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## Text mining as a valuable tool in foresight exercises: A study on nanotechnology

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### Abstract

Since its inception in 2001, the Center for Management and Strategic Studies (CGEE) has as its main activity the conduct of foresight studies in support of the decision making process related to the establishment of ST&I policies and activities in Brazil. The methodology used by the center combines quantitative and qualitative methods. Explicit and tacit knowledge is mobilized in the process of developing complementary or differentiated visions of the future.

Most of the studies conducted by CGEE begin with data monitoring activities, making use of text mining techniques. One case study carried out by CGEE on the field of nanotechnology is presented. In this case, text mining was used at the first stage followed by qualitative techniques. Results were used to guide government agencies to fund nanotechnology R&D to help raise the competitiveness of several sectors of the Brazilian economy.

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### 1. Introduction

Science, technology and innovation (ST&I) is the road ahead that provides “true answers” about the future. Research and development (R&D) activities must operate under a well structured policy in order to effectively promote a better and safe world for all. In that sense, it is crucial to know how an adequate

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knowledge management strategy can help decision and policy makers from industry, government and the academy to share ideas in a participatory process towards a sustainable future. New methods, techniques and tools have been developed during the last years, using the explicit and tacit knowledge available, not to forecast how the future will be, but to understand which are the drivers, variables and choices, as well as the best ways for shaping the future.

The Brazilian Science, Technology and Innovation (ST&I) system has made significant progress in terms of research and development coupled with organizational and institutional changes in the last decade. Currently, Brazil possesses a relatively strong and consolidated scientific base that is being used strategically for the promotion of social transformation and economic development. On the other hand, there is a clear understanding that science and technology will only play a central role in improving Brazilian society through continued efforts, at all levels. Considering the high degree of risk and uncertainty related to the innovative process, it is necessary to construct ways to guarantee society permanent participation to maintain support of the policies related to ST&I development. Articulation of a national system of innovation requires the government

- to harmonize technological and industrial policies
- to provide for a better ST&I structure and governance, focused on strategic issues and with broader participation of government, academy and private sector representatives,
- to disseminate technologies with favorable social-economic impact.

Considering the increasing complexity of the decision making process, the speed of technological changes and their economic and social impacts, and market interdependence, it is obvious how greatly a given decision making body depends on an efficient system of knowledge management. To understand the complexity including potential risks and threats in a given future dimension is not a trivial undertaking and involves the analysis of realities and situations that take into account many factors of both a social and technical nature. Foresight stands out as an important tool to be used in planning activities and other decision making processes, both in the public and private sectors, since it allows for the anticipation of technological ruptures and for the identification of trends, discontinuities, new perspectives and opportunities in a given time horizon. New models and tools for future analyses and studies are currently considered crucial for the development of institutions, countries and regions [1]. Foresight offers ample possibilities to identify and take advantage of opportunities; to investigate and understand the nature of risks; to neutralize and minimize the effects of the risks; and to find ways to provide a rapid reaction to mitigate the problems once they start to unfold.

The utilization of forecasting/foresight methods and techniques to support decision making and the establishment of S&T policies is a relatively recent development in Brazil. This is an outcome of deep changes in the international scenario, particularly in aspects related to the globalization of the economy and the acceleration of technological changes, which makes it mandatory for the country to reach higher levels of S&T development. The capacity to anticipate the future has become an element of extreme importance to increase the competitiveness of Brazilian companies and the country itself.

## **2. Brazilian strategies on science, technology and innovation (ST&I)**

Brazilian investments on Science, Technology and Innovation have historically come from government and with the ever growing number of ST&I institutions that have been created in the last decades, the

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