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Research Article

TECHNOLOGICAL FORECASTING (TF): THE METHODOLOGY USED BY PETROBRAS – BRAZILIAN OIL COMPANY

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A B S T R A C T

This paper discusses the use of Technological Forecasting as a tool for creating prospective scenarios within the process of strategic management in organizations. The work was guided by descriptive research based on bibliographical review of the theory and case studying was the procedure adopted. Data collection was carried out by a semi-structured questionnaire, previously tested, where data about the scenario building process at Petrobras. In the analyzed company this process has characteristics of systemic circularity, integration with the strategic management process, showing itself as a tool for following up and adjusting the organizational strategy. The techniques have their relative relevance in the process, which points out that the characteristics of the strategic process in the organization involve much of its culture and approach towards the future, its anticipation, action and appropriation of the strategic process.

INTRODUCTION

Speaking of the future makes us think about "what to look for" and "about what should we look for", according to Peter Schwartz (2006); considering this we are dealing with two worlds, the world of facts and the world of perceptions. The world of facts takes us to data on the future about which we are knowledgeable but are not completely sure when it comes to its functioning; we know it will have an impact on the reality of the companies, countries and societies; among these pieces of data we have: increase in life expectancy, decrease in birth rates, family size reduction, city growth, women's work, internationalization of markets, the impact from information and communication technologies, product life cycle reduction, environmental pressures, among others. On the other hand, the world of perceptions explores the facts by creating links in the decision makers' minds, by gathering information and making future scenarios about a new reality involving these same variables: will older people be healthy when they turn elderly? Will they have income? Will they be concerned about their health and diet? Will they use technology? Will they be tourists or look for a new activity or profession?

Another challenge that imposes itself on organizations involves the understanding and comprehension of technological changes, its possibilities and impacts on the economy, society, and business operations. Actually, as Carlota Perez (2004, P.3) states when writing about innovation and its technological changes, it is necessary to understand that "the technically viable world is always much larger than the economically viable one, which in turn is much bigger than the socially accepted one". Products, services and the production processes of a given company are directly impacted by technological evolution, not to mention that the same technology that creates development can also generate locking in and technological dependency (path dependent); according to Mendonca *et al (2013),* if the evolution of technology process is not seen as an evolutionary process of accumulation and creation of new knowledge, the technological development itself creates dependency and competitive segregation. Looking forward in this case implies knowing when to drift away from old technologies and which technologies to move towards in the future.

Within this point of view, Firat, Woon, and Madnick (2008) propose carrying out studies based on the *Technological Forcasting (TF)* concept, understood by the authors are being all the intentional and systematic attempts to forsee and understand the potential, the direction, the speed, the characteristics and the effects from technological changes, especially the invention, the innovation, considering its adoption and use. Innovation is not an exclusive concern of large companies, in small businesses its impact can be even more destructive and; in this same regard, governments carry out technological impact studies in their economies and competitive advantages in future markets in an attempt to develop new areas of knowledge and research in which they can be competitive. Considering this, TF can help governors to direct their research activities to develop new technological áreas with greater social and economical impact creating

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networks of consensus about the most promising scientific and technological areas in a give place, region, or country.

At first, aspects related to drawing up business strategic planning will be addressed in this paper with the help from scenario planning and Technological Forecasting (TF) as stages in the process of generating strategic alternatives. Secondly, a set of scenario prospecting techniques will be shown, categorized by families and identified as tools for powering the scenario prospecting methodology. At the fourth part, the methodological aspects of this work will be discussed. At the fifth part, the data about the analyzed company, methods and techniques used for drawing up scenarios will be presented. At the sixth part, we will have a discussion on the results of this case study in regards to the proposed theory. Finally, we will finish this paper with final considerations on the topic.

The Process of Strategy and Planning of Scenarios

The creation of scenarios within a strategic process traditionally aims at finding a favorable position for the business in a likely future setting. Hence the questions from Godet and Durance (2011): "What does your company intend for the future? Predicting it or building it? Strategic Foresight (American version) and Strategic Prospective (French version) work under a common proposal where the future is not to be predicted but built; it is not written. It is to be built and the responsibility for decision making in the present, in the light of a possible and desirable future, falls on the organization.

Prospective strategy works on the idea of pre-active anticipation (preparation for change) and proactive (making the change happen), see image 01; it means that pre-active organizations prepare themselves for inevitable and foreseeable changes but it does not mean that they cannot also be proactive, transforming the strategy into action taking ownership of the creation of their own future.

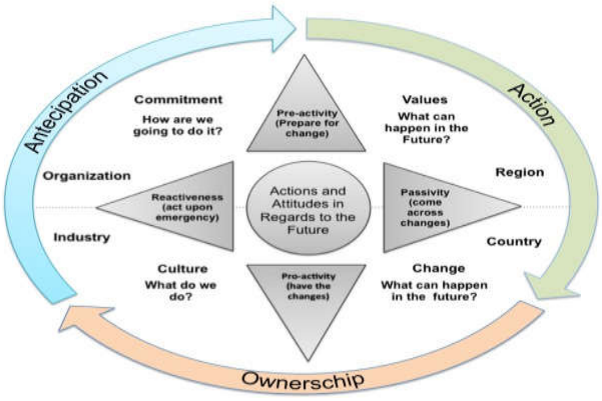

Image 1 Decision Makers' Actions in Regards to the Future

Source: Made by the authors basedon Godet and Durance (2011).

Godet and Durance (2011) thought of Gaston Berger (1959) as the father of prospective strategy and his thoughts on strategy point out that the action, being pre or pro-action, relies on the decision makers' strategic attitude and it involves: seeing far, seeing wide, seeing deep, thinking up the Man and taking risks. Planning as proposed by Ackoff (1973), involving "conceiving a desired future as well as the real means to get there", does not differ anyhow from the prospective proposal. However, when faced with future prospect, men can come across changes (passivity), act upon emergency (reactiveness), prepare themselves for foreseeable changes (pre-activity) and finally, act on making desirable changes (pro-activity) (GODET AND DURANCE, 2011).

Decision makers' positioning towards the future, whether they are organizational, plant, region, or country managers, is strongly influenced by their values, their commitment to change, culture and available resources for carrying out the change. By Godet and Durance (2011, p. 24)

The effectiveness of any organization comes from a balance alliance between logos (the thinking, the reasoning), epithunia (the desire, the will), and erga (the actions, the achievements). The marriage of passion and reason, of the heart with the soul, is the key to the success of the actions and development of individuals.

Strategic prospecting works on the idea that ruptures, tendencies, and uncertainties of the market are more easily noticed by decision makers when they understand that there are links between organizational strategy and future actions. For Ireland *et al* (2014), strategic management is a whole set of commitments, decisions, and needed actions for the company to get a competitive advantage and above average paybacks, see image 02; when managed on the basis of scenarios it guides decision makers over the required actions towards a possible future based on organizational competences in comparison with the playing out of the scenario context.

For Heijden (2004), scenarios are a language for strategic conversation and, in its creation process, decision makers can show their different points of view in regards to likely futures to be tried by the organization. It is possible to think up a common future, wished for, likely and possible to happen from discussing and understanding that it is doable; organizations take ownership of the creation of their own pathways towards the future, their decisions and actions start to involve proactive aspects, which promote change by managing the ambiguity and strategic uncertainty.

The creation of prospective scenarios does not intend to eliminate uncertainty, but organize it in such a way that it can be managed in a reduced number of options. For Kahn and Wiener (1968), a scenario is a "hypothetical sequence of happenings built to put in evidence the causal chains and the links of decision", as for Schwartz (2006), he understands that scenarios are a tool to order decision makers' perceptions in regards to future alternative environments in which the consequences of their decisions will happen; in other words, "it means making choices today with an understanding about what can happen to them in the future" (SCHWARTZ, 2006, p.15).

Strategic management is understood by Godet and Durance (2011) as being the prospective strategy that embraces, in its creation process, the drawing up of prospective scenarios as one of the elements in the strategic process. Under this point of view scenarios work as an element for taking ownership of what can happen to an organization in the future; it is what Schwartz (2006) calls dealing with two worlds, the world of facts and the world of perceptions. Heijden (2004) underlines that we do not know what will happen in the future but our ignorance is not absolute.

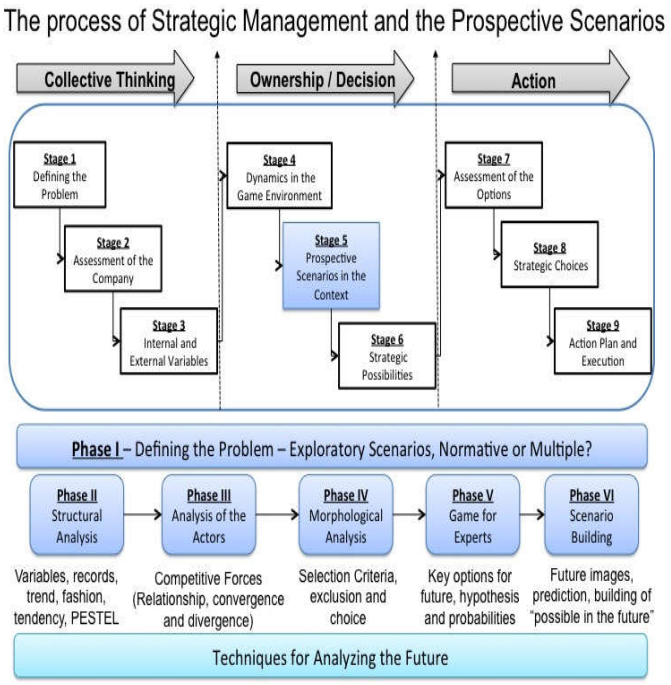

Image 2: Strategic Management and Scenarios

Source: Made by the authors based on Godet and Durance (2011)

In the process of drawing up scenarios, the first stage of the methodology involves defining the problem to be addressed: (i) it will be exploratory scenarios, free of surprises, with predictable variations, based on facts and data on the behavior of the main economical, social, environmental, political, and technological variables; (ii) it will be normative scenarios where the organization works aiming at building a desired and possible future; (iii) it will be Multiple scenarios, innovative, creative, contrasting, alternative.

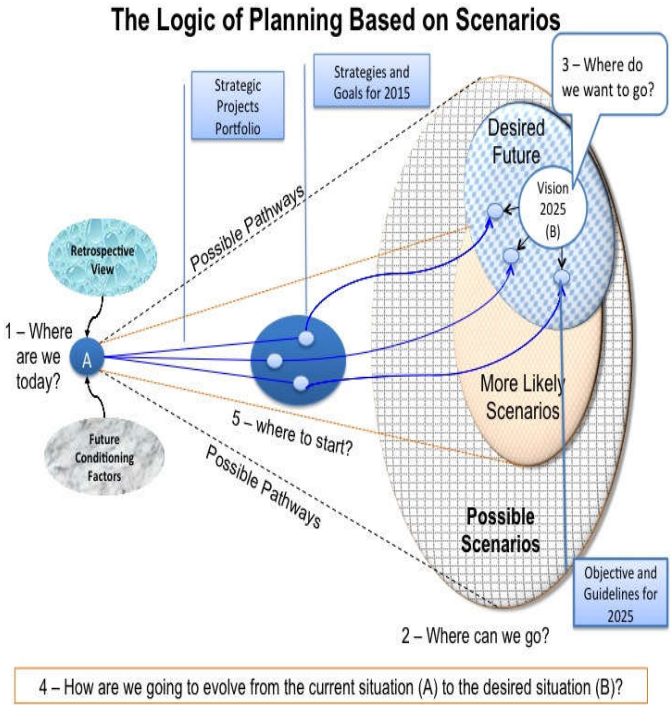

Image 3 Possible, Likely Scenarios, and the Desired Future

Source: Made by the authors base on Macroplan Model of Scenarios.

We must consider that drawing up scenarios is an intellectual interdisciplinary and transdisciplinary process characterized by a global and systemic view where the actors and the variables perform different roles in building one or more alternative, doable, and possible to happen futures, see image 03. Its drawing up involves knowing where we are today, where we can get to, where we want to get to, how we have to evolve in order to reach the expected result but mainly, it points out where to start the process.

The next stages in the process of drawing up scenarios are filled with techniques and tools that make prospecting future variables easier but according to Godet and Durance (2011, p.38), the techniques should be used to: "promote imagination, reduce incoherence, create a common language, structure collective thinking and allowing for ownership". However, methods and formal techniques should not replace the decision makers' ability of thinking, see chart 1, tools and rules making using the methodology easier but using them without knowing the cause can be more detrimental than beneficial.

Reflecting on Uncertainties in the use of Scenarios					
Type of Scenario	**Level of involvement of scenarios**	**What it is for**	**As for the Possibility to do it**	**Objective in the use of Scenarios**	**Scenarios, Strategy, and the Future**
Normative – building desired future	Worldwide Macro-scenarios, National or Regional	Testing strategies	Possible	Quality of decision	Strategy Aligning
Exploratory Extrapolative – free of surprises with predictable variations	Scenarios for industries, markets or specific segments of business	Creating new Vision	Likely or as a Reference	Risk and Tendency Perception	Behavior of Variables
Multiple Explorative – Innovative, creative, contrasting, alternative	Scenarios focused on strategic matters	Exploring new business possibilities	Favorable	Anticipation	New Events and tendencies
	Business Scenarios	Creating alternatives	we can make it happen	Visionary Process	New Strategies
		Creating ambiguity	Reference	Process of thinking about business competences	Capability to respond

Chart 1: Thinking about uncertainty and the use of scenarios

Source: Made by the authors

Scenario Prospecting Techniques

For Andersen and Andersen (2014), the studies that attempt to predict the behavior of technology, business, and the society have been mostly approached in a descriptive way and even in a prescriptive way or else, as Godet and Durance (2011) state, have been called scenarios, futurology, Forecasting, prospective strategies, pro-futures (future prospection), possible futures; what matters for the authors in this case is that there is a gap between theory and practice in these predictions. On the one hand, future studies are sometimes classified as art, imagination, thinking and creative action (Martin, 1995), but on the other hand a good prediction system about innovation should cover the interdependent dimensions of science, technology and innovation identifying synergy and barriers that could play a role in the interaction of factors hindering innovation (ANDERSEN and ANDERSEN, 2014).
Phadnis *et al* (2014) states that although we have several writers approaching the subject of scenario development process like Schwartz (2003, 2006), Heijden (2004), Godet and Durance (2011) among others, states are pointed out but how each stage of the process should be carried out in scenario drawing process is not described. The writers suggest three unanswered questions: (1) Who should carry out each stage

and what data sources should be used? (2) What are the methods to be used to gather the needed information? (3) What are the reasons for making the choices above? In the same text the writers discuss the importance of quality of data whether it is qualitative or quantitative, how this data is gathered and how important the human element is in this process, a diversified and prepared team can make a reliable and diverse set of scenarios.

Harries (2003) argues that scenario quality has to do directly with how methods and techniques are used, and states that methods and techniques are clearly prerequisites for validation or assessment of the scenario planning. For Godet and Durance (2011) the easy access to methodological choices involves having a tool box for prospecting scenarios and strategies available, allowing for the good strategic questions to be put forward, identifying the key-variables, analyzing the game of actors, the field of uncertainties, enabling a comprehensive assessment of the analysis environment.

For Firat, Woon, and Madnick (2008) there are too many ways and study methodologies for Technological Forecasting (TF) being currently used. By comparing with Schwartz (2006) concept of world of facts and world of perceptions, these study methodologies can be grouped in the following way, see image 04: (i) World of Facts: involves assessing data and concrete facts, which are observable and about the technological national systems, technological impacts and effects, methods for technology prediction from monitoring and surveillance on technological impact; (ii) World of Perceptions: involves intelligence and competitive technique from multidisciplinary teams to develop new possible routes for technology, its impacts and effects at late adoption or impacts from its development, thereby techniques that allow for this predictions are necessary.

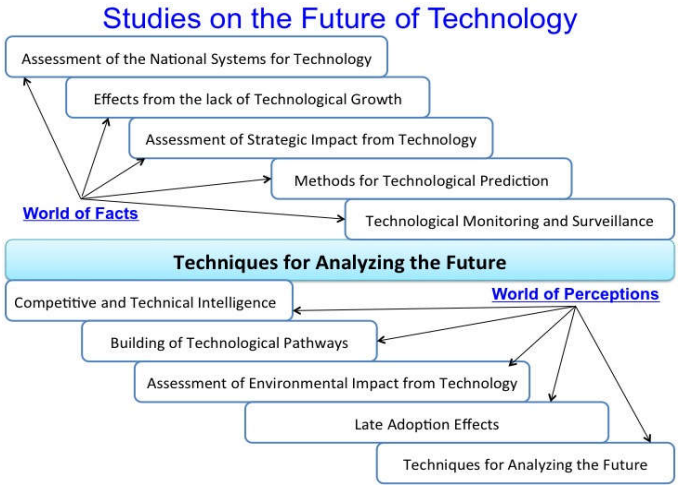

Image 4 Study on the future of technology: Techniques for Assessing the Future

Source: Made by the authors basedonFirat, Woon and Madnick (2008)

From these observations, Firat, Woon, and Madnick (2008) propose a classification of these techniques in nine big families described in chart 01.

Professor Michael Keenan from Manchester University, in a speech given at 3rdInternational Conference on Foresight – NISTEP, Japan 2007, already suggested that there were too many different methods in use, as shown in chart 01 but he also suggested that they can and should be combined in a lot of different ways creating several diverse ways to carry out the prospective process. Each scenario building process should look for a set of techniques that is sensitive to what we want to prospect, what impact we want to create, which relationships we want to measure, what level of change we want to put forth. In research done across a data base with more than 800 scenario case studies, professor Keenan reached the following results on the use of scenario prospection techniques:

- The most used methods are for sure, bibliographic review (437), board of experts (397), and scenarios (324).
- Other commonly used methods are futures workshops (195), brainstorming (157), extrapolation of tendency (133), interviews (127), questionnaires/inquiries (121), Delphi (120), key-technologies (120), megatrend analysis (110), and SWOT analysis (107).
- Some less used methods are roadmapping technology (76), environment monitoring (69), modeling and simulation (52), tests (50), and back-casting (42). More than half of the cases using road-mapping technology are from North America.
- Rarely used methods include mapping of interested parties (30), citizen boards (28), structural analysis (13), cross impact analysis (12), multi-criteria analysis (11), bibliometrics (7), games (4), morphological analysis (4), and relevance trees (2).

After looking at Keenan cases (2007) we come to the conclusion that for each specified goal in the first stage of the process, in other words, at the identification of the problem to be explained by the scenario, is when the methodological approaches are chosen, the techniques, the tools, and the team will perform exercises, the analysis and prospection of future scenarios. For the author only one thing is certain, the result: Complexity.

METHODOLOGY

The research methodology will be presented in two parts to make the understanding easier, being the first one the scientific character and the second one the carrying-out of the research. Building knowledge requires the research to show a level of order conveying the interests, research development and results, favoring the reader with deep understanding of the work. Thereby, the methodological procedure undertaken in this paper aimed at reaching the main objective of the research.This work, regarding approach, has qualitative characteristics because it intends to understand and classify the processes in the organization requiring more knowledge and a deeper study of its process and routine. (BEUREN, 2003). The research methodology will be presented in two parts to make the understanding easier, being the first one the scientific character and the second one the carrying-out of the research.

Scientific Carachterization

Acording to Vergara (2003), the research should be subdivided considering the ends and the means. As for the ends of the research, it is descriptive because it intends to report, identify, copare, analyze, classify the data, and qualitative due to the need for deeper analysis in regard to the subject of study. As for the means, the study used bibliographical research, whose premise is an investigation of all ever produced and published material on a specific subject, to analyze, interpret, and organize ideas in order to find the best possible solution for the problem under study. As for the technical procedures, it is characterized as a case study.

Technological Foresighting – Families of Methods	
1. Expert Opinion	Delphi (iterative survey) , Focus Groups [panels, workshops], Interviews, Participatory Techniques
2. Trend Analysis	Trend Extrapolation [Growth Curve Fitting], Trend Impact Analysis, Precursor Analysis, Long Wave Analysis
3. Monitoring and Intelligence Methods	Monitoring [environmental scanning, technology watch], Bibliometrics [research profiling; patent analysis, text mining]
4. Statistical Methods	Correlation Analysis, Demographics, Cross Impact Analysis, Risk Analysis, Bibliometrics [research profiling; patent analysis, text mining]
5. Modeling and Simulation	Agent Modeling, Cross Impact Analysis, Sustainability Analysis [life cycle analysis], Causal Models, Diffusion Modeling, Complex Adaptive System Modeling (CAS) [Chaos], Systems Simulation [System Dynamics, KSIM], Technological Substitution, Scenario-simulation [gaming; interactive scenarios], Economic base modeling [input-output analysis], Technology Assessment.
6. Scenarios	Scenarios [scenarios with consistency checks; scenario management], Scenario-simulation [gaming; interactive scenarios], Field Anomaly Relaxation Method [FAR]
7. Valuing / Decision / Economics Methods	Relevance Trees [futures wheel], Action [options] Analysis, Cost-benefit analysis, Decision anaysis [utility analyses], Economic base modeling [input-output analysis]
8. Descriptive and Matrices Methods	Analogies, Backcasting, Checklist for Impact Identification, Innovation System Modeling, Institutional Analysis, Mitigation Analysis, Morphological Analysis, Roadmapping [product-technology rodmapping], Social Impact Assessment, Multiple perspectives assessment, Organizational analysis, Requirements Analysis [needs analysis]
9. Creativity	Brainstorming [brainwriting; nominal group process (NGP)], Creativity Workshops [future workshops], TRIZ, Vision Generation, Science Fiction Analysis

Chart 1 Classification of Assessment Techniques
Source: Firat, Woon, and Madnick (2008, p.5-6)

Case study investigates only one organization checking deeply its management model to clarify the main objective of the research (BEUREN, 2003). In order to get vast and detailed knowledge on the object of study (GIL, 1999; COOPER; SCHINDLER, 2003.). Case study allows for unveiling a scientific distress in order to understand a phenomenon inserted in a real organizational context (YIN, 1989; 2005; 2011). The main distress, guiding this research is "Understanding which is the scenario building methodology adopted by Petrobras, as well as the techniques used in this process, aiming at understanding how they contribute to strategic planning of the company".

Operation of the Research

The operation of this research was separated in three stages. The first one was the building of a sequence of interviews done directly, in other words, the interviewer asks a question and the interviewee answers it in a face to face setting. At the second stage the subject of the research was defined, thereby some elements were taken into consideration, (1) the interviewee should really be the person who has the needed knowledge to satisfy the required information, (2) planning of the interview and the questions to be asked, they should be prepared beforehand, being the questions structured before the interview, (3) a pre-test was carried out with another researcher aimed at collecting some critique about the data collection instrument. (KAUARK*et al*, 2011).After knowing the methodological procedures of this research, the case study will be presented with historical elements in context along with the analysis of the data gathering followed by final considerations and bibliography.

RESULTS

Historical Record ofthe Researched Company

Petrobras was founded on 3rd October 1953 and it is constituted as an S.A., an open joint-stock company, with operations in 24 countries in all continents. It leads the oil business in Brazil and reached number 5 biggest energy company in the world in 2011 according to its market value by PFC Energy Consultancy ranking. In the oil industry, gas and energy, it works with the exploration, production, refining, marketing, transport of oil and natural gas, petrochemical, distribution of sub-products, electricity, bio-fuel, and other renewable sources of energy in an integrated and specialized way.

Petrobras was structured and legally registered intent on exploring the Brazilian state oil monopoly on behalf of the State. Its operations in exploring and producing petroleum, as well as other activities connected to the oil sector, were a monopoly run by Petrobras from 1954 to 1997. In that period of time Petrobras took the lead in selling petrochemicals in the county.After running the petroleum state monopoly in Brazil for over 40 years the organizations started to compete with other foreign organizations in 1997. From then on the National Petroleum Agency – ANP, responsible for regulating, supervision, and hiring of services in the sector, and the Energy Policy National Council, responsible organ for writing public policy on energy, were created.

In 2006 production at P-50 (platform) started, in Campo de Albacora Leste, in Campos Basin, and it allowed Brazil to reach self-sufficiency in petroleum. Besides the activities of the holding company, Petrobras System includes subsidiaries – independent organizations with their own directory connected to headquarters (LEITE, 2013). Under this point of view, according to Leite (2013, p. 98), Petrobras vision for 2020 is expressed below: "We shall be one of the five biggest energy integrated organizations in the world and the favorite one by our interest public." And still by Leite (2013, p. 98), Petrobras mission is: "Working safely and profitably, with social and environmental responsibility in the national and international markets, supplying products and services adequate to the customers' needs and contributing to the development of Brazil and the countries where it operates".

In 2007 an important Discovery emerges, the pre-salt. The petroleum and natural gas discoveries in the pre-salt of the Brazilian coast bring about a new horizon for the oil industry worldwide. At the same time Petrobras came up with a series of strategic actions that secure the development of all the goods and services chain bringing technology, professional education and great opportunities for the national industry. In 2012, production in platform FPSO Anchieta City started in the field of Baleia Azul. In 2013 the production in the pre-salt reaches the 300 thousand barrels of petroleum per day mark (PETROBRAS, 2014).

Petrobras Prospecting Model

Petrobras is an organization that, along its operations, has adapted and evolved constantly its business objective.It started as a crude oil extraction/exploration company and afterwards migrated to being an energy production company.The data will be presented in three large groups for better understanding Petrobras building strategy process, starting with the respondent's profile, organizational structure, and prospecting technique.

Profile of Respondent

For choosing the interviewee the researchers sent the company a request expressing research interest and a few days later were pointed to the employee responsible for building scenarios at Petrobras. The interviewee has a degree in economy and accounting, post graduation degree (*Lato Sensu*) in Petroleum Economy and Economical Conjunction Analysis, both courses done at Federal University of Rio de Janeiro, and a master's degree in Economy, with emphasis on public finances.

He has been in the company since 1990 and started his work in the hiring department (until 1993) and moved on to the planning department. His work was at first short termed with a 12 month deadline, making estimates and budgets, performance analysis, contributing for the building of the business annual plan. After 2007 started to work with long term planning especifically with strategic area and building of scenarios.Currently he is the coordinator of Macro-environment Analysisin Markets and Businesses Study Management, and resposible for building macro-scenarios of the company.

Organizational Structure

In regards to creation of scenarios, it falls under the responsibility of the Executive Management Department and Corporate Strategy, the strategy department contributes to the company since its start. By executive management department it is understood as having staff and, as objective, coordinating all strategic planning process in the organization assisting the presidency directly.This department has two large areas, one is responsible for short term strategic planning and the other for long term strategic planning. It is important to understand that both assign a lot of attention to management of *portfolio* and its integration to the strategic planning of the organization. There are two managing departments to help in this process, one deals with project evaluation systematizing and the other takes care of strategic allocation of portfolio, both are closely connected to strategic planning.

Thus, strategic planning is divided into several managerial, such as manage planning and budget, with a focus on short-term (one year), manages strategic analysis that works plan management business, taking into account the horizon five years and finally, manages markets and business studies with focus and track and monitor business environment and their interactions.

Thereby, strategic planning is divided into diverse managing departments, such as budget and planning management, focused on very short term (a year), strategic analysis management department that works out the business management plan taking into consideration 5 years ahead and finally, study of businesses and markets management department focused on following and monitoring business environment and its interactions.

Prospecting Techniques

The use of scenarios in the composition of strategic planning at Petrobras has its origins in the seventies but in a very beginner level. In the eighties (1986 – 1987), the company was part of a group of important companies in that time, including the Social and Economical Development National Bank – BNDS, and Eletrobras, that collectively developed scenarios in technology. But it was in 1989 that the company systemized the building of scenarios in its strategy.

The plan took five months to be developed (from August to December 1989) and the timeframe was from 1990 to 2000. The project was named the 1st Strategic Plan in the Petrobras System. The plan was jointly developed by superintendents of departments, Services, and Vice-Presidents of Subsidiaries having the support from Macroplan Strategic Prospection & Management, one of the most experienced Brazilian consultancies in prospective scenarios. The work drew up worldwide scenarios, national scenarios, and scenarios in the oil industry making it possible to formulate strategies looking at internal and external environment and intended to anticipate diverse difficulties in the short term.In regards to technical aspects, the work allowed for important pieces of information and established a base method for building of new scenarios.

The technique of prospecting and drawing up scenarios used in the company is from the American school and its origins is the theoretical model proposed by Schwartz (2003, 2006), and later concepts from Godet and Durance (2011) were incorporated, see image 05. The method evolved along the time and today it is known as "Petrobras Methodology".The building of scenarios process starts with defining the type of scenario to be built and then carry out the analysis of the historical sequence of known and relevant data for the context of the company. This is the time when the main actors and scenario's influencing variables are identified. At the same time the main questions or key factors are discussed and they limit the scenarios carrying out research with the consultants, researchers, analysts and stakeholders from other companies present in the micro environment.

This exercise is intended to explain the driving forces. After having a wide range of possibilities the process of purification and narrowing starts, going through debates with employees of the company to indentify which variables have bigger or smaller impacts and high or low uncertainty (predictability). Afterwards, the consolidated tendencies and critical uncertainties are defined, linked to a cross impact analysis, with qualitative characteristics, on the impacts and inter relationships between these variables. In this sense, it is very important to reduce the initial number of variables, not going over twenty variables to be analyzed for building the scenario. In the next step the pillars of the scenarios are established and there are usually two consolidated pillars from which four scenarios branch out. Following this, there is the process of describing the pathway and the scenarios taking into consideration the timeframe that is under study. All this process allows for predicting the outer environment and from this moment on the energy industry is focused by making additions related to the energy sector.

Once the scenarios are made, they are presented to the directory of the company for analysis and identification of variables to be monitored along with the monitoring premises (length of time for following up, variable indicator, frequency, data source). Monitoring and following the key variables in the scenarios has been one of the key characteristics of the strategic prospection process in the company besides scoring points for environmental monitoring. They serve as an input for the restart of the creation of scenarios process characterizing them as a systemic process in a spiral of organizational learning.

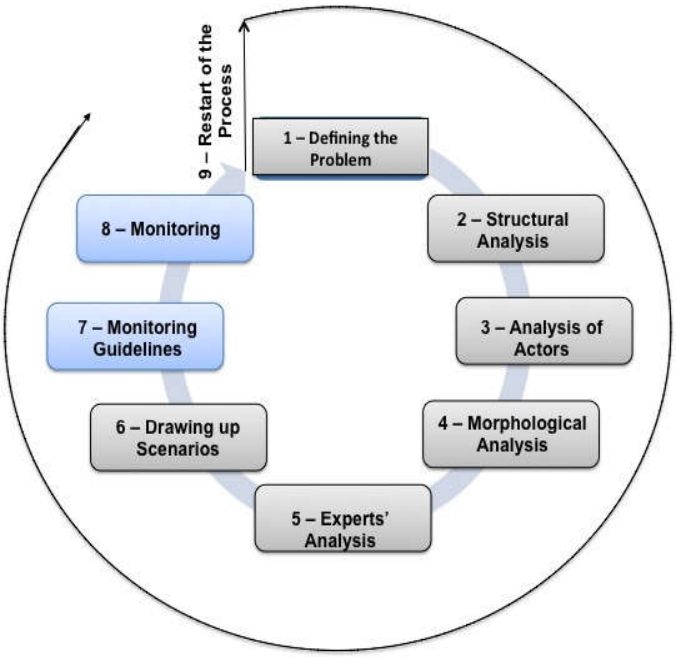

Image 5 Graphic Picture of Petrobras Methodology for Drawing up Scenarios

Source: Made by the authors

Once described the prospective scenario building process of the company, the analysis of the techniques used by the scenario team at each stage is started. The nine families proposed by Firat, Woon, and Madnick (2008, p.5-6), listed in chart 01, were used in the data gathering and the person in charge for supplying the data informed which techniques are used by the company in each stage of the process. Chart 02 shows us the data related to this questioning.

Following that, the respondent was requested to classify and list the used techniques according to criteria that involve: Their use (complex, average complexity, easy to use, or if the general information is qualitative or quantitative), Outcomes (Wide, specific, limited, or data that requires treatment and/or combinations to be used), Speed in the use of the techniques (very fast, average speed, regular speed, little speed), Financial cost (high, average, regular, low), Cost related to time in the use of the techniques (high, average, regular, low), Level of expertise from the expert in the use of the techniques (high, average, regular, low), and Main Disadvantage in the use of the techniques (Complexity, high cost, level of expertise from the analyst, gathering of data, and time consumption in the use of the technique). The data is shown in chart 03.

Families and Techniques of Analysis	Phases of the Process							
	I	II	III	IV	V	VI	VII	VII
1) Expert Opinion								
• Focus Groups								
• Interviews								
2) Trend Analysis								
• Trend Impact Analysis								
3) Monitoring and Intelligence Methods								
• Monitoring								
• Bibliometrics								
4) Statistical Methods								
• Correlation Analysis								
• Risk Analysis								
5) Modeling and Simulation								
• Agent Modeling								
• Cross Impact Analysis								
• Sustainability Analysis								
• Causal Models								
• Economic base modeling								
• Technology Assessment								
6) Scenarios								
• Scenarios								
• Scenario-simulation								
• Field Anomaly Relaxation Method								
7) Valuing/Decision/Economics Methods								
• Economic base modeling								
8) Descriptive and Matrices Methods								
• Analogies								
• Checklist for Impact Identification								
• Institutional Analysis								
• Social Impact Assessment								
9) Creativity								
• Brainstorming								
• Creativity Workshops								

Chart 2 Families and Analysis Techniques used in each phase of the drawing up scenarios process

Source: Made by the authors

Families and Techniques of Analysis	Phases of the Process						
	Use	Result	Speed	Financial Cust	Time Cost	Level of Expertise of the Analyst	Disadvantage
1) Expert Opinion							
• Focus Groups	Complex	Need to be traded	Regular	Average	High	High	Complex
• Interviews	Complex	Need to be traded	Regular	Regular	High	High	Complex
2) Trend Analysis							
• Trend Impact Analysis	Complex	Need to be traded	Regular	Low	Average	Large	Expertise
3) Monitoring and Intelligence Methods							
• Monitoring	Quantitative	Especific	Regular	Average	High	Average	Data Gathering
• Bibliometrics	Quantitative	Especific	Regular	Average	High	Average	Data Gathering
4) Statistical Methods							
• Correlation Analysis	Complex	Especific	Average	Low	Average	Large	Expertise
• Cross Impact Analysis	Complex	Wide	Regular	Low	Average	Large	Expertise
• Risk Analysis	Complex	Wide	Regular	Low	Average	Large	Expertise
5) Modeling and Simulation							
• Sustainability Analysis	Complex	Wide	Regular	Low	Average	Large	Expertise
• Diffusion Modeling	Complex	Wide	Regular	Low	Average	Large	Expertise
• Technology Assessment	Complex	Amplos	Regular	Low	Average	Large	Expertise
6) Scenarios							
• Scenarios	Complex	Especific	Regular	Average	Average	Large	Complex
• Scenario-simulation	Complex	Especific	Regular	Average	Average	Large	Complex
• Field Anomaly Relaxation Method	Complex	Especific	Regular	Average	Average	Large	Complex
7) Valuing/Decision/Economics Methods							
• Economic base modeling	Complex	Wide	Regular	Low	Average	Large	Expertise
8) Descriptive and Matrices Methods							
• Backcasting	Complex	Wide	Regular	Average	Average	Large	Expertise
• Innovation System Modeling	Complex	Wide	Regular	Average	Average	Large	Expertise
• Mitigation Analysis	Complex	Wide	Regular	Average	Average	Large	Expertise
• Organizational analysis	Complex	Wide	Regular	Average	Average	Large	Expertise
9) Creativity							
• Creativity Workshops	Quantitative	Wide	Average	Regular	Regular	Low	Expertise
• TRIZ	Quantitative	Wide	Average	Regular	Regular	Low	Expertise

Chart 03 Characteristics of the Analysis Techniques

Source: Made by the authors

DISCUSSION

This paper aimed at bringing up aspects related to the drawing up of business strategic planning, to the process of strategy, the use of prospective scenarios as a tool in the strategic management process, to the use of qualitative and quantitative techniques in the scenario building process. We will start this discussion from Phadnis *et al* (2014) point of view that there

are questions without answers in regards to the process of drawing up scenarios.

The first question from Phadnis *et al* (2014) involves (1) who should carry out each stage and what data sources should be used? The gathered data show that one of the main factors of the analysis involves, as cited by Firat, Woon, and Madnick (2008), Keenan (2007), and Phadnis *et al* (2014), the expertise and multidisciplinarity of the team. The listed techniques in use by the organization in its scenarios building process show, as main characteristics, see chart 03, the complexity, wide results that often have to be treated for a combined use of information, its complexity works as a characteristic and often as a main disadvantage of the technique but the correct term may be not disadvantage but a demand from the technique for it to provide the expected result.

The second question involves: (2) which are the methods to be used to gather the needed pieces of information? In this case, the gathered data points us towards Keenan (2007) reflections on this; he says that what matters is not the quantity of tools to be used, or if they are qualitative or quantitative, but that everything depends on the complexity to be analyzed, on the level of expertise of the scenarios team, on the expected results from the use of the techniques. Speed, cost and time for getting data are answered, almost as a standard answer in all questioning, being considered regular and average. Items like the use of the techniques, expected results, level of expertise from the analysts, and disadvantages (demands) are described as more important and determine the use of the techniques.

The third question involved: (3) what is the reason for making the choices above? This question can be answered by the data on chart 02, the choices for which techniques to be used is more related to the stages in the scenario building process or, as stated by Schwartz (2003, 2006), it depends on the world of facts and the world of perceptions. The quantitative tools provide the decision makers with a factual base for data and information analysis, even though they are complex, need treatment, need combinations to create information for the decision makers. The qualitative tools serve as a stage in the process where creativity, the extrapolation, invention and innovation are present. More reasoning (facts) or more intention (perceptions) depend on the management style of the organization and on its decision makers, as proposed by Godet and Durance (2011), it depends on passivity, reactivity, pre-activity, or pro-activity.

Another important aspect to be discussed in the paper involves the process of strategy. Whether it is because it is easy to explain or because it is understood in this way, the process of strategy usually is seen as a sequence of linear and encapsulated stages where scenario prospecting is a strategic possibility creation stage that involves purpose, likelihood for carrying out the strategy and objective of its use, see chart 01. In the model of scenario prospecting in the case under analysis some aspects are evident: (i) the first one is related to its circularity and systematizations in its building, scenario prospecting does not end with the drawing up of scenarios itself, it has to be carried on in the choosing and following of these variables having in mind the following up on the strategy and restart of the prospecting process; (ii) not all the selected variables in the scenario will be followed afterwards, the stage of monitoring guidelines will point out which ones should be observed, followed and monitored serving as a base for the next process; (iii) within this point of view the scenarios align themselves with organizational strategy creating more strategic readiness, monitoring of non-predicted events, capability of action and correction of headways of the strategy as proposed in chart 01 in its last column.

Thereby, the Petrobras Method for building prospective scenarios takes us to a systemic thinking, interrelated, going along with strategic management process. It is not only fulfilling a new stage in the process but creating pieces of information for proactive and pre-active decision making which is capable of building competitive advantage within Ackoff (1973)'s point of view that involves "conceiving a desired future as well as the real means to get there", or what is proposed by Ireland *et al* (2014) that, besides competitive advantage, the results should be above average in the industry where we are inserted. As Gaston Berger (1959) has said, action, being pre or pro action depends on strategic attitude from decision makers and this involves: seeing far, seeing wide, seeing deep, thinking the Men and taking risks.

CONCLUSIONS

The organizational management processes are strongly influenced by methods and techniques. The methods show a logic sequence of steps to be followed while the techniques tend to power the several stages of the method. Technological Foresighting techniques present in this article were grouped in nine families based on classification by Firat, Woon, and Madnick (2008) and after the vision from the analyzed company it is possible to see that a lot of tools can be used in different stages of the scenario building process being the manager of the process responsible for selecting the more adequate tools considering what is intended. Thereby, what determines the use of a technique in the process involves aspects like: level of expertise of the scenarios team, time and available resources, type of scenario to be drawn up, methodology used by the organization.

Another important aspect to be seen, affecting future researches, is related to decision makers' strategic posture. Depending on the level of ownership of the pieces of information and the level of action created by the command of these pieces, there are strategic postures, reactive, passive, pre-active or pro-active. There might not be two identical decision makers so, even using identical processes and techniques, the decisions, plans and programs of a country, region, or organization are totally different from each other. Decision making involves emotion and reasoning, thinking and action, thereby, individually, the unique characteristics of any strategic process.

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