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A Proposal for a Technological Surveillance Unit Aimed at Regional Competitiveness

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Abstract: Knowing and monitoring the market environment and global technological trends can contribute to better decision making in competitive intelligence. This research proposes the design of a technological surveillance unit for the construction materials sector of the department of Sucre, Colombia, through the identification of technological gaps and reference models. The research was developed methodologically through the development of a theoretical framework for reviewing scientific literature, diagnosis and identification of technological gaps in the sector and subsectors through semi-structured interviews and direct observation, the design of the surveillance unit through the needs captured from the sector and a proposal of structure and governance for the actors involved in the process. An intentional sample of 21 companies from the different subsectors of the construction materials sector was taken, revealing as results technological gaps in each of them and absence of R&D&I processes in most organizations.

Key words: Technological surveillance, competitive intelligence, innovation, technology management, competitiveness, business intelligence

INTRODUCTION

Technology surveillance is one of the fundamental tools in managing innovation being involved with changes and market trends can be beneficial to any organization in making decisions (Kadir, 2017; Ovallos-Gazabon *et al*., 2016). In Colombia, there are few technological monitoring units but specifically in Sucre, Colombia, there is no evidence that any entity provides services of this type and there is a low trend with respect to innovative processes. The National Government has directed efforts to improve the competitive situation in its regions and one of the strategies proposed to improve the competitiveness of Sucre, Colombia was to carry out a continuous technological surveillance and to strengthen the processes of technological appropriation and technical profiles for a better use of the cut looking for strategic benefits for strategic sectors prioritized by its high development potential such as the construction materials sector (Anonymous, 2014).

In the construction materials sector in Sucre, Colombia, the emergence of new ventures dedicated to the manufacture and commercialization of construction materials has been evident. On the other hand, mining, traditional in the region has also experienced growth and changes. Some of the companies dedicated to this activity are moving from the simple extraction to the search for new applications or higher levels of transformation. In the same way, incipient dynamics of clustering have been generated evidencing about 20 mining associations. Although, construction services companies have grown, the focus of this sector is the manufacture of building materials for their dynamism, new ventures and investments in the region in recent years. The same case occurs in the building construction subsector although, it is a business that has presented strong growth in the region is a chain that competes locally and with a low critical mass of agents (Anonymous, 2014; ProColombia, 2014).

Theoretical foundation: This study presents a brief approach to the main issues addressed in this study. Highlighting the works related to technology surveillance and competitive intelligence. Technological surveillance can be understood as a recent phenomenon based on Information and Communication Technologies (ICT), so, it is convenient to approach the concept from different definitions. Table 1 presents some definitions that account for the evolution of the concept.

Competitive intelligence is a structured process by methods that allows organizations to transform information into knowledge for their survival and thrive in the globalized economy (Jourdan *et al*., 2008; Niazi, 2016). As a result of this process, knowledge of the environment in terms of competition, customers, suppliers, technologies, products and the market in general is obtained with a high degree of certainty to predict and/or anticipate changes as a contribution to the

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Table 1: Some definitions of technology surveillance

Researchers	Definition
Roach (1988)	Technological surveillance is the art of discovering, collecting, processing, storing relevant and weak information and signals that will guide the future and protect the present and the future of competitive attacks. It transmits knowledge from the outside to the inside of the company
Makridakis and Wheelwright	Technological surveillance consists of a set of techniques that systematically organize the accumulation, analysis, dissemination exploitation of technical information useful for the survival and growth of the company. Its mission is to alert those responsible for the company of any scientific or technical innovation likely to modify its environment
Francois *et al.*	Technological surveillance is the observation and analysis of the environment followed by the well-specified dissemination of the information selected and analyzed, useful for making strategic decisions
Jakobiak (1995)	Competitive environment observation and analysis, followed by a well-targeted dissemination of selected and processed information that are useful for making strategic decisions
Martinet and Marti	Technological surveillance allows the company to determine sectors where the greatest innovations will come both for the processes and for the products that have an impact on the company
Morcillo (1997)	It consists of analyzing the innovative behavior of direct and indirect competitors, exploring all sources of information (books, gray literature, patent offices, etc.), examining existing products in the market (analysis of embedded technology) and attending fairs, and take knowledge of the technologies that will predominate in the future
Palop and Vicente (1999)	Organized system of observation and analysis of competitive environment, treatment and internal circulation of the observed facts and later use in the company
Anonymous (2006)	Organized, selective and systematic process, to capture information from outside and from the organization itself on science and technology, select it, analyze it, disseminate it and communicate it, to turn it into knowledge in order to make decisions with less risk and to be able to anticipate the changes
Bailon-Moreno (2013)	Technological surveillance, from the perspective of knowledge engineering, brings together procedures and instruments that contribute to the investigation, treatment and distribution of scientific and technical information on issues that concern the specific concerns of decision makers and agents

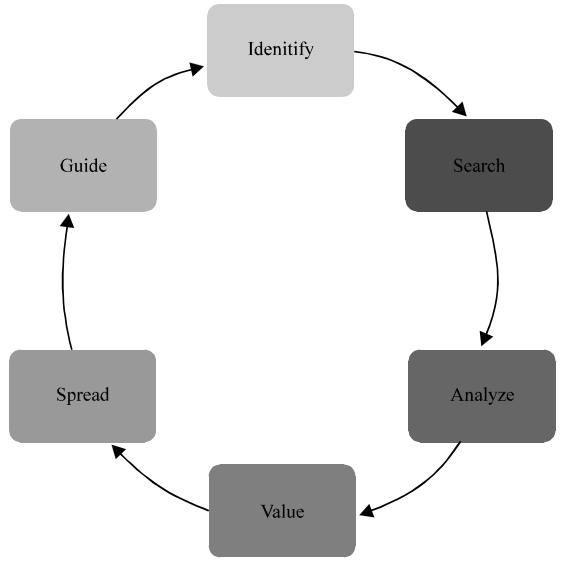

Fig. 1: Technology monitoring and competitive intelligence cycle

making decisions, a key factor in creating an innovative and competitive profile and to take advantage of intellectual property developed (Charris *et al*., 2017; Jourdan *et al*., 2008; Lis-Gutierrez *et al*., 2017; Gazabon and Amar, 2014; Builes, 2015).

At the moment of launching a system of technological surveillance and competitive intelligence, there is a general consensus on the steps to be followed by the technological surveillance process, called technology monitoring and competitive intelligence cycle (Fig. 1).

MATERIALS AND METHODS

Three phases were developed. It began with a detailed review of the literature corresponding to the topic of study in academic databases such as Scopus, Science Direct, Web of Knowledge, Redalyc, Scielo, Proquest and Google Scholar. The second phase detailed the processes, models and governance roles needed to form the technological surveillance unit. And finally a review of scientific publications was made to determine technological gaps in the constructions materials sector in Sucre, Colombia.

RESULTS AND DISCUSSION

The design of the unit was performed under the concept of interface structure according to Fernandez *et al*. (1996) and is constituted as a unit within a Higher Education Institution in Sucre, Colombia that has the experience and development in research processes, technological capabilities and inter-institutional relationships necessary to develop the processes of project monitoring and development of R+D+I (Fernandez *et al*., 1996) and considering the contemporary trends in office decision-making (Nijem, 2016). The design is shown in Fig. 2 and 3.

Roles of the actors involved in the surveillance unit are presented in Table 2. It should be noted that the analysis of institutional capacities in Sucre, Colombia showed that the surveillance unit should be created within a university, so that the Caribbean University Corporation (CECAR) was selected.

Table 2: Roles of the actors involved in the surveillance unit

Actore	Members	Funtions
Strategic	Direction of science, technology and innovation	Address of the unit, planning of activities and objectives, financing of the necessary resources and control and verification of processes
Missionary	Watch, assistant, thematic experts, intellectual property, research groups, technological development centers	Identification of needs, search and processing of information, valuation of information and legality of intellectual property
Support	State entities, guilds, entrepreneurship units	Provide support to the unit of financial, logistical, training, among others

Table 3: Current status and trends identified by subsector

Subsectors	Current status	Trends identified
Bricks, blocks and pavers	Outdated technology environmental pollution non-use of ICT	Advanced manufacturing techniques use of waste, reduction of gaseous emissions, new manufacturing methods, block discoloration ornamental blocks, thermal conductivity, life cycle assessment, embodied energy
Asphalts	No R&D investment environmental pollution,	Reduction of gaseous emissions and asphalt waste, Life cycle assessment
Concrete	Non-use of ICT, environmental pollution	Aggregates, new materials, geopolymers, strategic software, reduction and use of waste
Limestone	Methods of artisanal exploitation, raw material undervalued, little state support	New methods of exploitation, new products based on limestone, waste management
Ceramic, paints and adhesives	Environmental pollution non-use of ICT	Eco friendly processes, waste management, new innovative products, degradation, strategic software, nanocomposites nanostructures
Metals	Non-use of ICT	Heavy metals, strategic software, new metal transformation processes
Sale of building materials	Non-use of ICT	Strategic software

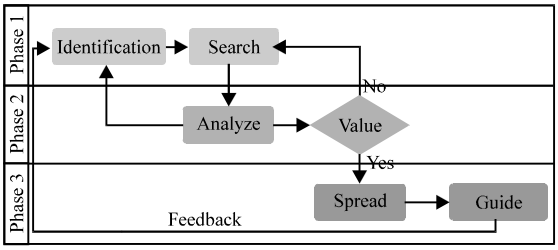

Fig. 2: Flow diagram of the technological surveillance unit

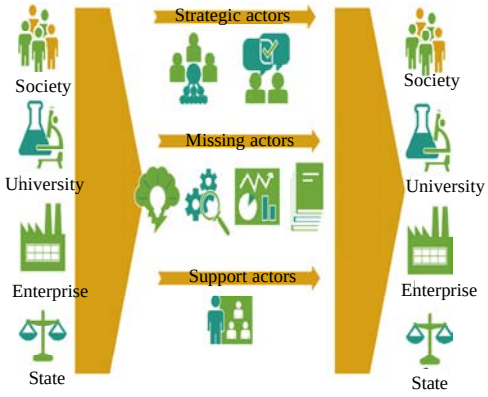

Fig. 3: Actors involved in the surveillance unit

Technological gaps identified in the sector: Interviews in each of the 21 selected companies, direct observation, data analysis and comparison with the current state of the technology (Fig. 4), allowed the quantification of the Technological breakthroughs in the construction materials sector in Sucre, Colombia and to define the needs or critical factors of surveillance for future exercises for the sector.

Figure 4 presents the behavior of scientific publications for the period 2010-2015 in building materials. The visualization in VOSviewer® was constructed using information from Scopus, ScienceDirect and Web of Science. Table 3 compares the current state of subsectors and identified trends.

With the consolidated information, a comparative analysis of the technological development was constructed in each one of the subsectors that compose the construction materials sector in Sucre, Colombia. For comparison it is considered that the state of the technique has a value of 10 and values are assigned to each subsector according to the state of development found (Fig. 5).

The low level of technological development in each of the subsectors analyzed is evidenced. Metals and limestone show the lowest level of development. In the case of metals, the subsector is composed principally by sellers although, there are few companies that are engaged in the primary transformation of metals and manufacture of metal structures among other transformation activities. Limestone subsector is composed by limestone extractors use artisanal techniques with great risk to the health and life of workers, however, large companies in this sector (2) use

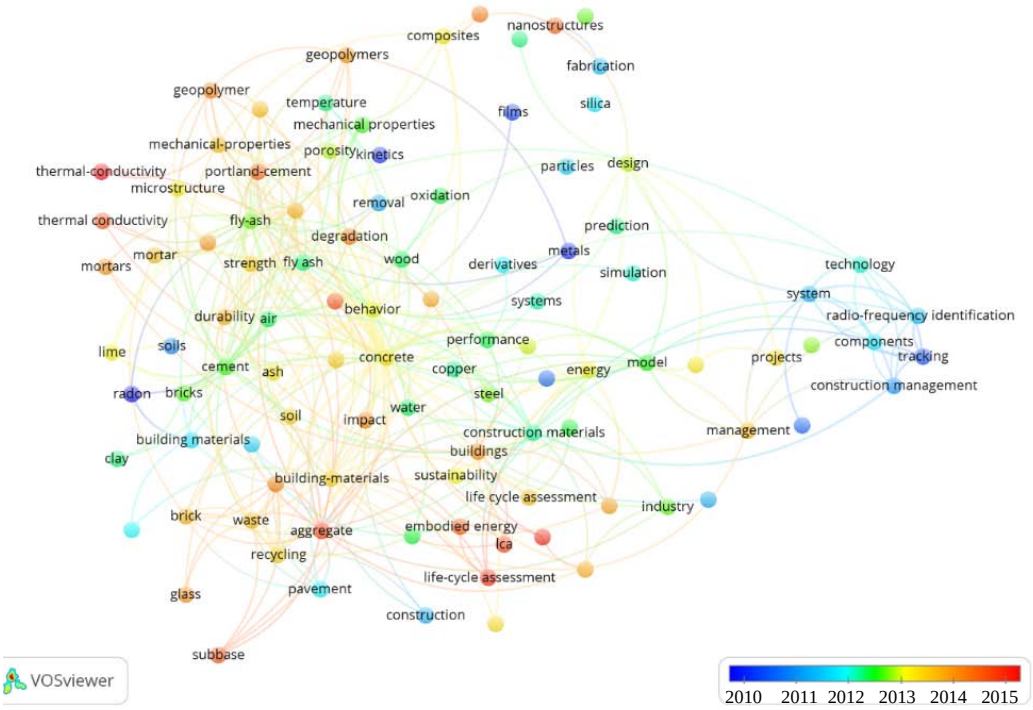

Fig. 4: Trends in research in construction materials

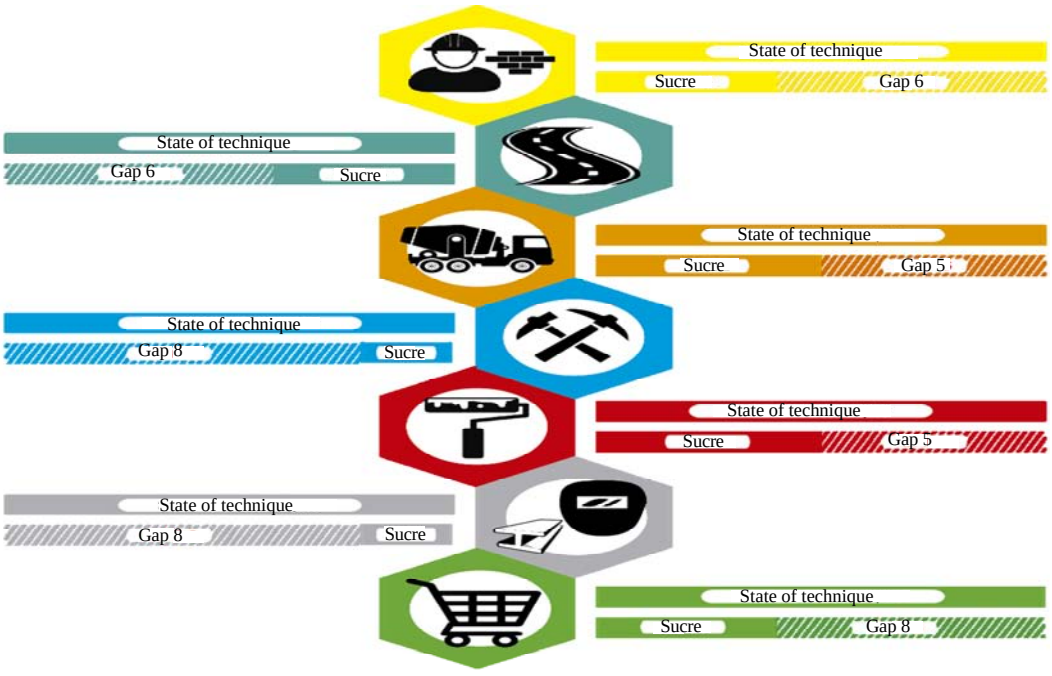

Fig. 5: State of technology in subsectors analysed

safer extraction techniques. Current trends show the advanced extraction using special machinery and new use to this raw material.

The subsector of bricks, blocks and pavers presents machinery with an average age of 10 years and its production level satisfies local and regional demand in

some cases, however, use not environmentally friendly processes. Current trends show products with higth added value ornamental type, decoloration, termal conduction or translude products. Concrete production sector is structured according to the current regulations, specifications are governed according to the needs of the customer, however, there is no investment in the development of new products. Sector trends show environmentally friendly production and new materials combination to reduce environmental pollution.

Asphalts production companies in Sucre, Colombia are standardized by the current regulations, however, their processes generate a high environmental pollution. Sector trends show combination with other materials that increase the strength and durability of the asphalt and reduce its contamination level, like polymers and new materials. Production of paints and ceramic adhesives is not far from the strongest competitors in the domestic market but distance with the international trends for the sector is significant. Sale of construction materials covers local and regional demand, there are companies in this sector with advanced logistics systems, competing even a national level with other companies.

CONCLUSION

The construction materials sector Sucre, Colombia is mainly composed of small and medium-sized companies of production and commercialization of raw materials and construction inputs in the local market, supplying domestic demand and even reaching regional markets.

Technological surveillance is an unknown issue for most members of the sector because there are no interface units that allow training and adaptation of the sector for innovation processes, so the unit design allows establishing a roadmap for creation of entities and processes that facilitate the university company state relationship in Sucre, Colombia as well as developing R&D&I activities and contributing to the developement of projects of this type.

Technological gaps found in the construction materials sector in Sucre, Colombia reveal the low production in research and development in the region and must will be the drivers of the joint effort between universities and companies to generate a higher level of competitiveness in the region.

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