

# Design in the natural stone transformation sector: evaluating a new concept

## El diseño en el sector de la transformación de las piedras naturales: evaluación de un nuevo concepto

S. Paixão-Barradas<sup>1</sup>, B. Hernandis<sup>2</sup>, B. Agudo<sup>3</sup>, I. Dickie<sup>4</sup>, K. M. Maciel<sup>5</sup>

### ABSTRACT

The European natural stone sector is declining; sales and imports are decreasing, owing to growing competition from Asiatic countries concerning the diversity of low-cost materials and European cultural and historical traditions demanding a commitment to invest in the best equipment and technology available. Design plays an important role in a company regarding the development, innovation and creation of competitive products. The present research involved a questionnaire being given to Portuguese and Spanish companies working in the natural stone sector to ascertain the companies' characteristics, identifying those working with internal departments specialising in innovation for developing new products and studying the feasibility of working with a new concept by studying the relationship between these companies and the importance they attach to the sensation of well-being which a natural stone product offers. The results showed that companies recognised most feelings presented here as being 'important', mainly those referring to social factors. It could be concluded that a company working with an internal design department for product development appreciates such concepts and adds more value to them.

**Keywords:** conceptual design, innovation, natural stone, a sensation of well-being.

### RESUMEN

El sector de la piedra natural en Europa vive un mal momento; por un lado, las ventas y las importaciones disminuyen debido a la elevada competitividad de los países asiáticos, que utilizan diversidad de material a bajos precios; por otra parte, su tradición cultural e histórica les induce a trabajar con el compromiso de invertir en los mejores equipos y tecnologías disponibles. El diseño desempeña un papel importante en las funciones de una empresa, dado que el objetivo es el desarrollo de productos, lo cual implica la creación de conceptos innovadores y competitivos. En el presente estudio y mediante la aplicación de un cuestionario se investiga la respuesta de empresas portuguesas y españolas del sector de la piedra natural, con la pretensión de conocer, desde la perspectiva del diseño, las características de las empresas, e identificar las que trabajan con departamentos internos especializados en la innovación para el desarrollo de nuevos productos, así como analizar la viabilidad del trabajo con nuevas orientaciones, analizando la relación que existe entre las empresas y la importancia que atribuyen a las sensaciones que nos aporta un producto en piedra natural (concepto de bienestar). Los resultados muestran que las empresas reconocen como "Importante" la mayoría de las sensaciones de bienestar analizadas. Podemos concluir que son las empresas que trabajan internamente con el diseño en el desarrollo de productos, las que mejor valoran y aprecian estos conceptos.

**Palabras clave:** Diseño Conceptual, Innovación, Piedra Natural, Sensación de Bienestar.

**Received: October 14th 2011**

**Accepted: November 30th 2012**

### Introduction

The European natural stone sector faces a critical moment; sales and imports keep decreasing, due to Asian countries' great competitiveness, the use of diverse materials and low prices (Pocar,

2010) and Europe's cultural and historical tradition involves a commitment to invest in the best equipment and technology available (Paixão-Barradas, 2008; Paixão-Barradas, Pacheco & Hernandis, 2012).

Stone, as a raw material extracted from nature, can be considered as being a material having intrinsic properties providing interesting interactions to be regarded when designing products. A natural stone product in direct contact with humans communicates through colour, texture and brightness and also through its vibration and temperature, conveying a sense of connection with the Earth, causing a feeling of protection, comfort and relaxation which may represent a bodily, mental and spiritual experience (Nelson and Scrivner, 2009).

It is imperative to emphasise innovation in a highly competitive business environment, since this makes a difference and, there-

<sup>1</sup> Susana Paixão-Barradas. Affiliation: Universitat Politècnica de València. PhD in Design. Industrial Designer. E-mail: [supaibe@upvnet.upv.es](mailto:supaibe@upvnet.upv.es)

<sup>2</sup> Bernabé Hernandis Ortuño. Affiliation: Universitat Politècnica de València. PhD in Industrial Engineering. E-mail: [bernand@dig.upv.es](mailto:bernand@dig.upv.es)

<sup>3</sup> Begoña Agudo Vicente. Affiliation: Universitat Politècnica de València. BSc Technical and Market Research. E-mail: [beago.agudo.vicente@gmail.com](mailto:beago.agudo.vicente@gmail.com)

<sup>4</sup> Isadora Dickie. Affiliation: Universidade da Região de Joinville, Brasil. MSc Design. E-mail: [isadora.dickie@gmail.com](mailto:isadora.dickie@gmail.com)

<sup>5</sup> Karla Mazarelo Maciel Pacheco. Affiliation: Universidade Federal do Amazonas. PhD in Design. E-mail: [karlamazarelo@hotmail.com](mailto:karlamazarelo@hotmail.com)

**How to cite:** S. Paixão-Barradas, B. Hernandis, B. Agudo, I. Dickie, K. M. Maciel (2012). Design in the natural stone transformation sector: evaluating a new concept. Ingeniería e Investigación. Vol. 32, No. 3. December 2012, pp. 83-88.

fore, achieves the key for a company to generate added value and start to excel in competition (Porter, 1985). Design plays a key role within a company in the search for innovative ideas for developing new competitive products in the market (Petre, 2004).

Firms use commercial expos to uncover, represent, promote and offer their products to foreign markets as a tool for communicating and distributing their products, confronting competitors and providing a platform for showing such products to the public in general. Trade exhibitions represent a meeting point for achieving business objectives: communication, promotion, sale, building up relationships, sharing information, research, promoting customer loyalty, positioning, distribution, training, testing the market and the product. Having a stand at such events brings representative companies together (Jiménez & González, 2008).

The CEVISAMA fair is an international expo for architectural ceramics, bathroom and kitchen equipment, natural stone, raw materials, frits and glazes which is held annually in Valencia, Spain, aimed at the international professional public. It provides industrial products focused on R&D+I, orientated towards architecture and design (Infurma, 2011). PEDRA is a national fair dealing with block extraction, finished product, machines, equipment, accessories and tools which takes place in Batalha (Portugal). It is held biennially, being mainly concerned with domestic products and is addressed to the entire sector.

The following objectives were drawn from a questionnaire answered by the companies which participated in these fairs:

- Identifying companies;
- Checking a company's position compared to some design variables;
- Identifying a company profile with R&D+I;
- Ascertaining the importance attached by companies to different sensations provided by the material; and
- Identifying the business relationship between R&D+I and the various sensations.

### Natural stone sector

An analysis of the natural stone market around the world led to identifying four major producers (i.e. production exceeding 10 million tons annually): China, India, Iran and Italy (AIDICO, 2008); large consumption markets have also been identified in which eight countries have over 1,75-million-ton consumption: China, India and the USA (CEVALOR, 2004).

Production, consumption and export expectations have indicated a trend towards global market growth, projecting an increase of about five times current global consumption by 2025, as well as international transactions of 2.1 thousand billion square metres per year (Abirochas, 2011).

Innovation is an important aspect of economic development, meaning that innovation and technological development capability should be evaluated (Torres, Castellanos & Salgados, 2007) to create new products and improve existing ones.

Resolving problems concerning engineering design begins with needs analysis in which a series of specifications is obtained (García, 1984) which are determined by a particular company, the industry, the consumer and so on.

### Product engineering

Since the very moment when various authors associated product engineering with the industrial revolution (Dorfles, 1991; Kunz,

2002; Mozota, 2003; Moraes, 2006a; Cardoso, 2008), design has been aimed at developing projects for serial device production or the means of solving problems (Davis, 2008). In agreement with Cardoso (2008), apart from industrialisation, design results from modern urbanisation and globalisation. These three occurring between the nineteenth and twentieth centuries are associated with the growth of design as a project activity because it emerges from the challenge of arranging a large number of disparate elements (people, vehicles, machines, houses, etc.) into harmonious and dynamic relationships.

As Lobach (2001) has put it, configuring industrial products has important functions for different groups of interests: from a user's point of view, design can be understood as a process adapting products to suit people's needs (physical or mental) whereas industrial design for companies is used adaptively to suit a company's interests and objectives (Sánchez & Cortés, 2005). The authors believe that incorporating industrial design forms part of strategic programmes based on diversification and differentiation. If diversification is tipped toward broadening the kind of products, differentiation seeks different versions of existing products. In the latter case, product development should be guided by supplying and competing for user's needs.

Understanding that design mediates connections between people and the activities they undertake for influencing or interacting within environments also reveals it as being a transforming agent in technological, social and human fields (Moraes, 2006b). Such transformation may be related to innovation, one of the main factors in product differentiation. Conceptual design leads to designing innovative products whose main feature is semantic load. Its main objective is to create stimuli, arouse emotions, generate evocations, send messages and cause reflection (Norman, 2004). A product needs a meaning in the contemporary, saturated, semantically-permeable market (Celaschi, 2005).

### The concept of well-being

Natural stone work will justify a different product, a market focused on specific products orientated towards the user's needs and desires regarding the circumstances that the natural stone sector is currently undergoing and knowing the characteristics of the material, which is unique in every country and place.

Some research, started in the 1980s, related and evaluated internal patients' welfare with creating and designing spaces in residential and hospital treatment. It was shown that when these spaces were attached to nature through images, materials, textures, sounds, lights, ornaments, etc., calm appeared in a patient's condition, leading to decreased blood pressure and reduced medication load (Ulrich, 1991; Devlin & Arneill, 2003; Malkin, 1991; Verderber, 1982).

Moreover, current consumer-related market trends analysed by research centres (within the habitat area) have reflected consumer need to establish contact and closeness with nature (Gober, Rodríguez, Casado, Jover, Gálvez, Navarro, Sales & Revert 2010).

### Experimental development

Quantitative study is based on logical probabilistic induction, intended to be systematic and generalised in obtaining data. The survey was used for obtaining information through a questionnaire having closed-ended questions, single and multiple choice questions and scale-type questions (I meant 'not important', up to 4, 'very important') in a given sequence.

The survey was carried out in two phases: the first personally with representatives of a company taking part in CEVISAMA in Valencia from the 8<sup>th</sup> to the 11<sup>th</sup> of February whilst the second, addressed to companies which had participated in the PEDRA fair held in Batalha, Portugal, from the 14<sup>th</sup> to the 17<sup>th</sup> of April, 2011, was sent by e-mail and answered online from June to August.

Twenty-five natural stone companies participated in CEVISAMA; sixteen engaged in stone transformation were interviewed. Sixty-six companies participated in the Portuguese fair PEDRA, twenty-four being dedicated to the transformation of material and fifteen of seventeen companies contacted by mail answered the online questionnaire.

There were thirty-one valid cases, representing a higher percentage than the 77% considered for our purpose. Chart 1 gives the firms' characteristics.

The sample mainly consisted of Portuguese (54%) and Spanish companies (44%). Most were small companies (45%), having been in the market for more than 20 years (53%). Most companies were not certified (58%) even though many companies were in contact with external centres to obtain technical support and information about the sector, some with technological centres (32%), others with associations (36%).

Most companies (52%) worked with other departments for investigating, creating and developing new products; just 10% had an internal department specialising in R&D+i.

## Results

SPSS 15 software was used for analysing and studying the results, using frequency analysis, average reckoning, contingency tables (frequencies and percentages) and ANOVA for average comparison.

### Characterising company-product variables:

Chart 2 shows how companies were structured in terms of activity, type of material used, type of product manufactured and the pertinent tools.

Many companies were involved in the whole production cycle: extracting (45.2%) and developing semi-finished products (51.6%) and sales involving wholesale distribution (58.1%) and retail (41.9%).

All companies worked on developing the final product, especially marble (67.7%), although many also worked with limestone (61.3%) to produce flooring (83.9%) using diamond or abrasive wire discs (80%) as tools of choice.

The companies were presented with a list of variables concerning different design aspects regarding the option 'Mainly'. Chart 3 highlights some variables such as 'communication', 'differentiation' and 'finishing'.

The companies mainly exhibited their own products through 'catalogues' (67.7%); a few companies used currently available virtual tools as a primary means of communication. These com-

Chart 1. Sample classification (single-answer questions)

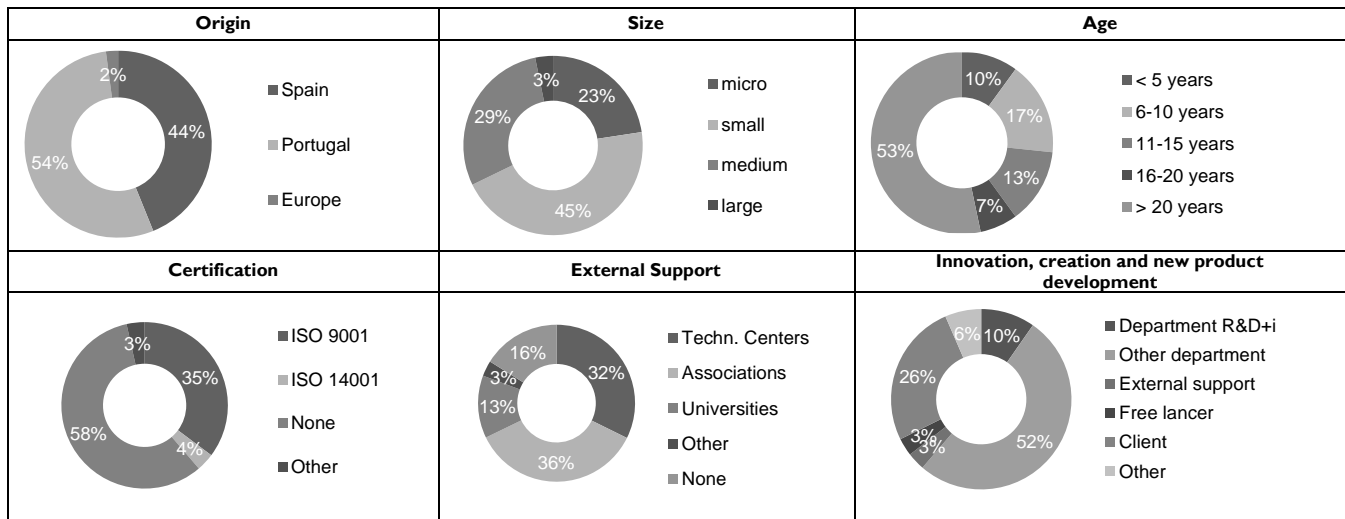


Chart 2. Characterisation of companies (multiple choice questions)

Activity	Type of material	Type of product	Tools
Extraction 45,2%	Granite 35,5%	Ext Cladding 80,6%	Disc/Wire 80%
Semi-finished 51,6%	Basalt 25,8%	Int Cladding 80,6%	Stones for polishing 43,3%
Elaborated 100%	Sandstone 25,8%	Flooring 83,9%	CNC 63,3%
Wholesalers 58,1%	Limestone 61,3%	Structure 67,7%	Hand tools 60%
Small retailers 41,9%	Travertine 35,5%	Urban Furniture 35,5%	Other 23,3%
	Marble 67,7%	Funerary Art 22,6%	
	Slate 25,8%	Crafts 19,4%	
	Others 19,4%		

Chart 3. Variables (single-answer questions)

Communication		Differentiation		Price		Finishing		Other material	
Catalogues	67.7%	Type of stone	67.7%	Very low cost	3.2%	Polished	67.7%	Glass	22.6%
E-commerce	3.2%	Finishing	9.7%	Low cost	29%	Semi-matt	3.2%	Wood	22.6%
Own Showroom	3.2%	Service	6.5%	Average cost	35.5%	Matt	25.8%	Ceramic	3.2%
Other Showroom	3.2%	Design	16.1%	Expensive	19.4%	Aged	3.2%	Metal	6.5%
National Fairs	16.1%			Luxurious	6.5%			Plastic	3.2%
European Fairs	3.2%			Highly Luxurious	3.2%			None	38.7%
Others	3.2%								
Total	100%	Total	100%	Total	97%	Total	100%	Total	97%

Chart 4: Profile of the companies having an R&D+I department

Type of company		Innovation, creation and new product development						Total
		R&D+I department	Another department	External support	Freelance	Client	Other	
Origin	Spain	100%	56.3%	100%	0%	0%	0%	41.9%
	Portugal	0%	31.3%	0%	100%	100%	100%	51.6%
	Europe	0%	12.5%	0%	0%	0%	0%	6.5%
Product	Ext cladding	33.3%	68.8%	0%	100%	750%	50%	64.5%
	Int cladding	66.7%	12.5%	0%	0%	12.5%	50%	19.4%
	Flooring	0%	12.5%	0%	0%	12.5%	0%	9.7%
	Structure	0%	6.3%	100%	0%	0%	0%	6.5%
Differentiation	Type of stone	0%	100%	100%	100%	100%	100%	100%
	Finishing	0%	12.5%	0%	0%	0%	50%	9.7%
	Service	0%	6.3%	0%	0%	12.5%	0%	6.5%
	Design	100%	0%	100%	0%	0%	50%	16.1%
Total		100%	100%	100%	100%	100%	100%	100%

panies' products were different on the market, mainly concerning the 'type and quality of material' (67.7%), a much lower percentage than that companies differing through 'design' (16.1%). The companies worked for clients mainly requiring 'low cost' (29%) or 'average cost' (35.5%) products and preferred 'polished' (67.7%) as finishing.

Most companies were not very receptive concerning adding some other material to natural stone as a supplementary material in a single product (38% of the sample would not add any material). Companies opting for additional material chose glass or wood (22.6%), excluding cork as the first choice.

**Companies having an R&D+I department**

Companies having a specific department for researching, creating and developing new products were in the minority (representing 10% of the sample). These companies had a well-defined profile (Chart 4); variables making a greater difference to the results were selected, the rest being rejected as less significant results.

Companies having an internal R&D+I department were Spanish and were mainly engaged in developing 'interior cladding'.

Companies having an internal R&D+I department, as well as companies having external support for creating and developing new products, mainly differed through 'design' (100%), while this was true for other companies through 'type and quality of stone'.

**Evaluating a new concept: a sense of well-being**

These companies' opinion was then analysed in terms of a new concept of willingness in the sector (a sense of well-being) for

innovation, creation and development of new products. Evaluating responses 1 to 4 (where 1 represented 'not important' and 4 'very important') Chart 5 shows that the material contributed positively to the product in almost all the feelings presented.

Chart 5: Evaluating the concept of a sense of well-being

Well-being	Total Media
Improves concentration	3,00
Reduces stress	3,03
Improves the state of mind	3,13
Gives tranquility	3,13
Increases pleasure	3,23
Helps to feel good	3,29
Helps feeling socially integrated	2,97
Helps feeling more in contact with nature	3,16
Makes you feel close to nature	3,10

Most concepts evaluated as being 'important' (meaning  $\geq 3$ ) started with psychological concepts, such as 'helping to feel good' and 'increases pleasure', and ended with physical concepts such as 'improves concentration', and social concepts such as 'helps to feel socially integrated'.

**Preferences of companies having an internal R&D+I department**

The last research phase contrasted the views of the different

Chart 6: Relationship between well-being sensations and type of companies

Well-being	Innovation, creation and new product development						Total	ANOVA	
	R&D+I department	Another department	External support	Freelance	Client	Other		F	Sig.
	Media	Media	Media	Media	Media	Media			
Improves concentration	3.33	3.06	2.00	2.00	3.00	3.00	3.00	1.575	0.203
Reduces stress	3.33	3.13	2.00	2.00	3.00	3.00	3.03	1.988	0.115
Improves the state of mind	4.00	3.13	2.00	2.00	3.13	3.00	3.13	3.667	0.13
Gives tranquillity	3.33	3.31	2.00	2.00	3.00	3.00	3.13	2.768	0.40
Increases pleasure	4.00	3.25	2.00	3.00	3.00	3.50	3.23	3.563	0.14
Helps in feeling good	4.00	3.31	3.00	3.00	3.00	3.50	3.29	3.111	0.26
Helps in feeling socially integrated	4.00	3.00	3.00	3.00	2.50	3.00	2.97	3.105	0.26
Helps in feeling more in contact with nature	3.33	3.38	3.00	1.00	3.00	3.00	3.16	3.432	0.17
Makes you feel close to nature	3.67	3.38	3.00	1.00	2.63	3.00	3.10	5.076	0.02

types of companies concerning the concepts being studied. ANOVA (considering normal behaviour and 0.1 significance level) showed that many concepts had a different average, depending on the type of company, showed in Chart 6.

Companies having an internal R&D+I department for the innovation, creation and development of new products valued all the well-being concepts best; however, the concept ‘helps in feeling more in contact with nature’ was highly valued by companies lacking specific product development departments.

## Conclusions

This study used the opinion of significant representation by Portuguese and Spanish natural stone processing companies, intended to demonstrate interest in using industrial design in the stone sector and emphasise innovation in using new product design as input for new value focused on consumer welfare.

Most companies had over 20 years’ activity in this sector and also engaged in almost all activities having to do with stone transformation, maintaining a relationship with the material, their business being rooted in their cultural and family tradition. Maybe that is why most of them did not have a department specialising in innovation, creation and developing new products as the directors, general managers and/or commercial assistants were directly in charge of such activity. They thus continued to position themselves in the market through difference regarding stone type and quality.

These companies knew the material well, appreciated and valued it, believing in material contributions to human health and well-being. The companies hiring freelancers or external consultants worked with the least valued concepts analysed here (feelings of wellbeing).

The companies having an internal R&D+I department understood the importance of design because all differentiated their products by designing them and emphasising the best value of their material contributing towards human wellbeing.

Such research contribution was clearly admitted as being interesting for the whole sector and should encourage future research to improve strategies and processes, incorporating design

as a fundamental tool enabling innovation for the pursuit of new products aimed at the welfare of humankind.

## References

- Abirochas (). Associação Brasileira da Indústria de Rochas Ornamentais. Rochas Ornamentais no Século XXI. Retrieved from://www.abirochas.com.br/livro\_01.php. 24 de agosto, 2011.
- AIDICO - Instituto Tecnológico de la Construcción (2008). Informe sectorial de la Piedra Natural 2007. Ámbito Nacional. Observatorio del Mercado de la Piedra Natural.
- Cardoso, R., Uma introdução a história do design. São Paulo: Blucher. 2008
- Celaschi, F., Nuovi confini etici del lusso: l'eumerce, Etica del bello e del ben fatto; Per una nuova tecnologia del valore. In: CELASCHI, Flaviano; CAPPELLIERI Alba; VASILE Alessandra. Lusso versus design. Italian design, beni culturali e luxury system: alto di gamma & cultura di progetto. Milano: Franco Angeli, 2005.
- CEVALOR – Centro Tecnológico para o Aproveitamento e Valorização das Rochas Ornamentais e Industriais, Estudo de mercado de exportação da Pedra Natural Portuguesa para a Alemanha e principais países do alargamento. Análise e diagnóstico 1, 2004.
- Davis, M. (). Why do we need doctoral study in design? International Journal of Design, Vol. 2, No. 3, 2008, pp. 71-79.
- Devlin, A. S. & Arneill, A. B., Health care environments and patient outcomes. Environment and behavior, Vol. 35, No. 5, 2003, pp. 665-694.
- Dorfles, G., O design industrial. Lisboa: Editorial Presença, 1991.
- García, G., Un proceso general de diseño en Ingeniería Mecánica. Revista Ingeniería e Investigación, Vol. 3, No.1, 1984, pp. 1-9.
- Gobert, D., Rodríguez, S.M., Casado, P., Jover, C., Gálvez, R., Navarro, J., Sales, V. & Revert, C., Cuaderno de tendencias del Hábitat 2010/2011. Valencia. 2010
- Infurma, Cevisama logra la confirmación de 441 empresas compradoras. Valencia: Infurma. Disponible en: <http://www.infurma.es/es/novedades/noticia/24387.es.html>. 2011
- Jiménez G., J. F. & González-Adalid, M. P., Ferias Comerciales. Información Comercial Española, Enero-Febrero (840). 2008.
- Löbach, B., Design Industrial: bases para a configuração dos produtos industriais. São Paulo: Blucher, 2001.
- Kunz, G., Design: a evolução técnica. Vitória: EDUFES. 2002
- Malkin, J., Creating excellence in healthcare design. Journal of health Care Interior Design, Vol. 3, 1991, pp. 27-43.

- Moraes, D., *Análise do design brasileiro: entre mimese e mestiçagem*. São Paulo: Edgard Blücher. 2006a
- Moraes, D., *Macroprojeto: o design do design*. Anais do 7º Congresso Brasileiro de Pesquisa e Desenvolvimento em Design, Curitiba, 2006b, pp. 1-10.
- Mozota, B. B., *Design Management: using design to build brand value and corporate innovation*. New York: Allworth Press. 2003.
- Nelson, M. & Scriver, J., *The official LaStoneTherapy Manual*. Great Britain: Piatkus. 2009.
- Norman, D., *Emotional Design: Why We Love (or Hate) Everyday Things*. New York: Basic Books. 2004, pp. 83
- Paixão-Barradas, S., *PICNIC: A Paisagem e a Pedra*. Lisboa: Edições Colibri. 2008.
- Paixão-Barradas, S.; Pacheco, K.M.M. & Hernandis, B., *La piedra natural como un material de diseño para el desarrollo de equipamiento urbano: reporte de un caso*. ICONOFACTO, Vol. 8 No.11, 2012, pp. 77-95
- Petre, M., *How expert engineering teams use disciplines of innovation*. Design Studies, Vol. 25, 2004, pp. 477-493.
- Pocar, R.G., *Perspectivas para la piedra natural de España en 2010: Identificando nuevas vías de crecimiento*. Global Stone Congress 2010, 2010.
- Porter, Michael E., *Competitive advantage. Creating and sustaining superior performance*. New York: The free press. 1985.
- Sánchez, C.M. & Cortés, C.J., *Conceptos de diseño para manufactura (DFM) de piezas microfundidas*. Revista Ingeniería e Investigación, Vol. 25 No. 3, 2005, pp. 49 – 60.
- Torres, L. M., Castellanos, O. F. & Salgado, C. A., *Evaluación de la innovación tecnológica de las MiPyME Colombianas. Parte 2: Problemática y retos de la innovación*. Revista Ingeniería e investigación, Vol. 27, No. 2, 2007, pp. 114-121.
- Ulrich, R. S., *Effects of interior design on wellness: Theory and recent research*. Journal of health Care Interior Design, Vol. 3, 1991, pp. 97-109.
- Verderber, S., *Designing for the therapeutic functions of windows in the hospital rehabilitation environment*. Proceedings of the 13th International Conference of the Environmental Design Research Association. College Park, MD, EDRA, 1982, pp. 476-492.