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Review

Using project management as a way to sustainability. From a comprehensive review to a framework definition

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ABSTRACT

The working hypothesis of this study revolves around the lack of integration of sustainability and project management. Organisations, nowadays are increasingly keen on to include sustainability in their business. Project management can help make this process a success but little guidance is available on how to apply sustainability to specific projects. This work has analysed connections between the two disciplines by means of a comprehensive literature review covering more than 100 references. Sustainability has become a very important step, particularly in terms of environmental aspects. However, slightly less progress has been made socially. In any case, the ideal characteristics for a project and its management might be considered sustainable have still not been specified to this day. The main scientific contribution of this article is a new conceptual framework helping project managers deal with sustainable projects. This framework is based on the supposition that project products designed using sustainability criteria, sustainable project processes, organisations committed to sustainability that carry out projects, and project managers trained in sustainability are all necessary elements, although, maybe not enough, to attain sustainable projects. In addition, the article suggests a future research agenda that might specify how project management can help incorporate sustainability into organisations and their projects.

1. Introduction

Growing pressure and sensitivity related to including sustainability in all fields increases the need to research and introduce effective ways to achieve this (Abidin and Pasquire, 2007). These new paths will be both technical (new materials, more effective processes, etc.) and management-related.

In this regard, policies laid down by (national, regional and local) Governments are essential to meet the sustainability challenge that society is demanding (Brandoni and Polonara, 2012).

On the one hand, when the topic of sustainability is brought up, aspects relating to management (strategies, communications, aims, integration, teamwork) are frequently encountered but project management is rarely explicitly designated, maybe due to lack of knowledge, maybe due to the fact that both disciplines are still finding their feet or maybe a combination of the two. On the other hand, sustainability and environmental issues are not specifically or systematically considered in most major project management frameworks such as PMBoK, ICB, ISO 21500:2012 and Prince2 (Brones et al., 2014).

Transforming strategic sustainability objectives into specific actions for projects is a complicated process. Multi-dimensional perspectives of sustainability such as economics, social and environmental aspects, combined with a lack of structured methods and information at different hierarchical levels, only emphasise the problem (Ugwu et al., 2006a). In addition, sustainability seems at first to be counter to traditional project management in which almost all aspects are superimposed on the investment's economic profitability.

There are many pending questions concerning sustainability and project management. Is any project really sustainable? How might a sustainable project be defined? Could a project be sustainable without a sustainable management? Does management of sustainable projects refer to sustainable results and sustainable management of projects refer to sustainable processes? How can a project manager include sustainability when setting up and managing his/her projects?

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The authors have not found any answers to these questions in the reviewed bibliography; therefore, a functional approach was used, focused on searching for practical solutions for the project manager. The main objective of this article is to present the state of the art for sustainability in project management from the project manager's perspective and to propose a new conceptual framework (see Fig. 3) to contribute towards sustainable management of the project, leading to sustainable results. It should be highlighted that the scope of this research comprises industrial and civil engineering projects.

2. Background and terminology

Conditions for sustainable development are difficult to achieve and even more difficult to demonstrate (Boswell et al. 2005). Sustainability is a complex term to define in a sufficiently significant or practical way so as to make it operative (Pope et al. 2004; Glavic and Lukman, 2007) and there are wide-ranging insights into sustainability and its practices (Maletic et al. 2014). It is a holistic, ambiguous, forward-thinking, global and normative concept and these characteristics can be seen in calls to mesh cross-border considerations with local considerations, qualitative and abstract with quantitative and specific aspects, future and present considerations and the individual with the conceptual aspect (Pope, 2006).

In addition, in terms of sustainability, concepts seem to be widely dispersed: ethics, decision-making, assessment, rules, etc. and perspectives, and it is usually analysed globally but in single issues (Lozano et al., 2014). As Glavic and Lukman (2007) pointed out, sustainability terms and their definitions are essential to achieve sustainable development.

In the authors' opinion, sustainability is linked to any human action on its environment. This action, through projects or otherwise, must not be governed merely by economic reasons. Sustainability also implies the decisive consideration of human and environmental aspects in decision-making concerning any developed economic activity.

This work has used the definitions presented below as a reference. The ISO 26000:2010 standard (AENOR, 2010) and World Commission on Environment and Development (1987) define sustainable development as:

'development that meets the needs of the present without compromising the ability of future generations to meet their own needs, integrating social, economic and environmental goals to mutually reinforce each other'.

The term Corporate Sustainability offers a global view of aspects related to sustainability (economic, social and environmental) for companies' business and how it is managed (Lozano et al., 2014). However, the bibliographic review has almost always come across the term Corporate Social Responsibility so, in the end, this was included in the analysis. This term refers to '*safe*, *respectful*, *liberal*, *equitable and equal human development*, *contributing to humanity and the environment*' (Glavic and Lukman, 2007).

The term Triple Bottom Line is also frequent. De Medeiros et al. (2014) state that the triple bottom line concept was introduced by Elkington to indicate that an organisation's results should be measured in terms of inter-related environmental, economic and social dimensions. According to Hallstedt et al. (2013) both triple bottom line and CSR refer to organisations but CSR emphasises participation from the people involved and responsible behaviour from organisations.

Eco-design and Life cycle assessment have been included among the different approximations made in this work as common. So far, sustainability has mainly been introduced in industrial projects through eco-design. As a result, the authors considered this topic specifically interesting compared to other areas. Eco-design and design for environment are often used as synonyms because both consider the complete life cycle of a product, particularly its environmental aspects (Glavic and Lukman, 2007).

Previous authors also state that the Life Cycle Management term generally includes the decision-making process and life cycle assessment (LCA). LCA is one of the most used methods for evaluating a product's impact on the environment over its entire lifespan.

Companies and governments should try to include sustainability in their strategies to successfully tackle one the greatest current challenges (Wan Alwi et al., 2014). In the authors' opinion, projects and project management are contributing aspects in this respect if they integrate sustainability. The most widely-accepted definition of project management was proposed by the Project Management Institute (2008) and it refers to applying knowledge, skills, tools

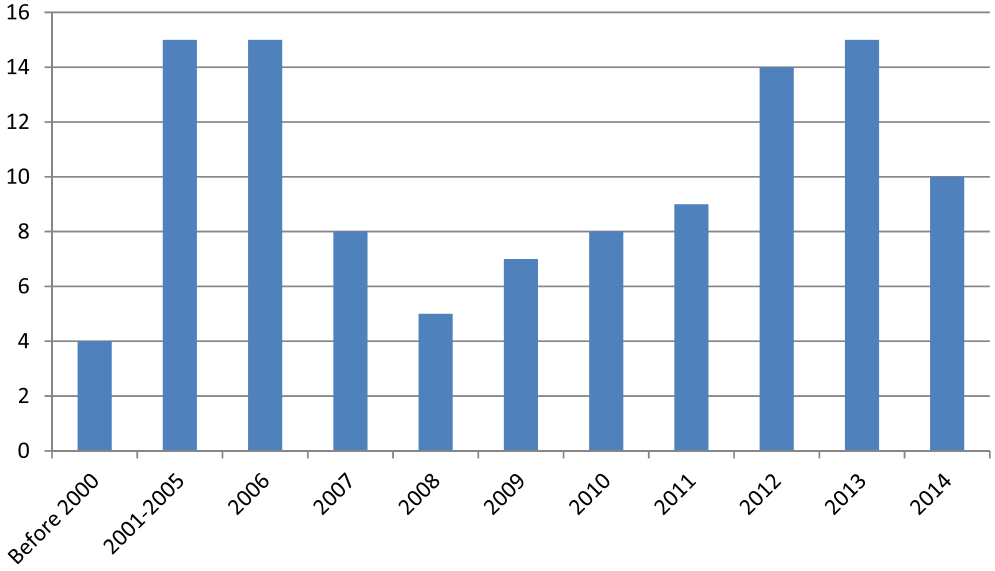

Fig. 1. Distribution of publications over time.

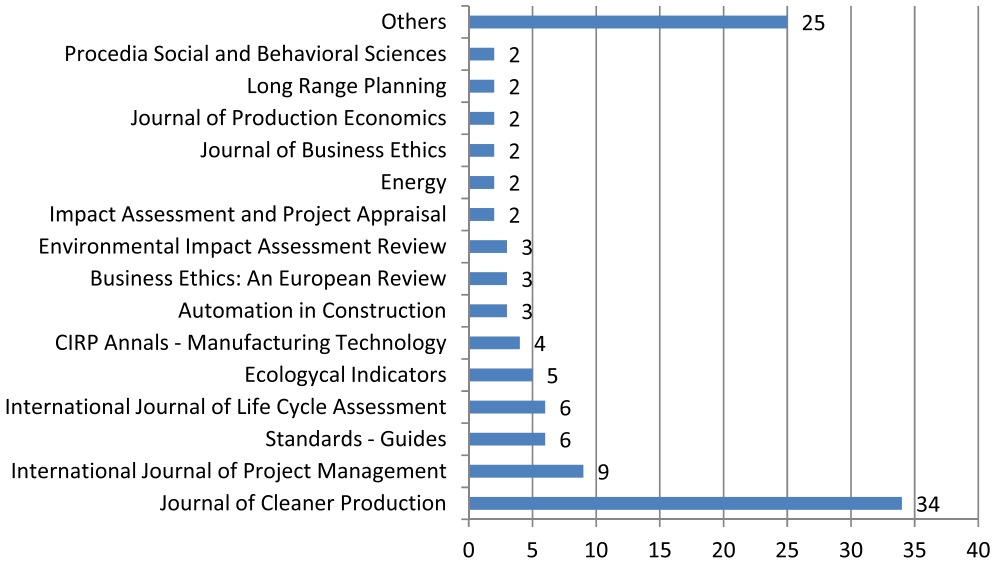

Fig. 2. Distribution of publications by journal.

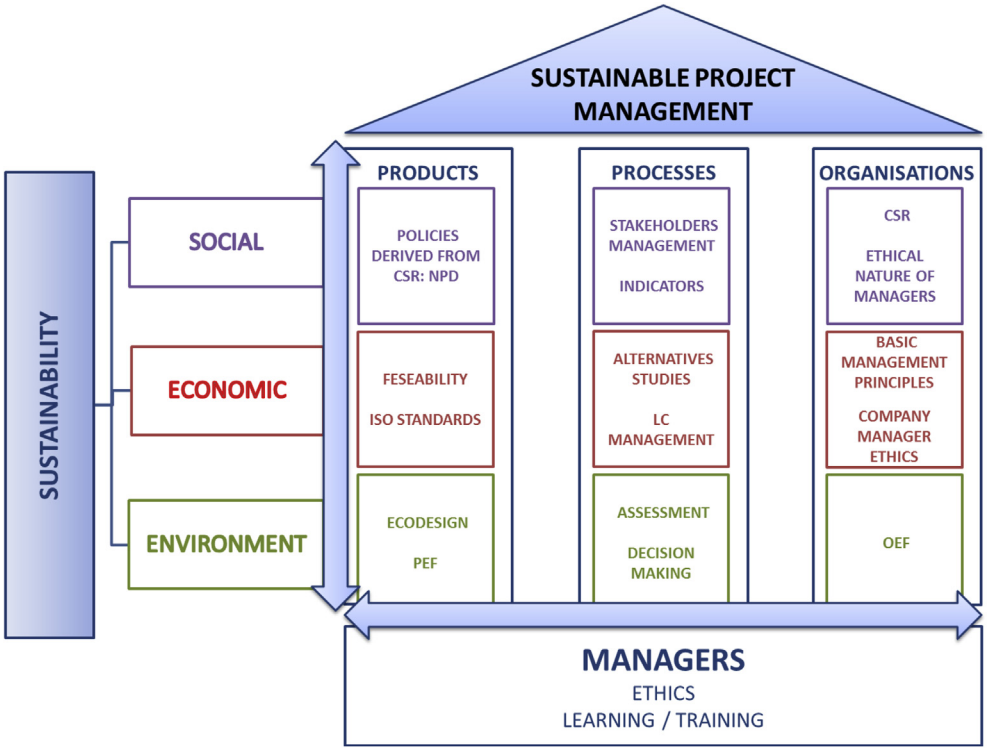

Fig. 3. Four dimensional conceptual framework for managing sustainable projects.

and techniques to project activities to meet the project requirements. Therefore, sustainability (socially, economically and environmentally) should be included in all these aspects of project management.

Amini and Bienstock (2014) and Bocken et al. (2014) identify innovation as a key factor both in terms of business success and for introducing sustainability within management and therefore within its strategic objectives and decision-making. Projects are often utilized as a means to achieve an organization's strategic plan (Project Management Institute, 2008). In fact, project portfolio management is the manifestation of business's strategy (Cooper et al., 2001). Therefore, project management allows to turn today's objectives into something real in the future.

Furthermore, they are the meeting point between the present and the future of companies as they implement their strategies through their project portfolio. On the one hand, they have no difficulty incorporating the fourth dimension of sustainability, time, defined by Lozano et al. (2014). On the other hand, projects

allow them to link in both sustainability practices defined by Maletic et al. (2014): Exploitation and Exploration.

In addition, projects can improve ties between the business strategy and sustainability initiatives, an aspect identified by Amini and Bienstock (2014) as the main cause behind lack of success when introducing sustainability into company management.

Finally, another characteristic that makes project management a good way of introducing sustainability in organisations is that all the aspects required for sustainable management emerge in the management areas defined by Project Management standards: stakeholders, processes, products/services, learning (Maletic et al., 2014).

Consequently, the work hypothesis for this article states that if projects are the ideal instrument for change management, the necessary change that we require towards sustainability will be boosted by applying the project management discipline to sustainability.

3. Methods

The interdisciplinary nature of research on coupling posed a challenge for the review because there was no established framework for guiding the literature search.

First of all, a bibliographic search was carried out in Scopus and in the Web of Knowledge. “Project Management” and “Sustain*” were used as basic search words (sustainability, sustainable, etc.). As hardly any reference was found, the search was expanded using “Project” and “Sustain*”. An initial selection was made of approximately 450 articles using the title and the abstract.

Based on the group of articles identified, content analysis was used to ensure that the articles addressed the central research topics. From this analysis, the most relevant articles were chosen according to their alignment with the research topics. The final selection was reduced to about 100 references.

This gave a list of topics in addition to the first two concepts (project and sustainability): ISO standards, ecodesign, indicators, stakeholders, life cycle analysis, training, ethics and corporate social responsibility. Subsequently, to go into greater depth on some of the aforementioned topics, a subsequent search was occasionally made by eliminating the sustainability topic (for example, searches using “project” and “ecodesign”).

Fig. 1 shows the distribution of the articles over time, revealing a higher incidence of publications in 2006 and over the last three years. Fig. 2 classifies publications according to the source of the articles, and shows a clear distribution. 30.9% of articles came from *Journal of Cleaner Production* and 22.72% of articles (classified as *Others*) came from publications that have only one occurrence included.

The content of the selected material has been structured into four sections depending on four focus points, in an effort to systemise how sustainability is applied in project management. As a result, Fig. 3 presents the conceptual model of the four dimensions of sustainable projects. The first focuses on sustainable project products, the second on the processes that help to include sustainability in the project, the third on organisations committed to sustainability that undertake projects and finally the fourth on persons trained and aware of sustainability that make up the project management team. Each dimension includes principles and approximations that are related to the three main aspects of sustainability: social, economic and environmental.

Contributions from reviewed articles have been classified according the conceptual framework presented in Fig. 3. Table 1 shows the results of this analysis for each dimension (products, processes, organisations and managers), each including the three pillars of sustainability: economic (EC), environmental (ENV) and social (SC) (Table 2)..

To the author's knowledge, this article represents one of the first attempts to review coupling efforts across sustainability and project management. The advantage of this unique synthesis is that it provides the opportunity to learn about research approaches from wide-ranging perspectives. One limitation, due to the broad scope of literature covered, is that it is unlikely that all relevant studies have been identified.

4. Sustainable project products

This point has been structured in three sections. Firstly, reference is made to the important contribution from some ISO rules to practical use of sustainability elements in projects. Secondly, the ecodesign topic is tackled as a fundamental focus to achieve more environmentally-friendly products that have had important repercussions on industrial product design projects. Thirdly, construction projects are tackled including significant initiatives to attain more sustainable buildings and infrastructures.

4.1. Sustainability through ISO standards

The ISO 14000 family standards have been a key tool over the last few years in terms of incorporating sustainability into projects. This is because they can be integrated into other ISO standards, particularly the ISO 9001/14001 system, already successfully implanted in many organisations.

ISO/TR 14062:2002 Environmental management – Integrating environmental aspects into product design and development, is far and away the most used and quoted standard. The work by Quella and Schmidt (2003), is outstanding, presenting the fundaments of the ISO/TR 14062 application in design for the environment (DfE, Design for Environment)/ecodesign. They indicate that it is necessary to use a strategic mentality for its implementation. Likewise they recommend to integrate the standard into existing company management systems, trying to respect its tools and culture.

The second most quoted is *ISO 14040:2006 Environmental management – Life cycle assessment – Principles and framework*. Its frequent application to generate life cycle analysis is clearly documented. It is extremely useful, particularly when it is used fully as part of sustainable product development in the ISO/TR 14062 environment. Finkbeiner et al. (2006), Tingström et al. (2006), Lewandowska and Kurczewski (2010) and Kurczewski and Lewandowska (2010) present cases from the automotive industry and electrical products where the usefulness of ISO/TR 14062 is proven in conjunction with ISO 14040 in project management methods when developing products in a sustainability context.

On the other hand *ISO 14006:2011 Environmental management systems – Guidelines for incorporating ecodesign* widens the field of 14062, although it is barely quoted, probably due to its recent publication. The ISO 14006 is based on the Spanish standard *UNE 150301 Gestión ambiental del proceso de diseño y desarrollo. Ecodiseño*, and its application has generated good results (Arana-Landin and Heras-Saizarbitoria, 2011).

However, the concept of project management is not addressed formally in ISO/TR 14062 and ISO 14006 documents (Brones et al. 2014). In the same way, Pryshlakivsky and Searcy (2013) do not mention project management in their review of the history and application of ISO 14040.

References have not been found for organisations or projects that have jointly applied one or several standards from the ISO 14000 family with standards or project management ISO standards *(ISO 10006:2003 Quality management systems – Guidelines for*

Table 1
Contributions from reviewed articles to proposed framework.

Contributions from literature to framework	Sustainable project											
	Products			Processes			Organisations			Managers		
	EC	SC	ENV	EC	SC	ENV	EC	SC	ENV	EC	SC	ENV
Abidin and Pasquire (2007)	X			X	X	X	X					
Achterkamp and Vos (2006)				X	X	X						
Amini and Bienstock (2014)							X	X				
Arana-Landin and Heras-Saizarbitoria (2011)	X		X									
Arts and Faith-Ell (2012)		X	X									
Azkarate et al. (2011)				X								
Blengini et al. (2012)				X		X						
Bocken et al. (2014)							X	X	X			
Bond et al. (2012)				X								
Boons and Lüdeke-Freund (2013)								X				
Borchardt et al. (2011)	X											
Boswell et al. (2005)				X	X							
Bovea and Pérez-Belis (2012)	X		X									
Bovea and Pérez-Belis, (2012)	X		X									
Brandoni and Polonara (2012)							X	X	X			
Brones et al. (2014)	X		X									
Burke and Logsdon (1996)							X	X				
Byggeth and Hochschorner (2006)	X	X			X	X						
Byggeth and Hochschorner (2006)	X	X										
Cassar et al. (2013)				X		X						
Dalkmann et al. (2004)				X	X	X						
De Brucker et al. (2013)					X	X						
de Medeiros et al. (2014)		X					X	X				
Díaz-Aguado and González-Nicieza (2008)				X	X	X						
Duflou et al. (2003)	X											
Edum-Fotwe and Price (2009)		X										
Fernández-Sánchez and Rodríguez-López (2010)	X		X	X		X	X					
Finkbeiner et al. (2006)	X		X									
Gasparatos and Scolobig (2012)				X	X	X						
Gibson (2006)				X		X						
Glavic and Lukman (2007)										X	X	X
Hacking and Guthrie (2008)				X								
Hallstedt et al. (2013)	X	X	X									
Hanssen (1999)	X											
Helgadöttir (2008)										X	X	X
Yao et al. (2011)	X	X	X	X	X	X						
Husted and Allen (2007)								X				
Hwang and Ng (2013)	X	X	X									
Johansson and Magnusson (2006)		X	X									
Kemp et al. (2005)				X		X						
Kengpol and Boonkanit (2011)	X		X	X		X						
Kerzner (2003)										X	X	X
Khalili-Damghani and Sadi-Nezhad (2013a,b)				X								
Khalili-Damghani et al. (2013)				X								
Khan et al. (2004)				X								
Knight and Jenkins (2009)	X		X									
Kurczewski and Lewandowska (2010)	X											
Labuschagne and Brent (2005, 2006)					X		X	X				
Labuschagne and Brent (2008)				X		X						
Le Pochat et al. (2007)	X	X	X									
Lenferink et al. (2013)	X	X	X									
Lewandowska and Kurczewski (2010)	X			X	X							
Lofthouse (2006)	X		X									
Lozano et al., 2014							X	X	X		X	
Maletic et al. (2014)	X			X	X		X	X				
Manzini et al. (2011)				X		X						
McDermott et al. (2002)				X	X					X		
Mishra et al. (2011)				X	X					X	X	
Murillo and Lozano (2006)							X					
Ness et al. (2007)				X								
O'Connor and Spangenberg (2008)							X	X				
Parry (2012)							X					
Pearce (2008)	X	X										
Pelletier et al. (2014)												
Pigosso et al. (2013)	X		X					X	X			X
Ploufee et al. (2011)	X		X									
Pope (2006)				X								
Prasad and Holzinger (2013)							X	X				
Pryshlakivsky and Searcy (2013)	X		X									
Pujari (2006)	X		X									

(*continued on next page*)

Table 1 (*continued*)

Contributions from literature to framework	Sustainable project											
	Products			Processes			Organisations			Managers		
	EC	SC	ENV	EC	SC	ENV	EC	SC	ENV	EC	SC	ENV
Quella and Schmidt (2003)	X		X									
Rahbek (2010)							X	X				
Rinne et al. (2013)				X								
Schieg (2009)							X	X				
Schmidt and Taylor (2006)				X	X	X						
Schrettle et al. (2014)				X	X							
Seuring and Gold (2013)				X	X							
Shen et al. (2010)	X	X	X	X	X	X	X					
Singh et al. (2007)				X	X							
Spangenberg et al. (2010)										X	X	
Spence (1999)							X					
Tam et al. (2007)					X	X						
Tchetchian et al. (2013)	X			X								
Thabrew et al. (2009)				X	X							
Thomson et al. (2011)	X	X			X							
Tingström et al. (2006)	X											
Tsai and Chang (2012)	X	X	X	X		X						
Ugwu et al. (2006a, b)	X	X		X	X							
Umeda et al. (2012)				X	X	X						
Walters and Anagnostopoulos (2012)								X	X			
Westkämper (2002)	X			X	X							
Westkämper (2003)	X											
Wideman (1995)										X	X	X
Zhang et al. (2014)	X		X	X	X							
Zou et al. (2007)				X	X							
	EC: Economic			SC: Social			ENV: Environmental					

Table 2
Most frequently mentioned aspects of the life cycle focus.

Life cycle aspect	Focus points	Reference
Life cycle analysis	Improvement of an existing product and its associated life cycle to make it more environmentally friendly for manufacturing, retail and disposal.	Lobendahn Wood et al. (2010)
Life cycle cost	Life cycle costing approach within a multidimensional perspective for more sustainable product design.	Schmidt and Taylor (2006) Lewandowska and Kurczewski (2010); Kurczewski and Lewandowska (2010)
Life cycle assessment	Traditional approach. LCA is a well known technique used to assess environmental impacts associated with all stages of a product's life.	Schmidt and Taylor (2006) Finkbeiner et al. (2006) Lewandowska and Kurczewski (2010); Kurczewski and Lewandowska (2010) Thomson et al. (2010) Blengini et al. (2012) Tchetchian et al. (2013)
Life cycle impact assessment	Approach proposed to evaluate the social impacts of life cycle systems from compiled life cycle inventories. Suited to process industry.	Labuschagne and Brent (2006)
Stakeholder-based life cycle assessment	Life cycle framework including mapping stakeholder involvement in each activity during upstream and downstream stages.	Thabrew et al. (2009)
Life cycle engineering	Used among manufacturing firms, aims to integrate technical issues and parameters throughout a product's life cycle, taking into account the requirements of long-time usage and recycling.	Westkämper (2003) Duflou et al. (2003) Finkbeiner et al. (2006) Umeda et al. (2012)
Life cycle design	Search for the most environmentally efficient products from a life cycle perspective. This is equivalent to design for life cycle.	Hanssen (1999) Westkämper (2002) Umeda et al. (2012)
Life cycle planning	Concept proposed to designate a systematic and strategic approach to design or plan an entire product life cycle in parallel to the product design.	Umeda et al. (2012)
Upgrade lifecycles	Remanufacturable product design that includes defining and simulating potential upgrade cycles	Pialot et al. (2012)
Life cycle management	Management of various processes forming a product life cycle flow, from beginning of life to end of life, such as supply chain management, operation and maintenance and reverse supply chain management.	Labuschagne et al. (2005); Labuschagne and Brent (2005, 2006) Umeda et al. (2012) Westkämper (2002, 2003)
Project life cycle	Product life cycle and project life cycle are separated. Project life cycle is the reference in building projects. In other sectors, another life cycle is considered: assets life cycle.	Labuschagne and Brent (2005, 2006, 2008) Boswell et al. (2005) Tsai et al. (2011) Blengini et al. (2012)

quality management in projects, *ISO 21500:2012 Guidance on Project management)*.

Doubtlessly, another benchmark standard for organisations as they work towards sustainability after incorporating the ISO 14000 family is the ISO 26000: Guidance on social responsibility (AENOR, 2010). This standard contributes to sustainable development, complementing analysis on organisations' impact on the environment and its ecosystem by emphasising the importance of results and improvements in how organisations' social responsibility is deployed.

Finally, ISO is attempting to standardise applying sustainability through specific standards for particular sectors such as in construction projects (Fernández-Sánchez and Rodríguez-López, 2010). However, bibliographic references are still scarce for cases of applying these standards.

4.2. Ecodesign/DfE

Both terms, ecodesign and design for environment, have been used indiscriminately, and can be considered as the most general, used and proven focus for incorporating environmental aspects into project products. However, when entering only environmental considerations, this focus is far from the sustainable design (Knight and Jenkins, 2009). Hallstedt et al. (2013) also highlights the difference between strategic sustainable product development and ecodesign, which essentially strives to improve environmental impacts. Important aspects, from a sustainability perspective, are often missing in ecodesign tools (for example, social and economic aspects plus ecological aspects), which can lead to incremental changes without bearing in mind the long term outcome (Byggeth and Hochschorner, 2006). In addition, there are techniques with an even smaller scope within ecodesign such as design for life cycle, design for assembly, design for dismantling, design for recycling, design for longevity, etc. Design for sustainability includes design for the environment, but it goes one step further, integrating social, economic, environmental and institutional aspects and offering opportunities for participation and expression of own identity beyond large scale consumption of standardised products (Spangenberg et al., 2010). According to the same authors, sustainability plays a lesser role in design training and practice and design is not recognised as a relevant factor in sustainability discourse.

Hallstedt et al. (2013) identified eight key elements for implementing a strategic sustainability perspective in the product innovation process: 1) ensure organizational support from senior management; 2) bring in a sustainability perspective effectively early in the product innovation processes; 3) utilize knowledge and experience of procurement staff in the earliest phases of the process; 4) include social aspects across the product life cycle and its value chain; 5) assign responsibility for sustainability implementation in the product innovation process; 6) have a systematic way of sharing knowledge and building competence in the sustainability field to report decisions taken in future product development projects; 7) utilize tools for guiding decisions as a complement for assessment tools; and 8) utilize tools that incorporate a backcasting perspective from a definition of success. On the other hand, from a practitioners' perspective, strategy tools would usually be over-ruled by customer specifications, implying a lack of freedom in applying ecodesign and restricting the company's scope to implementing a self-determined strategy (Knight and Jenkins, 2009).

Bovea and Pérez-Belis (2012) mention three typical aspects for optimising a product's ecodesign process: a) bringing environmental aspects into product design and the development process early on; b) life cycle focus; and c) multi-criteria focus, given that environmental and traditional criteria have to be considered simultaneously.

Different research projects indicate that between 80% and 90% of a product's economic and environmental costs are set in the initial design stages (Kengpol and Boonkanit, 2011). However, in practice there are few ecodesign tools for products in the initial stages of the design process, particularly if this refers to complex products (Tchetchian et al., 2013). In addition, according to Duflou et al. (2003), the effectiveness of life cycle engineering techniques and tools is limited in initial phases because detailed data is sometimes not available in these preliminary stages. This is particularly clear when a new product is going to be developed and there is no information on former product generations. According to Hanssen (1999), it is difficult to give general rules on improving sustainability for different types of product as the best solution for a specific product system is highly dependent on that system's specific life cycle conditions.

The life cycle focus requires products to be permanently connected to the manufacturers' networks. Communication is essential in any product expecting to make maximum profit throughout its life (Westkämper, 2003). Westkämper (2002) recommends modular architecture for products, with mechatronic components connected by standardised communication. This can reduce system diagnosis costs in assembly, dismantling, integration, updating, repair and later integration of additional equipment.

By adding environmental considerations to other product requirements, decision-making must necessarily be tackled from a multi-criteria point of view. The majority of tools designed for design for the environment include the multi-criteria perspective (Bovea and Pérez-Belis, 2012). For example, Lewandowska and Kurczewski (2010) put MCA (Multidimensional Comparative Analysis) at the same level as LCA (Life Cycle Assessment) and LCC (Life Cycle Costing). More specifically, Kengpol and Boonkanit (2011) propose a tool that, through an indicator, provides the basis for making decisions on ecodesign in the conceptual design phase.

There are a large number of methodological tools designed to integrate environmental requirements into the product design process. Designers are provided with a guide to select the most appropriate tool for a specific case in Bovea and Pérez-Belis (2012). These authors propose a taxonomy of ecodesign tools according to six criteria: the method applied for environmental assessment, 2) product requirements that have to be integrated along with environmental requirements (multi-criteria focus), 3) if the tool has a life cycle perspective, 4) nature of the results (qualitative or quantitative), 5) conceptual design process stages where the tool can be applied, and 6) methods chosen as a basis for integration.

Knight and Jenkins (2009) classify the design tools into three categories: a) guides, b) checklists and c) analytical tools. The criterion followed in the previous classification is use of language that is accessible to the end-users of this type of tool.

Different authors mention that the ecodesign application is not generalised in different countries, due to implantation and management difficulties (among others, Le Pochat et al., 2007; Knight and Jenkins, 2009; Pigosso et al., 2013). Knight and Jenkins (2009) talk about the need to carry out prior adaptation work for tools. It is necessary to develop holistic tools for industrial designers with a combination of guidance, training and information (Lofthouse, 2006). Lofthouse (2006) presents a tool based on the internet that makes ecodesign more accessible to designers using an “Information/Inspiration” focus. Le Pochat et al. (2007) study ecodesign implantation in SMEs and propose to tackle this matter from the point of view of organisational change in companies. Pigosso et al. (2013), propose a manufacturing organisation ecodesign maturity model that is used as a framework for its

progressive implantation. There are three parts to the model: ecodesign practices, maturity levels and application method.

The process for integrating environmental aspects into product development is only effective if it leads to an improved product (Finkbeiner et al., 2006). One line of improvement is doubtlessly the economic aspect. Cost reductions are possible and there are documented cases (for example, Borchardt et al., 2011) However, Ploufee et al., 2011, state that overheads seem to be greater for ecodesigned products than for traditional products, although it might be expected that green product commercial success would recover the difference in a normal period. In any case, it seems that, as Pujari (2006) states, eco-innovation that does not raise costs is still a challenge.

A product is developed from an operative point of view, through projects. However, few authors tackle ecodesign from a project focus. Tingström et al. (2006) describe the management model for new product projects that are used by the ABB company. This is based on stages and gates (ABB GATE model) that are crucial points for quality control and deciding whether the project should continue or not. Johansson and Magnusson (2006) present a case study of developing a complex product where a green subproject is entered in the project organisation to make sure that environmental considerations are included. This solution helped to give visibility and relevance to environmental requirements although, on the other hand, it represented an addition coordination challenge in the project team.

Definitively, and as Brones et al. (2014) found, there is a gap between ecodesign and project management that, if filled, could enhance the effectiveness of ecodesign in the product development process.

4.3. Sustainable construction projects

Within project management, sustainability has been more generally introduced in construction projects, particularly in environmental aspects. Consequently, most sustainability and project management experience is found in this type of project and it is frequently used as an expert opinion when introducing sustainable aspects into other fields. Therefore, a specific section has been introduced for this type of projects.

Sustainable construction promotes the balance between environmental protection, economic development and social development (Shen et al., 2010). Within construction projects, sustainability has focussed almost exclusively on buildings although inroads have been made in civil engineering over the last few years (Fernández-Sánchez and Rodríguez-López, 2010). In particular, infrastructure construction projects have been looked into given that they have a greater impact on the environment, society and the economy (Yao et al., 2011).

Although different studies have covered sustainability, it is still difficult for project designers to include sustainable concepts in their work. As an example, some relevant contributions are presented below.

Shen et al. (2010) back implementing the practice of sustainable construction through project feasibility studies. If these studies, that normally include fundamentally economic attributes, also included environmental protection and social development elements, the solutions developed would be more sustainable. For this idea, they propose a list of 18 economic attributes, 9 social and 8 environmental. On the other hand, Abidin and Pasquire (2007) study how to introduce sustainability into projects practically by means of value management (VM). Both focuses have the advantage of attaining the consideration of sustainability aspects in the initial project stages and that therefore hold weight in decision-making.

Different research projects claim to assess construction project sustainability, generally through indicators (see section 4.3). Edum-Fotwe and Price (2009) identify the elements and factors for social assessment of construction projects, distinguishing different levels: material, building and urban. There are simulation studies for completing a construction project from the point of view of sustainability, such as by Shen et al. (2005), Yao et al. (2011) and Zhang et al. (2014), who use the system dynamics methods, or Li and Chen (2012), who use neuronal networks. The disadvantage of this type of proposal might be that non experts would find it hard to set up.

With a more qualitative and operative focus, Thomson et al. (2011) present a specific experience that incorporates all stakeholders into assessment and they connect it to project life cycle. They show how the project team considers sustainability proactively, using assessment tools to guide the design, construction and operation of a building. Along a similar line, Tsai and Chang (2012) have created a checklist incorporating the necessary elements to take into account in design projects for sustainable motorways.

Ugwu et al. (2006a, b) found that both customers and consultants influence whether specific contract clauses relating to sustainability should be included. Arts and Faith-Ell (2012) call for better coordination of all existing tools for infrastructure projects to give sustainable results. In their opinion, the focus should be on integrating green provision, partnership agreements and environmental declaration. Lenferink et al. (2013) propose following three paths to develop more sustainable infrastructures: green provision, strategic resource management and relational contracting.

The compiled literature demonstrated a more global focus by tackling sustainability in construction projects rather than in new product development projects. Not only are social aspects more present, but sustainability is tackled at different levels: global, national, and regional. In any case, also in construction projects, the greater qualitative leap of the last few decades from the point of view of sustainability has come through the environmental vector, with the appearance of so-called green construction.

According to different studies, green construction projects are more expensive (Hwang and Ng, 2013). Pearce (2008) proposes the concept of holistic cost management that consists of considering three aspects from the start of the project: (1) the impact of design/construction decisions on costs throughout the entire life cycle; (2) opportunities to improve design that counter the higher initial cost; and (3) the possibility of outsourcing it so that it might represent a better decision in terms of costs. Pearce concludes that the challenge for project managers, designers and other stakeholders in the project is to identify and justify the use of sustainability elements that do not influence the cost or that even save costs.

Hwang and Ng (2013) obtained ten challenges for green construction project management in their research:

- greater time required during the pre-construction process;
- difficulty to select subcontractors that provide green construction services;
- uncertainty concerning green equipment and materials;
- high cost of green materials and equipment;
- increase in meetings and coordination required with consultants and specialist engineers;
- most frequent design variations, emerging during the construction process;
- difficulties to include green specifications in the contract details;
- unexpected circumstances when completing green projects;
- planning in a non traditional sequence of operations;
- planning for different construction techniques.

It stands out that many challenges are technical, surely because green construction is a recent field. From the point of view of project management, communication, stakeholders, costs, risks and deadlines are the areas with the most implications. Similar research was found for new product design projects. This was an exploratory study carried out by Brones et al. (2014) that identified the supply chain, quality, deadlines and risk as the most critical aspects for integrating environmental aspects in project management.

5. Sustainable project processes

Most accepted project management standards as PMBok of PMI (Project Management Institute, 2012) or ISO 21500 are based on processes. The processes approach has been the most used by the main authors to introduce sustainability in project management. The processes more frequently mentioned are: Stakeholder management, Life cycle management, Assesment and Decision-making.

5.1. Managing stakeholders

Including sustainability within companies is a process that requires boundaries to be crossed throughout the supply chain (Seuring and Gold, 2013; Hwang and Ng, 2013; Brones et al. 2014; de Medeiros et al. 2014). Stakeholder management is a key point in this aspect and it is gaining importance in the literature and in sustainability practices. Stakeholder participation is fundamental to agree on the meaning of the sustainable product or process in a specific project (Achterkamp and Vos, 2006) or draw up the indices used to assess the sustainability of that project (Singh et al. 2007).

On the other hand, to introduce more sustainable product systems, it is necessary to make decisions at different levels of society: individual persons, companies and national and international organisations (Hanssen, 1999). Greater cooperation is required among companies, between companies and consumers and between companies and authorities. On many occasions the rules, regulations, standards and infrastructure built up by the authorities both nationally and internationally are obstacles for sustainability. However, on many occasions, as Brandoni and Polonara (2012) have found, regional and municipal governments can play a facilitating role in designing and implementing sustainability policies.

One of the first difficulties in sustainable management of a specific project is specifying a sustainability strategy in this particular case. According to Singh et al. (2007), managing the stakeholders has been considered a tool connecting the strategy to social and ethical matters. Achterkamp and Vos (2006) back the project stakeholders' role to agree on the meaning of the sustainable product or process that the project aims to achieve.

From the sustainability point of view, the focus for managing stakeholders is attempting to balance their interests and particularly balance aims for personal economic profit against social and environmental aims (De Brucker et al., 2013). This conflict in stakeholder aims is more acute in public sector projects than in projects in an organisation because the aspects up for discussion are much broader in a company and vary more widely, particularly when referring to sustainable development (De Brucker et al., 2013).

Achterkamp and Vos (2006) propose a framework for stakeholder participation in projects with sustainability criteria, corresponding to whoever will participate inside and outside the organisation, the contribution they can make and when, or in other words, in which phase the project is in. In addition, within the sustainability criteria they introduce an additional perspective to the triple P (people, planet, profit) that is the focus of the project's undesired effects. This implies that all negative impacts from the projects should be equally distributed among the interest groups without overloading any in particular.

The focus points for the stakeholder participation and implication study are diverse. Thomson et al. (2009) look at the different types of knowledge on sustainability held by the stakeholders. Tam et al. (2007) focus on cooperation and communication among project participants, after identifying construction projects in the literature that are some of the first obstacles for environmental management of these projects and they design a communication mapping model. Thabrew et al. (2009) approach the need for intersector integration of projects in order to meet sustainability goals. In addition, they also propose participation from different stakeholders in making decisions as this is usually limited to the stakeholders who are more directly influenced, without considering others who might be key at particular moments. Along the same lines, Singh et al. (2007) suggest that the stakeholders participate in drawing up sustainability assessment rates. De Brucker et al. (2013) defend the contribution of multi-criteria analysis in the field of sustainability and to assess complex projects, where multiple aims come into play from multiple stakeholders.

The majority of references found concur on the focus to connect the participation of the stakeholders with the project life cycle (Westkämper, 2002; Boswell et al. 2005; Achterkamp and Vos, 2006; Zou et al. 2007; Tam et al. 2007; Lewandowska and Kurczewski, 2010; among others). Thabrew et al. (2009) state that the life cycle framework that includes a map with the stakeholder's participation in each activity in upstream and downstream stages provides stakeholders with a holistic view that they would not otherwise have.

5.2. Life cycle management

The life cycle is the focus paradigm for the policies, business and projects with sustainability criteria. Almost all sustainability elements identified around the projects, and as they are compiled throughout this work, take the life cycle focus.

Precisely, and according to Labuschagne and Brent (2005, 2008), a starting point for aligning project management standards against sustainable development principles is understanding that there are several life cycles involved in a project and that there are interactions between them. In the process industry, these life cycles are:

- Project life cycle: This is the life cycle where an idea is generated, developed and implemented.
- Asset/Process life cycle: This is the life cycle for the idea that consists of the design and development, construction, operation/implantation and removal of the service.
- Product life cycle: the deliverable is the idea that generates income for the company.

One specific case involves mining projects. In these projects, the project, media and product life cycles are interdependent and inseparable and they should be incorporated into holistic life cycle management emphasising the mineral's life cycle (Blengini et al., 2012). According to these authors, these projects bring about specific circumstances that do not appear in other types of projects: a) the project life cycle is limited by the non renewable nature of the resource; b) the environmental implications of the project life cycle and the production media life cycle are not insignificant compared to the product life cycle.

In construction projects, there is an important overlap between the project life cycle and the building's life cycle. This overlap occurs in the design and building construction phases. In the latter, in particular, the environmental impact is considerable. This justifies

that Tsai et al. (2011) apply the life cycle assessment (LCA) only to the life cycle for the building project.

Although in usual practice the concept of life cycle is usually associated with LCA methods (Life Cycle Assessment) and its application with the ISO 14040 standard, the life cycle focus is broader than the LCA (Labuschagne and Brent, 2005 2006; Umeda et al. 2012), and must necessarily involve life cycle management that will include certain elements or aspects. Table 1 shows a list of specific life cycle focus points found in the bibliography.

In the case of products, Umeda et al. (2012) defend the idea that there should be a product life cycle planning and design strategy in parallel with the actual product design. In this respect, they propose a life cycle development framework that includes three stages: 1) planning the life cycle by considering the social, business, technological and environmental factors; 2) product design and its life cycle flow to achieve the plan; and 3) implementation of the designed product life cycle.

The life cycle assessment (LCA) is widely used in industry to provide detailed assessment of designed products, but according to Tchetchian et al. (2013), this is not appropriate for the concept design stage, partly due to the great quantity of information required to assess initial concepts. Life cycle assessment is applied more effectively in standardised production systems than in non standardised systems (Blengini et al., 2012). According to the same authors, although this is a well defined methodology, its standardisation is not suitable for application in specific sectors.

5.3. Sustainability assessment

The traditional reference frameworks for assessing sustainability are developed by Global Reporting Initiative (GRI), United Nations Commission for Sustainable Development (UNCSD), Institute of Chemical Engineers (IChemE) and Wuppertal Institute (Labuschagne et al. 2005; Singh et al. 2009). They all include economic, environmental and social aspects, and the UNCSD and Wuppertal Institute also add the institutional dimension.

Applied to businesses, one of the most usual terms is TBL (Triple Bottom Line), the extension of the traditional economic profitability framework considering social and environmental aspects.

The sustainability assessment can be applied both to projects and to making strategic decisions (Pope, 2006; Hacking and Guthrie, 2008). The sustainability assessment process must be designed explicitly to deliver sustainable results (Bond et al., 2012). A key point for distinguishing between the different practical examples of sustainability assessment is the sustainability conceptualisation included in each process. According to Pope et al. (2004), at project level, it is generally desirable and often crucial to specify the relevant sustainability principles, objectives and criteria as completely and realistically as possible before proposers begin to think about their proposals and options.

Assessment tools are techniques that can be used to make it easier to compare different project/policy alternatives (Gasparatos and Scolobig, 2012), and also make decision-making easier (Bond et al. 2012; Rinne et al. 2013; among others).

Ness et al. (2007) developed a holistic framework for sustainability assessment tools, with three categories: (1) indicators and indices (2) product-related tools, and (3) integrated assessment. This last category includes a collection of tools usually focussed on the change of policies or on implementing the project. Gasparatos and Scolobig (2012) conclude that the relevant literature contains three broad categories of assessment tools:

- Monetary. They are anthropocentric with humans assuming the role of individual consumers that aim to maximise their usefulness (their happiness).
- Biophysical. They are egocentric, quantifying the natural resources invested during production of the goods or service.
- Indicator-based. They can take on multiple perspectives, depending on the methodological choices made.

Table 3 compiles the main experiences in sustainability assessment in projects that have been compiled in the bibliography. It can be seen that, in most cases, the assessment is based on indices and indicators. The indices can have a different level of totality. They might refer to the plant, countries, regions, cities, organisations or processes and products. The projects can make an impact at different levels.

Drawing up indicators involves making choices (Singh et al. 2009; Gasparatos and Scolobig, 2012). This introduces elements of uncertainty such as choosing data, its accuracy, processing and standardisation methods, diagrams and weighting values and aggregation methods (Singh et al. 2009). For that reason, it is often argued that compound indicators are too subjective. In order to estimate solidity and increase its transparency, uncertainty and sensitivity analysis is particularly useful. Gasparatos and Scolobig (2012) distinguish between compound indicators and indicators resulting from a multi-criteria analysis depending on whether there is aggregation or not. It is clear that using any means of aggregation, a certain degree of compensation and substitution between the different sustainability aspects is inevitable. This introduces an ethical dimension that must be consistent with the stakeholders' points of view and must be explained in the analysis (Gasparatos et al. 2009).

One of the difficulties of applying sustainability indicators in projects identified by Cassar et al. (2013) was their limited time frame.

One of the most all-encompassing approaches to managing project sustainability was developed by FIDIC (International Federation of Consulting Engineers), with two elements (Boswell et al. 2005):

- A framework of the sustainable development goals and their corresponding indicators working from Agenda 21 aspects, goals and priorities and the corresponding sustainability indicators developed by UNSCD (United Nations Commission on Sustainable Development).
- A process to set and modify the goals and indicators for sustainable project development so that they are consistent with the project owner's view and objectives, within Agenda 21 and adapted to the local stakeholders' concerns and priorities.

One of the main arguments against the three pillars of sustainability model is that it promotes exchanges between the pillars and it does not recognise interrelating the many and varied considerations that can fall within the sustainability label (Pope, 2006; Gibson, 2006; Kemp et al. 2005). The exchanges may even occur within one of the pillars, as for example when the purchaser has to decide which environmental aspects are the most important (Byggeth and Hochschorner, 2006). On the other hand, Gasparatos et al. (2009) state that the current assessment paradigm is reductionist and does not take into account, among other aspects, interrelating a system's components and the possible multiple and legitimate perspectives of assessment.

According to Bond et al. (2012) sustainability assessment is currently still in an initial phase of development where preliminary practice is being adapted to new situations and contexts, as a situation has not yet been reached where the particular methods or focuses used are working well. Therefore, methodological pluralism, along with stakeholder participation, seems to be a safer path (Gasparatos et al. 2009).

Table 3
Sustainability assessment per type of project.

Type of project	Focus	References
Construction	Simulation model, using the system dynamics methods. Includes economic, social and environmental aspects.	Shen et al. (2005)
Construction	Methods to identify sustainability indicators working from ISO 21929-1 and risk management standards in projects.	Fernández-Sánchez and Rodríguez-López (2010)
Construction	Prototype model that incorporates the effects of dynamic factors. Incorporates two fundamental factors: technological progress and people's perception.	Zhang et al. (2014)
Infrastructures	Methods that includes indicators at a project level and how they relate to more global sustainability policies as well as decision-making techniques.	Ugwu et al. (2006a, 2006b)
Infrastructures	Simulation model, using the systems dynamic principles. Includes economic, social and environmental aspects.	Yao et al. (2011)
Mining	Experimental index based on flow charts that include economic, environmental, social and risk aspects.	Díaz-Aguado and González-Nicieza (2008)
Energy	Index of environmental sustainability to compare project design alternatives.	Manzini et al. (2011)
Production	Framework for social assessment of projects and indicator of social impact based on the project life cycle.	Labuschagne and Brent (2005, 2006), Labuschagne et al. (2005)
New Products	Life cycle index (LInX) to help select and design products and processes. Incorporates life cycle attributes.	Khan et al. (2004)
New Products	Product Sustainability Index (PSI) by Ford of Europe, working from eight indicators of social, environmental and economic attributes of vehicles.	Schmidt and Taylor (2006)
New Products	Adaptation of the Ford of Europe PSI to the tool machine design.	Azkarate et al. (2011)
New Products	Ecodesign indicator that compares a conceptual design with a prior product, tied to a decision-making system.	Kengpol and Boonkanit (2011)

5.4. Decision-making

Decision-making is tied to sustainability assessment. Bond et al. (2012) consider that sustainability assessment is emerging everywhere as a key decision-making tool. In fact, the aforementioned authors state that sustainability assessment practice varies considerably depending 1) on the form of decision-making applied and 2) on the legal structures and on the jurisdiction government in particular.

Regarding decision-making, we can refer both to selecting the most appropriate project and to choosing the most sustainable alternative once the project has been selected. Due to the multiple dimensions of sustainability, analysis will always be multi-criteria. On some occasions, it will also be multi-objective.

The most frequently applied decision-making support systems tied to sustainability, as presented in the previous section, were based on indicators or indices. The project or alternative chosen, after assessment, will be whichever obtains the best indicator or index.

Some more specific techniques or proposals that have also been used are:

- Analytical Hierarchy Process (AHP). Singh et al. (2007) use it to determine the weight of sustainability indicators and sub-indicators at different levels. They apply it to the steel industry.
- Analytic Network Process (ANP) and Distance to Target (DT) method. Kengpol and Boonkanit (2011) integrate these two elements into a decision-making support system specifically designed to be applied to developing new products that are more eco-effective than a previous reference product.
- Fuzzy rules systems. Khalili-Damghani and Sadi-Nezhad (2013a,b) and Khalili-Damghani et al. (2013) present different applications based on fuzzy rules systems to select sustainable projects or portfolios, regardless of their type.
- Value management. Abidin and Pasquire (2007) rely on value management, including sustainability issues into its structure.
- Cognitive reasoning maps. Ugwu et al. (2006a, 2006b) state that they can illustrate the complexities and interactions between the different sustainability indicators and they apply it in infrastructure project assessment.
- Decision windows. According to Dalkmann et al. (2004) these are critical phases in the decision-making process where relationships are analysed between the sub-decisions, integrating information and environmental values.

Regardless of the decision-making technique used, there are subjective elements. According to Dalkmann et al. (2004) the problem is not whether there are subjective elements in the decision-making process but that these elements are not articulated transparently. In particular, project sustainability necessarily brings up the question of decision-making (McDermott et al. 2002; Mishra et al. 2011), transparency (Thabrew et al. 2009; Thomson et al., 2011) and involvement of the different stakeholders (Dalkmann et al. 2004; Thabrew et al. 2009; De Brucker et al. 2013).

The decision making process is always complex and it is highly influenced by the context in which the project is developed. Schrettle et al. (2014) propose a reference framework to help companies, particularly small companies, introduce the sustainability context within this process.

6. Sustainable project organisations

Doubtlessly, sustainability should be introduced at organisation level and yet it is still an under-developed research area (Boons and Lüdeke-Freund, 2013).

Project management provides an opportunity in this respect. It facilitates continuous learning in organizations since it includes specific processes for knowledge management, making it easier to accumulate knowledge generated by experience. According to Bond et al. (2012), learning from experience gained from assessing sustainability can be framed in two ways: learning by doing and learning from mistakes.

Boons and Lüdeke-Freund (2013) highlight the role that innovation and management tools play in the task of integrating sustainability due to its cross discipline aspect in organisations. Undoubtedly, project management is one of the most used

management tools both in innovation and in business management and this leads to the importance of PM in implanting sustainability in organisations.

As in the case of project products and project processes, project organisations are also wending their way towards sustainability through the environmental vector. The key instrument in this process has been the environmental management system that has been implanted in most organisations based on the ISO 14000 standard.

In order to go into greater depth in eliminating the environmental impact generated by organisations in their business, the European Commission Institute for Environment and Sustainability has developed the Organisation Environmental Footprint (OEF) claiming to measure the environmental performance of an organisation from a life cycle perspective (OEF Guide, 2012). However, organisations' sustainability analysis is much less advanced than for products (PEF) and should be strengthened with other practices that complement it in other aspects of sustainability (Pelletier et al., 2014).

If we analyse this method from the point of view of the projects and their management, it can be seen that it is complicated to include it, maybe due to the temporary nature of the projects and the uncertainty of their results in many cases. However, it would be possible to apply it to strategic project analysis and use it as a project selection criterion within the company's portfolio.

The next level of accomplishment can come through Corporate Social Responsibility that adds a social vector to the company. Over the last decade, both sustainability and Corporate Social Responsibility (CSR) have become highly relevant as a management concept and a measure of business 'achievement' (Labuschagne et al., 2005; O'Connor and Spangenberg, 2008, Schieg, 2009).

The ISO 26000:2010 (AENOR, 2010) offers great help to organisations that decide to include sustainability in their deployment. Its gives them the main concepts, principles and shows how to incorporate them in their processes.

The great advantage of considering CSR in project management is its contribution in terms of establishing values such as integrity, credibility and reputation. These values must be understood as a long term investment that will make a company more competitive and reduce certain financial risks.

In addition, projects have been identified as a valuable tool that some organisations can use to fully get to grips with CSR within their own structure (Walters and Anagnostopoulos, 2012). The key to attaining this aspect is to search for and develop social partnerships that strengthen the CSR focus in several areas of the organisation.

Along the same lines, Burke and Logsdon (1996), establish the relationship between CSR and the businesses' strategic benefits through producing long term strategic programmes. In order to identify the most appropriate projects to develop this strategy, CSR is included within the actual project planning, particularly in stakeholder identification and analysis and in selecting and evaluating alternatives to possible projects to be included in the portfolio.

One difficulty that many project administrators come across when considering CSR within their projects is how to measure whether stakeholders' expectations are met (Husted and Allen, 2007).

Schieg (2009) identifies the different systems in the project environment related to CSR standards. The aspects identified in relation to the project focus on the different stakeholders (employees, customers, competitors, public), the actual company and its policies; and the environment.

Shen et al. (2010) conclude from their study that out of the three factors making up CSR (economic, social and environmental), the economic aspect is the most usually considered compared to social and environmental aspects and any analysis on them is limited.

Fernández-Sánchez and Rodríguez-López (2010) propose classifying the risks and opportunities for the projects in relation to sustainability. This suggests using a Sustainable Breakdown Structure (SBS) that reflects sustainable development blueprints based on the triple bottom line (TBL) focus throughout the project life cycle.

Specifying this aspect with small companies, despite being an increasingly important aspect, there is still very little research into analysing the relationship between SMEs and CSR (Parry, 2012).

However, what the majority of the literature does confirm is the fact that different sized companies tackle sustainability differently. Several reasons have been identified, most importantly that motivation and decision-making is very different in small businesses and large companies (Spence, 1999; Murillo and Lozano, 2006). When implementing sustainability in their projects, motivated above all by the company manager's ethical standpoint, small businesses seek out the necessary technological advice to be able to tackle projects that can implement the sustainable strategy defined by the owner (Parry, 2012).

Rahbek (2010) analysed the answers regarding CSR administrators' chosen view and on the whole, this focussed on eliminating risks more than generating positive impacts. However, stakeholders usually have a more positive view of it.

One of the dangers highlighted by Prasad and Holzinger (2013) is the false implementation of CSR in companies and their projects as this runs the risk of turning this sustainable strategy into a simple marketing strategy that helps the company to make money without really inserting it in their processes and projects.

In an attempt to unify and classify the concepts and contributions made by the different practices in sustainability in this field, Bocken et al. (2014) propose a classification of the sustainable business model archetypes using their technological, social and organisational components.

7. Sustainable project managers

No sustainable project can exist without calling on the ethical aspect of the project manager and his team. In fact, it is already accepted as a fundamental skill in project administrator training and accreditation according to the most extensive standards.

Working from the definition of ethics made by Helgadöttir (2008), it can be concluded that ethics and sustainable development are intricately linked and therefore, ethics should be considered in sustainable project management, above all in the decision-making processes (McDermott et al. 2002; Mishra et al. 2011).

Despite not being included in the three main strands of project management (scope, cost and schedule), ethics are becoming increasingly important, particularly due to the fact that the current environment is much more complex. Therefore, aspects that are highly related to ethical project management such as stakeholders, risks and the effects of projects on people and the environment, among others, are focussing a great deal of interest on current project management (Kerzner, 2003; Helgadöttir, 2008; Mishra et al. 2011). One way of including ethics in project management is to analyse both the project results and processes under classic ethics perspectives (Virtue, ethics/utilitarianism, deontology/social contract) (Helgadöttir, 2008).

Mishra et al. (2011) identify ethics as the fourth dimension of project management by adding it to the traditional project management triangle (time, cost and schedule) and conclude that including it will result in sustainable project management.

Table 4
Summary of key ideas found in literature: sustainability dimensions *vs* project management.

		Sustainability dimension		
		Economic	Social	Environment
Project management aspects	Products	Sustainability in NPD projects is introduced by ISO 14062. Sustainability is included in construction projects management especially through project life cycle management.	When NPD is carried out in large sustainable organisations, sustainable management comes from management policies derived from CSR.	The greatest progress in introducing sustainability has come via environmental aspects. Ecodesign, along with Corporate Social Responsibility, seems to be the best way of reaching higher levels of sustainability in design.
	Process	Sustainability could be a criterion when choosing projects, but it does not seem to be integrated in project management yet. Current project management frameworks do not effectively tackle the three fundamental aims of sustainable development. LCA techniques are essential when introducing sustainability in project management. Large companies have already included some aspects of sustainability in projects and their management.	Stakeholder management is the element that can be used as a connection between traditional project management and the social and ethical aspects, improving their participation and coordination. Most of the indicators compiled in the literature include stakeholders as an important factor to be considered.	Little has been found regarding sustainable project processes. Introducing indicators (including OEF y PEF) into project management processes, especially evaluation and decision-making, seems to be the easiest and most efficient way to run sustainable project management.
	Organisations	The concept of sustainability has been developed in businesses adding sustainability to its basic management principles. However, this trend has not been correctly transferred to the field of decision-making and evaluating the impacts of company activities. The size of the company does affect how the organisation tackles CSR: • In LCs, CSR comes from its policies and it is progressively incorporated into its processes. • SMEs adopt it as a consequence of the company manager's ethics.	Applying CSR principles is becoming more important, emphasising the ethical nature of the organisations. Project management does not prevent the CSR reference framework incorporating those priorities.	A great need has been detected to set up a criteria framework particularly focussed on sustainability during project management. Calculating the PEF and OEF for the whole project and its products could be used as a way to introduce sustainability in organisations.
	Managers	Ethics are implicit throughout the entire project life cycle: definition, stakeholder management, decision-making, provision. Project management standards include ethics in training and accreditation for project managers, and they are progressively incorporating aspects related to sustainability into the definition of their processes and skills		

As mentioned by Wideman (1995), much work has been done on standardising knowledge relating to project management that manages to attain the expected results and yet these bodies of knowledge still need to reflect how this knowledge is implemented in project management. They describe what has to be done but not how to do it. For this reason, a review of the project success concept is suggested, including expectations from the different stakeholders in the projects.

Although the PMBoK does not specifically include ethics in its processes, the PMI (2006) has an ethical code that aims to influence project managers in its organisation. In addition, in its new (5th) edition (Project Management Institute, 2012), it has included stakeholder management as a new knowledge area, thereby recognising the growing importance of this management in project success.

Other standards such as NCB or APMBoK (Association for project management, 2006) include ethics as one of the skills that a project manager should master but barely go into any greater depth. In the same respect, Spangenberg et al. (2010) identify these skills in their DEEDS (DEsign EDucation and Sustainability) project as among the elements for future project administrators to contemplate in education and training.

In addition, back in 1995 Wideman (Wideman, 1995) described five areas in which project administrators should be trained (Life cycle, Environment, Integration, Processes and Success). These areas encompass the fields subsequently proposed by Helgadóttir and they are areas where the sustainability factor can be introduced in project management more directly and overall.

8. Discussion

Despite the significant progress that has been made in terms of sustainability over the last few years, there is still a long way to go. There is little guidance on what a sustainable project might comprise (Boswell et al. 2005). According to Fernández-Sánchez and Rodríguez-López (2010) a project is sustainable when it makes improvements in the three dimensions of sustainable development (regarding environment, social integration and social economy) maintaining cost, time, quality and effort within an acceptable range. On the other hand, Bond et al. (2012) consider that the concept of sustainability is regulatory and cannot be defined singularly or categorically. As the context differs, the meaning of sustainability in an individual assessment should be determined case by case.

References have been found to strategic approaches, generally with wide scope: local, national, etc. However, detailed descriptions of specific cases are missing where strategic sustainability approaches have been incorporated into their projects for some of the private organisations that promote and carry out projects.

Table 4 shows a summary of sustainability and project management aspects found in the comprehensive review from this work (Table 5)..

When project managers wish to manage their projects sustainably, they have to take different elements into account. Firstly, they should seek out a sustainable result. Some ISO standards, eco-

Table 5
Proposed research agenda.

Aspect	Further research
Sustainability strategy	Experiments on how to transfer a strategy tied to sustainability to specific projects.
Social	Developing tools that we might call social-design, helping to include social aspects in the project.
Project management areas.	Identification of the most affected and influential project management areas for sustainable project management.
Project processes	Development of techniques that include sustainability in the different project processes: stakeholders, life cycle, assessment, decision, procurement, etc.
Competence from the organisation tackling the project	Identification and characterization of a set of sustainability competences that a company must acquire and develop.
Project team competences	Identification and characterization of a set of sustainability competences that project managers must acquire and develop.

design tools and humanistic focuses used in construction projects could be used a guide. However, the result cannot be sustainable if sustainable processes are not applied to the project. In the bibliographic review, the processes mentioned most often are project assessment, decision-making and managing stakeholders, always from a life cycle focus. If the project involves participation from organisations that include sustainability in their strategy, fundamentally through corporate social responsibility, the project manager will be backed up by policies and so additional resources. Finally, the actual Project Manager's ethical nature and his training in sustainability will be key.

There are other important open questions, which should be discussed. For example, is it possible to have a proactive focus, instead of a more reactive focus that is more comfortable for project administrators? It has been argued that simply considering the three pillars of sustainability is not appropriate, given that it encourages exchanges between pillars. A systemic focus is more appropriate as it helps us look for net gain in sustainability instead of minimising the negative effects (Pope et al. 2004; Gibson, 2006).

Another important matter is whether sustainability is built from the bottom up or from the top down. According to Hacking and Guthrie (2008) sustainability assessment at project level can, to different degrees, take a strategic perspective, particularly in the absence of well-developed planning at higher levels. Ugwu et al. (2006a, b) state that the literature is lacking methods and techniques that facilitate sustainability assessment and decision-making at project level. They believe that the focus is currently on macro level aspects of policy and strategy and that there are weaknesses in terms of transferring these aims to micro level. On the other hand, by presenting the Korean situation regarding sustainable buildings, Tae and Shin (2009) believe that the time is right to make the transition from project level to a more general level. They are claiming a pro-environmental international network to exchange policies from each country and eco-friendly technologies so that they work together towards the challenge of jointly protecting the planet.

As a result of the literature analysis, a summary of sustainability aspects and projects for further research is proposed (see table 5). No doubt this list is incomplete, but it is also a great opportunity for research that can contribute to the sustainable project management process, and hence to sustainability in general.

9. Conclusions

This work selected and analysed 110 references that cover the topic of sustainability and introduce the project term in one way or another. Few mentions have been found that tackle sustainability from a project or project management focus.

In practice, sustainability has become a very important qualitative and quantitative step, particularly in the project's environmental aspects. However, in social matters, slightly less progress has been made.

The main scientific contributions of this paper are, on the one hand, to show the interconnections between two disciplines, sustainability and project management, that traditionally have been tackled in a separate way but that must have been integrated nowadays. On the other hand, an innovative conceptual framework to manage sustainable projects is defined, based on four dimensions: products, processes, organisations and managers.

To date, including sustainability in projects has fundamentally focussed on achieving more sustainable products or services. However, the issue of the project's sustainable management has not been tackled. Is it possible to run a sustainable project without managing it sustainably? The authors of this work propose a framework and a research agenda with the following aims: a) help the Project Managers to manage their projects more sustainably; and b) be used as a basis for future research to open lines of work that develop new methods and tools for sustainable project management. There can be no doubt that this proposal is open to contributions from the scientific community in future research.

In short, this work is based on the supposition that project products designed using sustainability criteria, sustainable project processes, organisations committed to sustainability that carry out projects, and project managers trained in sustainability are all necessary elements, although maybe not enough, to attain sustainable projects. In any case, it will not easy to make significant progress down the path to project sustainability when the debate is still open on defining a sustainable project.

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