

## **STRATEGIC SCENARIOS: AN APPLICATION IN THE BIOTECHNOLOGY AREA**

**Esper Cavalheiro**

Center for Management and Strategic Studies in Science, Technology and Innovation  
esper@cgee.org.br

**Lelio Fellows Filho**

Center for Management and Strategic Studies in Science, Technology and Innovation  
lelio@cgee.org.br

**“Homo sapiens is an amphibian who can live and function in two very different realms - the domain of actual fact which we can investigate in observational inquiry, and the domain of imaginative projection which we can explore in thought through reasoning” (Rescher, 1991).**

### **ABSTRACT**

Scenarios are stories that describe different possible but equally plausible futures developed through methodologies aiming to include the perception of different actors regarding the certainties and uncertainties of complex environments. This paper reviews the role of scenario development as a key tool for the analysis of the future. It also highlights that the function of scenarios is not to predict the future, but to provide opportunities to take part in its construction consistently.

**Key words:** Scenario. Future Studies. Foresight.

## **CENÁRIOS ESTRATÉGICOS: UMA APLICAÇÃO NA ÁREA BIOTECNOLÓGICA**

### **RESUMO**

Cenários são histórias que descrevem futuros diferentes, mas igualmente plausíveis, e que são desenvolvidas a partir de metodologias que se destinam a agrupar as percepções de vários atores sobre as certezas e incertezas sobre ambientes complexos. Este trabalho procura fazer uma pequena revisão sobre o papel da elaboração de cenários como um dos instrumentos importantes nas análises de futuro na tentativa de tornar evidente que a função dos cenários não é de prever o futuro, mas sim de prever as possibilidades para que possamos participar coerentemente de sua construção.

**Palavras-chave:** Cenário. Estudos de Futuro. Prospecção.

## **1 INTRODUCTION**

When Leo Rosten, a sociologist, writer, scriptwriter and voluntary advisor to the RAND Corporation, observed a group of physicists who were trying to create a suitable name for alternative descriptions of how satellites could behave, he said: "You should call them scenarios. In films, a scenario is an extremely detailed outline of a future film..." Herman Kahn, a pioneer in the field of scenarios, loved the suggestion. Scenarios, such as those proposed by Kahn, should be fictional and amusing. They should not focus on making accurate predictions, but rather on understanding the fictitious scene.

Thereafter, the word "scenario" became part of the language of strategic planning, helping organizations to adopt positions regarding complex environments and to construct alternative visions of economic and social behavior by means of the collective construction of possible future representations. In this context, Roubelat (2006) compares the construction of scenarios to the production of ideologies, since these two situations are based on a consistent system of beliefs and/or ideas that are used to explain behaviors and that demand coherent actions.

In order to understand the role of scenario building in strategic planning and its integration into the prospection process, this report will present a short review of the bibliography on subject and then analyze its function at the strategic level.

### **1.1 PROBLEM AND OBJECTIVE**

The usefulness of constructing scenarios first became apparent when the more traditional prospection techniques, which had been used for several decades in the search for reliable forecasts, began to fail, because they were based on an essentially stable world (Bood and Postma, 1997). According to companies, it was necessary for long-term forecasts to take into account economic and social turbulence (Linneman and Klein, 1983). Kahn and Wiener's 1967 interpretation, according to which the central focus of scenarios lies in the causal processes and in the elements that help decision-making based on the mapping of a hypothetical sequence of events, was of fundamental importance

for the consolidation of scenarios as an essential method for future studies.

There are several definitions of the scenario concept, just as there is a wide range of methods for constructing them. However, the core concept that scenarios are a sequence of events that emerge from the present and lead to the future (Masini, 2000) is found in every definition and forms the basis for the entire range of methodologies. In its most frequently used form, the scenario that is drawn up reveals a possible future and explains a sequence of conditions, changes or events that are required to get to this future. Analysis of multiple scenarios introduced the possibility of alternative situations, increasing the options available to decision-makers. It was with this image that scenario studies spread across strategic study environments.

During the construction of scenarios, the participants discuss the current and future trends of a specific undertaking to then come up with scenarios of possibilities. Therefore, decision makers exercise their ability to make decisions in the face of a range of possible futures, trying to concentrate on the handful identified as the most plausible ones. By using scenarios that have been designed based on the undertaking's external and internal contingencies and its uncertainties, trends and opportunities that are normally difficult to anticipate can be identified and evaluated, enabling one to take coherent actions (Miller and Waller, 2003).

A structured process is used to develop scenarios: stories are created based on real data and on the human capacity to "foresee" things, making it possible to explore possible futures. Through the creation of structured stories, facts are combined with perceptions, in an attempt to expand ideas to beyond those that are simply "pre-conceived" and to open up the entire array of environmental contingencies. Thus, the blend of real facts, intuition and creativity makes it possible to generate scenarios that are consistent as well as plausible, without limiting qualitative richness to quantitative figures.

When compared to other strategic evaluation methods, scenario building reveals a series of qualities seldom found in the others, namely: the active participation of various players both inside and outside the undertaking being studied; a wealth of details and an abundant analysis of contingencies that probably would not be highlighted by quantitative studies; the narrative format used to present the possible futures; the ample scope of multiple scenarios

covering the conceivable contingencies and decisions; and the knowledge gained from the interactions between the key variables, among others.

As has already been mentioned, scenarios are not predictions of the future. They help us to perceive the different futures in the present. Schwartz (1991) defines a scenario as a tool that helps us organize our perceptions in relation to the possible environmental futures in which our decisions will have their effects. In other words, it is a set of organized paths that effectively enables us to dream about our own future.

Summing up, scenarios are a disciplined way of thinking about the future (Mietzner and Reger, 2005). Given that the future is unpredictable, this attempt to understand uncertainties becomes the structural part of the scenario building exercise. One of its main objectives is to discover the driving forces that may influence future environments based on pre-determined elements linked to those uncertainties. The scenarios describe different worlds rather than different outcomes for the same world (Wack, 1985).

## **2 METHOD**

This report was drawn up using bibliographical research of academic papers regarded as being at the very core of research into scenarios, showing the main steps that allow the construction of strategic scenarios. It ends with the presentation of an actual case study about biotechnology at a large multinational company, Siemens AG.

## **3 STEPS TO DESIGN SCENARIOS**

There are various methods for constructing scenarios. The "Centre for Innovative Leadership" identified six steps that mirror most of the currently available methodologies:

**Step 1 – Organizational Decisions:** The process begins by clarifying the strategic decisions that one comes across and what type of scenarios might help one improve work in regard to the said decisions. The decision may be as broad as the organization's strategic future or as specific as the simple development of a new program. Regardless of the scope of the decision,

clarifying the “focus of the decision” is doubly important; first, because it reminds us that the scenarios are not an end in themselves, but rather tools that help us make better decisions; second, focusing facilitates the problem of how to use scenarios, because without them we would get lost in broad generalizations about the future of societies and the implications for a particular organization would be lost.

**Step 2 – Key decision factors:** Once we have reached the strategic decision, we are in a better position to examine the “key decision factors,” which can be thought of as “the main things we’d like to know about the future so that we can make the best decision.” Although one cannot know the future, it would be useful if one could at least imagine a set of possibilities.

**Step 3 – Environmental Forces:** Now one must try to identify the forces that may mold the future of these “key decision factors,” which are usually divided into two categories: micro-forces, encompassing those that act directly on the organization’s main activity, and micro-trends, such as demographic changes, economic growth, income distribution, etc. The better one’s understanding of the multiplicity, the interaction and the uncertainty of these “forces,” the more realistic one’s scenario will be. Therefore, a number of specialists use a type of ranking system to estimate the possible impact of these trends on the organization. In general, one may work with:

- “High impact/high probability” forces – which include situations that are relatively certain as regards the future and which must be covered by planning;
- “High impact/low probability” forces – which include the factors that might shape the different futures and for which planning should be prepared.

**Step 4 – Scenario Rationale:** This is the central step in the process and establishes the basic structure of the scenarios. In the case of “high impact/low probability” forces, most can be grouped into two or three “critical axes of uncertainty” where “opposite rationales” are present, namely, opposing visions or theories of “how the world should work” in the future. For instance, one of these axes might anticipate alternative visions that “the health system will be primarily public” or “the privatization of the health system will increase drastically.” Working with these axes and their rationale, one will eventually

select three or four scenarios capable of “grouping the uncertainties” that we are likely to face.

**Step 5** – The scenario itself: This may take various forms, but it must have three main features:

- Be a convincing story: Considering the scenarios as narratives of how events might unfold between the present and the future that has been marked out, taking into account the dynamics (or rationale) attributed to each specific scenario, these narratives must be convincing, logical and plausible.
- Have highly descriptive titles that represent the essence of what is proposed in each scenario.
- Be accompanied by comparative tables that can help decision makers see the main differences in the dependence of the various planned dimensions.

**Step 6 – Strategic Implications:** This is the stage that attempts to interpret the scenarios, connecting them with the strategic decisions addressed in Step 1. The simplest and most direct way to take this step is by answering two basic questions:

- What are the main opportunities and threats that each scenario poses for the organization?
- Is the organization prepared (or could it prepare itself) to take advantage of these opportunities or to avoid (minimize) the threats?

#### **4 HOW TO USE THE SCENARIOS?**

In addition to drawing up the opportunities/threats, there are various strategic considerations that can be derived from the use of scenarios. One of the most obvious ways to deal with them is to see them as “pilot tests” of the strategies used by the organization. Based on the analysis of opportunities or threats addressed in the scenarios, another set of questions can be drawn up, including those about the suitability of the current strategy or the existing flexibility in order to deal with the various conditions. Another way to use scenarios is for their capacity to stimulate the exploration of new strategic

options, since different scenarios require different strategies and futures. If the future were only to include incremental changes, it would be possible to make incremental changes in the strategic options. However, the future includes significant uncertainties and, at specific moments, it is important to propose radical changes in the organization's current practices. The power of scenarios lies in their capacity to group personal strategies with those from the future.

## **5 THE SIEMENS EXAMPLE FOR BIOTECHNOLOGY**

In 2006, Siemens launched a document called "Biovisions 2015" with three scenarios for biotechnology that, although seemingly divergent, appeared to be extremely realistic. By coherently combining the "state of the art" with biotechnology, the specialists who met in October 2005 tried to determine biotechnology's frontier zones and possible futures for this field in 2015. Based on the observation that government investments in biotechnology R&D grew on average by 12% between 2000 and 2005, that there are more than 6,000 companies involved in biotechnological activities and that this figure is growing at the rate of 6% a year, the specialists began to evaluate the need to predict what the growth of biotechnology-based industry will be in the future. As stated in the document, "Biovisions 2015" aims to provide an opportunity to discuss and evaluate social and technological trends, ethical issues, critical success factors, future opportunities and the challenges of biotechnology, and to cover these points from a broader perspective.

To this end, the report takes into account the following sectors for biotechnology-based industry:

- Health: diagnostic kits, immunoassays, diagnostic biomarkers, etc.
- Pharmaceutical: biotechnological drugs.
- Chemical industry: bio-compounds and enzymes, intermediary biotechnological processes, etc.
- Foodstuffs and beverages: fermentation and functional foods.
- Paper: bio-whitening, etc.
- Metals and minerals: biological neutralization of toxic compounds, bioremediation.

- Energy: biomass fermentation to produce ethanol.
- Safety: treatment of waste by biological means.
- Others: bio-defense, environmental monitoring, etc.

It is then proposed that the biotechnological sector should be divided into four distinct segments, according to the application area:

- Red biotechnology: applied to medical and diagnostic use.
- Green biotechnology: applied to agriculture.
- White biotechnology: applied to industry.
- Scientific biotechnology: developed at public or private research centers in all areas of the life sciences.

From the trends and challenges that biotechnology faces, the specialists selected the following:

- Ageing of the population and increase of healthcare costs.
- Lack of specialized human resources.
- Increase in infectious diseases.
- Scientific development and new discoveries.
- Pharmacogenomics and personalized medicine.

Based on these data, three scenarios designed. The first, entitled "Just the Basics," outlines a scenario in which there is an avian flu pandemic between 2006 and 2015, forcing governments to invest heavily in the search for a vaccine, which is conceived by means of modern biotechnology. This spurs small and medium-sized biotechnology companies, especially those that work with cell cultures and recombinant proteins. As a result, economic growth is mediocre. With the rising cost of health systems, the rising production of unbranded drugs in the poorest countries and the centralization of academic research in the search for solutions to infectious diseases, the development of new drugs is abandoned and the pharmaceutical companies try to offset the economic loss by increasing the automation of production processes and by investing in "in silico" experimentation. The absence of spectacular discoveries in the field of biotechnology reduces the population's enthusiasm and ongoing malnutrition in a number of countries increases the level of distrust regarding the announced benefits of genetically modified seeds.

The second scenario proposed, "Perpetual Motion," begins with the accelerated economic development of the European countries, which is challenged by a bioterrorist attack resulting in significant investment in the bio-defense systems of various countries. Additionally, suspicions regarding the involvement of scientists in the biotechnology area and increased insecurity lead to restrictions upon their activities. The ongoing rise of oil prices puts pressure on the quest for alternative energy sources, promoting the development of bio-refineries.

The so-called "Full Steam Ahead" is the third scenario. It presents an environment of unprecedented scientific development. The first discoveries in proteomics are made. Moreover, new information on the growth and use of RNA interference for the treatment of diseases and the development of new drugs arise swiftly. These developments are encouraged by the growing financial contributions from both public and private sources. "In silico" simulation of organs and pathways permits the validation of clinical trials. New chips make it possible to detect the molecules and proteins involved in human pathologies. These scientific successes go hand-in-hand with the development of regulatory and legal frameworks suitable for using genetically modified organisms, tissue engineering and gene patenting. Bio-generics reach high standards and are globally accepted. Thanks to the stimulating scientific environment, the utilization of generics is no longer a problem for the pharmaceutical industries, which actively invest in innovation. In response to globalization and international harmonization, talented people can move freely between countries and biotechnology's success increases the degree to which they are accepted by society. Summing up, the "knowledge based bio-economy" that was proposed in the year 2000 at the Lisbon Encounter comes true.

As one can see, each scenario presents different possibilities of success depending on the perspective adopted by the decision maker. In scenario 1, "Just the Basics," the pharmaceutical industry encounters different opportunities and challenges from those faced by the academic world. Biotechnology based companies are motivated by different forces from those that drive the consumers in scenario 2, "Perpetual Motion." However, one should keep in mind that each of the scenarios provides various items of information that will enable the decision makers to interpret each one of them. The correct interpretation and the steps

taken based on the aforementioned interpretation might be the conditions required to enable the competitiveness and participation of the organizations in the future, which is definitely uncertain, but undoubtedly also very stimulating.

## **6 FINAL THOUGHTS**

Based on the above analysis, it is worth taking a fresh look at the three core aspects that underlie the creation of scenarios, as Michel Godet explains: Coherence, which means that the description should be worded reasonably and logically; Pertinence, which shows the assumptions linked to the main topic that is being studied rather than to other concepts; and Likelihood, meaning that all the concepts and ideas that make up the description of each scenario are credible. Perhaps these three conditions can better summarize what makes construction of the scenarios logical, transforming them into tools that are of great help to decision makers.

The simultaneity of these three aspects provides the scenarios with a robustness that would be hard to find using any other method; the design of likely situations and trends related to the future brings the feeling of predictability closer, and therefore helps those who carry out the drawn up suggestions to get a better understanding of things.

However, the fact that the future is constructed rather than predicted imposes the need to imagine alternative situations to those identified in the trend analyses, allowing one to produce some images that generate the "Desirable Scenario" concept. This may be very different from those that result solely from the appropriation of trends, but much closer to the future that all are working to construct.

What is certain is that scenarios are fundamental tools in future analysis in the most diverse environments and with the widest imaginable range of players. What is even more certain is that, like every other tool, it is subordinate to the talent of those who use it to sketch out the future possibilities and thus collaborate with mankind's fantastic determination to construct its upcoming days.

## REFERENCES

- Biovisions, 2015. Scenarios for Biotechnology. Siemens AG, 2006
- Bood, R. and Postma, T. "Strategic learning with scenarios." *European Management Journal*, 15:633-647, 1997.
- Burt, G. and van der Heijden, K. "First steps: towards purposeful activities in scenario thinking and future studies." *Futures*, 35:1011-1026, 2003.
- Godet, M. *Creating Futures: Scenario Planning as a Strategic Management Tool*. Economica Ltd., 2001.
- Kahn, H. and Wiener, A. J. *The year 2000: a framework for speculation on the next thirty-three years*. Macmillan, New York, 1967.
- Linneman, R. and Klein, H. E. "The Use of Multiple Scenarios by U.S. Industrial Companies: A Comparison Study, 1977-1981." *Long Range Planning*, 16:94-101, 1983.
- Masini, E. B. *Penser le Futur: L'essentiel de la prospective et des ses méthodes*. Dunod, Paris, 2000.
- Mietzner, D. and Reger, G. "Advantages and disadvantages of scenario approaches for strategic foresight." In *J. Technology Intelligence and Planning*, 1:220-239, 2005.
- Miller, K. D. and Waller, H. G. "Scenarios, real options and integrated risk management." *Long Range Planning*, 36:93-107, 2003.
- Rescher, N. "Thought experimentation in pre-Socratic philosophy." In: Tamara Horowitz, Gerald J. Massey (Eds.), *Thought Experiments in Science and Philosophy*. Rowman and Littlefield Publishers, Bollman Place, Savage, MD, 1991.
- Roubelat, F. "Scenarios to challenge strategic paradigms: Lessons from 2025." *Futures*, 38:519-527, 2006.
- Scenario Based Strategy. The Centre for Innovative Leadership – [www.cil.net](http://www.cil.net)
- Schwartz, P. *The Art of the Long View*. Doubleday Currency, New York, 1991.
- Wack, P. "Scenarios: shooting the rapids." *Harvard Business Review*, 63:135-150, 1985.