ISSN:1991-8178

Australian Journal of Basic and Applied Sciences

Journal home page: www.ajbasweb.com

Technological Forecasting: the Methodology Used by a Federation of Industries in Brazil

[1]Dálcio Roberto dos Reis and [2]Rodrigo Cortopassi Goron Lobo

[1]Affiliation of first author: Positivo University, PMDA – Masters and Doctoral Programs in Business. Rua Prof. Pedro Viriato Parigot de Souza, 5300. 81280-330, Curitiba, Parana, Brazil
[2]Affiliation of second author: Positivo University, PMDA – Masters and Doctoral Programs in Business. Rua Prof. Pedro Viriato Parigot de Souza, 5300. 81280-330, Curitiba, Parana, Brazil

ARTICLE INFO

Article history:
Received 16 April 2015
Accepted 12 June 2015
Available online 10 July 2015

Keywords:
Technological forecasting, multi-method forecasting, validation

ABSTRACT

This paper aims to study how a Federation of Industries develops the future technological forecasting. The rationale behind it is the limitation of forecasting activity within organizations, which confine forecasting to an essay within the planning process. It is intended here to raise and evaluate four groups of information within the forecasting scope: complexity, periodicity, reliability and costs. Taking place in the intelligence sector of the Parana State Federation of Industries (FIEP System), named SESI/SENAI/IEL Observatories (SESI – Industry Social Service; SENAI – Industry Learning National Service; IEL – Euvaldo Lodi Institute), this work is of qualitative nature deepened as an exploratory research using mainly primary, but also secondary data gathered within FIEP and in the internet. For the data collection method, the semi-structured interview was used and for validation, the triangulation process. The main findings of the study ate the use of multi-method forecasting sustained on strong methodological basis with great institutional alignment and qualitative commitment in relation to reliability and validity of delivery. A theoretical debate about the collected forecasting methods is expected to be generated in order to provide future researches about this topic with elements and structural conditions about their applicability.

To Cite This Article: Reis, D.R. and Lobo, R.C.G., Technological Forecasting: the methodology used by a Federation of Industries in Brazil.. ***Aust. J. Basic & Appl. Sci.,*** *9(20): 503-509, 2015*

INTRODUCTION

Little has been written or researched about future - or even present - technological forecasting. Despite the strategic relevance of the topic for several types of organizations, such as companies, unions and federations - among others, the subject is dealt with more in the sphere of the will of people rather than in a prospective context, with the use of appropriate techniques and methodologies to attempt the forecasting of new technologies, as well as their trends and uses. Usually, forecasting is confined to an essay about prevision within the planning processes, yet devoid of technique or mitigating elements for the possible mistakes.

Forecasting work presumes the existence of appropriated tools for its execution. Only the will to see what is about to happen is not enough. It should be strongly supported by a consistent methodology, with the necessary accuracy so the findings receive the validation and the importance that this subject requires. Thus, forecasting and strategy meet in an interdependent manner, as in the resulting action, one´s input is the other´s product.

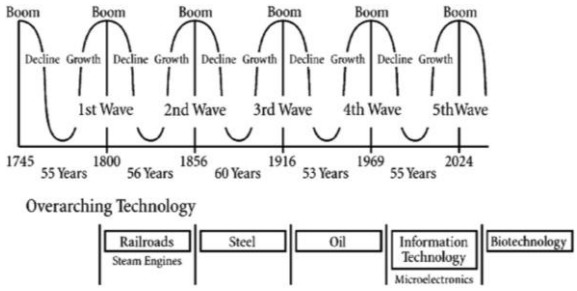
There are several forecasting methods, often jointly used, in order to provide higher amplitude and accuracy for the forecasting work. Such combination aims at improving the longitudinal performance through a reliable preview of the future, as anticipating is a strong tool for increasing results. As mentioned by Godet and Durance (2011), "action taken in the absence of a goal is meaningless and anticipation generates action. That is why Prospective and Strategy are, in general, inseparable, hence the expression 'strategic foresight'. Yet the complexity of problems and the need to present them collectively impose the use of methods as rigorous and participatory as possible, in order to have them recognized and the solutions, accepted. The limits of formalization, however, should not be forgotten, as people are also guided by intuition and passion" (Godet and Durance, 2011, p.9). In this sense, it seeks to contribute to foresight studies within organizations.

Corresponding Author: Rodrigo Cortopassi Goron Lobo, Positivo University, PMDA – Masters and Doctoral Programs in Business. Rua Prof. Pedro Viriato Parigot de Souza, 5300. 81280-330, Curitiba, Parana, Brazil.
E-mail: rodrigolobo@terra.com.br Ph: # +55(41) 3317-3275 and 9961-9069.

This work aims at studying and understanding the future technological foresight process developed by a Federation of Industries within its intelligence sector. The research is basically exploratory and of qualitative nature. It used primary data collected through deep semi-structured interviews and validated through the triangulation process. Secondary data was also collected "*in loco*" and through bibliographic references and the internet. The intention is to bring contributions about forecasting methods and practices that would subsidize future research on the subject, as well as present an empiric forecasting case including important analysis as complexity, periodicity, reliability and financial dimensions of the process.

Materials:

Technological forecasting can be applied to every systematic and intentional attempt of anticipating and understanding in which direction, rate, characteristics and potential effects technology changes, specially its invention, innovation, adoption and use (Firat *et al*, 2008). The basis of the technological forecasting comes from the industrial era, with the work of Frederick W. Taylor, known as the father of the Scientific Management, with the publication of his book *"The Principles of Scientific Management"*, in 1911 (Linstone, 2011). Since the 19th century, a cycle of economic prosperity, recession, depression and recovery is observed and such repetition also occurs in the technological innovation. Figure 1 presents these global behavioural waves in the industrial (fourth wave), information technology (fifth wave) and micro- and nano- technologies waves (beginning in the decline of the fifth wave).



Source: Linstone, 2011
Fig. 1: Global technology waves.

Significant evolutions took place since World War II. For example, the analysis of systems, which became a central tool for the development of new ones, while the complexity of those systems under development meant long planning and deadlines. Therefore, technological forecasting has become imperative for the analysis of future needs, as in the case of the United States Department of Defense and its research about defense technologies and monitoring.

Analysis of emerging technologies and their implications provide information for critical decisions, ranging from the multinational level up to the individual organizations. Big and small companies depend on technological innovation for their existence (Firat *et al*, 2008). In this era of strategic Science, of high investment projects, decision makers want to identify possible and promising directions and options for the advancement of emerging technologies, in order to help them chose the right path ahead (Robinson *et al*, 2013). New and emergent Science and Technology, such as proteomics, bio-electronics and nanotechnologies can impact on several sectors with a wide range of industrial structures. That emphasizes the strategic intelligence as a relevant and timely requirement, which will make possible effective decision-making and strategic development.

Some academic future studies focus, in general, in the growing conscience that even governments try to use technological forecasting as tools to improve networking and build consensus in S&T communities or in national, regional or sector innovation systems (Firat *et al*, 2008). In this sense, there are hundreds of technology forecasting methods, which can be categorized in nine families: a) Specialists opinions; b) Trend analysis; c) Monitoring and intelligence methods; d) Statistical methods; e) Modelling and simulation; f) Scenarios; g) Valuation / decision / economic methods; h) Descriptive and matrix methods; and i) creativity.

The quality of forecasting depends not only on the methods, even with their significant evolution, but mainly on the selection and application of the appropriated methods. Application requires the used technique to be specific in time, space and technology (Firat *et al*, 2008). Many articles demonstrate that, because of the complexity of technological forecasting and because each forecasting method can deal with only limited aspects of a case, it is always beneficial to use various different forecasting methods simultaneously. One example is the integration of

Delphi and participatory backcasting (Zimmermann *et al*, 2012), when both techniques were combined for the study of electrical mobility in Germany. Backcasting is a well-established approach to reach a desirable future, focusing on the findings instead of on the justifications. This method is applicable when the goal is to glimpse an alternative future, which is discontinuous, instead of the untenable *status quo*.

With the concern about the applied methods in backcasting projects, a variety of additional methods, qualitative and quantitative combinations, have recently arisen. Among these combinations is the use of Delphi. The Delphi technique is a promising tool frequently used to incorporate visions of different groups of stakeholder. It is a method to structure a group communication process so the process allows for a group of individuals, as a whole, deal with a complex problem.

Another example was the creation of a development framework of institutional analysis for a nanotechnology consortium (Allarakhia and Walsh, 2012). Firstly, three sets of drivers that promoted the consortium creation were developed. The framework showed that the knowledge, as well as technological and trade complexities, encourage the development of different consortium formats. Three formats prevailed: the consortium mainly dedicated to create networks among the members; the consortium guided by the need to correct complex equipment for R&D activities; and the consortium to enable or support technology development for the end user.

The current era, which comes near the top of the fifth wave of the Figure 1, IT has its greatest evolution. IT has revolutionized the whole society and has become an intrinsic part of the current way of life. It allowed previously divergent concepts to come closer, such as centralization and decentralization, globalization and regionalization, all due to the extensive capacity of computers and telecommunications (Linstone, 2011). A characteristic definition of "information economics" has been the tremendously higher access to information. This access, in particular, brings the promise to improve the technological forecasting (Firat *et al*, 2008).

Another forecasting perspective is the strategic foresight, which as in the French Schools its greatest representative. Michel Godet, one of the main names in strategic foresight, says that it is the result of the association between the prospective thought and the planning action, with the appropriation of the participatory management (Godet and Durance, 2011). In other words, strategic foresight integrates the prospective and planning actions in an attempt to see the future. According to the authors,

Strategic prospective puts anticipation at the service of action and relies upon the strong potential synergies, which exist between prospective, and strategy. The ideal synthesis is an integrated approach to strategic planning using scenarios. The objective is to propose various strategic orientations and subsequent actions, which correspond to the competencies of the organization, based on the scenarios of the context evolution (Godet and Durance, 2011, p. 25).

In a dimension in which the future is not set and it is necessary to build it – therefore the result of human will – five key ideas surround the strategic foresight: I. The world changes, but the problems stay the same; II. The future, result of chance, necessity and will; III. Against complications of the complex; IV. Ask the good questions and suspect of the preconceived ideas and V. From anticipation to action through appropriation (Godet and Durance, 2011). It implicates that the future is plural, where a great variety of possible futures can be fit in. This way, the strategic foresight is generated around three processes: first, the collective reflexion, which allows for the identification of key variables, player analysis, the raising of key issues for the future, reduction of doubts about these issues and the elaboration of more probable context scenarios with the advice of experts. Second, the preparation of the decision, when the process is returned to the organization decision-makers, the evaluation of the strategic option is considered and there is the move from reflexion to decision, which is subject to a council of representatives of steering committee. And third, the action, which is aimed at the implementation of the action plan.

Lastly, Neves Cristo (2002) also approaches the strategic foresight within the aspect of the construction of the future from the integration between strategic planning and foresight. It starts with a reflexion about "who we are" and follows to the systematic perception of the subject studied, considering the institutional and the organizational ambiences. According to the author, there is more analysis than prognosis in the prospective, what leads to the difficult prognosis elaboration due to working with non-structured systems, data limitation and methodological weaknesses. It is resorted to four techniques that are more common: Bayesian Methods, Cross Impact Analysis, Delphi and Brainstorming.

Methods:

The present study is of qualitative nature. According to Vergara (2000), such research is considered of great relevance mainly because it presents "characteristics of determined population or phenomenon, being able to establish co-relations between variables and define its nature. In essence, it does not have the obligation of explaining the phenomenon described, although it can be used as basis for such explanation" (Vergara, 2000, p.45). Along with the qualitative research, it was also applied a descriptive research that, according to Churchill Jr. (1987), has as objective the knowledge

and interpretation of reality without modifying or interfering with it.

The subject organization of this research is the FIEP System (Parana State Federation of Industries), and within it, the intelligence sector named SESI/SENAI/IEL Observatories, that produces prospective futures studies for the development of the Parana State industries, acting in multi-sector projects, planning strategies with representatives of different industries to promote connections between public and private organizations, with the aim of strengthening interactions and promoting innovation to enhance competitiveness.

Data collection was made through semi-structured interviews, conducted with Coordinators and Researchers that are part of the analyst team directly involved in the forecasting studies. In total, there were three interviewees. The interview followed a guide to collect data about the complexity of the forecasting process, involving the operational and human infrastructure for forecasting, its periodicity, the time dimension of forecasting and reviewing, reliability for the understanding and accuracy of the forecasting and, at last, financial dimension to understand how economic resources are allocated for forecasting. The interview guide was composed by questions that would involve the four dimensions mentioned, as well as:

- How the forecasting is made, by which method(s) is obtained;
- To get to know the methods and structure offered by the institution to perform the forecasting;
- Understand how the process of validation, reliability and investments in forecasting is.

The research focus on the analysis of forms and procedures adopted by this organization, concerning forecasting efficacy. The information obtained was treated with qualitative methods, with brief analysis of speech and content analysis, once all interviews were transcript in order to understand the researched phenomenon. Interviewees' responses were compared and understood in regards to the theoretical framework inherent to the subject in question, as well as triangulated for instrumental assessment. As it is also an exploratory research, it is possible to say that among the main limitations are the sample and respective representativeness, nonetheless maintaining the perspective of generalizing the conclusions because of the research nature. Even with the interviews as primary source of data, secondary data collection was also made to complement the interviews. Bibliographic reviews and empirical and internet research were collected as secondary sources.

Results:

The research results are described below according to the compilation of the transcripts of the interviews about future technological forecasting. Thus, within this study forecasting means technological forecasting. The description is divided into four groups: complexity, periodicity, reliability and costs. The complexity group refers to the organizational structure used in the forecasting activity. It involves items as structure, forecasting methods, formats, relative importance and strategy. The periodicity group refers to the time dimension of the forecasting works, including periodicity of the forecasting in itself and the review. The third group, reliability, deals with validation and procedures to guarantee the reliability of the forecasting activities. Finally, the costs group addresses the financial dimension of investments, estimates and criteria of return calculations and financial resources allocation for future forecasting.

Research indicated that the available structure, as well as employed methods, show works with a high level of complexity, even though there is not a deeper financial analysis over the payback, as will be seen later in this article. The organization of the Parana State Federation of Industries System (FIEP System) is, although linear, wide and reasonably complex. However, the organization of the intelligence area, named SESI/SENAI/IEL Observatories, which are responsible for forecasting, even being located in one of the service groups of the Federation, is transversal to all groups, what demonstrates an operational inter-functionality. Its works involve several demands, not regular all the time, pointing to a complex net of necessity sources, although they have a common ground, which is the forecasting of the industry in Parana State. Such format suggests the high complexity mentioned, formed by directorates and sectors in charge of researches, content production, forecasting and social economic studies. In its multidisciplinary staff of approximately sixty people, more than 90% of them are Masters or PhDs and have access to software tools, such as MIC/MAC, databases and memorandums of understanding with research institutions in the country and abroad.

The forecasting activity is called within the institution of foresight, terminology usually adopted by some forecasting schools, such as the French, that has Michel Godet as its main representative. Despite having developed a specific methodology, the methodological basis adopted is the French one, which deals with the strategic foresight. However, the Observatories' activities are guided by multi-method profiles that include the expert panels, the use (at least partially) of Delphi, cross-impact analysis, roadmap, scenarios, among others, considering that each foresight project is customized and the method to be used is defined in its implementation planning. In a summarized way, the foresight process begins with a game of key words input in a database. Through the cross-reference of words and co-related words of a determined sector, important topics about the subject in question are

raised. These go through successive refining and filtering processes until the necessary reference is reached in order to produce the trend model in a higher growth baseline. Their methodology, developed through learning-action, has the grounding for the foresight process mentioned.

The future foresight developed has institutional importance, as offers support to the member industries, considering that the visions are based on accurate foresight criteria and that will serve as key elements for the planning process of several of them. There is a great contribution to the increase of industrial competitiveness in Parana state. Such importance becomes evident when there are elections to the FIEP System. When there are macro-political changes in the organization board, the SESI/SENAI/IEL Observatories do not lose their operational capacity because of changes in the priorities of each mandate, even if eventually they may suffer alterations in the organization allocation. This situation reinforces the importance and credibility given to the results achieved, serving as strong evidence of its applicability in the industry. It becomes also clear that there is a close connection between the foresight product and the strategy, both from the FIEP System and the member industries.

The second group of information gathered refers to the periodicity of the foresight activity. The idea of this group is to understand the longitudinal perspective of foresight, once the available structure can be related to both the periodicity of which is made and to its strategic relevance. It was found that the foresight work is usually annual, with revisions in shorter cycles that vary according to the topic in question. Some cycles can be monthly and others longer, quarterly or biannual. However, methodologically speaking, there is no pre-defined periodicity. There is the time set in the implementation planning, which is performed and delivered accordingly. Therefore, the structure mentioned in the previous group is prepared to foresee this dynamics, counting with outsourced consultants, when needed. In the same way, the strategic relevance is demonstrated according to the periodicity of reviews and susceptibility of the foresight subject.

Information gathered on the third group are those related to foresight reliability, including validation procedures. Reliability is dealt with in the same way as the development of foresight work, within the scope of the used methods. However, the collective participation deserves special mention for this process. The experts' panel generally used in the foresight is also used for the validation, aiming at increasing the reliability of the results. In this sense, there are several redundancies, such as the use of staff, specific software and the involvement of partners like educational or other reference institutions. It is not unusual for the process to have more than one form of validation; that is why there are several redundancies available. This mechanism aims at guaranteeing the reliability and consequently the credibility of the foresight work.

Lastly, the forth group of information gathered refers to the financial dimension of forecasting. Despite having restrictions towards disclosing values *per se*, it is possible to say that there is great amplitude in the forecasting investment allocation. Firstly, it is important to mention that investment on capacity building is frequent. One of the reasons for that is the type of training coming from academia. In this training, there is great expertise on analysis of the past, however, few for future analysis; in other words, few professionals are prepared to act effectively in the future forecasting field. Hence the need to invest in complementary development for the forecasting researcher profile. This investment is central to the forecasting process because the activity itself is extremely dependent on qualified professional profile.

At the same time, there is another strong component of the foresight activities financing, which is the service provision. In one hand, within the FIEP System context, the SESI/SENAI/IEL Observatories are treated as an organizational sector and as such, are under a corporate budget. But on the other hand - the external context, it is possible for them to provide forecasting services as in a commercial relation, involving price, negotiation and sales, what generated income directly to the SESI/SENAI/IEL Observatories. Concerning criteria for calculating payback over investments in foresight, both contexts presented can be applied. In the external context, where there is a commercial relationship, the payback calculation is responsibility of the hiring part, which will allocate the service payment under forecasting investment. In the internal context, there is an intangible institutional dimension in the appropriation of investments. There is no specific payback calculation, but the perception that the forecasting results are beneficial and necessary to the state industries. This perception assumes an institutional role that positions forecasting within the strategic objectives of the FIEP System, allocating an overhead for the maintenance of its operations.

Discussions:

SESI/SENAI/IEL Observatories develop a wide forecasting work and with consistent theoretical framework, having its own methodology and using the concepts of the prospective French school. They adopt the strategic foresight as guide for future prospective plans, within a multi-methods approach and specific planning for each accomplished work. Although there is no accurate payback calculation over the foresight investment, there are solid ways to approach the matter. The first, applied for contexts originated externally to FIEP, services are priced and the payback is calculated by the hiring part. The internal context differs in the way that it is treated as

organizational sector, and so, subject to the organization budgetary allocations.

Implementation of the forecasting work is based in a structure especially organized for it, in which specific groups formed by combined criteria, considering expertise as the main reference, perform all phases of the process. The selection of the workgroup is one of the key features for forecasting to be successful. However, it is important to mention that sometimes internal staff does not meet the work demand, especially when seasonality is experienced. In this situation, external consultants are hired under the same technical principles of internal staff. Efficiency is prioritized and a well-defined functional structure is in place, which includes hierarchic levels categorized by the nature of the work, as well as expert technical levels by function. Such organization characterises a professional bureaucracy, because even having bureaucratic conditions, the expertise and work distribution among professionals characterise autonomy within its implementation area.

According to the findings of Firat *et al* (2008), the Observatories follow the line of strategic decision regarding the use of specific method for each project. There is a customizing level in which the initial phase is the implementation planning, when the method is defined. The use of expert opinions seems to excel within the multi-method approach. The experts are defined according to the project demands and engaged in two phases: first, in the forecasting itself, where opinions are collected through panels; and second, in validating the forecasting work results in order to increase its reliability. The panellists, as panel experts are called, can be internal or external and have distinct knowledge in the area of forecasting being developed. Expert opinion technique can be applied in several formats, as per example, the Delphi method, focus groups (panels and workshops), interviews or other participatory techniques. Observatories already use Delphi in a partial way, via web. Characterizing experts as panellists comprises the adoption of focus groups, which are also complemented by workshops, if necessary. These are less usual due to the implementation difficulties, once part of the experts are geographically distributed, hampering the implementation.

The success obtained by SESI/SENAI/IEL Observatories in the forecasting work is due to several factors discussed here. Special features are the functional composition of the operative structure, the profile and training of the researchers, the multidisciplinary thought adopted in the projects appraisal and the flexibility in the adoption of forecasting methods. Multidisciplinary thought is closely connected to methodological flexibility, once there is no lock in one specific technique, benefiting the forecasting needed composition, according to the forecasting topic demands. In other words, even having a methodology base, there is no dogmatic prescription over the use of one forecasting technique, adopting the multi-method composition in a transversal way, allowing for the scope of each method and its best applicability. It is important to mention that the integration among the team favours forecasting. Researchers work in a cooperative and complementary regime, and have developed a specific common sense, which allows for some operational overlaps towards the work progress instead of creating territorial conflicts generated by interferences external to each one's activity scope. This attitude reinforces the commitment with the hiring parts, being them external or internal to FIEP System, and also increasing the reliability of work delivery.

Another key factor within SESI/SENAI/IEL Observatories is the non-political posture. FIEP System goes periodically through elections that institute their directors. Despite the political influences arising from the board, the Observatories maintained their forecasting work in an eminently technical way, keeping the researchers' training as a priority for the work development. This way it is possible to continue to producing works impartially and with credibility, favouring the provision of information and input to the industries of the state. It also reinforces the strategic positioning of both the Observatories structure and of their works. Their works, for producing the mentioned information and inputs; and of their structure, for remaining with direct connection with the institutional purposes of the FIEP System, with regards to strengthening the industry in the state - even if eventually they suffer changes in their allocation within the organizational structure of the Federation.

Operations in the SESI/SENAI/IEL Observatories follow a constant flow, not only by the service demand, but by the own nature of these services. Forecasting requires an intense observation dynamics that continually feeds the forecasting process for its validation. This way, forecasting observations are accumulated in a longitudinal manner, caused by short cycle researches. As said by Neves Cristo (2002),

It is not without reason that we employ more analysis than prognosis. Analysis is produced "ex-post" and, evidently, do not work with uncertainties. Prognosis, in the other hand, deals with non-structured, complex, dynamic, ambiguous and uncertain systems. Lack of data and methodological and conceptual weaknesses contribute to hampering the elaboration of prognosis (Neves Cristo, 2002, p.4).

Such accumulation, within forecasting, results from periodical revisions. However, forecasting *per se* is usually performed in an annual basis. From this process two methodological propositions are inferred: first, there is a significant preoccupation with updating the forecasting incoming work; and

second that the credibility of results obtained in the forecasting work is, at least, partly due to the caution to minimize mistakes potentially arising from forecasting. This redundancy optimizes the work quality.

As mentioned, the use of expert opinion techniques seems to prevail in the works of the SESI/SENAI/IEL Observatories, even though other techniques are used in complementary, independent or joint manner. It is important to reinforce the forecasting periodicity aspect and respective validation. Experts' opinion, mainly in the form of panels, is used both in the forecasting development phase and later, in the validation one. In this way, the longevity of the relationship with the experts, as well as the collective feature of the validation, minimizes eventual problems and reduces the probability of mistakes. Their opinions are not merely situational, but contextualized in a longitudinal scope of validation, which increases the work reliability. This procedure confirms the credibility of the Observatories productions, presenting new qualitative redundancy.

Lastly, financial analyses of payback over forecasting investments are still incipient. As previously mentioned, treatment of investments made by external hirers are made by the hirers themselves, from a pricing process that integrates a business plan or similar tool. In the internal context, it assumes a budgetary composition, using the cost centre model, as part of an organizational structure. Such situation is understood as discordant from the substantial technical and functional structure employed by the SESI/SENAI/IEL Observatories, as well as their technical competencies for the forecasting work. It is understood that the implementation of a forecasting investment payback analysis would strengthen the Observatories delivery with information of great utility for the hiring parts.

Conclusion:

The forecasting work of the SESI/SENAI/IEL Observatories from the FIEP System is sustained on strong methodological basis with great institutional alignment and qualitative commitment in relation to reliability and validity of delivery. This study tried to raise and evaluate four groups of information within the forecasting scope: complexity, periodicity, reliability and costs. The conclusion is that the Observatories have a mature and complex structure, methodologically and operationally strong and experienced in the application of the methods used. There is a qualitative concern with redundancies to ensure that forecasting is made and validated longitudinally and that deliveries are reliable in the light of their strategic importance to the hiring parts. For that, a consistent relationship with experts was built and they are consulted not only in the forecasting phase, but also in the validation of the forecasting results. In this way, the periodicity of works follows two types of cycles: a long one, for the actual forecasting, and a short one, for validation. The profile of the team is equally prepared to deal with work in accordance to the nature of the demands. More than 90% of the staff has either a Master or a PhD degree. Refined forecasting techniques and methods are used, and the French line is adopted as methodological base. An improvement suggestion would be the implantation of an analysis model of the return over forecasting investments, being the hiring parts internal or external to FIEP System. Such analysis would bring potentially useful information for investment decisions, as well as feed databases with historical series over investment and return, what would be valuable for future works. The difficulty for this calculation is known in view of the measurement uncertainties and difficulties. However, as mentioned previously, a model including these barriers could be created.

REFERENCES

Allarakhia, M. and S. Walsh, 2012. Analyzing and organizing nanotechnology development: Application of the institutional analysis development framework to nanotechnology consortia.Technovation, 2012, 32 ed., pp: 216-226.

Churchill, Jr., G.A., 1987. Marketing Research: methodological foundations. Chicago: The Dryden Press.

Firat, A.K., W.L. Woon and S. Madnik, 2008. Technological Forecasting - A Review. Working Paper, Composite Information Systems Laboratory, Massachussetts Institute of Technology, Cambridge.

Godet, M. and P. Durance, 2011. A prospectiva estratégica para as empresas e para os territórios. UNESCO - Organização das Nações Unidas para a Educação, Ciência e Cultura.

Linstone, H.A., 2011. Three eras of technology foresight.Technovation, 31 ed., pp: 69-76.

Neves Cristo, C.M.P., 2002. Prospectiva estratégica: instrumento para a construção do futuro e para a elaboração de políticas públicas. VII Congreso Internacional del CLAD sobre la Reforma del Estado y de la Administración Pública, Lisboa, Portugal, 8-11 Oct.

Robinson, D.K.R., L. Huang, Y. Guo and A. Porter, 2013. Forecasting Innovation Pathways (FIP) for new and emerging science and technologies. Technological Forecasting &Social Change, 80 ed., pp: 267-285.

Vergara, S.C., 2000. Projetos e relatórios de pesquisa em administração. São Paulo: Atlas.

Zimmermann, M., D. Inga-Lena and H.A. Von Der Gratch, 2012. Integrating Delphi and participatory backcasting in pursuit of trutworthiness - The case of electric mobility in Germany. Technological Forecasting & Social Change, 79 ed., pp: 1605-1621.