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Integrating environmental sustainability and project portfolio management: case study in an energy firm

Integrando sustentabilidade ambiental e gestão de portfólio de projetos: estudo de caso em uma empresa de energia

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Abstract: Although international and relevant research on environmental sustainability and project portfolio management is quite developed, there are few studies integrating the two areas. We could only identify research on each of the areas and very few interfaces between them, either in empirical or theoretical terms. In constructing a case study, our choice was to study of the existing European largest firms of energy production and supply, and one that is globally recognized in the area of renewable energy. This article aims to analyze and enable understanding of the policies and practices for integrating environmental sustainability and project portfolio management. Among the main results we observed that the environmental and social aspects of portfolio projects are inseparable for this organization. Good communication and active negotiation with stakeholders, especially with the local communities in the vicinity of projects, was highlighted as a management practice that may be used to improve project management performance. Furthermore, it was noted that logic in relation to identification, analysis and approval of new projects in the firm is also guided by the same environmental and social concerns.

Keywords: Environmental sustainability; Project management; Project portfolio management; Social sustainability.

Resumo: *Apesar de existirem muitos trabalhos sobre sustentabilidade ambiental, por um lado, e sobre gestão de portfólio de projetos, por outro, não há pesquisas que analisem esses temas de maneira integrada. Assim, as duas áreas seguem separadas e com apenas raras interfaces teórico-empíricas. Seguindo uma estratégia de estudo de caso em uma das maiores firmas europeias de energia, que se destaca mundialmente na produção de energias renováveis, este artigo tem como principal objetivo analisar e compreender as práticas adotadas para a integração das duas componentes, sustentabilidade ambiental e gestão de portfólio. Entre os principais resultados obtidos observou-se que os aspectos ambientais e sociais são indissociáveis nos principais projetos da empresa. A boa comunicação com stakeholders e, especialmente, com as comunidades locais e as diretamente afetadas pelos projetos também foi destacada como prática de gestão que pode ser empregada para melhorar o desempenho de projetos. Notou-se também que a lógica para a análise e aprovação de projetos na empresa, admissão de projetos para o portfólio empresarial também se pauta pelas análises das externalidades ambientais e sociais previstas pelos próprios projetos.*

Palavras-chave: *Sustentabilidade ambiental; Gestão de projetos; Gestão de portfólio de projetos; Sustentabilidade social.*

1 Introduction

Environmental sustainability is considered one of the most relevant contemporary challenges faced by firms (Dangelico & Pujari, 2010). The pressure from stakeholders, including governments (Dalhammar, 2016) and various actors in consumer markets (Ji et al., 2015), to adopt sustainable practices has been increasing. This importance and pressure to adopt environmental sustainability has been evidenced since 1972 with the United Nations conference for the environment that occurred in Stockholm, and the global problems of environmental sustainability have been part of the political agendas of most countries (Dangelico, 2015). For example, in 2015 the main goal of the meeting in Paris called COP21, which was attended by representatives of over a hundred countries, was to reach an agreement with universal participation among all nations to reduce the use of

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carbon and increase the use of renewable energies (Robbins, 2016).

Aligned with this trend and pressure from government agencies, many firms have been striving to develop new technologies, products, equipment and facilities with greater energy efficiency and effectiveness (Tiwari et al., 2015). It is known that project management plays a central role in the development of these more sustainable practices and technologies (Silvius & Schipper, 2014). Even considering the triple bottom line of sustainability (environmental, economic, and social), some authors (Brones & Carvalho, 2015; Cluzel et al., 2016; Luiz et al., 2016; Marcelino-Sádaba et al., 2015) emphasize the need to expand research focused specifically on the relationship between environmental sustainability and project management. This project management practice is undergoing adaptations towards greater sustainability (Abidin & Pasquire, 2007; Martens & Carvalho, 2016).

Gemünden & Schoper (2014) highlight climate change and pollution as one of the major trends that will affect construction project management; Martinsuo & Killen (2014) point to the fact that although it is a poorly studied theme, integrating social and environmental sustainability into portfolio management is becoming one of the most prominent themes in project management; Marcelino-Sádaba et al. (2015) observed that despite not being included in the three main dimensions of project management (cost, scope, and deadline), there is a tendency for the ethical and sustainable aspects to assume increasing importance in organizations and their interfaces with various stakeholders (Abidin & Pasquire, 2007; Martens & Carvalho, 2016).

Although the area of investment analysis has recognized for some time the importance of social appraisal of projects (Rebelato, 2004), and more and more world-class companies tend to consider the principles of sustainability in portfolio management (Morioka & Carvalho, 2016), the literature has suggested that few studies focus on researching and proposing practices aimed at the integration of environmental sustainability in project portfolio management, and especially in portfolio decision-making (Brones & Carvalho, 2015; Brones et al., 2014; Khalili-Damghani & Tavana, 2014; Silvius & Schipper, 2014). In addition, the selection of projects with environmental bias is still closely related to radical innovation, with the development of disruptive solutions, such as hybrid cars and the use of solutions based on solar energy (Brook & Pagnanelli, 2014).

Based on a case study, the main objective of this article is to identify and understand the practices used for the integration of environmental sustainability in project portfolio management (PPM). The intention is that the article will answer the following questions that still need further studies: How can PPM incorporate aspects of environmental sustainability? What management practices can be used to integrate environmental sustainability into portfolio management?

Due to the exploratory nature of this research, a qualitative approach was used through a case study. The firm investigated and visited *in loco* in the city of Lisbon (Portugal) is one of the largest energy companies in Europe, operates in 12 countries, and stands out as one of the first in the world to produce renewable energy. The investigation of companies that operate in the energy sector is relevant in this field of research because, in addition to it having socioeconomic and environmental impacts that are directly related to their operations (Trapp & Rodrigues, 2016), the energy sector also has a relevant role in the economic and social development of organizations and countries (Fisher et al., 1998). Moreover, energy production can also potentially have significant environmental impacts, such as significant increases in CO_2 emissions, water pollution, soil contamination, deforestation, and loss of biodiversity (World Bank, 2013). These facts provided an adequate context in the company for reflections and investigations in this research field.

After this introduction, the paper presents a theoretical review. Secondly, it states and justifies the methodological procedures used in the case study. Thirdly, it presents and analyzes the results and lastly presents final considerations.

2 Environmental sustainability and project portfolio management

According to the World Commission on Environment and Development, sustainability is the satisfaction of present requests without compromising future generations in social, economic, and environmental aspects World Commission on Environment and Development (WCED, 1987). Specifically, Uzzell et al. (2002) define environmental sustainability as the protection of natural wealth, control of the consumption of nonrenewable resources, control of the emission of pollution, maintenance of biodiversity, and preservation of flora and fauna and the health of the population.

Porter & Van der Linde (1995) emphasized that the adoption of environmental sustainability practices can represent opportunities to improve the innovation capacity and competitiveness of companies (avoiding the waste of water and energy, for example). Dangelico & Pujari (2010) and Dangelico et al. (2013) highlight the fact that in the area of business and operations management, environmental sustainability has become one of the main themes in the areas of strategy, marketing, and innovation. This is because more environmentally sustainable companies tend to reap benefits, such as an increased market share,

improved reputation, improved innovative capacity, better compliance with legislation, and increased exports, among others (Dangelico, 2015).

Some studies have also drawn attention to the relationship between project management and environmental impacts generated throughout the project life cycle (Brones et al., 2014; Sánchez, 2015; Silvius & Schipper, 2014). Therefore, it is important that the choice of project portfolio also considers the environmental aspects (Brones & Carvalho, 2015; Sánchez, 2015). Specifically, PPM can play an important role by selecting each project in relation to organizational objectives and its alignment with the sustainability perspective. In addition to the harmonious management of portfolio projects, especially at the resource level, PPM can guide firms on which projects should be approved, how to prioritize them, and which ones to cancel (Abrantes & Figueiredo, 2014, 2015; Cooper et al., 1999).

There are four performance goals traditionally recommended for PPM (Cooper et al., 1999; Kock et al., 2015; Voss, 2012): (i) strategic alignment: aims to translate and coordinate the company strategy in a set of projects responsible for the viability of the corporate strategy; (ii) balance: aims to establish the mix of projects, incorporating aspects such as the degree of innovation, risks and rewards foreseen with the projects, and deadlines (short and long term), among others; (iii) maximized portfolio value: seeks to optimize the relationship between resources used and expected returns with projects; and (iv) preparation for the future: verifies how the set of projects prepares the company in terms of technology and infrastructure for future competitiveness.

To achieve these goals there are several methods and tools that can be used in PPM (Dutra et al., 2014). In a systematic review on the subject, Carvalho et al. (2013) observed that the most cited methods and tools are financial, mathematical programming, and statistical models; and the criteria for the selection of projects that stand out most are now based on market potential, economic-financial analysis, and risk/uncertainty analysis. Jugend et al. (2014) propose a framework for project portfolio decision-making based on the systematic application of financial methods, checklists, scoring and prioritization models, diagrams and graphs, and market research.

Some studies (Abrantes & Figueiredo, 2015; Dutra et al., 2014) emphasize that the application of these methods and tools associated with PPM tends to help companies improve their evaluation, selection, project prioritization, scope management and allocation of resources among different projects. In routine cases, PPM can determine how to allocate resources among projects, thereby safeguarding the global interest (portfolio) against local interests (projects) in order to guarantee good performance in environments in which resources tend to be scarce (Kock et al., 2015; Teller et al., 2012). For example, Padovani et al. (2010) observed, through action research in a chemical company, that the application of formal methods of PPM contributes to improving aspects such as: alignment between projects and company strategy; prioritization of projects and allocation of resources among projects; and quality of information exchange among all, and especially decision-makers.

With respect to environmental issues, some research studies have recommended the application of ecodesign methods (Bovea & Pérez-Belis, 2012; Brones & Carvalho, 2015) and project life cycle analysis (Silvius et al., 2012) as support for incorporating environmental sustainability into project portfolio decisions. Among the methods associated with ecodesign and project life cycle analysis that can assist managers in the selection of projects that meet environmental sustainability criteria, we find environmental quality function deployment (EQFD), the MET (materials, energy, and toxicity) matrix, environmental failure mode effects analysis (E-FMEA), and the ecodesign checklist (Bovea & Pérez-Belis, 2012; Byggeth & Hochschorner, 2006; Knight & Jenkins, 2009). The literature also presents stimuli for, and barriers to, the adoption of ecodesign (Luiz et al., 2016; Van Hemel & Cramer, 2002). Van Hemel and Cramer (2002) list as stimuli the improvement of the company's image, opportunities for innovation, benefits effectively generated for the environment, improvement of product quality, etc. Among the barriers, we can mention the low perception of the environmental benefits obtained, the possible commercial disadvantage, the technological restriction, the greater complexity that is associated with these projects – which tends to consume more development time – the greater need for information and the greater uncertainty of results (Collado-Ruiz & Ostad-Ahmad-Ghorabi, 2013; Van Hemel & Cramer, 2002).

With a concern for sustainability, environmental analyses can also guide PPM (Sánchez, 2015). Given the integration of product portfolio and environmental sustainability, the work of Brook & Pagnanelli (2014) suggests that environmental decision-making in portfolio management should consider aspects such as: (i) strategic alignment: projects must be aligned with the company's sustainability agenda; (ii) brand: projects should strengthen the firm's position on sustainability; (iii) CO_2 emissions/biomaterials: projects should contribute to zero emission levels, and be based on biomaterials; (iv) strengthening technology capabilities: improving the company's technological capabilities in relation to sustainability. Dobrovolskienė & Tamošiūnienė (2016) also emphasize that it is relevant to adopt specific sustainability criteria for choosing and allocating resources within the project

portfolio. Silvius et al. (2012) and Khalili-Damghani & Tavana (2014) propose the adoption of environmental indicators in project portfolios, such as: the materials to be used; the consumption of energy and water; impacts on biodiversity; emissions, effluents and waste, and transport.

3 Research method

In order to understand the main practices used for the integration between environmental sustainability and PPM, we opted for the use of a qualitative exploratory research approach. The choice of this approach proved adequate as a methodological option because we verified in a search for the keywords "environmental sustainability" and "portfolio management" in titles and abstracts in the Scopus database in August 2016, resulted in only four articles, of which only two are published as journals (the other two are publications in congresses). This demonstrates that environmental sustainability related to project portfolios is still little explored either in environmental management or in project management research fields. Moreover, this research collected primary data in a single case study, not proposing to test theoretical models, but in listing and relating practical evidence on the topic addressed, it can be classified as exploratory.

According to this approach, the presence of the researchers in the field was important in order to capture and understand the perceptions of the professionals involved in the decisions and activities related to environmental sustainability and project portfolios. As a research procedure, we used the case study method, which, according to Yin (2005) and Miguel (2007), is adequate when seeking a better understanding of the facts researched. Moreover, according to March et al. (1991) and Yin (2005), the case study allows an intense analysis of a relatively small number of situations, and sometimes the number of cases is reduced to one, or fewer.

Because emphasis is given to the broad understanding of the phenomenon in this unique reality chosen for intense investigation. In addition to being one of the leading energy companies in Europe and operating in South America, North America and Africa, it has always been sensitive to sustainability aspects; it has a sustainability board of directors and a director of sustainability, and also has focused R&D projects for wind energy production, being the third largest producer of this type of energy in the world.

The applied questionnaire was constructed based on the qualitative study of Brones et al. (2014), whose central concern was to identify how the environmental dimension is integrated with project management practices, as well as to identify the challenges of this integration. However, in order to align the questionnaire with the purpose of this research the questions were adapted for the project portfolio theme. After constructing the questionnaire it was sent for analysis and suggestions from a Ph.D. who is active in a European university and who has worked as a project manager in European and North American companies. The summary of the questionnaire applied can be found in Annex A.

After initial personal contact was made with the company, the questionnaire was sent by email and analyzed by an engineer from the innovation division and by the director of sustainability. Then the company was visited *in loco*, in the city of Lisbon (Portugal). In addition, to supplement this information, we researched and read documents related to the company's environmental policies and practices (especially on the Internet). So, for the triangulation of data, the sources of evidence used were mainly based on interviews, complemented by observations, informal conversations, and document studies.

The next section, after characterizing the company, presents the results of the case study.

4 Case study

4.1 Characterization of the firm

The research company is Portuguese, was created in 1976 and has approximately 12,000 employees spread throughout the world. It operates in the production, commercialization, and distribution of electricity and gas. It is one of the leading European energy companies, notably in the production of sustainable energies, especially wind, but has undertaken significant research in the production of electricity through classical energies and wave energy. It has more than 200 wind farms, and is one of the world's leading wind energy companies. In addition to Portugal, the company has units in countries such as the USA, Spain, the UK, Romania, Brazil, and Mexico. The company has a sustainability directorate that develops sustainability policies to meet the social, environmental, and economic requirements of its stakeholders. The company also adopts consolidated sustainability indexes such as the Dow Jones Sustainability Index (DJSI) and has also applied for other indexes and followed other reference models based on environmental and ethical indicators.

4.2 Case study: integration of environmental sustainability and project portfolio management

As the company surveyed is from the energy sector, its projects that have the greatest environmental impacts, while at the same time being more complex, are the hydro and thermal power plants. The life cycle of these projects includes the phases of designing, building, installing, operating, maintaining, and uninstalling. The sustainability directorate emphasized

that minimizing environmental impacts in all these stages is a fundamental aspect in terms of the planning and execution of projects. All stages of the projects are considered with a view to ensuring that the integration of environmental sustainability in the life cycle of their projects is foreseen and that adequate procedures are developed

To allow the selection and approval of projects, environmental impact studies are always developed, in addition to political variables. The company is always obliged to carry out a thorough analysis of the current legislation in order to guarantee that all the dictates are stated by the legislation. An additional difficulty pointed out in this regard was that of attending to different legislations in different countries. As the director of sustainability observed:

> For example, Spain has its own peculiarities that are different from other countries. State entities define what is legal in terms of projects, and the company has to comply.

The environmental analysis to start water and thermal construction projects begins with the choice of location. Among the various options, the choice has to fall on the location that guarantees the least environmental impact, mainly choosing the solution that guarantees the lowest social risk. In this regard, there is concern over aspects such as: minimization of environmental and social impacts in terms of location, in order to minimize the pollution generated by transportation during the construction and operation of these plants; equipment used and load capacity required; materials used (which do not harm the environment in the short and long term); convenient hours for work; and itinerary and logistics of materials (so as not to disturb the local population), among others. It was mentioned that although these analyses increase the cost of the project, they reduce not only environmental risks but also social risks.

It was highlighted that because of concerns throughout the project life cycle, from design and construction until its possible uninstallation, a lot of capacity was required for forecasting and planning in projects considering the long term. An additional difficulty mentioned, which has been highlighted as being little studied by the literature on project portfolio management, refers to the difficulty of measuring and accounting for long-term environmental impacts, and thereby improving decision-making about which projects to select and how to prioritize them. This difficulty was illustrated by the director of sustainability as follows: "When installing a hydroelectric plant, how should you measure long-term environmental impacts? "How can you offset environmental impacts generated on biodiversity?"

Since the construction of the plants can alter the life of local populations, it has already been mentioned that due to their particular characteristics, this type of project generates environmental impacts but also social impacts. In this regard, the example of thermal plant projects could affect the quality of life of the population where the plant will be installed due to its higher pollution potential. Because of these aspects the company does not usually separate aspects of environmental and social sustainability from portfolio decisions on projects.

In order to identify potential problems, mitigate and/or avoid the associated risks and develop contingency plans that are used at the moment of making a portfolio decision, and through the installing and operation, the sustainability unit has developed its own methods of interaction and negotiation with stakeholders, especially with local communities. Often, representatives of all the stakeholders affected by the project are invited to meetings, especially the population that lives near the construction areas of the project. In the last mentioned projects the leader of this communicative and negotiation process was a professor with a doctorate in social and environmental behavior. In the pre-project moments, from the interaction and sharing of ideas between these stakeholders and representatives of the company, the managers try to discuss and predict opportunities and possible environmental and social problems related to the project.

It was emphasized that to improve the integration of environmental aspects in these projects, it is essential that the company be able to interpret the demands of stakeholders adequately, which involves continuous processes of communication and feedback. Therefore, the planning and organization of these meetings was mentioned as one of the fundamental aspects in the decision-making process about the new projects and their prioritization.

Two major difficulties related to the integration of environmental sustainability in the project portfolio were mentioned. The first of these was the lack of technical and scientific knowledge available at certain times of project planning and execution weird situations. This obstacle can be explained by the lack of knowledge regarding the development of "fish lifts" in the construction of dams (development of "lift-type" systems for fish to spawn while maintaining their ascending river movement). The solution of the problem requires the integration of several areas of knowledge, which makes project execution very difficult. The company has its own R&D center to strengthen its capacities in environmental projects. Furthermore, the company practices open innovation initiatives. Among these initiatives are projects such as competitions for innovative energy projects, partnerships with universities for the development of joint projects, and the adoption of web systems (crowdsourcing) to attract ideas for projects in areas such as energy efficiency, solar and wind energy, natural gas, Internet of things, and others.

Chart 1. Comparative synthesis.

Variable	References	Evidence from the case study
Strategic fit	Brook & Pagnanelli (2014), Cooper et al. (1999), Kock et al. (2015)	Presence of a sustainability board that develops sustainability policies to meet the social, environmental, and economic demands of its stakeholders. The influence of this board reinforces the environmental and social analyses of the projects planned, approved, and executed. R&D efforts to develop projects for the production of wind energy.
Balance	Cooper et al. (1999), Kock et al. (2015)	Some of the projects that make up the company's portfolio are complex and long term (such as thermal and hydroelectric power plants).
Maximized portfolio value	Brook & Pagnanelli (2014), Cooper et al. (1999), Kock et al. (2015)	Difficult to measure and account for long-term environmental impacts in their projects, especially when considering the impacts on biodiversity.
Preparation for the future	Cooper et al. (1999), Kock et al. (2015), Voss (2012)	Internal R&D projects and open innovation initiatives for the joint development of projects (energy project competition and partnership with universities, for example).
Brand	Brook & Pagnanelli (2014).	The company positions itself as a sustainable company. Large portfolio of projects in wind and solar energy.
Environmental indicators in the project portfolio	Brook & Pagnanelli (2014), Khalili-Damghani & Tavana (2014), Silvius et al. (2012)	Adoption of consolidated sustainability indices such as the Dow Jones Sustainability Index. The need to develop environmental project indicators to meet the legislation in the countries where it operates.
Stimuli for the adoption of environmental sustainability in the project portfolio	Van Hemel & Cramer (2002)	Organizational culture oriented towards environmental sustainability (the company aims to be recognized as sustainable from the environmental point of view, which is contemplated in its various projects). Compliance with the legislation of the countries in which it operates.
Barriers to the adoption of environmental sustainability in the project portfolio	Collado-Ruiz & Ostad-Ahmad-Ghorabi (2013), Van Hemel & Cramer (2002)	Adequacy of legislation in different countries. Lack of clarity of legislation. Technological restrictions.

The second difficulty refers to environmental legislation in the area of energy. According to the interviewees, in many cases legislation comes late and in other cases this legislation is not sufficiently clear or does not encourage energy companies to adopt the most environmentally sound alternatives. This argument was illustrated by the director of sustainability:

> *For example, the environmental impacts of coal exploration are much larger. However, regulation is lacking to avoid the exploitation of coal. Prohibiting coal or reducing its exploitation through legislation is a difficulty. But the legislation does not encourage a reduction in the exploitation of coal.*

4.3 Discussion

Concern about environmental issues in project portfolio management can help organizations to select, prioritize, or discontinue, as well as allocate resources among their set of projects and manage scope in an integrated perspective taking into account the application of environmental sustainability criteria. This concern in the project planning stage can be useful for improving the level of companies' responses to diverse internal and external legal requirements, as well as generating internal benefits in terms of technological capacity to develop products and services, always with sustainable processes (Dangelico et al., 2013).

The results of this study demonstrate that two of the main trends in project management and project portfolios are adopted by these firms: the incorporation of environmental sustainability in the portfolio of projects, and the effective involvement of stakeholders during the project life cycle (Gemünden & Schoper, 2014; Marcelino-Sádaba et al., 2015; Sánchez, 2015). The incorporation of sustainability into the project portfolio is an internalized aspect of the company, since most of its projects have environmental and social impacts (projects for hydro and thermal plants, for example). In addition, even to meet the legal and

regulatory standards in the different countries where it operates, the company is obliged to meet certain environmental standards in its project portfolio. As regards the involvement of stakeholders, the development of specific communication methods is highlighted, with the active participation of representatives of the local communities affected by the projects. According to the observations mentioned in the case study, this dialogue/negotiation with the stakeholders enables the anticipation of problems and opportunities, thereby facilitating the development of adequate contingency plans at the level of project sustainability.

The lack of technological knowledge and difficulties related to environmental legislation were pointed out as the main barriers to a correct and comprehensive incorporation of sustainability in the project portfolio. The barrier regarding environmental legislation is an aspect already recognized in the literature (Dalhammar, 2016; Van Hemel & Cramer, 2002). For example, when investigating European industries, Dalhammar (2016) noted that firms tend to be skeptical of environmental legislation, since new legislation and new environmental standards generate uncertainty. On the one hand, environmental legislation can be beneficial from the socioeconomic perspective; on the other hand, it may not benefit firms, which often anticipate problems related to the technical solutions they will have to develop. In addition, as observed by Cluzel et al. (2016), technological and regulatory constraints related to environmental sustainability may decrease the willingness and ability of companies to innovate. In the case studied, the legal barrier occurs because the legislation is not clear enough to encourage companies to adopt more environmentally adequate alternatives in their projects. We observe this in the company studied by the example given where there is a lack of legal incentives to avoid the exploitation of pollutants such as coal (item 4.1). From this perspective, the results of this research reinforce that it is relevant that governments can develop clear legislation that effectively encourages companies to adopt coherent and comprehensive environmental sustainability practices.

The lack of technological knowledge available in certain projects, another of the difficulties highlighted and illustrated in the study by the case of "fish elevators," is also revealing as regards barriers to the integration of environmental aspects into projects (Dangelico, 2015; Van Hemel & Cramer, 2002). In response to this question, Dangelico et al. (2013) suggest that competencies in this area can be improved by firms through internal efforts in terms of R&D projects focused on the environmental area; by strengthening skills for the development of environmentally sound products and processes; and by the development of transversal skills and knowledge, which can occur through collaboration with diverse actors, such as partner companies, universities, and research centers. Not only was the realization of internal R&D company projects observed for the development of environmentally sustainable technologies, but also the adoption of open innovation practices.

Chart 1 presents a synthesis that compares PPM variables that were studied by the company researched with topics presented in the literature.

5 Final remarks

By presenting and analyzing the environmental sustainability practices in PPM in one of Europe's largest energy firms, which stands out worldwide in the production of renewable energy, this study contributes in areas such as environmental management, innovation management, and project portfolios, and the interconnection of these three. Although stakeholder theory is predominantly related to the areas of strategic management and organizational ethics (Freeman, 1984; Phillips et al., 2003), the results of this research suggest the possibility of extending their contribution also to project portfolio management and sustainability activities. We note the importance of developing and managing good communication with relevant stakeholders, which is mainly articulated through meetings with local communities. This practice is innovative in relation to that already indicated by the literature in portfolio management, and may be relevant for improving environmental and social performance in an integrated manner. Moreover, it is important to note that the logic for the analysis and approval of projects in energy companies, which lead to projects that generate both environmental and social impacts, should not only be guided by economic criteria, but it is important to take into account also systemic values and externalities.

Among the goals traditionally recommended for PPM, such as strategic alignment, value maximization, balancing, preparation for the future, and integrated management among them, we observe that due to the complexity of energy projects and the impact these projects can have on biodiversity, the company has shown difficulties in evaluating value maximization criteria. Possibly, companies with similar characteristics should face the same difficulty. In addition, due to the characteristics of its' your project portfolio, the company has demonstrated a good capacity not to separate social and environmental aspects in its projects, since its projects influence not only the environment, but also the communities that live where the projects are developed. Thus, future studies could focus on investigating value enhancement criteria in companies whose projects generate environmental and social externalities.

With regard to the barriers to the adoption of environmental sustainability in projects, this study observed the presence of two of the most commonly

cited in the literature: a lack of technological knowledge and difficulties related to environmental legislation. We observed that these barriers effectively hamper the decision-making process based on which projects should be effectively approved and then their planning. Given these results, we understand that it is important that future research in areas with complex projects and portfolio management of rigorous projects indicate directions on how to overcome these obstacles.

Even though the research company is one of the largest energy companies in Europe and stands out worldwide in the production of renewable energy, it is recognized that the empirical results of this study should be viewed with due methodological restriction. Due to the limitation of the research method used (case study) the results presented here cannot be generalized.

Therefore future research, also using the qualitative approach, could carry out new investigations in companies operating in different sectors and environments, and operating in different countries with the objective of identifying other and new practices for the integration of environmental sustainability in project portfolio management. Moreover, it would also be interesting for future quantitative research to verify and analyze the relationships of influence between the adoption of environmental sustainability practices incorporated in the portfolio management of projects in different dimensions related to performance and definition of value.

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References

Abidin, N. Z., & Pasquire, C. L. (2007). Revolutionize value management: A mode towards sustainability. *International Journal of Project Management*, 25(3), 275-282. http://dx.doi.org/10.1016/j.ijproman.2006.10.005.

Abrantes, R., & Figueiredo, J. (2014). Feature base process framework to manage scope in dynamic NPD portfolios. *International Journal of Project Management*, 32(5), 874-884. http://dx.doi.org/10.1016/j.ijproman.2013.10.014.

Abrantes, R., & Figueiredo, J. (2015). Resource management process framework for dynamic NPD portfolios. *International Journal of Project Management*, 33(6), 1274-1288. http://dx.doi.org/10.1016/j.ijproman.2015.03.012.

Bovea, M. D., & Pérez-Belis, V. (2012). A taxonomy of ecodesign tools for integrating environmental requirements into the product design process. *Journal of Cleaner Production*, 20(1), 61-71. http://dx.doi.org/10.1016/j.jclepro.2011.07.012.

Brones, F., & Carvalho, M. M. (2015). From 50 to 1: Integrating literature toward a systemic ecodesign model. *Journal of Cleaner Production*, 96(1), 44-47. http://dx.doi.org/10.1016/j.jclepro.2014.07.036.

Brones, F., Carvalho, M. M., & Zancul, E. S. (2014). Ecodesign in project management: A missing link for the integration of sustainability in product development? *Journal of Cleaner Production*, 80(1), 106-118. http://dx.doi.org/10.1016/j.jclepro.2014.05.088.

Brook, J. W., & Pagnanelli, F. (2014). Integrating sustainability into innovation project portfolio management - A strategic perspective. *Journal of Engineering and Technology Management*, 34, 46-62. http://dx.doi.org/10.1016/j.jengtecman.2013.11.004.

Byggeth, S., & Hochschorner, E. (2006). Handling trade-offs in ecodesign tools for sustainable product development and procurement. *Journal of Cleaner Production*, 14(15-16), 1420-1430. http://dx.doi.org/10.1016/j.jclepro.2005.03.024.

Carvalho, M. M., Lopes, P. V. B. V., & Marzagao, D. S. L. (2013). Gestão de portfólio de projetos: contribuições e tendências da literatura. *Gestão & Produção*, 20(2), 433-454. http://dx.doi.org/10.1590/S0104-530X2013000200013.

Cluzel, F., Yannou, B., Millet, D., & Leroy, Y. (2016). Eco-ideation and eco-selection of R&D projects portfolio in complex systems industries. *Journal of Cleaner Production*, 112(5), 4329-4343. http://dx.doi.org/10.1016/j.jclepro.2015.08.002.

Collado-Ruiz, D., & Ostad-Ahmad-Ghorabi, H. (2013). Estimating environmental behavior without performing a life cycle assessment. *Journal of Industrial Ecology*, 17(1), 31-42. http://dx.doi.org/10.1111/j.1530-9290.2012.00510.x.

Cooper, R., Edgett, S., & Kleinschmidt, E. (1999). New product portfolio management: practices and performance. *Journal of Product Innovation Management*, 16(4), 331-351. http://dx.doi.org/10.1016/S0737-6782(99)00005-3.

Dalhammar, C. (2016). Industry attitudes towards ecodesign standards for improved resource efficiency. *Journal of Cleaner Production*, 123(1), 155-166. http://dx.doi.org/10.1016/j.jclepro.2015.12.035.

Dangelico, R. M. (2015). Green product innovation: where we are and where we are going. *Business Strategy and the Environment*, 25(8), 560-576. http://dx.doi.org/10.1002/bse.1886.

Dangelico, R. M., Pontrandolfo, P., & Pujari, D. (2013). Developing sustainable new products in the textile and upholstered furniture industries: Role of external integrative capabilities. *Journal of Product Innovation Management*, 30(4), 642-658. http://dx.doi.org/10.1111/jpim.12013.

Dangelico, R. M., & Pujari, D. (2010). Mainstreaming green product innovation: why and how companies integrate environmental sustainability. *Journal of Business*

Ethics, 95(3), 471-486. http://dx.doi.org/10.1007/s10551-010-0434-0.

Dobrovolskienė, N., & Tamošiūnienė, R. (2016). An index to measure sustainability of a business project in the construction industry: lithuanian case. *Sustainability*, 8(1), 1-14.

Dutra, C. C., Ribeiro, J. L. D., & Carvalho, M. M. (2014). An economic-probabilistic model for project selection and prioritization. *International Journal of Project Management*, 32(6), 1042-1055. http://dx.doi.org/10.1016/j.ijproman.2013.12.004.

Fisher, T., Teixeira, E., & Heber, F. (1998). Estratégia de gestão e reconfiguração organizacional: os setores de energia elétrica e de telecomunicações. *Revista da Administração Pública*, 32(3), 9-27.

Freeman, R. E. (1984). *Strategic management: a stakeholder approach*. Boston: Pitman.

Gemünden, H. G., & Schoper, Y. (2014). First results of the new expert survey 2014: future trends. *Projektmanagement Aktuell*, 25(5), 6-16.

Ji, P., Ma, X., & Li, G. (2015). Developing green purchasing relationships for the manufacturing industry: An evolutionary game theory perspective. *International Journal of Production Economics*, 166, 155-162. http://dx.doi.org/10.1016/j.ijpe.2014.10.009.

Jugend, D., Crepaldi, A. F., & Miguel, P. A. C. (2014). Gestão de portfólio de projetos: métodos e práticas. In D. Jugend, S. C. M. Barbalho & S. L. Silva (Orgs.), *Gestão de projetos: teoria prática e tendências* (pp. 27-48). Rio de Janeiro: Elsevier.

Khalili-Damghani, K., & Tavana, M. (2014). A Comprehensive framework for sustainable project portfolio selection based on structural equation modeling. *Journal of Project Management*, 45(2), 83-97. http://dx.doi.org/10.1002/pmj.21404.

Knight, P., & Jenkins, O. (2009). Adopting and applying eco-design techniques: a practitioners perspective. *Journal of Cleaner Production*, 17(5), 49-558. http://dx.doi.org/10.1016/j.jclepro.2008.10.002.

Kock, A., Heising, W., & Gemünden, H. G. (2015). How ideation portfolio management influences front-end success. *Journal of Product Innovation Management*, 32(4), 539-555. http://dx.doi.org/10.1111/jpim.12217.

Luiz, J. V. R., Jugend, D., Jabbour, C. J. C., Luiz, O. R, & Souza, F. B. (2016). Ecodesign field of research throughout the world: mapping the territory by using an evolutionary lens. *Scientometrics*, 109(1), 241-259. http://dx.doi.org/10.1007/s11192-016-2043-x.

Marcelino-Sádaba, S., González-Jaen, L. F., & Pérez-Ezcurdia, A. (2015). Using project management as a way to sustainability. from a comprehensive review to a framework definition. *Journal of Cleaner Production*, 99, 1-16. http://dx.doi.org/10.1016/j.jclepro.2015.03.020.

March, J. G., Sproull, L. S., & Tamuz, M. (1991). Learning from samples of one or fewer. *Organization Science*, 2(1), 1-13. http://dx.doi.org/10.1287/orsc.2.1.1.

Martens, M. L., & Carvalho, M. M. (2016, in press). Key factors of sustainability in project management context: a survey exploring the project managers' perspective. *International Journal of Project Management*. http://dx.doi.org/10.1016/j.ijproman.2016.04.004.

Martinsuo, M., & Killen, C. (2014). Value management in project portfolios: identifying and assessing strategic value. *Project Management Journal*, 45(5), 56-70. http://dx.doi.org/10.1002/pmj.21452.

Miguel, P. A. C. (2007). Estudo de caso na engenharia de produção: estruturação e recomendações para sua condução. *Produção*, 17(1), 216-229. http://dx.doi.org/10.1590/S0103-65132007000100015.

Morioka, S.N., & Carvalho, M.M. (2016). Sustentabilidade e gestão de projetos: um estudo bibliométrico. *Production*, 26(3), 656 -674. http://dx.doi.org/10.1590/0103-6513.058912.

Padovani, M., Carvalho, M. M., & Muscat, A. R. N. (2010). Seleção e alocação de recursos em portfólio de projetos: estudo de caso no setor químico. *Gestão & Produção*, 17(1), 157-180. http://dx.doi.org/10.1590/S0104-530X2010000100013.

Phillips, R., Freeman, R. E., & Wicks, A. C. (2003). What stakeholder theory is not. *Business Ethics Quarterly*, 13(4), 479-502. http://dx.doi.org/10.5840/beq200313434.

Porter, M. E., & Van der Linde, C. (1995). Green and competitive: ending the stalemate. *Harvard Business Review*, 28(6), 160-173.

Rebelato, D. (2004). *Projeto de investimento*. Barueri: Manole.

Robbins, A. (2016). How to understand the results of the climate change summit: Conference of Parties21 (COP21) Paris 2015. *Journal of Public Health Policy*, 21, 1-4. PMid:26738430.

Sánchez, M. A. (2015). Integrating sustainability issues into project management. *Journal of Cleaner Production*, 96, 319-330. http://dx.doi.org/10.1016/j.jclepro.2013.12.087.

Silvius, G. A. J., & Schipper, R. P. J. (2014). Sustainability in project management: A literature review and impact analysis. *Social Business*, 4(1), 3-96. http://dx.doi.org/10.1362/204440814X13948909253866.

Silvius, G. A. J., Schipper, R. P. J., Planko, J., Van DenBrink, J., & Köhler, A. (2012). *Sustainability in project management: advances in project management*. Surrey, England: Gower Publishing.

Teller, J., Unger, B. N., Kock, A., & Gemünden, H. (2012). Formalization of project portfolio management: The moderating role of project portfolio complexity. *International Journal of Project Management*, 30(5), 596-607. http://dx.doi.org/10.1016/j.ijproman.2012.01.020.

Tiwari, M. K., Chang, P., & Choudhary, A. (2015). Carbon-efficient production, supply chains and logistics. *International Journal of Production Economics*, 164, 193-196. http://dx.doi.org/10.1016/j.ijpe.2015.02.008.

Trapp, G. S., & Rodrigues, L. H. (2016). Avaliação do custo sistêmico total da geração de energia eólica em face da substituição das fontes hidrelétrica e termoelétrica considerando as externalidades socioeconômicas e ambientais. *Gestão & Produção*, 23(3), 556-569. http://dx.doi.org/10.1590/0104-530x2028-15.

Uzzell, D., Pol, E., & Badenas, D. (2002). Place identification, social cohesion, and environmental sustainability. *Environment and Behavior*, 34(1), 26-53. http://dx.doi.org/10.1177/0013916502034001003.

Van Hemel, C., & Cramer, J. (2002). Barriers and stimuli for ecodesign in SMEs. *Journal of Cleaner Production*, 10(5), 439-453. http://dx.doi.org/10.1016/S0959-6526(02)00013-6.

Voss, M. (2012). Impact of customer integration on project portfolio management and its success – developing a conceptual framework. *International Journal of Project Management*, 30(5), 567-581. http://dx.doi.org/10.1016/j.ijproman.2012.01.017.

World Bank. (2013). *Toward a sustainable energy future for all: directions for the World. Bank Groups energy sector*. Washington: World Bank.

World Commission on Environment and Development – WCED. (1987). *De uma terra a um mundo: uma visão geral*. Oxford: Oxford University Press.</bok>

Yin, R. K. (2005). *Estudo de caso: planejamentos e métodos* (3 ed.). Porto Alegre: Bookman.

Annex A – Overview of questionnaire.

Part I: Company characterization

Part II: Practices for the integration of environmental sustainability in project portfolio management

- Does the company have environmental concerns in project management? How does this occur?
- Are environmental criteria considered by the company when making decisions about which projects to start? How does this occur?
- Are environmental criteria considered in decisions related to the technologies developed or chosen for the projects to be selected (e.g. processing of raw material, formula, packaging, process, others)? How does this occur?
- The following incentives are considered by the company to integrate environmental aspects in the projects to be selected.

Give a score (0 = not important; 5 = it's very important). If possible, please provide a comment.

Stimulus	Score	Comment
Benefit to the environment		
Cost reduction		
Innovation opportunities		
Improving company image		
New market opportunities		
Increasing project quality		
Compliance with legal requirements		
Synergy with other projects		
Other:		

- The company has difficulties in integrating environmental aspects into its projects, because:

Give a score (0 = not usually an obstacle; 5 = this is a frequent obstacle). If possible, please provide a comment.

Obstacle	Score	Comment
The environmental benefit is not clear		
There is no incentive for legislation		
Generates commercial disadvantage		
The necessary technological solutions are not completely available		
Requires more available time		
Insufficient available knowledge		
The return on investment is insufficient		
Technical conflicts with other functional features of projects (if applicable)		
Other:		

- Does the company adopt specific ecodesign methods to support decision-making on which projects to develop? (For example: EQFD, MET matrix; E-FMEA, ecodesign checklist, other.) Please comment.
- Does the company use guides or legislation specific to the environmental area to guide the development of projects? (For example: ISO 14001, guidance on integrating environmental aspects into product design and development – ISO/TR 14062, other). Please comment.
- Do environmental issues interfere with quality issues throughout the project? How does this occur?
- Do environmental issues interfere with cost issues throughout the project? How does this occur?
- What are the main difficulties or needs in the incorporation of environmental aspects in project management? Please comment.

- In your opinion, what are the best practices for incorporating environmental aspects into a project portfolio?
- In your opinion, how can environmental aspects influence decision-making on which projects to develop? Can you offer any suggestions for improving the integration of environmental aspects in project management?