as a network of actors and organizations pursuing a common goal with hurdles, difficulties and complexity. This process is more or less coherent, effective and efficient. Thus, for Karder et al. (2013), the concept of megaproject is declined according to different dimensions. First, it is a physical work (manufacture, infrastructure) that transforms its environment in a profound and irreversible way in different ways. Second, the megaproject requires planning at different levels, in terms of capital, technology, human resources and skills. We can therefore consider that the megaproject is characterized and defined by elements that affect 4 aspects:

- The network of agents that can be assimilated to stakeholders (direct and indirect).
  The mobilized resources which are as much material (equipment, supplies, etc.) as they are intangible (knowledge, techniques, processes, etc.) especially the knowledge available and to be developed.
- The context of the project, namely the environment in which a megaproject takes shape.
- The dynamics that develop at the level of the first 3 strands in view of the objective sought, namely to produce the expected deliverable.

Each of these components is characterized by a high degree of uncertainty, which makes it difficult to predict and control what needs to be done to ensure that the megaproject can be carried out accurately according to the planned framework.

2 STATE OF THE ART RELATED TO MEGAPROJECT

It must be noted that megaprojects constitute particular situations characterized by, among other things, irreversibility and uniqueness within a framework of resources and impacts beyond norms. The expectations generated by megaprojects are also commensurate with the resources mobilized, the expected impacts and the problem to be solved. As Flyvbjerg points out (2014a, p. 6), "They are designed to ambitiously change the structure of society". Unfortunately, various data collected over almost 70 years show that megaprojects fail to deliver the expected results (Flyvbjerg, 2014b). Indeed, various authors (Siemiatycki, 2016, Dumez 2012, Flyvbjerg, 2004, 2002) highlight the current challenges related to megaprojects. They cover the following dimensions: 1- the estimate of the demand to which the megaproject is supposed to respond; 2- estimating the benefits; 3- control and control of costs; 4- risk management; 5- compliance with deadlines.

2.1 Challenges related to megaprojects: the issue at stake

With respect to estimating demand, it is the first issue because it is often the basis of justification for a megaproject. Indeed, in every project, the design and the response to be formulated are linked to the appreciation of the demand to be satisfied and its evolution over time. The observation is that in most megaprojects, demand is overestimated (Dumez 2012). This is evident from the projects analyzed in terms of transport infrastructure (rail, tunnel, seaway). Whether in terms of attendance, passenger or freight use, data on which go / no go decisions on the megaproject are overestimated. This means that in reality we only respond to a fraction of the order of 10% to 20% of what was foreseen (Flyvbjerg, 2014a). There are a number of reasons for this afterthought, including the cognitive biases of promoters and consultants hired to complete the studies. What seems to be a tactic of using sales arguments to justify the launching of a megaproject, considering that once the decision is made, due to irreversibility, a reversal will no longer be possible. This way of forcing as much the commitment of the investments as the public authorizations and the citizens has direct consequences on the materialization of the megaproject and the potential spin-offs. The direct impact of this erroneous overestimation of demand is reflected in both design and spin-offs. Thus, in spillovers, in terms of contribution to the growth inherent in the production of collective wealth and economic added value, there is also a chronic overestimation (Flyvbjerg, 2014a). Generally, the expected impacts are as much about improving the performance of the regional and local economy through job creation, increased trade and an impact on the monetary value of goods produced. Analysis of the data collected shows that these impacts are neither dismantled nor proven in the majority of the projects studied. For example, Flyvbjerg (2009) cites a study by The Economist on the Channel Tunnel which ultimately generated a negative return of (-14%) and a loss for Britain's economy ($17.8 billion) instead of the expected 10% return.

As regards control and cost control, the results are also negative. Indeed, on the basis of the 250 megaprojects analyzed by Flyvbjerg (2014b), it shows that the cost overrun varies from 50% to nearly 1900%. According to him, cost overruns are linked to various reasons, inter alia, that additional costs

are often financed by the public authority or borne by the citizen through taxes. He also refers to the fact that the megaproject is amortized over a long period of time, so the proponents believe that they will have enough time to recover the investment, as well as the additional costs realized. For some, it would be necessary to overestimate the income in order to show that the megaproject generates a positive return that meets the expectations previously identified for the justification of its materialization. It should be noted that the rational approach is to demonstrate financially that the megaproject is profitable, either that the financial surpluses accumulated over the amortization period of the project are greater than the investment and that in addition the project produces positive externalities (creation of employment, increased GDP, etc.) while preserving the environment. The reality and all the studies carried out ex post contribute to the same result, namely a chronic over-cost and a systematic over-evaluation of incomes. It can be argued that this is also due to the non-repetitiveness of this type of initiative. As far as risks are concerned, they are taken into account, but not necessarily in an adequate and systematic way. Risk is central to any project situation because of the uncertainty associated with it. Moreover, because of the variables involved in a megaproject and the quality of available information, all this contributes to assuming a significant risk in the context of a megaproject. For various authors, the weakness of mitigation solutions goes up although when some of these risks materialize, costs and duration explode. Dumez (2012) emphasizes the weakness of the sensitivity studies used to establish an adequate measure of risk, for example there is a tendency to limit cost overruns to 10%, which is not the case. It can therefore be considered that this approach of minimizing risks using very conservative assumptions (cost overruns only at 10%) is inappropriate. On the other hand, it is consistent with the finding and willingness to underestimate costs, since the first consequence of a better estimate of risks would be an increase in costs. With respect to the timetable, there is also an overrun of the time allotted to megaprojects. These overruns are inherent in a number of factors, including: 1- the management of oppositions, which often act as a brake on the progress of activities as planned; 2- conflicts of jurisdiction and arbitrations to be made at the political level; 3- the difficulties inherent in the complexity of the structure; 4- the weakness of the estimates made; 5- management difficulty inherent in the different trades involved in the megaproject: this requires not only mastery of technical knowledge, but also knowledge about cultural factors and the dynamics of human interactions so that the practices and attitudes of cooperation may take place at the expense of potential conflicts that may affect the overall duration of the project.

Beyond these five dimensions, Heunis (2016) points out that there are also contextual and organizational variables that affect the success of any megaproject. Indeed, efforts and attentions are focused on the technical and technological and financial challenges and issues surrounding the megaproject, neglecting the workings needed to achieve the expected results. These elements of an environmental and contextual nature are as follows: 1- the incompatibility between the different stakeholders; 2- person or group conflicts; 3- rationalization of resources, which can lead to downsizing, i.e. an inadequacy of resources between those required and those available; 4- threats to strike and organizational climate due to demanding working conditions; (5) the insecurity which the workers may experience on the site; 6- lack of effective communication; 7- the lack of effective coordination with external subcontractors; 8) - Effective coordination of resources with multiple expertise and interests. Incidentally, it must be recognized that every megaproject is characterized by the need for specialized and diverse skills that work on the same subject matter, at different times and with specific constraints. However, in the literature, very little attention is given to this issue as the integration and coordination are critical factors for any organized structure to manage the complexity, uncertainty of tasks and specialization, which is the case of a megaproject.

Moreover, given the technical and technological challenges inherent in any megaproject, knowledge management is crucial because it is at the heart of the solutions to be created to carry out the project. However, the uniqueness of the megaproject and the logic inherent in any project management make knowledge management critical and difficult. Indeed, a project is characterized by constraints of time, resources, quality and an obligation of results. This ad hoc and temporally limited structure leads to the conclusion that the sharing of knowledge is not necessarily automatic. In the literature this aspect is not addressed, whereas it may also contribute to the improvement of the results of a megaproject. Finally, Lethonen (2014) highlights the inherent weaknesses in accountability. This weakness, which corresponds to a lack of evaluation, makes it impossible to identify the gaps and limitations that undermine the possibilities of achieving the desired results, since it is impossible to improve what we do not know and do not measure. The evaluation and performance of any system is an important basis

for learning and developing successful and robust practices. This is all the more important given the sustained increase in megaprojects in different institutional and geographic contexts. There is therefore a need for a framework to adequately assess the various impacts and outcomes of a megaproject.

2.2 Currents solutions and limitations

The challenges and issues that characterize megaprojects are now attracting interest (Flyvberjg, 2014a, 2014b, 2009). In the literature, there is an explicit recognition that actions must be taken to improve the performance of megaprojects (Sanderson, 2012; Van Marrewijk, 2008). In this regard, the following initiatives and approaches can be cited. For Flyvberjg (2014a), the fact of the recognition of failures constitutes a saving benefit insofar as it will be possible to think of concrete actions of mitigation. Among these actions is the initiative of the Infrastructure Committee of the Dutch Parliament which held a commission of inquiry to determine how to better structure megaprojects. From this exercise came out a white paper recommendations to establish the success factors. In Britain, a similar initiative was also followed, but rather it resulted in the establishment of a training framework for civil servants - managers involved in the management of megaprojects.

There is also a need for governance, which includes integrating the various stakeholders at all stages of the megaproject. For example, Flyvberjg (2014b) argues that it is necessary to minimize the cognitive biases that currently prevail among promoters and consultants, such as the systematic underestimation of costs. With open governance, the responsibility for forecasting would be more diffuse and shared among the different stakeholders, which would lead to debate and to arrive at more reliable solutions. The benefits for all "stakeholders" involved in the mega project would be multiple, among others benefit from a more robust database, to share a common understanding of the issues, to define the objectives and expected deliverables. Thus, open governance redefines the division of powers and would inevitably bring greater collaboration and cooperation between the various parties. This necessity therefore requires greater cooperation and collaboration in order to minimize complexity and uncertainty. Dumez (2012) goes further, speaking instead of establishing a new institutional framework in which transparency should be prioritized and therefore effective sharing of information. Because, for some (Sanderson, 2012; Brockman et al., 2016; Flyvberjg, 2014a, 2014b), a megaproject is also a result of processing information to decide, direct, provide specific solutions. One way to explore is to establish a performance specification framework that is systematically established throughout the mega-project, from its initial phase to operation. Giezen (2012) emphasizes that to minimize the complexity effects inherent in the megaproject, the KISS (keep it simple and stupid) principles should be applied instead. On this basis, emphasis should be placed on simplified techniques and communications. On the other hand, such an orientation is not always possible in all megaproject cases. Consequently, this orientation does not seem very relevant to take account of the megaproject issues.

Overall whether the consideration of protocols related risk megaproject or guidance on the new governance and the new institutional framework of mega-projects management, these actions and proposals do not induce a framework and approach to achieve better results, but above all to develop new capacities to improve the results related to the processes inherent in megaprojects. This orientation is now required, as pointed out by other authors, among others Pau et al. (2016), Ewje et al. (2012), Sanderson (2012), Brockman et al. (2016) and Dumez (2012). Flyvberjg 2014a) also recognizes the need to understand the anatomy of megaproject. On this basis, it seems pertinent to note that a megaproject must be considered as a set of processes that transform the needs (income), by mobilizing the resources (input) in order to bring an effective solution. On this basis, by defining a megaproject as a system of systems, the preferred approach consists of mapping all the processes and establishing benchmarking practices. The complexity of megaprojects induces an understanding of management practices and modalities based on the diversity of case studies. It is on the basis of in-depth qualitative studies that it will be possible to document the different facets of a megaproject.

3 THE METHODOLOGICAL APPROACH FOR A NEW FRAMEWORK

The characterization of megaprojects and their current importance require to bring and to emerge new proposals for innovative or better performing practices. Despite the uniqueness and irreversibility of megaprojects, it seems to us that an approach combining benchmarking and knowledge management (particularly the community of practice) would be the path to explore. The community of practice is a formal or informal organizational framework: a place where knowledge is shared and transferred, or its

expertise is made available to the participating partners in order to generate new knowledge and solve problems together. It is a collective learning framework and a natural way of producing and transmitting knowledge. The community of practice contributes to the emergence of new practices, to their dissemination through a network to which they adhere voluntarily (Wenger, 2002, 1998; Pavlin, 2006). The materialization of such a framework consists of associating the benchmarking methodology with the specific activities inherent in knowledge management (Akhavan, 2013).

Benchmarking involves the following actions: 1-determine the process relating to one aspect of the megaproject for which one or more improvements are sought; 2- identify the key performance measures related to the process and the identified aspect; 3- choose the basis of comparison (internal or external); 4- collecting data on practices inherent in the process involved; 5- analyze data and identify areas for improvement; 6- adapting and implementing best practices. Thus, the methodology associated with benchmarking allows for a comparative analysis to lead to an improvement in the performance of operations and processes. Thereby, it is possible to characterize the processes and practices involved in a megaproject on the basis of the pathologies to be analyzed and compared. By focusing on a benchmarking approach, the aim is to identify the best performance that generates good practices and that can be adapted in other sectors, circumstances and projects (Bauer et al., 2004). Benchmarking can also be seen as achieving operational excellence and being part of a continuous improvement process (Mesnard and Tarondeau, 2003). Moreover, the principle of benchmarking requires that the basis of comparison be carried on precise dimensions.

The specificity of megaprojects thus induces to examine the practices and knowledge that are developed in these types of initiatives. The aim is to favor a knowledge management approach. Knowledge management is essentially characterized by a series of activities that correspond to the development, acquisition, use, sharing and conservation of knowledge (Malhotra, 2005; Alavi, 2001; Davenport, 2001). Knowledge management therefore encompasses the following aspects: 1- the different approaches to processes, activities, physical and organizational infrastructures; 2- from which the actors of the organization develop relationships of collaboration, partnership and exchanges; 3- by activities of development, codification, creation, acquisition, conservation, transformation, use of knowledge; 4- building on human relationships and organizational, relational, material and technological supports; 5- to ensure, on the one hand, added value to tangible and intangible assets and, on the other hand, better organizational performance. Knowledge management can thus materialize by implementing a community of practice to identify and share best practices; which corresponds to the essence of benchmarking. Therefore, by implementing a benchmarking approach based on knowledge management on processes implemented in megaprojects, the teams involved will be able to improve from project to project their current performance according to different levels (Marquès et al., 2006), among others: 1- more timelines specific; 2- the minimization of the discrepancies between the estimated and actual costs; 3- minimizing the discrepancies between estimated and actual revenues; 4- the adequacy between the projected and actual benefits; 6- management of the multicultural teams involved in this type of project.

4 RESULT: BASICS OF THE PROPOSED FRAMEWORK

Our goal is to propose a framework in order to tackle challenges affecting megaprojects. The proposed framework highlights dimensions based on knowledge management, namely community of practice and benchmarking approach (Figure 1). It is structured on five steps:

1. Identifying the different processes involved in stakes or pathologies affecting a megaproject.
2. Organizing according to the methodological phases of benchmarking.
3. Treating them according to the characterization of Nonaka and Takeuchi (1997), distinguishing tacit knowledge from explicit knowledge.
4. Distinguishing the actions, activities and practices implemented in the megaproject: this leads to specific results.
5. Evaluating them in terms of robust practices in order to determine the impacts, whether those retained have made it possible to reduce the discrepancies that characterize the pathologies, or what prevails between the predictable results and those actually obtained.

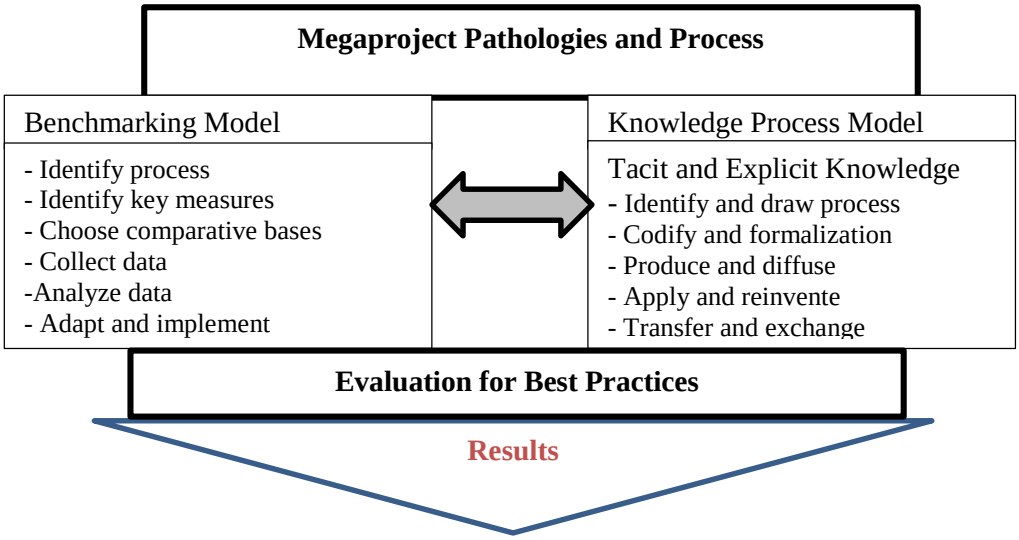

Figure 1. Model of knowledge-benchmarking for megaprojects

A knowledge management approach associated with benchmarking would thus make it possible to enrich the knowledge and practices which one should need to manage properly megaprojects and decrease the present pathologies previously identified. In other contexts, previous studies have reached the same conclusions (Forstenlechner, 2007, 2009; Zaim, 2007) showing that manage knowledge improve productivity, generate new knowledges and bring continuous improvement. With benchmarking, it will be possible to tackle best practices and share them in a megaproject ecosystem.

5 CONCLUSION

As we stated, megaprojects represent today a theme of study of great interest based of the requested resources and impacts supposed to be generate. In spite of this increasingly important presence of megaprojects in different social contexts and sectors, different pathologies (underestimation of costs, risks, complexity, etc.) affect the expected results (lack of beneficial impacts on different levels, namely financial, economical, social). In this article, the importance of these pathologies is stressed and we identify others like those concerning the management of multicultural teams, the difficulty to coordinate them, but also the lack of taking to account an approach based on self-evaluation to improve practices and processes. Indeed, in the presence of a great complexity like the one inherent to a megaproject, the self-evaluation and the training rising from its own practices can represent an important base for improvement. With this orientation, we propose a framework associating benchmarking and knowledge management (De Jagger, 1999), two combined approach which will make it possible to develop a better comprehension and knowledge of megaprojects and to improve results, processes and finally the overall performance. The next step is to provide empirical data to assess the present model and look forward for concrete results. For that purpose, we intend to follow firstly a qualitative study.

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