Paper 1: Adding Value to Information in the Process of Promoting Technological Innovation:
an approach implemented by the Center for Management and Strategic Studies on Science, Technology and Innovation in Brazil

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1. Introduction
The growing awareness of the central role of science, technology, innovation, culture and society in the general development of nations, in increasing competitiveness and adding value to cultural and economic assets is essential for the construction of the new economic structure, which has the transformation of knowledge in value as its main vehicle. In many ways, these advances are happening through the adoption of new information and communication technologies, the formal and informal networks and the new management models, thus making feasible strategies for new knowledge generation and also for the adaptation and use of already existing knowledge, as well as for the appropriation of cultural diversity and preservation of national identity.

Innovation and knowledge are crucial to sustainable development and international insertion. To conciliate technological and industrial policies, structure and invest in strategical areas, to disseminate technologies with social impact and to articulate a national system of innovation is essential to create an effective sustainable human development, with strategies of social inclusion and a broad notion of citizenship.

Considering the increasing complexity of the decision making process, the speed of the technological changes and its economic and social impacts, the markets interdependence and the need of support for information coming from formal and informal sources internal and external to the organization, it is obvious that an organization, nowadays, depends more and more on an efficient system of knowledge management.

Regarding the points above and the high levels of uncertainty with which the society is confronted, the area of strategic planning is being shifted from the traditional approach to a more dynamic one that considers the changes of current times. The studies developed under the denomination of foresight fill the space where there is an intersection between the areas of strategic planning, future studies and policy analysis. (FOREN, 2001)

Thus, future studies, foresight and technological forecast are important for strategic planning and for supporting the decision making process, since they allow the anticipation of technological ruptures, trends and discontinuities, new perspectives and opportunities that are presented for a society from the identification of its challenges and potentialities. New models and tools (Porter et al., 2004) for future analyses and studies are currently considered crucial for the development of institutions, countries and regions.

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Concerning different possible interpretations, the words in Portuguese “prospecção”, “prospectiva”, “exercícios prospectivos” or “estudos do futuro”, as well as its English versions, forecast, foresight, future studies, have become generic denominations - not free of controversies - for the diverse methodologies and approaches that try to answer questions presented by the challenges of the future, either for technologies and its impacts, or for important social issues.

In fact, trying to understand the potential risks and threats, analyzing the future and glimpsing new ways and opportunities that allows the choice of reasonable futures is not a trivial challenge and involves complex questions that must take into account many factors of social and technical nature and different realities and situations. Some of the challenges Brazil faces relating the intensification of its capacity to use foresight/forecast methodologies, pointed out in this paper, remark the need to adopt definitions that better reflect real situations and to state clearly the limits of this area. The diversified nature of the themes under analysis and the flexibility required for its treatment, that is, the questions that are made, the needs of who demands it, and the main objectives, justify and allow the choice of different types of methods, techniques, approaches and methodologies. Amongst the general trends of evolution in scientific knowledge, social transformations, governmental public policies, pragmatic questions of competitiveness (in short and medium terms), and strategical questions of sustainability and survival in the long run, the possibilities of extent, focus, objectives and results of foresight/forecast/future studies are many. (Miles et al., 2002)

This paper presents the conceptual and theoretical model elaborated by the Center of Management and Strategical Studies - CGEE to guide its foresight activities through analyzes of international experiences and methodological and conceptual discussions that are being lead in the current time. What can be affirmed, at the moment, is that this is an area in constant evolution and that countries and organizations are in search of models, tools, methodologies and concepts that can face the challenges of the future, brought, particularly, by the advances of information and communication technologies, nanotechnologies, genetic and molecular engineering, among others. (Antón et al., 2001; Linstone, 2004).

2. The Center for Management and Strategic Studies and its role on strategies for Science, Technology and Innovation

Brazil and the world are experiencing a significant movement represented by a new look to the importance of science, technology and innovation as transforming agents of the society. The search for solutions on emergent social problems, the formulation of future strategies, as well as the exercise of democratization, that could make possible the participation of the society in the construction of a desired future, points out the necessity to diversify the economic tissue, to rescue cultural values and the process of planning and management of public goods and the environmental questions, preserving the national identity.

Despite its recognition for the exploitation of the economic and regional national potentialities, the Brazilian historical path in the last decades lacks the strengthening in relation to the construction of a nation with a modern economy, integrated to the globalized markets, with internationally competitive industries, high investments in science and technology, strong ecological conscience and with an operating structure in the concretion of citizens social rights and in the development of the social tissue in more democratic bases.
Initiatives towards structuring a broad spectrum policy of science, technology and innovation, capable of facing some of the emergent questions in the scientific and technological areas, have been part of the national agenda in 2002. This happened in a new movement that stimulated the country to insert the technological innovation as one of the main objectives of the national efforts of science and technology. (Silva and Melo, 2001)

In this context, CGEE was created as an institution which aims at promoting and accomplishing future studies and foresight in the area of science, technology and innovation, as well as the activities of evaluation of strategies and economic and social impacts of scientific and technological policies, programs and projects. Moreover, CGEE acts on the dissemination of information, experiences and projects to the society. One of its main features is the capacity of interlocution and interaction with the science, technology and productive sectors.

In Brazil, the word “prospecção tecnológica” seems to have been, initially, the most adopted to assign such activities. However, recently, it has been discussed the possibility to call this activity “prospecção em ciência, tecnologia e inovação” searching to stand out the current trend of this type of study, incorporating social, cultural, strategical elements and strengthening the interactions between technology and society. This is a consequence of the importance of the construction of visions that can express the national reality, either for the economic view, or for questions of political-institutional and regional characteristics, science and technology, and demography, besides the questions of environment, sustainability, information and knowledge.

CGEE’s strategy was based upon the perception that decision making emerges of a negotiation between multiple actors. This perception was the key point of the methodology known as foresight, which can be defined as a process that leads to a more complete understanding of the forces that shape the future and that must be considered in the formulation of policies, planning and decision making. (Martin, apud Cuhls and Grupp, 2001). It means that this approach aims to link the present actions to a strategical perspective, coping with the possibilities of the future for the construction of commitments and coordination concerning the national priorities of research and innovation.

According to the European Union, foresight is defined as an activity that connects three different dimensions on the same process: thinking, debating and shaping the future as shown below. (Santos & Santos, 2003)

**Thinking the future:** possible future events are examined from long term trends and assumptions of new and unexpected facts. The trends of science and technology are monitored, however, changes in the economy, society, geopolitics and culture are also considered;

**Debating the future:** in general, the process of thinking the future in the foresight approach is a participatory one and it requires the involvement of different stakeholders, including authorities, companies and organizations of R&D. Such process can occur in different levels: transnational, national or regional.

**Shaping the future:** through the identification of possible and desirable futures and the learning and interaction processes, it is possible to reach different levels of decision that can help the coordination efforts and the materialization of the visions of future.

Moreover, the creation of communication channels and the process of coordination in different levels stand out the importance of the governance process that must guarantee the validation of technological possibilities identified during the process by the decision makers.

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3 Technology forecast or foresight.
4 Forecast or foresight in science, technology and innovation.
makers and be transformed into concrete actions. Thus, CGEE has an active attitude regarding the future, stimulating the search for an institutional culture of foresight, with a global vision of science, technology and innovation, which estimates complexes mechanisms of interaction, exchange of information, experience and feedback between the different involved actors.

3. CGEE’s foresight approach

There is an extensive list of studies related with exploring the future. In a simple examination of literature it is possible to find different denominations for “families” or conceptual structures, such as technological forecasting, technological foresight, social foresight, inclusive foresight, technology assessment, monitoring (environmental scanning, technology watch), prospective networks, roadmapping, scenarios studies, multicriteria decision analysis, etc (Porter et al., 2004). This has generated some confusion in the terminology. Therefore, the elaboration of simple and direct definitions and the establishment of different levels of scope and use of such methods, techniques, methodologies and tools becomes rather complex.

As a result, it is common to find techniques developed for specific objectives being used to answer questions of broad and complex nature. This, in certain cases, contributes to discredit this field of study. This also confirms the great difficulties found on the uncertainties about the future. The reflection on the different approaches is necessary as a way to improve the activity and its results.

Nowadays, the approach called foresight is the most used methodology to assist the establishment of research and development priorities and to promote the alignment of R,D&I policies to the economic and social needs of the countries.

Foresight includes qualitative and quantitative ways to monitor indicators of development trends, and is better and more useful when directly linked to the analysis of policies and its implications. Foresight prepares people for future opportunities. In the government, foresight does not define policies, but it can help them to be more appropriate, more flexible and more robust in its implementation, in changing times and conditions.

The theoretical model organized to guide the foresight process in CGEE is presented in figure 1. This model was created taking into account the methodological structure proposed by Horton (1999) and improved by the ideas of Conway and Voros (2002), as well as the orientations of the Handbook of Knowledge Society Foresight (2002).
3.1 Understanding the Process

Foresight studies constitute powerful assistants in planning and managing uncertainty levels. However, they must be placed in a planned context, i.e. to be based upon pre-established policies and needs. Its effectiveness is intrinsically linked to an adequate methodological proposal, which can only be obtained from a correct delimitation of the questions to be answered, of the type of desired replies, of the spacial orientation, the scope of the issue, as well as the constitution of a network of stakeholders, able to articulate and reach the necessary consensus and commitments aiming to the implementation of the identified plan of action. The elaboration of foresight exercises in CGEE tries to follow the theoretical model, considering four great sets for its implementation:

3.1.1 Definition of Objectives

The definition of objectives is obtained from public policies and strategies of the federal government.

3.1.2 Identification of Themes

Once the strategical objectives are defined, the prioritary themes that answer the critical questions are selected. In general, the studies are anchored in governmental plans and programs. Examples are the studies developed to subsidize the application of Science
and Technology Sector Funds. For each selected theme, it is made a rigorous planning, that takes into account the strategical focus, the time horizon, the space scope, the institutional and expert mobilization, duration and costs, the choice of the methods and techniques that will compose the methodology. It also considers the target public of the research, considering its extension, frequency and reach, possible partners of the initiative, the available infrastructure, the relationship with the initiatives in progress and the strategy of dissemination. After all this information is obtained, the exercise can effectively begin.

3.1.3. Implementation of the Foresight Exercise
This step, in general, is divided in three phases. Each phase adds value in relation to the previous one creating a chain that turns information into knowledge and knowledge into strategy. Each phase has a higher level of complexity, diminishing the uncertainty level and increasing the potential of contribution of the results to the decision making process.

a) Initial phase
The question here is: What is happening?
This phase corresponds to the collection, organization and summary of the available information on the theme or subject under analysis, using for this purpose studies, diagnosis, analyses and intelligence systems in order to have a better understanding of the problem. Elements that can potentially impact the theme/subject under study are identified and delimited as opportunities and threats, forces and weaknesses, and cultural, social, technological, economic, political and environmental factors. In a complementary way, the experts and other stakeholders are identified and mobilized.

b) Main Phase
In this phase, the questions are: What seems to be happening? What is really happening? What should be happening?
During the main phase, processes of translation and interpretation concerning the current trends and the future possibilities occur, using forecast and foresight techniques. It is emphasized, in this phase, the broad participation of experts, groups of interest and decision makers, strengthening networks and collective learning. The expected result is to empower the existing knowledge with a better understanding of the involved conditionings and the possibilities presented for the future.

c) Phase of commitments
In this phase, the question is: What can be made?
In this phase, it is important to disseminate the results and to strengthen the commitment of stakeholders that participated on the previous stages with the decisions based upon the results of the study, with procedures of validation, dissemination and assimilation for a broader public. The expected result is the establishment of consensus and commitments and the transformation of the accumulated knowledge in strategies and proposals that can be taken by the decision makers, searching the expansion of the perception of strategical options.

3.1.4 Decision making
Here, the main questions are: What will be done? How it will be done?
The strategical options which seem to be more adequate amongst the identified ones are selected, through interaction with the main decision makers. The expected results involve the definition of mechanisms and tools for implementation of the selected options, as well as the identification of other themes for future analysis.

Figure 2 presents the expanded model of the methodology in use by CGEE. The central idea of this approach is to provide flexibility to planning, considering the high level of uncertainty associated with complex and hyper-competitive environments of current times.
Figure 2. expanded model

4. Conclusion: Key Points and Lessons Learned

The creation of visions of the future to anticipate emergent opportunities, potential threats and to indicate trends and priorities is vital for the success of the innovation process and requires permanent monitoring and sharpened perception to catch the indications that allow this anticipation. In relation to the construction of future strategies, the efficient use of the different techniques and existing methods stands out as a basic aspect, in order to comply with the specificities of the problem, as well as the emphasis on participatory approaches, communication networks and horizontal and vertical communication channels.

In this context, the creation of CGEE is emblematic, for at least three distinct aspects:

1) The importance of institutionalization of foresight activities in the federal government, taking into account the context of governance and macro coordination for the establishment of governmental strategies;

2) Strengthening of foresight activities, future studies, and formulation of strategies that gain renewed importance; and

3) Strengthening the process of technological innovation.

One of the main tasks in future studies and foresight exercises is the careful and disciplined exploration of representative landscapes of future situations. The information, the knowledge and the perceptions obtained as a result of these activities are used by people and organizations to make decisions, to elaborate strategies and, above all, to get a better view of the future.

The global leadership in any field depends, more and more, upon a change that includes the effective and innovative use of technological management. The key for leadership is in process management of creative ideas, the generation of new technologies, the development and commercialization of new products in existing and new markets. The innovation management tries to congregate mechanisms and tools, methodologies and
forms of organization that guarantee the organizations innovative capacity and, as a result, its competitiveness. Strategical and multidisciplinary themes with a high degree of complexity that involve different and contradictory interests and mobilize the public opinion, require adequate methodological approaches to make possible the decision making based on information of quality, obtained by shared, participatory and articulated means within the academy, government and enterprises with the involvement of representatives of the civil society. Another important point is related to the need of creation of new tools and approaches that can deal with the increasing trend towards multidisciplinarity and flexibility, necessary to understand the complexity of the current reality, when the models in use seem to be insufficient.

Through the communication and cooperation between researchers, users and financiers, the methodology in use by CGEE looks forward to articulating the search for “visions of the future”. Privileging the knowledge of the environment and the factors that determine the context of the problem, a more effective communication occurs among the stakeholders, which influence the development of science and technology, leading to the strengthening of the technical-economic networks that they participate. Additionally, the activities of foresight developed by CGEE look forward to leverage the process of technological innovation in the country, adding value to the existing information and transforming it into useful knowledge ready to be used.

References


