

Uncertainty in Megaprojects: Opportunities for the Future

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Abstract

International literature presents many definitions of megaprojects generally characterized by large-scale, technical and organizational complexity, often with budgets higher than US\$1 billion, a lifecycle of decades and major social, political and economic impacts (Flyvbjerg, 2014). Referring to the classical “iron triangle” (time, cost and scope management) many studies give evidence of the low performance of megaprojects management due to the high level of uncertainties these projects needs to face (Eweje, Turner, & Muller, 2012), and that situation reduces also the mega project success. This paper wants to investigate the understanding of megaproject success from the point of view of value management, defining best and proven practices to maximize added value in megaproject value, and so limiting the predominant “iron triangle” perspective (that refer to project management success and not to the project success). The evidence of these opportunities normally emerges only during the project execution phase and is not predictable in the planning phase. Taking stack of these unforeseen opportunities plays an important role in long term success of megaprojects. The research is based on the usage of case studies and interviews that allowed the analysis of the Oil and Gas sector and put the bases for future trends and approaches towards prosperity of megaprojects.

Keywords

Megaproject, risk, uncertainty, value, opportunity

Biography

Roya Derakhshanalavijeh is a PhD student at Politecnico di Milano, department of Management, Economics and Industrial Engineering. She has a Bachelor’s in civil engineering and a graduate degree in construction management. She has publications in the field of managing cost overrun in Oil & Gas projects. She is currently a PhD researcher at Politecnico di Milano and her field of interest includes understanding the concept of value and identification of criteria for measuring levels of success in megaprojects.

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several national and international research projects about Construction, megaproject and energy sector, he is author of more than 80 international publications in Project Management, Operation Management and Energy.

1. Introduction

Complex projects, sometimes referred as megaprojects, are trait making projects which are designed to ambitiously change the structure of the society (Flyvbjerg, 2014). Despite the poor performance of complex projects which have aroused international concerns about their ability to reach their project management targets, in terms of delivering project on time, on budget and at a predefined quality or the classic project management “iron triangle”, complex projects proved to be recognized as successful in long term horizons. This perception is constructed on the fact that complex projects are able to bring very influential benefits to their surrounding environment and their performing organization which could even cover their poor project management success or projects efficiency, as called by some researchers (Serrador & Turner, 2015). So as Terry Cook-Davis proved in 2002, project management success should be separated from project success but as Serrador&Turner speculated, “efficiency is...neither the only aspect of project success nor an aspect of project success that can be ignored. So, beside project efficiency there should be other dimensions (criteria) for evaluating their level of success in longer times.

Creating and capturing benefit from different perspectives, complex project have enormous potentials of bringing more values to their performing organization as well as their surrounding environment. Practitioners and researchers still need to explore approaches to maximize the created and capitalized values during the whole project lifecycle by the different project stakeholders, both internal (from now on, linked by a direct or indirect agreement or contract to performing organization) or external (whitout any contractual link with the performing organization

This research aims at enhancing success in complex project, focusing on the engagement of external stakeholders and knowledge management in organizations and limiting the number of investigated stakeholders to *participants of project's performing organization and local community*, t. The main focus of this research is firstly on economic, cultural and social values that local community of a project site can obtain, secondly, from project's performing organization, on the values created and captured from knowledge and experience gained through complex projects deployment and finally on maximization of values by capturing unforeseen opportunities.

This research is based on a qualitative inductive method. After a comprehensive literature review, a set of structured interviews with project managers and project participants (Owners, consultants and contractors and project managers) from Oil and Gas (O&G) industry were designed and performed in order to gather empirical data for theory building. This research tries to answer the following questions:

RQ1: How project managers can involve local community in project design and execution in order to maximize created and captured value?

RQ2: How knowledge management in an organization can increase the amount of value obtained from a project?

RQ3: How project managers can increase the value of projects, during the execution phase, by identifying and taking stack of unforeseen opportunities?

2. Background

2.1. Project Success: A Multidimensional Concept

Traditionally most organizations link project success to financial prosperity of projects (Shenhar et.al., 2001). But some researchers have shown that such measures alone are insufficient indicators for long term success appraisal of projects ((Eweje et.al, 2012); (Oliomogbe & Smith, 2013); (Construction Industry Institute, 2015); (Mišić & Radujković, 2015)). The complexity of the concept increases while considering that success can be assessed differently by different stakeholders (Chih & Zwikael, 2015); (Freeman & Beale, 1992); ((El-Gohary et.al, 2006); (MEGAPROJECTS COST ACTION, 2012)). In addition, some researchers state existence of different dimensions of success for different types of projects ((Pinto & Mantel, 1990); (Shenhar, Dvir, Levy, & Maltz, 2001); (Shenhar A. J., 2001); (Muller & Turner, 2007); (Turner & Zolin, 2012);). These variations, all together, make assessment of

project success quite challenging and controversial, attracting researchers' interest for extending the knowledge of the field.

Pioneer researchers of the field introduced similar success dimensions for all types of projects. However, as Shenhar (2001) states in his famous article "one size does not fit all projects", it is not true to evaluate the success of all of types of projects with the same criteria. Scales for measuring projects prosperity must be different according to the size, scope, cost and target of projects and the mindset taken to manage projects should be adjusted to the scope of the project.

Shenhar et.al., (2000) introduce a framework in which different success dimensions of projects have different degrees of importance according to the project's level of technological uncertainty. This research categorizes projects in four respective groups of *Low-Tech*, *Medium-Tech*, *High-Tech* and *Super High-Tech* projects. According to this research, as the level of technological uncertainty of a projects surges, the performing organization seeks longer term goals rather than just meeting the project management goals that is a short term. Based on this classification, megaprojects should be considered as Super High-Tech projects and subsequently the degree of importance of long term prosperity of these projects is high to a level that may even eliminate the significance of short term objectives of the project such as meeting schedule, budget and performance.

Resulted from the work of Pinto and Mantel (1990), in megaprojects, which are designed to have major social, political and economic impacts on their surrounding society ((Flyvbjerg et.al., 2003); (Zhai, et.al. 2009); (Eweje et.al., 2012); (Dimitriou, Ward, & Wright, 2013); (Oliomogbe & Smith, 2013)), the weight of the last two aspects is much more significant than the first one. This argument again confirms the results of the research achieved by Shenhar et.al. (2000): evaluation of megaprojects must be done based on the political, social, environmental, economic and organizational changes they bring in longer time frames, in contrast with their project management success.

2.2. Project Value

The very first use of the concept of value in management and business field can be traced back to 1940s, when the notion generated to optimize processes (Oliomogbe & Smith, 2013). From 2000 onwards, a number of researchers tried to consider value in project context through introducing concepts such as value, benefit, worth and success ((Marrewijk, 2007); (Akintola et.al, 2010); (Eweje et.al, 2012); (Liu et.al, 2014); (Laursen & Svejvig, 2016)). Within this research stream, some researchers conceptualize projects as value creation processes (Winter & Szczepanek, 2008) or a process of delivering beneficial objectives of change (Turner & Müller, 2003) developing a different view on final creation of the project: from a unique product or service to beneficial or valuable changes.

Value management was later established as a more generic term to focus on the overall achievement of a project and as the combination of costs and benefits. Laursen & Svejvig (2016) define benefit as: "*the improvement resulting from a change (outcome) that is perceived as positive by one or more stakeholders.*" The intention of value management is then, the optimization of both benefits and costs in projects. But till today, practices are narrowed to enhancing value by reducing capital cost rather than increasing the benefits (Morris P. , 2013). It has been just quite recently that, practitioners of the project management field illustrated a shift from sole focus on product creation (project output) to a broader focus on both product and benefit (project outcome), (Laursen & Svejvig,2016).

The concept of value is recognized to be multifaceted and highly confusing. Scholars from different fields (strategic management, organizational behavior, strategic human resource management, corporate finance, marketing and organizational psychology, social science, etc.) address value differently ((Lepak, Smith, & Taylor, 2007); (Barney, 2013); (Della Corte & Del Gaudio, 2014); (Laursen & Svejvig, 2016)). The process of value creation is confounded with two questions: who creates value and who captures value. It is believed that these two processes should be distinguished as two separate processes (Bowman & Ambrosini, 2000).

Value creation can be performed in three different levels: Micro level (individual, group), Mesa level (organization), and Macro level (networks, industry, society). According to resource-based theory, a resource is valuable when "exploits opportunities and/or neutralizes threats in a firm's environment" and "when they enable a firm to conceive of or implement strategies that improve its efficiency and effectiveness" (Barney J. , 1991). From external stakeholders' point of view, value creation depends on the relative amount of value that is captured by a target user

who is the focus of value creation (i.e. individual, organization or society). The purpose of the organizations is to create value in many different ways for many different targets, including earning for owners, pay for employees, benefits for customers, and taxes for the society. But by definition, various stakeholders (value targets) have different views as to what is valuable. That is due to the unique knowledge, goals and context conditions that affect how the novelty of the new value will be evaluated.

Chang et.al., (2013) states that stakeholders play a central role as an active resource for creating and capturing value during project lifecycle. External stakeholders, in particular, have been transformed from passive audience to active players (Pralhad & Ramaswamy, 2000). Stakeholders' knowledge, which has an experiential nature, emerges during the project lifecycle. As Prahalad (2004) states, personalized experiences which is captured through cognition and emotions of stakeholders is a major source of the created value. Stakeholders' consequent competencies, gained after knowledge gains, is another important source of value in project.

Value creation is a continuous process, going on during the whole lifecycle of a project. Due to different perception of value for different stakeholders, all of them should be engaged in this process. With the use of this approach, value is co-created during the combined efforts of firms, employees, customers, stockholders, government agencies and other entities but on the other hand there are stakeholders who capture different values determined by beneficiary (Vargo et.al., 2008).

Co-creation integrates the value of the project with the value perceived by other stakeholders during the modifying and tailoring the project outcome. Projects are different in nature and that's due to the fact that different stakeholders have different desires and needs from the same project. Therefore, close interaction of different stakeholders and exchange of knowledge and experience among them is of great importance since it will enhance participative values of stakeholders by satisfying their needs and co-development of their perceptions. Using this approach, value creation becomes a bidirectional process conducted between at least two stakeholders exchanging knowledge and experience (Prahala & Ramaswamy, 2004). As Liu et.al., (2014) speculate, it is actually the "experience" or the value creation process which is of value, rather than the passive receiving of the output of project.

Resulted from value co-creation process, despite the uncontrollable nature of social, governmental, environmental and ecological surroundings of a project, these could be better managed and integrated to be used as sources of value creation (Vargo et.al., 2008). However, prosperity of the value co-creation is highly dependent on the ability of the organization leaders (i.e. project owner, financier, project manager, etc.) to keep constant contact with stakeholders, investigate and explore their knowledge and interest and try to align the skills, knowledge and efforts of both sides to each other. The value co-creation process, the methods that project participants use in order to perform it is the focus of R.Q. 1 of this research.

An important source of value for organizations is their knowledge and experience gained from a project; both at individual level and organization level. According to service dominant logic (S-D), knowledge is composed of two parts: propositional knowledge, which is abstract and generalized; and prescriptive knowledge, which is often referred to as techniques. These techniques "*...are the skills and competences that entities can use to gain competitive advantage*" (Vargo and Lusch 2004a, p. 9).

Knowledge management is the concept of combining the expertise, wisdom and insights of individuals in an organization. The concept of knowledge management has been around for decades, but most organizations accept it only as theory and have not put it into practice. The most profound aspect of knowledge management is that ultimately, an organization's only sustainable competitive advantage lies in what its employees know and how they apply that knowledge to business problems. If the wisdom could be captured and shared within the project management community, it would make sense that organizations would benefit infinitely. Knowledge management approaches is the focus of the second research question of this paper.

Due to uncertain nature of projects (Turner & Müller, 2003), it is very difficult to precisely predict what values will be delivered at the end of the project. In addition, if an unforeseen opportunity emerged, project participants should be able to first identify this opportunity and second, need to be able to use it in order to create more values from the same project. Payne et.al. (2008), defined co-creation opportunities as the strategic options for creating value. They suggest three different types of value co-creation opportunities that should be considered: 1. Opportunities provided by technological breakouts 2. Opportunities provided by changes in industry logics and 3. Opportunities provided by

changes in customer preferences and lifestyle. Considering these three pillars, this research tries to identify if project managers and participants, in contact with local community that is considered as customer, take stock of these opportunities in their projects.

Resulted from the three different aspects of value maximization which are selected as the target of this research, it is tried to investigate how project organizations take these approaches in order to increase the levels of success of their projects.

3. Methodological Approach

To build a theory from best practices in Oil and Gas industry (O&G) one of the authors designed and developed a set of structured interviews to gather data from project participants in order to deeply understand the different approaches taken to maximize the value and the level of success of their projects.

3.1. Literature Review

Semi-structured literature review was conducted, following a set of non-structured literature reviews, in order to gain knowledge about literature of the field. Several keywords (in both title and abstract) were used in order to understand different schools of thought and opinions on the field. They were: success, benefit, value creation, value capturing, value co-creation, complex projects and megaprojects. There was no chronicle limitation applied to the search and searching for articles was not limited to the project management field, but also included researches from business and marketing. After skimming the abstracts, the relevant papers were selected for reviewing.

Based on the literature review, different sources of value creation and value capturing emerged and a set of stakeholders in the O&G industry appeared to be further investigated. Three research questions were designed in order to test how it is possible to maximize value. The first research question explores value co-creation process between project managers (representative of project organization) and the community living close to the project site. The second one is focused on value captured from knowledge and experience gained by the organization during project execution. The third research question investigates identification of unforeseen opportunities by project's performing organization in order to maximize the value.

3.2. Interviews

Focusing on O&G industry in Iran, the interviewees were selected from the pool of project managers and different members of project participants, including consultants, owners and contractors. They were primarily selected and contacted through social media (LinkedIn) or by researchers' personal network. The interviews lasted between two to four hours, asking to interviewees experiences from knowledge management, communication with public community and co-creation opportunities. Table. 1 illustrates the interviewees' attributes.

Table. 1. Interviewees Attributes

Interviewee No.	Sector	Education	Years of Experience
1	P.M.	MSc. Energy Management/relevant	20+
2	P.M.	MSc. Nuclear Science/irrelevant	20+
3	Consultant	PhD. Energy Management/ relevant	20+
4	P.M.	Phd. Mechanical Engineering/ irrelevant	20+
5	Contractor	MSc. Energy Management/relevant	20+
6	Consultant	Msc. Civil Engineering/ relevant	10+
7	Owner	M.A. Finance/ relevant	15+
8	Owner	M.Sc. Construction Management/ relevant	10+

4. Analysis and Results

The conducted interviews were analyzed in order to address the research questions. Below, the conclusion of the interviewees' opinion comes:

4.1. RQ1. Value Co-creation and Communication with Local Community

Local communities, people who live in the project's neighborhood, are among the most important stakeholders of O&G projects (Eweje, 2006). They normally have different concerns and constraint which rise up more obviously during the project execution. Environmental effects of project, the effect of project on the financial status of community and social and cultural effects of projects on the community are the three main concerns and constraints of the local residents. Local communities may decide to rise against the project or to be in support of it. But according to interviewees' opinions, the project organization policies can totally change the community's position from one to another.

O&G project and refinery plants can have sever environmental effects in forms of air, water, soil and sound pollution. The most obvious influence of these projects for local communities is air pollution. As one of the interviewees mentioned:

"... It is not something you can hide. People breathe and they clearly feel the sour taste in the air. They also have heard about these effects before we start execution... You can not do anything. They have heard a story which unfortunately is true..."

According to this interviewee, the symptoms of pollution are obviously clear for local community. But project organizations can plan in order to minimize these effects. Primarily, people should be kept distant from the project site and relocated in further places. But this generally cannot be done by performing organization, as one of the interviewees explains. The O&G reservoirs dictate the location of project and in most cases there are people living nearby.

"They need to be moved from the neighborhood of project site. But it is out of the organization authority. More major policies should be imposed by government...."

Another solution is minimization of these effects on surrounding environment by following the environmental standards. There are two levels of standards: International and national, (in that case developed by National Environmental Association of Iran).

"...the only thing we can do is to obey international standards; Both in design and planning and during execution. Filters and sensors should be installed on sewer system pipes and chimneys...we can reduce the amount of pollution but there is no way to totally eliminate it...we need to continuously keep track of what is emit to the air, water and soil and also noises during construction. ...We should try to stay within the borders and limitations of standards..."

"Environmental Impact Assessment Report is a document prepared during the feasibility studies of the project. It is from such importance that can sometimes change the scope, design and even the location of a project"

In some cases these rules are obeyed. Phase 1 of Mah-shahr refinery site is shut down due to the high pollutions it releases to the Persian Gulf. However, according to another interviewee, the power and authority of O&G industry is dominating to a level which in most cases, organizations don't let the environmental inspectors to enter and visit the site, during construction and operation.

O&G projects in Iran are normally located in remote areas of the country where the financial status of population is poor and not stable. Therefore, in these areas, execution of a project can have a great influence on the economic condition of the neighboring habitants. There are certain rules implied by national government in order to maximize the number of job opportunities brought by these projects to their surrounding community.

“...governmental rules force us to hire a percentage of demanded human resource from the local community...otherwise, local government won't cooperate with us. They can easily build barriers for the project. We need facilities, permits and cooperation. So it is wise to convince the local government that we came here with peace and this project will benefit the habitants.”

However, in most cases communities need to get prepared by training and skill teachings prior to the start of the construction phase of the project.

“...in most cases we use local population in positions which don't need skilled human resources. It is not easy to find skilled welders or engineers from these small villages...”

“People are invited to be taught and trained prior to project execution. It can take from six months to one year. We send some people to project site in order to teach welding, piping and software skills...The recruitment level for women is much lower. We hire woman as secretaries or typists. ”

Nevertheless, the increase in job opportunities does not last long. After the project execution ends, the hired human resources are released and since they don't have a permanent contract with the organization and their experiences and skills are no more demanded in their residence, they become unemployed again. So this value does not last until the whole life cycle of the project (i.e. during the operation phase).

O&G projects may last for decades and are able to change the face of the surrounding area (Eweje, 2006). There are so many people from other cities and even countries working on project site and can have social and cultural effects on the surrounding community. But apparently these effects are totally neglected in planning, design and execution of these projects. They are not conducted or used in a guided way. During the interviews the researchers found no evidence of attention of projects organization and national and local governments on these aspects of populations life.

Summarizing the overall results , local community is able to have great influences on creating and capturing values of O&G projects. When a community starts opposing a project, there are possibilities for sabotages on site and organizations need to invest a lot of money for higher site security purposes. Organizations may face issues in procuring human resources and NGOs may rise against the project. However, by identifying and considering local community's concerns and constraints, organizations can prevent these barriers by keeping constant contacts with local community and making them informed about the project, its effects and its benefits as well as providing the community with infrastructures and financial and social benefits.

4.2. RQ2. Knowledge Management in Organization

During the interviews, a broad span of knowledge management approaches was observed. Three interviewees explained that knowledge management and spreading experiences gained from a project does not happen in their respective firms:

“Experience and lessons learned, they are just names...They are never practical in our organization. We collect them. We never use them.”

“In O&G industry, you can not find the culture of using gained knowledge and experience. We don't have a database of our experiences. We also don't keep our trained and experience human resources. They regularly get replaced by young freshmen. Because young employees ask for less salary”

It is important to highlight that this considerations are strongly influenced by the personal picture of knowledge management in a company and in this kind of analysis the variance of perception is very big in the same company and even in the same department of the company. However all these interviewees belonged to the public/governmental sector of O&G industry. So it seems this sector has difficulties in getting advantage from the knowledge and experiences grown in their organization. Other interviewees from the private sector, on another hand, explained that knowledge is a major source of value for them.

“We have an integrated system for training our personnel. We regularly organize seminars to spread the knowledge gained from previous projects. Different departments participate in these meetings and share their knowledge in a conducted way.”

In a very interesting case, the company has started capturing financial benefits from selling a software they developed (initially for their own use) in one of their project to collect information during the project projects.

“Our company has come up with the idea of development of an integrated knowledge collection system. Different participants of the project have access to the same database through their gadgets...and they enter their experiences, thoughts and ideas in that system...we have started to find a market for this software”

It can be concluded that it is very difficult that public O&G organizations effectively recognize knowledge and experience as a major source of value in projects. However, private firms take much attention (and more effective approaches) in taking stock of knowledge management and try to remain repetitive in the industry by continuous knowledge gathering and spreading at individual and organizational levels. Examples of experiences and knowledge that should be gathered during and after deployment of a project are: past data on completed projects, milestones, and work packages, identification of real risks, risk approaches and techniques used to alleviate them, skills for conducting interviews and internal survey (to recognize successful and failed activities) and skills for communications with stakeholders..

4.3. RQ3. Taking Stock of Co-Creation Opportunities

Project participants were questioned whether they have ever faced a new opportunity which has changed the project scope and has resulted in an increase in the total amount of value of the project. However, it seems that definition of risk for project participants is limited to negative risks rather than opportunities. For technological breakouts, the construction methods are dictated by availability of machineries and skilled human resources. So even if a new technology emerges and organization wants to invest on it, its application depend on other factors such as availability of monetary resources and procurement of machinery, operators, licenses, insurance, etc.

“We participate in international exhibitions and conferences. So we regularly receive information from the state of the art. But we need to overcome sanctions and then have financial resources to get them.”

The rules and logics of O&G industry are determined by international standards and regulation as well as international laws and macro economics. Therefore, development of new channels for reaching customers seems difficult, if not impossible.

Changes in external stakeholders' needs, demands and perceptions should be closely tracked by organizations in order to tailor the scope of the project in order to benefit from values created and captured from perception changes. However, in O&G industry, demands of a part of stakeholders are constantly considered (i.e. end users, customers, etc.). However, it happens that local communities, mainly in developing countries, are sometimes neglected in order not to alter the project scope.

5. Conclusion and Future Researches

This research uses a qualitative approach in order to explore and investigate approaches taken by project participants in order to maximize the value of O&G projects from different selected perspectives. According to the results of this research, project organization can conduct local community in a way to change their position, from being against a project to being supportive of it. This will produce a process of value co-creation for both local community and organizations. Organizations can reduce their costs and unfavorable situations and local communities can benefit the job opportunities associated to the project as well as the infrastructures and training courses provided by the organization.

National governments, in cooperation with local governments, should use their authority to ratify laws to protect local communities from the unfavorable influences of O&G projects in terms of environmental, cultural and social effects.

As one of the main resources of value for organizations, firms should shape their long term policies in a way to be able to keep their skilled and experience human resources and try to collect, organize and spread the individuals' and organization's knowledge and experience. Experiences gained through project deployment can make an organization to a leading reputable firm which will bring benefits in long terms.

Future researches can be done in order to identify and explore other resources of value creation and capturing of organizations. There are numerous stakeholders involved in O&G projects and each of them could be investigated in order to increase the total amount of values of a project. An interesting subject for research are the different aspects of knowledge and experiences coming from a project and their effects on the future prosperity of a firm..

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