Creative Technical Intelligence in Biomaterials: a technology mapping proposal.

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ABSTRACT :
Technical Intelligence (TI) is a systematic process of monitoring the S&T environment. Having the purpose of anticipating and understanding trends or events that could harm or benefit the competitive position of the organization, TI represents a valuable methodology to strategic planning.

This document presents main results of a creative TI system developed in Biomaterials field where a methodology that includes technology mapping has been applied. An analysis of scientific research in Biomaterials during years 2000 – 2002 was carried out. The objective of this study was to obtain elements that could be useful not only as a guide to develop R&D in the biomaterials field, but also as a reference for the further applications of TI cycle.

1. Theoretical framework

The techniques for technology mapping are based on co-word analysis. The origin of co-word analysis could be found several decades ago, to explain the co-occurrence knowledge, and to describe the correlation between the affinity of language units and its appearance in language (Rodriguez and Lopez 2000). Co-word analysis measures the simultaneous occurrence of words in scientific documents to establish their cognitive relation (Callon, Courtial, and Penan, 1995; Rodríguez, and López, 2000; Cahlik, 2000; Courtial, Sigogneau, and Callon, 1997).

Starting from this point in the following sections we will focus our attention to the results that Olivares-Benítez (main author of this article) obtained by integrating technology mapping into a CTI proposal. The study was developed and presented in a graduate dissertation at ITESM (Instituto Tecnológico y de Estudios Superiores de Monterrey) in Mexico (Olivares, *Graduate Dissertation, 2003*). ITESM is a leading private institution in Latin America. Founded in 1943, it has grown into a nationwide university system of more than 30 campuses with headquarters in Latin America and connection offices in the USA, Canada, Europe and Asia. In January 2001, a unit of competitive technical intelligence was established in the Center for Design and Products Innovation located on the Monterrey campus headquarters (http://inteligenciacompetitiva.mty.itesm.mx/mission.htm). The purpose of this unit is to promote academic and research activities within this field and assist companies in the identification of opportunities and drawbacks for improvement of their innovation processes.

The study we present in this document was applied in a field with increasingly importance: biomaterials. In the last years this field has gained attention in S&T worldwide activity. It has received special interest to produce spare tissues and organs that help to improve the public health. Considering this potential, some governments, for example of the USA and the UK have manifested their interest to include biomaterials in the formulation of their national scientific policies (UK Government, 2001; National Intelligence Council 2000-2002).

2. Method.

This proposal is composed by the five stages of the Competitive Technical Intelligence methodology (CTI): 1) planning, 2) selection of information sources, 3) information processing, 4) information analysis and 5) results validation. The principal purpose of the study is to apply this methodology to identify the major subjects in Biomaterials research (properties, manufacturing processes, new applications, etc.). All of them are based in a complete analysis of international sources of information.

In order to have a complete analysis, we included primary and secondary sources in our analysis. Like primary sources we had a group of distinguished researchers from Germany, Australia and Japan. Like secondary sources, after a search on databases several specialized journals were identified, and the final selection was based on their relevance and content.

In the information processing and analysis activity, a selection of the different journals' articles was made from 2000 to year 2002. The articles were set in groups of journal-year and each set was indexed. Then, keywords were identified from the abstract and this group of keywords was added to a database which had reference parameters such as: journal name, volume, issue, year, authors and countries... Moreover, the keywords from the database were grouped and classified to form clusters for better handling, and a co-word analysis was done building matrices for each year, and with these elements a technology map was built for each year.

After processing and analyzing information, a results validation was made with the support of the technical advisors that participated in this study.

3. Results.

A study of scientific articles from eight international journals relevant to biomaterials was made corresponding to the period 2000 to 2002. Specifically two main topics were analyzed: a) the levels of research activity per country, and b) the main technologies in this area. A total of 18,217 different keywords were identified initially. The equivalent terms were overlapped and 8,891 keywords were obtained. Finally, these keywords were classified into 3,150 clusters. A co-word analysis was done forming matrices for each year.

With these elements a technology map was built for each year (2000 to 2002). In this way we obtained results focused on: the most important countries that have activity in this field; the number of documents assigned to each country, the countries' working groups, and in general terms, the identification of the major biomaterials in the world and their ranking.

The results showed that USA had the main activity, behind it was placed a group of countries comprising: Japan, the United Kingdom, Italy and Germany. Concerning materials, hydroxyapatite and polymers were prominent. Among the main applications, two groups were distinguished: a) implants and prosthesis related to bone tissue and those biomaterials such as hydroxyapatite, metals and hard polymers, and b) microspheres and delivery systems related to soft and degradable polymers.

In conclusion, the general results revealed the major research themes as:

- Biomaterials: Hydroxyapatite and calcium phosphates, Collagen, Polymers, Titanium and its alloys, and Ceramic glass.
- Tissues: Bone tissue and Blood fluids.
- Manufacturing processes: Surface modification, Polymerization and Plasma spraying.
- Applications: Implants, Microspheres and Prosthesis.

4. Conclusions.

The implementation of a competitive and technical intelligence (CTI) is increasingly significant for improving the strategic planning of the organizations. In this study interesting evidences were obtained through a proposal that comprised a standardized and methodological analysis of the technological and scientific environment.

For this study was very important the ITESM (Mexico) support to access information resources in databases. Besides, one of the most relevant factors during the analysis was the participation of experts from Germany, Australia and Japan, whose contributions were fundamental from the planning stages of the study to the final validation of results.

From a general point of view, the experience we have in technical intelligence field (Escorsa, Rodríguez and Maspons, 2000, Rodríguez and López 2000, Rodríguez 2001, Rodríguez, Eddy and

Garza, 2002) leads us to conclude that the quality of the results obtained by the identification of the cognitive structures of research through mapping will depend on: the definition of the objectives of the study; the experts support during all the stages of the study; the quality of information consulted; the statistical analysis methods; the map and its interpretation.

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