El estándar ISO14006: Una herramienta que ayuda a mejorar la competitividad de los estudios de arquitectura

The standard ISO14006: a helpful tool to improve the competitiveness of the architecture firms

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Resumen

En el presente artículo se analiza el proceso de adopción del estándar de ecodiseño ISO14006 y su influencia en los resultados de los estudios de arquitectura. Con estos objetivos, tras una introducción y una descripción del estándar de ecodiseño ISO14006, se analiza su difusión. En este apartado se comprueba el fuerte impacto que han tenido estos estándares entre los estudios de arquitectura. Posteriormente, se muestra la metodología de investigación utilizada basada en un estudio de nueve casos, cuyos resultados se han cruzado con una serie de entrevistas en distintas fases temporales realizadas a consultores, auditores, organizaciones tractoras y un miembro del comité técnico ISO/TC207. En la investigación se exponen las motivaciones, dificultades y resultados del proceso de adopción y certificación del estándar ISO14006 por parte de los estudios de arquitectura. Entre los principales resultados, se constata que los estudios analizados obtienen ventajas competitivas con la adopción de este estándar que les permite mejorar su posición en el mercado. Por último, se muestran unas conclusiones de interés tanto para los estudios de arquitectura como para las instituciones, en general.

Palabras Clave: Ciclo de vida, ecodiseño, ISO14006, gestión medioambiental, estudio de arquitectura

Abstract

In this article, the process of adopting the eco-design standard ISO14006 and its influence on the results in the architecture firms sector have been analyzed. With these aims, following an introduction and a description of the eco-design standard ISO14006, its dissemination has been presented. About this aspect, it should be remarked the strong impact that this standards has among the architecture firms. Subsequently, the research methodology based on the study of nine cases is shown. The results have been crossed with the data obtained from interviews with consultants, auditors, organizations that act as driving forces and a member of the technical committee ISO/TC207 at different times in the course of the investigation. Motivations, challenges and results of the process of adoption and certification of ISO14006 by architecture firms are then analyzed. Among the major findings, it was found that the adoption of the standard ISO14006 can be a helpful tool in order to improve the competitiveness of the architecture firms. Finally, in the last chapter of the article, some interesting conclusions both for architecture firms and institutions, in general, are shown.

Keywords: Life cycle, eco-design, ISO14006, environmental management, architecture firm

1. Introduction

The development model defining our civilization, over the past two centuries, inevitably leads to the environmental deterioration of our cities (Damasceno Do Nascimento and Caldas, 2008). So as to avoid such situation, the construction sector, which is characterized by generating high environmental impacts, should mainly focus on decreasing such damages (Martí & Ragué, 2010).

Therefore, in general the scopes of construction sector and; in particular the architecture firms, should develop and implement management systems based on standards reducing environmental impacts (IHOBE, 2010). The implementation of the Green-Lean concept in construction projects, as well as the use of eco-design management standards and integrated operational control, among others, endeavor companies to improve building environmental performance and to achieve competitive advantages related to the fulfillment of environmental objectives (Martínez et al., 2009; Arana and Heras, 2011).

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Regarding the most specific standards in the sector, ISO and CEN, they have developed a series of standards intended for controlling environmental sustainability in the construction sector, which are summarized by Table 1.

Tabla 1. Estándares ambientales elaborados por ISO y CEN orientadas al sector de la construcción.

Fuente: elaboración propia a partir de los datos de ISO y CEN

Table 1. Environmental standards elaborated by ISO and CEN oriented to the construction sector.

Source: self elaboration from data provided by ISO and CEN

Estándar/ Standard	Objeto/ Objective
ISO/FDIS 15392 (2008)	Principios generales de la sostenibilidad en la construcción. <i>General sustainability principles in construction sector</i>
ISO/TS 21929 (2006)	Panel de indicadores destinados a medir la sostenibilidad de edificios. <i>Indicators panel intended for measuring buildings sustainability</i>
ISO 21930 (2007)	Principios para realizar una declaración ambiental de los edificios. <i>Principles to make a building environmental statement</i>
PrEN 15804 (2008)	Principios para realizar una declaración ambiental de los edificios. <i>Principles to make a building environmental statement</i>
PrEN 15643 (2008)	Integración de los impactos ambientales en el sector de la construcción. <i>Integration of environmental impacts in the construction sector</i>

However, a series of non-specific standards in the construction sector are strongly influencing it (Pellicer et al., 2008). Therefore, as far as the environmental management system is concerned, the role played by the standard family ISO 14000 (ISO, 2004) is significant. In the eco-design field, the technical report ISO/TR14062 is remarkable. It describes the integration process of environmental aspects during products' design and development processes (ISO, 2002). In July 2011 the international eco-design standard ISO14006:2011 (ISO, 2011) was published, based on the Spaniard standard UNE150301:2003 (AENOR, 2003). Such standard goes far beyond other environmental standards such as ISO14040 (ISO, 2006) - dealing with the analysis of a product life cycle – or the quoted ISO/TR14062 (ISO, 2002), since it integrates inherent aspects of the design process, the assessment of environmental impacts generated by designed products, the management and treatment of such impacts on the Environmental Management System (EMS) in the organization.

Considering the dissemination level of the standard UNE150301 in Spain, it is expected that the international eco-design standard, ISO ISO14006, will be significantly broadcasted in the construction sector (Sáez de Cortázar, 2011). Consequently, the purpose of this paper is to analyze the driving forces, the implementation process and results of the standard ISO 14006 on architecture firms first implementing such management standards, so as to serve as a benchmark to other firms, members of public organizations and the stakeholders involved in this process when determining an strategy and detecting the key aspects in the process.

Consequently, the following section briefly describes the standard. Its dissemination in the sector is further on analyzed, showing that the eco-design standard has been widely accepted by architecture firms. Section 4 analyzes the methodology used by this research and describes in detail a representative case of the process implementation. Finally, the last section shows discussions and conclusions not only considering this specific case, but also the other eight cases carried out by construction sector companies. It also presents interviews held with involved entities, belonging to diverse professional fields eco-design experts.

2. Characteristics of the standard ISO 14006

The main purpose of the ISO 14006 is the same pursued by its Spaniard predecessor, the standard UNE 150301, which is to serve as a benchmark for the organizations willing to implement this environmental variable in the product design and development stages, as long as the organization is willing to control and influence the process integration into their EMS.

The structure, terminology and requirements of the standard ISO 14006 are based on the standards ISO9001 and ISO14001, in order to facilitate the integration with the Quality and Environmental Management Systems of the organizations, respectively. The first three sections of ISO14006 are the typical management standards, which describes its objective and scope as well as the key reference documents for its implementation.

Chapter 4 is focused on the crucial role played by chief executives when determining a systematic and well structured approach for the implementation of a guiding plan inherent to eco-design into the EMS in the organization. Following the structure provided by Table 2, the chapter 5 shows the guiding plan for an eco-design management system, which in turn fulfills the standard ISO 14001. Finally, section 6 provides the required directions to systematically and continuously identify, to control and improve the environmental aspects during products' design and development stages in the organization.

Tabla 2. Estructura del estándar ISO14006:2011. Fuente: elaboración propia a partir del estándar ISO14006:2011
Table 2. Structure of the Standard ISO14006:2011. Source: Self elaboration according to Standard ISO14006:2011

1.	Objeto y campo de aplicación/ 1. Objective and field of application
2.	Referencias normativas/ 2. Regulatory references
3.	Términos y definiciones/ 3. Terms and definitions
4.	Rol de la alta dirección en el ecodiseño/ 4. Role played by chief executives in deco-design
4.1.	beneficios de realizar ecodiseño/ 4.1. Benefits from implementing eco-design
4.2.	tareas relativas al ecodiseño/ 4.2. Tasks related to eco-design
5.	Directrices para la incorporación del ecodiseño en un sga/ 5. Guidelines for implementing eco-design into EMS
5.1.	directrices generales/ 5.1. Overall guidelines
5.2.	política ambiental/ 5.2. Environmental policy
5.3.	planificación/ 5.3. Planning
5.4.	implementación y operación/ 5.4. Implementation and operation
5.5.	verificación/ 5.5. Verification
5.6.	revisión por la dirección/ 5.6. Inspection by chief executives
6.	Actividades de ecodiseño en el diseño y desarrollo del producto/ 6. Eco-design activities developed for the design and development of a product
6.1.	generalidades / 6.1. Basic concepts
6.2.	enfoque de ciclo de vida / 6.2. Life cycle approach
6.3.	proceso de ecodiseño / 6.3. Eco-design process
6.4.	evaluación ambiental de los productos / 6.4. Environmental assessment on products
6.5.	análisis de los requisitos ambientales de las partes interesadas / 6.5. Analysis of environmental requirements from involved entities
6.6.	revisión del ecodiseño / 6.6. Eco-design review
6.7.	implicación de la cadena de valor / 6.7. Implications of value chain
Anexo A (informativo). La alta dirección y las cuestiones estratégicas en el ecodiseño/ Annex A (informative). Chief executives and strategic issues on eco-design	
Anexo B (informativo). Correlación de la norma ISO 14006:2011 con otras normas internacionales sobre ecodiseño/ Annex B (informative). Correlation of standard ISO 14006:2011 with other international standards on eco-design	
Bibliografía/ Bibliography	

3. Broadcasting the standard ISO14006 in Spain

According to information delivered by diverse certification organizations, shown on Figure 1, in March 2013 there were 177 certified organizations. It is worth mentioning that 142 companies develop their activities within the construction sector; 136 out of them correspond to architecture firms. This situation responds to the growing environmental awareness and concern by the society and, especially by public organizations, due to the progressive establishment of mandatory regulations in the construction sector, which are even more restrictive, and due to the increasing relevance granted to environmental aspects in public works tenders (Arana et al., 2012).

Figura 1. Empresas certificadas conforme a la ISO14006 por sectores de actividad (marzo de 2013).

Fuente: elaboración propia, a partir de los datos de empresas certificadoras

Figure 1. Companies certified as per ISO 14006, per activity sector (March, 2013). Source: self elaboration, from data obtained from certification companies

4. Analysis cases

4.1 Methodology

Since this research study began when the standard ISO 14006 had not been published yet, it was decided to employ a qualitative methodology to achieve information related to the implementation process of the standard UNE150301, based on the study of cases. As stated by Yin (2009), such methodology enables to go in detail on the study case and to reach a better understanding of its nature. The first stage of the research, which was conducted between January 2009 and November 2011, analyzed six cases of firms that had implemented the standard UNE150301 (Oneka Arquitectura, Ramón Ruíz Cuevas Arquitectos, Ache Arquitectura, Gausark and Toledo Taldea). Those initial researches, of exploratory nature, enabled us to understand the process implemented by architecture firms when integrating eco-design standards.

After the standard ISO14006 was published, the research methodology had to be modified. Figure 3 describes the new scheme, following the development guidelines provided by the literature (Miles and Huberman, 1994; Yin, 2009). Afterwards, the research purposes were re-defined, and new cases of architecture firms certified in accordance to ISO 14006 were selected, in order to understand in detail the implementation process of this international standard.

At the same time, interviews were held in parallel with members of driving organizations, auditors, consultants and a member of the technical committee ISO/TC207, who was the chief of the standard elaboration. From such interviews and previous experiences, the procedure to be followed was designed for the study cases. The research was conducted by following a semi-structured protocol, in order to avoid restricting its results, but keeping common guidelines and focusing on the research objective to be studied, so as to guarantee the consistency and reliability of the research (Maxwell, 2005).

After solving methodological issues, between November 2011 and March 2012, three new study cases were selected (Hirilan, LKS and MAAB). The six cases previously studied were reviewed once again, since the six firms had already implemented the standard ISO14006. Selection was restricted to nine cases, as it was proven that collected inputs were progressively less, and a theoretical saturation phenomenon was taking place (Yin, 2009).

Figura 2. Proceso de investigación realizado. Fuente: elaboración propia, basado en Yin (2009) y Miles y Huberman (1994)

Figure 2. Executed research process. Source: self elaboration, based on YIN (2009), Miles and Huberman (1994)

27 interviews were held with chief officers and technicians and, 52 documents of restricted nature were reviewed. In order to guarantee the reliability and soundness of collected information, inputs were crossed with different sources (Maxwell, 2005). Information from each certified firm was crossed with the information from the other firms and later it was triangulated with data obtained by means of interviews held with two members of driving organizations, two consultants, two auditors and a member of technical committee ISO/TC207 who was the chief of the standard ISO14006 elaboration. Such interviews were held in three different stages throughout the research, coinciding with the task of gathering descriptive and explicative elements from UNE150301 & ISO14006 and crossed cases analysis.

As previously stated, due to the extension of this paper, this section only shows one case in detail. However, discussion and conclusion section considers the global research process.

4.2 Development of the LKS case

4.2.1 Introducing the Firm

LKS Ingeniería, S.Coop. (Hereinafter LKS) is a member of the LKS Holding. It has a payroll of 1,050 employees and its yearly income is 700 millions of Euros approximately. It operates locally and abroad, with presence in Chile, Costa Rica, Dominican Republic, Mexico, France, Colombia, Uruguay, India and China. LKS integrates the Mondragon Corporation, the first business group of the Basque Country, seventh in Spain and a worldwide leader in cooperative movement.

Nowadays, LKS, due to its business size and volume, is the biggest Engineering Services and Construction Company certified according to the eco-design standard ISO14006 in Spain. LKS has a remarkable policy of sustainable development within its activities, including the environmental aspects into the cooperative commitment of social and economic development of its business strategy.

4.2.2 Experience in implementing management systems.

The first experience LKS had when implementing certified management systems was not quite satisfactory. In 1998 LKS achieved its first certificate in quality management system according to ISO9001. However, in 2001 the firm decided not to maintain the certification mainly because of two reasons: disagreement with the auditor team and the low business success that maintaining the certification meant. Nevertheless, the procedures implemented into the management system were kept. In the course of time, under no pressure for achieving the certification, maintaining the system became progressively hard, so it was decided to reestablish a system based in processes management as per standards ISO9001 and ISO14001. In 2009 the system was completed with the incorporation of eco-design standard UNE150301 and work safety and health standard OHSAS18001.

4.2.3 Implementing standard ISO14006

In 2011 the implementation of the eco-design standard ISO14006 into the organization was relatively simple.

It was possible due to the support provided by chief officers, due to the previous environmental work conducted by LKS Sustainability Committee and the experience achieved so far with the standard UNE150301.

At the very beginning, the standard's rules were applied in residential projects and shortly after other projects were eco-designed in accordance with this standard, with the exception of industrial buildings as they do not offer any allowance to implement environmental measures in the design stage of the project.

Generally, in the design and development stage of each building the most relevant environmental aspects are identified for each phase of the building life cycle. Afterwards critical aspects and magnitude of environmental aspects are assessed following criteria contained in the subject literature. Finally, based on the most significant environmental aspects, the improvement objectives are established.

Supported by a data base created by LKS Sustainability Committee, which contains the characteristics of material environmental behavior, and by employing the ECOTEC software for the simulation of the building thermal behavior under operation stage, the project manager determines the environmental improvements to be carried out. In this stage the endeavor to create new solutions to improve and implement the existing ones for reducing the building energy consumption becomes especially significant.

Since the eco-design methodology was first implemented into a construction project, including 84 public housing units in Salburua (Vitoria-Gasteiz), in accordance with this standard's guideline, LKS has been working in improving concepts and sustainable technical solutions for its projects.

An example is the enlargement and remodeling of the indoors sport arena Fernando Buesa, opened in April 2012 in Vitoria-Gasteiz, city distinguished with the award "Green European Capital 2012". The multi-purpose arena increased its seating capacity from 9,750 up to 15,504 people, thus becoming the third basketball stadium of greater seating capacity in the European Union (EU-27) and the first in Spain. It has even achieved the highest score (67.67%) of the environmental sustainability certification BREEAM (BRE, 2013). The enlargement work shown by Figure 3 was carried out by assembling a fourth seating platform. To do so, twelve 48 metres length towers were constructed to support the new cover structure of 120m diameter.

Figura 3. Pabellón multiusos Fernando Buesa Arena. Fuente: Servicio de Secretaría Técnica de Arquitectura de la Diputación Foral de Álava (2010)

Figure 3. Multi-purpose arena Fernando Buesa. Source: Architecture Chief Technical Office at the Foral de Alava City Government (2010).

The project intended to improve the building environmental behavior during its complete life cycle and, therefore, to meet the environmental requirements from clients. The first stage assessed the project environmental aspects considering its complete life cycle. The results from such evaluation are shown by Table 3, which was used by the company in order to set up a hierarchy of the aspects to be improved.

Concretely, significant aspects were considered, with an importance level (magnitude x critical nature) equal or higher than 15. That is to say, in the stage "Extraction and Elaboration of products" the consumption of energy and raw materials was considered. In the stage "Works Execution" greenhouse gas into the atmosphere was accounted. Finally, in the stage "Operation and Maintenance" the energy consumption and greenhouse gas into the atmosphere were considered.

Tabla 3. Identificación y evaluación de los aspectos ambientales. Fuente: elaboración propia a partir de los datos obtenidos de LKS**Table 3.** Identification and evaluation of environmental aspects. Source: self elaboration from data obtained from LKS

ASPECTO AMBIENTAL ENVIRONMENTAL ASPECT	MAGNITUD/ MAGNITUDE		CRITICIDAD/ CRITICAL NATURE	SIGNIFICANCIA/ IMPORTANCE	
	CRITERIO/ CRITERION	M	CRITERIO/ CRITERION	C	M x C
Extracción y Fabricación de Productos/ <i>Extraction and Elaboration of products</i>					
Consumo de materias primas/ <i>Raw materials consumption</i>	Obra nueva Sc > 10.000m² <i>New Building Sc > 10.000m²</i>	5	3	3	15
Consumo de energía/ <i>Energy consumption</i>	Obra nueva Sc > 10.000m² <i>New Building Sc > 10.000m²</i>	5	10-35	4	20
Ejecución de la obra/ <i>Work Execution</i>					
Consumo de energía/ <i>Energy consumption</i>	Obra nueva: volumen movimientos tierras <20.000m³./ <i>New building: volume of earth movement <20,000m³.</i>	3	No requiere excavación/ <i>No excavation required</i>	1	3
Consumo de agua/ <i>Water consumption</i>	Derribo y movimiento de tierras (precisa transporte)/ <i>Demolition and earth movement (require transportation)</i>	4	Zona pluviométrica III/ <i>Rainfall area III</i>	3	12
Emisiones a la atmósfera/ <i>Emissions into the atmosphere</i>	Existe derribo y movimiento tierras (precisa transporte)/ <i>Demolition and earth movement carried out (require transportation)</i>	4	ZONA C, 4-5/ <i>AREA C, 4-5</i>	4	16
Emisión de ruidos/ <i>Noise pollution</i>	Obra nueva con derribo previo / <i>New building, previous demolition carried out</i>	5	<50 dB(A)	1	5
Generación de residuos/ <i>Generation of waste residues</i>	Escombros procedentes de derribos/ <i>Debris produced by demolition tasks</i>	4	ÚNICAMENTE envases contaminados por productos tóxicos / <i>ONLY packs polluted by toxic products</i>	2	8
Uso y Mantenimiento/ <i>Operation and Maintenance</i>					
Consumo de energía/ <i>Energy consumption</i>	Arquitectura: ocio/ <i>Architecture: leisure</i>	5	D1, C2, C3, C1	4	20
Consumo de agua/ <i>Water consumption</i>	Arquitectura: ocio (sin jardín)/ <i>Architecture: leisure (no garden)</i>	4	Zona pluviométrica III/ <i>Rainfall area III</i>	3	12
Emisiones de gases a la atmósfera/ <i>Gas emissions into the atmosphere</i>	Arquitectura: ocio/ <i>Architecture: leisure</i>	5	D1, C2, C3, C1	4	20
Vertidos de aguas residuales/ <i>Disposal of waste water</i>	Arquitectura: ocio / <i>Architecture: leisure</i>	4	Red de separación/ <i>Separation network</i>	1	4
Emisión de ruidos/ <i>Noise pollution</i>	Actividades-recreativas y de ocio/ <i>Recreation-leisure activities</i>	3	Sector con predominio de suelo industrial/ <i>Sector prevailing industrial land</i>	1	3
Impacto visual/ <i>Visual impact</i>	> 30.000m³	5	Suelo urbano: altura o volumen mayor significativo (>25%)/ <i>Urban land: significantly higher height and volume (>25%)</i>	2	10
Ocupación suelo/ <i>Land use</i>	NO SE EVALUA/ <i>NOT EVALUATED</i>				
Biodiversidad/ <i>Bio-diversity</i>	NO SE EVALUA/ <i>NOT EVALUATED</i>				
Fin de vida/ <i>End of life cycle</i>					
Consumo de energía/ <i>Energy consumption</i>	>50.000m³	3	> 80% Construcción industrializada/ <i>> 80% Industrial construction</i>	1	3
Generación de residuos/ <i>Waste material production</i>	>100.000m³	5	> 80% Construcción industrializada/ <i>> 80% Industrial construction</i>	1	5
Emisión de ruidos/ <i>Noise pollution</i>	NO SE EVALUA/ <i>NOT EVALUATED</i>				

Subsequently, from this evaluation an indicator panel was elaborated including the objectives to be reached. So as to achieve such objectives an action plan was designed, which defined the strategies and measures to be adopted. This plan included the reduction of residues generated by the work execution stage, as well as water consumption in every stage, which were considered as relevant aspects by LKS and the client. A summary of objectives of this improvement plan is described by Tables 4 and 5, showing measures to be implemented:

Reducing from the extraction and elaboration of products stage:

- 10% of raw material consumption
- 10% of energy consumption

Reducing from the works execution stage

- 25% of greenhouse gas emissions into the atmosphere
- 15% of water consumption
- 20% of waste material

Reducing from operation and maintenance stage

- 20% of energy consumption
- 20% of greenhouse gas emission into the atmosphere
- 60% of drinking water consumption

Tabla 4. Definición de objetivos, estrategias y medidas ambientales a ejecutar en las fases de extracción y fabricación de productos, y ejecución de obra. Fuente: elaboración propia a partir de los datos obtenidos de LKS**Table 4.** Definition of objectives, strategies and environmental measures to be implemented into the stage of extraction and elaboration of products and works execution stage. Source: self elaboration from data obtained from LKS

FASE:/ STAGE:	EXTRACCIÓN Y FABRICACIÓN DE PRODUCTOS UTILIZADOS/ EXTRACION AND ELABORATION OF EMPLOYED PRODUCTS
OBJETIVO:/ OBJECTIVE:	REDUCCION DEL CONSUMO DE MATERIAS PRIMAS Y CONSUMO DE ENERGIA/ REDUCTION OF RAW MATERIAL CONSUMPTION AND ENERGY CONSUMPTION
Estrategia:/ Strategy:	Consumo de un 10% menos de materiales de bajo impacto ambiental con un 10% menos de energía embebida en los mismos. Sistemas de fachada y cubierta sostenible con calificación BRE (Building Research Establishment Ltd.): A/A+/ 10% lower consumption of raw materials with low environmental impact. 10% of energy reduction absorbed by them. Sustainable front walls and cover roof systems as per BRE standard (Building Research Establishment Ltd.): A/A+
	Medidas ambientales:/ Environmental measures:
	1. Selección de sistemas constructivos según la Guía Verde del BRE. /1.Selection of constructive systems as per BRE Green Guidelines.
	2. Utilización preferente de aislamientos térmicos no procedentes del petróleo y sin CFCs./ 2. Preferential use of thermal isolation not coming from petroleum derivatives and not containing CFCs.
	3. Pinturas interiores con niveles bajos de emisión de compuestos orgánicos volátiles (COV)./ 3. Indoors paintings with low emission levels of volatile organic compounds (VOC)
	4. Aprovisionamiento responsable basado en el ámbito y el alcance de la certificación obtenida por el proveedor o fabricante del material./ 4. Responsible procurement based on the certification field and scope achieved by the product supplier or manufacturer.
	5. Toda la madera no certificada utilizada en la construcción debe ser de procedencia legal y no incluida en la lista CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora)./ 5. All non-certified woods employed in the construction shall have a legal origin and they shall not be included by the CITES list (Convention on International Trade in Endangered Species of Wild Fauna and Flora).
FASE:/ STAGE:	EJECUCIÓN DE LA OBRA/ WORK EXECUTION
OBJETIVO:/ OBJECTIVE:	REDUCCION DEL CONSUMO DE ENERGÍA Y EMISIONES A LA ATMOSFERA/ REDUCTION OF ENERGY CONSUMPTION AND EMISSIONS INTO THE ATMOSPHERE
Estrategia:/ Strategy:	Aplicar al menos 5 buenas prácticas de las recogidas en la certificación BREEAM sobre requisitos de gestión./ Applying at least 5 good practices provided by BREEAM standard regarding management requirements.
	1. Reutilización de la cubierta existente en el emplazamiento para reducir las emisiones de demolición y transporte en obra./ 1. Recycling the existing cover roof at the same location to reduce emissions derived from demolition and transportation at the job site.
	2. Construcción de fachadas más ligeras e industrializadas para reducir la cantidad total de material necesario, el transporte de materiales, el peso a soportar por la estructura y, por tanto, reducción del peso de la estructura del edificio./ 2. Construction of lighter and industrialized front walls to reduce the amount of total material to be used, as well as material transportation, weight to be supported by the structure and, therefore, reducing the building structural weight.
	3. Monitorización de los consumos y emisiones en obra./ 3. Controlling consumption and emissions at the job site.
	4. Utilización de elementos constructivos y estructuras prefabricadas, elección de productos industrializados de ejecución rápida y aprovechamiento planificado de los medios auxiliares, con el fin de reducir las emisiones en obra en un 25%/ 4. Utilization of prefabricated constructive elements and structures. Selection of industrialized fast execution products. Planned exploitation of secondary goods, in order to reduce emission down to 25% at the job site.
	5. Aplicación de las mejores prácticas ambientales en la construcción en relación a la contaminación atmosférica por polvo, resultante de las actividades./ 5. Implementation of the best environmental practices in construction regarding dust atmosphere pollution resulting from work activities.
OBJETIVO:/OBJECTIVE:	REDUCCIÓN DEL CONSUMO DE AGUA/ REDUCTION OF WATER CONSUMPTION
Estrategia:/Strategy:	Estrategia: Reducción de un 15% del consumo de agua de obra./ Strategy: 15% reduction of water consumption at the job site
	1. Especificación de sistemas de construcción seca para reducción del consumo de agua en un 10%/ 1. Specification of dry construction systems to reduce water consumption in 10%.
	2. Seguimiento, información y establecimiento de objetivos de consumo de agua procedentes de las actividades de la obra./ 2. Following-up information and objectives on water consumption for activities developed at the job site.
OBJETIVO:/OBJECTIVE:	REDUCCION DE LA GENERACIÓN DE RESIDUOS/ REDUCTION OF WASTE RESIDUES
Estrategia:/Strategy:	Estrategia: Reducción de un 20% de los residuos en obra. /Strategy: 20% reduction of waste residues at the job site.
	1. Reutilización, reciclado u otra forma de valorización del 60% (en peso o volumen) del Reciclado de residuos de construcción y demolición (RCD) total generado en obra (exceptuando los residuos peligrosos)./ 1. Reutilization, recycling and any other method of energy recovery for the 60% (weight and volume) of the total construction and demolition recycled residues (CDR) generated at the job site (excepting for dangerous residues).

Tabla 5. Definición de objetivos, estrategias y medidas ambientales a ejecutar en la fase de uso y mantenimiento. Fuente: elaboración propia a partir de los datos obtenidos de LKS.

Table 5. Definition of objectives, strategies and environmental measures to be implemented into the operation and maintenance stage
Source: self elaboration from data obtained from LKS

FASE:/STAGE:	USO Y MANTENIMIENTO/ OPERATION AND MAINTENANCE
OBJETIVO:/ OBJECTIVE	REDUCCION DEL CONSUMO DE ENERGIA Y REDUCCION DE LAS EMISIONES A LA ATMOSFERA/ REDUCTION OF ENERGY CONSUMPTION AND REDUCTION OF EMISSIONS INTO THE ATMOSPHERE
Estrategia pasiva 1:/ Passive strategy 1:	Hacer un diseño que reduzca la demanda energética para calefacción en invierno y climatización en verano./ Designing a system to reduce energetic consumption for heating during winter and air conditioning in summer.
	Medidas ambientales:/ Environmental measures:
	1. Reducción de la transmitancia térmica en cubiertas y fachadas respecto lo establecido en el DB-HE-1 del Código Técnico de la Edificación (CTE)./ 1. Reduction of thermal transmittance in cover roofs and front walls in accordance with the DB-HE-1 of Building Technical Code (BTC).
	2. Instalación de vidrios de baja emisividad térmica 6t /15/4+4 (U=1,6 w/m ² k)./ 2. Installing low thermal emissivity glasses 6t /15/4+4 (U=1.6 w/m ² k).
	3. Eliminar el sobrecalentamiento de las oficinas en las fachadas con mayor soleamiento mediante vuelos./ 3. Installing cantilevers to protect offices' front walls from overeating due to sun exposure.
Estrategia pasiva 2:/ Passive strategy 2:	Luz natural./ Day light
	Medidas ambientales:/ Environmental measures:
	1. Optimización de la luz natural en zonas comunes./ 1. Day light optimization for common areas
Estrategia activa 1:/ Active strategy 1:	Instalaciones eficientes 1. Climatización (oficinas). Reducción del consumo de gas y reducción de emisiones a la atmosfera./ Efficient installations. 1. Air conditioning (Offices). Reduction of gas consumption and reduction of gas emissions into the atmosphere.
	Medidas ambientales:/ Environmental measures:
	1. Climatizadoras de alto rendimiento y bajos niveles de emisiones de NOx./ 1. High performance air conditioning equipment for low NOx emissions levels
	2. Instalación de un sistema de geotermia para la climatización de las oficinas y locales anejos./ 2. Installation of a geothermal system for air conditioning in offices and attached premises.
	3. Contadores individuales monitorizados de agua caliente sanitaria (ACS) y calefacción./ 3. Separate control devices for solar water heating (SWH) and air conditioning.
	4. Optimización de la difusión de aire en el pabellón, con una reducción del consumo energético del sistema de climatización en un 75%, en el 82% del tiempo que se usa el pabellón (periodos de entrenamiento)./ 4. Optimization of air flow inside the multi-purpose arena by reducing the energetic consumption of air conditioning system down to 75%, and 82% for the time the arena is occupied (training periods).
Estrategia activa 2:/ Active strategy 2:	Instalaciones eficientes 2. Ascensores./ Efficient installations 2. Elevators
	Medidas ambientales:/ Environmental measures:
	1. Modo stand-by de ahorro energético cuando el ascensor no está en funcionamiento./ 1. Stand-by mode for energetic saving when the elevator is not operating.
	2. Regulador de velocidad para la mejora del rendimiento del motor, ajustando su funcionamiento al par y la velocidad que se requiera en cada momento./ 2. Speed regulator to improve engine performance by adjusting operation in pairs and adapting speed at any required moment.
	3. Sistema regenerativo que aprovecha la energía generada durante las deceleraciones del ascensor para devolver energía a la red eléctrica./ 3. Regenerative system taking advantage of energy produced during elevator decelerations to feed energy back to the power supply.
	4. Sistema de iluminación eficiente (LED)./ 4. Efficient lighting system (LED).
Estrategia activa 3:/ Active strategy 3:	Compensación de los consumos y emisiones del edificio con la generación de energía renovable in situ/ Compensation of building consumption and emissions with in situ renewable energy.
	1. Producción de energía eléctrica en la cubierta del pabellón con paneles fotovoltaicos: 425.000kWh.año. Se evita la emisión de 170tn de CO ₂ al año./ 1. Generation of electric energy on the arena roof by using photovoltaic panels: 425,000kWh/year. CO ₂ emission of 170 ton is avoided per year.
	2. Producción de energía eléctrica en la cubierta mediante generadores eólicos: 45.000kWh.año./ 2. Generation of electric energy on the arena roof by using wind turbines: 45,000kWh/year.
OBJETIVO:/ OBJECTIVE:	REDUCCION DEL CONSUMO DE AGUA/ REDUCTION OF WATER CONSUMPTION
Estrategia:/ Strategy:	Ahorro en el consumo del agua potable en un 60%. / 60% saving of drinking water consumption
	Medidas ambientales:/ Environmental measures:
	1. Minimizar el consumo de agua potable en instalaciones sanitarias mediante la instalación de aparatos sanitarios de bajo consumo de agua: – Los inodoros de doble descarga no podrán superar 4,5l/3l. de consumo y los inodoros de simple descarga no podrán superar los 4,5l. – Todos los urinarios del edificio tendrán como máximo un caudal efectivo de descarga de 1,2l./ 1. Minimizing the consumption of drinking water used by plumbing equipment by means of the installation of flushing toilets with low water consumption. – Double flushing toilets cannot exceed 4.5l/3l consumption. Single flushing toilets cannot exceed 4.5l consumption. – All urinary devices in the building will have a maximum effective flushing flow of 1.2l.
	2. Todos los grifos llevarán una etiqueta indicativa con explicación del correcto funcionamiento del mismo para el ahorro del agua./ 2. All taps will hold an explanatory label with correct use instructions for water saving.
	3. Instalación de 12 depósitos de recogida de agua de lluvia (un depósito por torre), para el aprovechamiento de esta agua para la descarga de urinarios e inodoros./ 3. Installation of 12 rainfall water tanks (one tank per tower), so as to take advantage of this water for toilets and urinary devices flushing systems.

The improvement measures implemented into each environmental aspect, considered by this project, contributed to improve the environmental behavior of this building. The implemented measures were mainly oriented to reduce environmental impacts on the two most critical aspects of the operation stage: energy consumption and emissions of CO₂ into the atmosphere. Such measures, among other environmental measures, have reduced the energy consumption in 40%, and CO₂ emissions in 44.6% in comparison to the reference building, as per the Building Technical Code (CTE) (Spain, 2006). Such Code establishes the requirements to be fulfilled by buildings in Spain, in order to guarantee inhabitants safety, society welfare, building sustainability and environmental protection.

The new Fernando Buesa Arena is the result of applying knowledge and experience achieved by LKS in improving buildings environmental behavior. It was possible due to the permanent training provided to the technical staff on subjects such as bio-climatic architecture and eco-design management system, since 2009, which is the year LKS achieved the eco-design certification according to the standard UNE150301.

The most important benefit of LKS certification is that “the company was launched towards the direction they wanted to go”, i.e., it is an endeavor and support to continue developing and improving a business model, which is sustainable in the long term. On the other hand, the implementation of eco-design into the processes map of the management system and into the project design diagram has meant a lower effort when fulfilling the environmental standards demanded by public tenders and, it has also helped to improve the buildings management level in design and development stages. Furthermore, this standard served as a basis for achieving LEED (Katz, 2012) and BREEAM (BRE, 2013), certificates on building sustainability assessment.

However, the implementation of these kinds of constructive solutions into the project stage slightly increases buildings expenses, mainly due to the application of active measures of energetic saving and renewable energies. In most cases the cost of applying passive measures is higher, as materials and constructive systems are more expensive than the traditional ones. Nevertheless, the estimated economic savings in the stage of building operation and maintenance, considering a life cycle of 100 years for a residential building (Spain, 2011), justifies the adoption of such measures. In spite of the fact that the benefits are proven, the public organizations are diffident in regards to these matters. Since the standard was created, public organizations have not been clearly determined to implement the eco-design as a tool for buildings sustainable development. Such situation and the fact that the eco-design standard was not elaborated for certification purposes, lead LKS to consider that the standard ISO14006 had an uncertain future. Anyway, LKS has the information regarding the Integrated Management System, especially elaborated for tenders demanding for it.

In spite of such inconveniences, LKS executives are satisfied with the implementation and certification of eco-design standard. In their opinion, this standard is more rewarding than others, as results are clearly seen, not only in profitability terms for the organization itself, but also in environmental terms, which offers workers satisfaction as they understand their work provides benefits for the environment and for the society.

5. Discussion and conclusions

Nowadays, we are facing a deep economic crisis that we have not been able to overcome yet; therefore, the architecture firms are developing their activities within an especially afflicted sector. They struggle to find differentiator elements for achieving results that would allow them to survive in this market (Arana et al., 2012).

Consequently, from the nine analyzed cases and 21 interviews held with seven entities involved in the broadcasting process for this standard, we have observed that companies' main objective is to find differentiator elements providing comparative advantages when tendering their projects. Similarly, they need a tool allowing them to improve their creative process and integrate aspects not only related to the environment, but also related to the improvement of the quality of their solutions, such as reduction of energy and water consumption in the operation stage. Regarding environmental aspects, they consider that the possibilities of reducing environmental impact during the project elaboration stage are quite high and, therefore, most architecture firms think this standard may become a valid tool for such purposes.

As far as this process implementation is concerned, companies that have adopted the standard ISO14001 consider that, in comparative terms, the implementation of ISO14006 has demanded a larger effort, although they have achieved significantly better results, since direct environmental impacts produced by an architecture firm is not comparable to the impacts produced by the projects they design. Furthermore, they state that in spite of not convincing clients to accept all their proposals, they have managed to achieve significant environmental impacts reductions, mainly because they have reduced energy consumption in all stages of a project life cycle.

However, in all study cases, they state that one of the major problems they have faced is related to obtain the client approval to implement measures to reduce environmental aspects. Clients assume that such measures would increase costs, so they usually reject them; even though in many cases they represent a cost reduction, mainly during the operation stage.

In order to avoid such situations, the public organizations play a fundamental role at the time of establishing mandatory regulations and recognizing the value of environmental aspects in public tenders. However, public organizations are not acting as driving agents, as demanded by diverse sectors of the society. Especially in times of economic crisis, as the current one, they are taking too long in implementing actions regarding environmental regulations.

For the construction sector, such delay complicates the implementation of valuable efforts made to improve quality and the environmental behavior of buildings during their whole life cycle, thus decreasing the competitiveness level of the most engaged companies in environmental concerns. On the other hand, the costs derived from the operation stage, in poor sustainable buildings, directly affect the final user.

In spite of above, it is observed that the studied architecture firms are satisfied with the implementation of the eco-design standard. In general, they declare that it has contributed in improving their corporate image and status in tenders. In the same way, they indicate that the progressive improvement process allows cost reduction mainly in the operation stage, by means of the optimization of water and energy consumption. Due to above reasons, there is a unanimous consensus among architecture firms when stating that the implementation of the eco-design standard has improve their competitiveness level. Although some firms expected better results in comparison to the effort they had made.

Anyway, since standard ISO14006 is in its first diffusion stages and the research has been developed in a restricted geographical zone, such as Spain; it is advisable to be careful when extrapolating results into other countries. Being careful is also suggested when indicating if some improvements will be steady in the course of time, because as far as the external improvements achieved by the implementation of a management standard are concerned, they tend to decrease as long as the growth phase of the standard diffusion progresse (Llach et al., 2011).

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