

# Searching for sustainability inside project management processes: a case study of nuclear power plant project construction

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## Purpose

Today, more than ever, achieving a sustainable development of a business and of innovation projects is one of the key issues and one of the most challenging objectives for companies. Sustainability is considered a process that creates a community vision

that respects the prudent use of natural resources to ensure that present generations can achieve a high degree of economic security while preserving integrity of the ecological system and of life (Elkington, 1997). Above all considering sustainability not only as an economic dimension, but also from an environmental and social point of view. Project Management activities are no exception. Sustainability, as field of study, can provide project management with new perspectives, supporting project manager in its decision-making about planning, management and control of the resources assigned to the project, considering the economic, social and environmental impacts of not only the project life cycle, but also the assets' life cycle and the life cycle of the product delivered. In fact, following the traditional project management approach based on the triple constraints (time, cost and quality), the allocation and exploitation of resources should be done in respect of those three parameters, seeking the optimal combination for maximizing the internal benefits of the organization. This approach proved to be very reductionistic over time (Atkinson, 1999), because it does not take into consideration social and environmental issues, which are the real challenges of today. The problem is highlighted also by the fact that in the widespread Bodies of Knowledge as the Project Management Body of Knowledge, sustainability is poorly addressed. This raises the problem of the need for a more holistic and coherent view of projects in terms of the degree of fitness with their environment and society at large (Tinoco et al., 2016).

As already stated by Martens and Carvalho (2016a), many researches addressed and deeply studied project management and sustainability. In fact, on the industrial side, there is an increasing interest in using practices in project management (PM) and certifying professionals in this field, and principles of sustainability dominate every context of business and organizational management. Nevertheless, the research on how sustainability can affect projects dynamics deserves an increasing attention, as just few studies have considered this topic so far. Therefore, there is a generic lack of academic literature about sustainability integration in the project management field (Carvalho and Rabechini, 2017; Marcelino-Sádaba *et al.*, 2015; Singh *et al.*, 2012; Thomson *et al.*, 2011). Recently, some authors have tried to address this topic through both literature review (Silvius and Schipper, 2014) and analysis of case studies (Silvius *et al.*, 2017; Mavi and Standing, 2018), considering both internal and external economic, environmental and social factors that influence actual project managers' decisions during all project phases. Some other authors have analyzed the correlation between project success and sustainability (Silvius and Schipper, 2016; Martens and Carvalho, 2016b) pointing out a relationship that still needs to be proved by obtaining further mathematical and statistical evidences.

Anyway, there is still a lack of specific definition and structure of the concept and of the practices and this is the main obstacle for further investigations.

Therefore, the main objective of this work is to increase scientific knowledge in relation to a new way of managing projects in a sustainable way, the so-called "Sustainable Project Management" (SPM).

The first step toward this goal was to analyze the literature (part of that was mentioned above). Then, based on the conceptualization of the dimensions of sustainability integration in projects found in the literature, we developed a conceptual framework that shows key dimensions and the relationships among them (Figure 1). The dimensions emerging from the reviewed papers and reported inside the framework represent key factors for the effective integration of a sustainable approach into project management processes and practices.

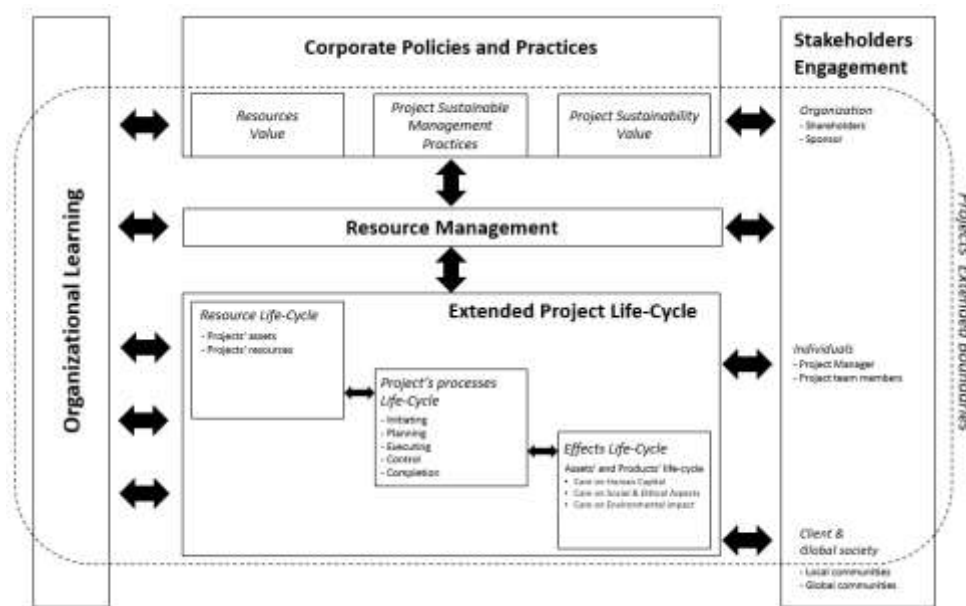


Figure 1 - Sustainable project management framework (Armenia et al. 2019).

Starting from this foundation, the research question to which this study wants to answer is the following:

How to practically implement a sustainable approach within project management processes? What are the relevant characterizing activities?

## Design/methodology/approach

To test and to bring more validity to the framework and individuate relationship between the components inside the model, we conducted some interviews to project managers, who are working in renowned construction companies that take proper ac-

count of sustainability issues. Companies operating in civil engineering sector are exemplary case of implementation of SPM, because construction projects are easy to analyze on a project management perspective.

We collected data through semi-structured interviews with project managers of the involved companies. After a first set of questions focused on the description/classification of potential SPM practices, the interview aimed at understanding the implementation process asking which practices and outcomes are usually requested to project managers by companies and which kind of barriers and advantages they encounter for sustainability integration in terms of stakeholder engagement, resource and waste management, benefit realization, etc.

The research aimed to identify, classify and integrate conceptually what is currently done by professionals and companies in this specific area, in order to bring out best practices and approaches that can give substance to the concept of Sustainable Project Management.

For the purpose of this paper, we are going to present findings and conclusions from an interview made with a project manager engaged in an important nuclear power plant project construction, which is actually on-going.

## Findings

The professional interviewed, L.F., is a project manager in a large company that operates in more than 80 countries worldwide, with annual sales of around 11 billion euros and one of the leading experts in the field of civil nuclear engineering. Currently he is following a contract concerning the execution of some works for the construction of a new nuclear power plant. These types of construction projects impact the economy, the environment and society in a very different way and weight than any other project in the construction sector. They include extremely complex activities, with costs of billion euros and the public opinion that is not always in favour.

This study, however, aims to understand and analyse how, during the management of a such complex project, aspects related to sustainability emerge; opinions on its actual necessity and convenience are left to other studies.

We will rely on the answers obtained from L.F, who is following and coordinating, for his organization, some activities worth over 600 million euros, which will contribute to the construction of the nuclear power plant. The activities concern in particular the management and coordination of “the sealing of the reactor casing, the construction of tanks for containing liquids and pools for liquid cooling”

The interview will be divided in different sections based on the project phase (start-up, planning, execution and closing):

During the start-up phase, economic, social and environmental analysis are made at corporate level. Plants of this magnitude are manufactured under strict government directive. In fact, as said by L.F.: “*The analysis is based on the energy plan of a nation,*

*mainly based on the per capita expense for the purchase of energy. This is a very complex analysis made through government agencies and technology ownership. In this phase a feasibility study will be carried out with attached an in-depth cost-benefit analysis”.*

In the start-up phase beyond the market analysis, assessments regarding the economic effects that the project development and output have on the local economy are made. Thinking about nuclear-related projects, it is easy to imagine that the impact on the site area is enormous. It creates important satellite activities on the territory.

*“A nuclear plant counts on average 7,000 jobs at the time of peak production (ranging from the Project Director to the lady in the canteen)”.*

This immediately leads to benefits, for example, for hotels in the area, which will be able to accommodate the workers in their premises. Not to mention that already at this stage the number of new hires required for the commissioning of the new reactor are estimated.

Naturally, it should be noted that, as regards the activities that directly impact the production of the final output, an international selection is made between a certain number of professionals and companies that deal with carrying out the required activities with a high level of specialization. But for activities that do not directly impact on the construction instead, such as for example the canteen service or the cleaning service of the workers' locker rooms, local businesses are chosen.

*“In this phase of the project a site analysis and technology analysis are carried out”.* The analysis allows to understand how the plant will impact on the environment during its activity. The reactors in this project are expected to have a life span of 60 years. According to the analyses carried out by the major stakeholders involved, the choice of this type of reactor will satisfy 7% of the electricity needs of the country and will also be able to produce low-emission energy.

*“In this phase of the project re-use plans of some materials are carried out. We only talk about excavation materials, because it is not possible to reuse anything. Logically the excavation material must be analysed and stored in some way. One part will be reused to cover the areas around the structure and the other part to make the arrangement of the land around the plant”.*

Given that in this type of project the contractors are many and they carry out their activities both in parallel and in sequence, it is very important to respect the general Plan of the activities or Master Plan, in which the scheduling of the activities is defined.

The time has a key role in this type of project: *“Delays are very expensive, every day you don't produce energy is money lost. If, for example, the plant should start on January 15th, but instead the plant is ready at 16th, we have already lost 1 million euros. The plan is very important”.*

Just to minimize the risk of going late with activities, *“A mitigation plan or risk response plan is done. A ‘plan B’ to meet deadlines or try to minimize delays as much as possible”.*

In this phase we talk about Nuclear Safety, referring to the fact that every activity must be carried out in a safe and economical way respecting the Master Plan, and the

Nuclear Quality that represents *“the management of all the documents to be produced, all the procedures to be carried out. You can't do anything if you don't have a plan where you describe the activity you are going to do, step by step. There is no activity where a risk assessment plan is not carried out, where all the risks that that activity entails are analysed”*.

For each material used for the construction of the reactor, an environmental impact assessment is carried out and a waste disposal plan is studied.

L.F. wanted to underline the fact that for Nuclear Quality *“Any element must be traced and must be unique and unrepeatable”*. This aspect greatly affects the planning phase with suppliers, since they should minimize the errors. In fact, every mistake can lead to huge losses of money, also because the excess materials cannot be reused for similar works in other construction sites.

A nuclear plant has its peak on costs during the execution/construction phase. *“To lower these costs, specifically in this project, we use the experiences gained in other projects (especially two other power plants finalized in other countries)”*.

Very important in such complex projects is learning from past experiences and trying to standardize all design, planning, execution and management control procedures. Having an ideal scheme to follow, or a protocol of standard operations to be respected during a phase of the project can lead to the elimination of many variables linked to uncertainty. *“Using the experience to avoid the mistakes made. For example, in a project in which I took part, there were some unrealized welds that led to a delay of about a year and a half”*.

In relation to a social issue as workers and public safety L.F. said *“Our motto is ‘be safe, do safety’. Everything must be done safely, otherwise it cannot be done”*. The issue of workplace safety is very important and delicate for this type of work. Special methods and systems are used to formulate *“Construction Site Safety Plans”* and *“Operational Safety Plans”*. The level of detail of these plans and the way they are implemented are extreme.

*“Any area of the site is bounded with pedestrian walkways, where a fixed route must be followed. This is done to prevent injuries as much as possible. In fact, in these areas there will be no suspended loads for example. The same thing applies to vehicles, which must follow the identified roads and are monitored by personnel in charge of checking the internal roads”*.

The prevention of accidents that could impact on the environment during the execution is very high. *“A nuclear plant is built with the greatest attention to safety and considering all the aspects that could negatively affect the environment”*.

Each crucial phase for the project is supervised and inspected by third parties. At the national level from national monitoring organizations; at European level with the IAEA (International Atomic Energy Agency) based in Vienna; and finally, at global level with the WANO (World Association of Nuclear Operators).

*“These bodies are from time to time to check and monitor that everything is performed according to Nuclear Quality”*.

Every single deliverable of the construction process is checked, supervised and approved. *“The safety standards are so high, that a change occurs only and exclusively after an accident, that is very unusual”*.

Only after a “lesson learned” it is possible to review the safety plans. The lessons learned not only change the way of dealing with the execution phase, but mainly influence the design phases of the new plants.

At the end of the project, through information programs, the local community is updated on the activities carried out on site. Furthermore, the local community is periodically involved in some simulations. *“Accident simulations are organized at fixed times, involving people residing in countries near the plant”*. These simulations aim to train and educate the community about the behaviours they must take on emergencies.

Regarding the disposal of waste materials, there are documents that contain all the procedures to be followed, including those related to the storage and disposal of unused materials. *“Since nuclear power is thought to have zero impact on the environment, I see no reason why the management of the material on site should not be the same”*.

The interview touched many times and differently all the dimensions of the Sustainable Project Management approach. We tried to summarize the links to the framework with the Table 1.

**Table 1** – Main characteristics of the case study for SPM framework

Corporate policies and practices	<ul style="list-style-type: none"> <li>• The Nuclear quality is a concept that permeate all policies and practices. All the activities to be carried out need to be justified, with an appropriate risk assessment plan.</li> <li>• Everything must be done safely, otherwise it cannot be done.</li> </ul>
Resource management	<ul style="list-style-type: none"> <li>• For each material used, an environmental impact assessment is carried out and a waste disposal plan is studied.</li> <li>• In terms of reuse, only excavation material is reused, to cover the areas around the structure</li> </ul>
Extended project lifecycle	<ul style="list-style-type: none"> <li>• The reactors in this project are expected to have a life span of 60 years after its completion. The project management process works for ensuring the right functioning of the plant for all the 60 years, and beyond with the decommissioning plan.</li> <li>• Great attention also for the project materials lifecycle, suppliers must comply with stringent criteria about productivity and environment.</li> </ul>

Stakeholder engagement	<ul style="list-style-type: none"> <li>• A nuclear plant counts on average 7,000 jobs at the time of peak production. It creates important satellite activities on the territory.</li> <li>• There is great attention to the safety of the project team member.</li> <li>• There are information programs for local communities and activities to train and educate the community about the behaviours they must take on emergencies.</li> </ul>
Organizational learning	<p>Using experience from other projects to</p> <ul style="list-style-type: none"> <li>• lower costs</li> <li>• reconsider power plant design</li> <li>• enhance safety plans</li> </ul>

## Originality/value

This study has implications for both scholars and managers. In terms of theoretical implications, it firstly provides a synthesis of current knowledge on the new topic of Sustainable Project Management, proposing a conceptual framework whose concepts are then transferred in a case study interview to explore new pathways towards definition of the approach.

In terms of managerial implications, this study shows most relevant dimensions on which project managers should focus to integrate sustainability into their project management practices. In particular, the dimension of organizational learning proved to be very important as the concept came out frequently during all the interview. Therefore, the choice to include organizational learning inside the framework seems to have been successful.

We found that nuclear power plant projects have a strong relation with sustainability principles due to the project features (many stakeholders on different levels, special materials, very extended lifecycle both for project process and project's product). Nevertheless, we have found some limits for complete integration of sustainability principles. In fact, analysing the interview deeply, the answers are almost always related to regulations and in very few cases they express a natural approach committed to sustainability.

Furthermore, another important result is that, unlike other types of project, the reuse of remaining material is not possible. This is a relevant limit, because one of the key concepts at the base of sustainability is about eliminating waste by stocking what was not used in the present for future activities and projects.

From a very practical perspective, the main subjects of this research are companies that work on important innovative projects; in particular, projects that consume



large quantities of materials and energy and their benefits and outcomes have life-long impacts on the economy, society, and environment. For many of these companies, sustainability is still viewed as a burden, a matter of liability towards regulation, while the new project management perspective that this research is addressing would help companies to focus on new business opportunities, given by the integration of sustainability principles inside their own business processes. The path towards this goal is represented by the real comprehension of impact of sustainable project management as a new concrete competitive capability.

### **Research limitations/implications**

The main limitation of this study is that, unfortunately, Sustainable Project Management is still in its infancy, so the choice of the five dimensions of framework and the subsequent development of the survey are based on a limited number of studies. However, market needs are increasingly changing towards sustainability issues, so integration of sustainability and project management practices represents a topical subject and further research on its structure definition is needed. As the topic addressed is very innovative, the findings can contribute to the research as a starting point for further empirical researches.

Another limitation is that the case study presented is very extreme, as it deals with a specific type of project (nuclear) that, although very interesting, it represents a limited vision of the wide variety of project typologies in the world.

Future research should, therefore, be devoted to testing and enriching the developed framework through exploratory research involving in-depth case studies and interviews with industry experts, of which this paper is an example. This activity will serve to strengthen and refine the framework and definition of SPM, involving different industries (to highlight significant differences based on industry peculiarities), as well as different countries (to identify significant differences due to distinctive cultural features).

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