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SCENARIO-BUILDING METHODS AS A TOOL FOR POLICY ANALYSIS [1]

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ABSTRACT

A scenario is a *policy analysis tool* that describes a possible set of future conditions. The most useful scenarios (for corporations, for policy decision makers) are those that display the conditions of important variables over time. In this approach, the quantitative underpinning enriches the narrative evolution of conditions or evolution of the variables; narratives describe the important events and developments that shape the variables. In terms of innovative methods for policy analysis, the foresight and scenario building methods can be an interesting reference for social sciences. Some examples of these exercises will be present in this paper, either related to vision in science and technology developments, social and technological futures, or related to aggregated indicators on human development. Two cases (Japan and Germany) are held on behalf the ministries of science and education (respectively, MEXT and BMBF), and another with the support of United Nations.

Keywords: scenarios; policy analysis; foresight; forecasting methods; technological futures.

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INTRODUCTION

In terms of innovative methods for policy analysis, the foresight and scenario building methods can be an interesting reference for social sciences. A scenario – as a central concept for the prospective analysis – can be considered as a rich and detailed portrait of a plausible future world. It is a useful tool for policy-makers to grasp problems clearly and comprehensively, and to better pin-point challenges as well as opportunities in an overall framework. The purpose of scenario-building is (...) policy decision making. A scenario is not the prediction of a specific future. Rather it can better be considered as a plausible description of what *might* occur. In this sense, scenarios describe events and trends as they could evolve. They are <u>not</u> simulations.

The term "scenario" comes from the dramatic arts. In the theatre, a scenario refers to an outline of the plot; in movies, a scenario is a summary or set of directions for the sequence of action. Often in creating a scenario, the questions that are considered are of the following types: What is uncertain? What is inevitable? What are the driving forces of...? In general, this term has been used in two different ways: first, to describe a snapshot in time or the conditions of important variables at some particular time in the future; second, to describe the evolution from present conditions to one of several futures. The latter approach is generally preferred because it can lay out the causal chain of decisions and circumstances that lead from the present. Some authors try to introduce exclusive quantitative techniques to the method. The results are normally not very consistent and in this case it proves the need for a balanced use of qualitative as well quantitative techniques for data analysis.

In a book entitled *Toward The Year 2000,* Kahn and Weiner examined [2] the future possibilities of world order, describing potential power alignments and international challenges to American security. One of their scenarios depicted an arms control agreement between the United States and the former Soviet Union; another assumed the former Soviet Union would lose control of the Communist movement; a third projected construction of new alliances among countries. These authors also described the technology "hardware" of the future, which included centralized computer banks with extensive information on individuals as well as parents able to select the gender and personal characteristics of their children through genetic engineering (cf. UN-Millenium project, below)..

Some corporations also developed scenarios as their planning became more sophisticated. For example, Shell International Petroleum Company used scenarios before the 1973 oil shock. The method proved useful in allowing Shell to anticipate the rise and subsequent fall of oil prices. In the mid-80s, this same corporation created scenarios that focused on the future of the Soviet Union because that country was a major competitor in the European natural gas market. This kind of applications of the method are well disseminated in the economic structures, although mainly with large-sized and internationally operating firms, or with state institutions and public administration (Ministry of Economy or Finances, Ministry of Health, central planning departments, statistical bureaus).

Thus, a scenario is a *policy analysis tool* that describes a possible set of future conditions. The most useful scenarios (for corporations, for policy decision makers) are those that display the conditions of important variables over time. In this approach, the quantitative underpinning enriches the narrative evolution of conditions or evolution of the variables; narratives describe the important events and developments that shape the variables. In this respect one may say that there is, to a certain extent, some compatibility with Charles Ragin's (1987, 2000) approach underpinning both QCA and Fuzzy Sets. However the specificity of scenario-building is that it is specifically aimed at *future* sets of conditions. Techniques such as QCA and its extensions have (thus far) not been used specifically for scenario-building.

Some examples of these exercises will be present in this paper, either related to vision in science and technology developments, social and technological futures, or related to aggregated indicators on human development. Two cases (Japan and Germany) are held on behalf the ministries of science and education (respectively, MEXT and BMBF), and another with the support of United Nations.

APPROACHING SOME FORECASTING METHODS

One of the main references to the topic of foresight and policy analysis is Peter Schwartz, a member of the Royal Dutch/Shell scenario team, and he describes several steps in the scenario development process. In his main work, *The Art of the Long View,* he presents these process steps that include the following (Schwartz, 1991):

a) identification of the focal issue or decision;
b) identification of the key forces and trends in the environment;
c) ranking the driving forces and trends by importance and uncertainty; selecting the scenario logics;
d) filling out the scenarios;
e) assessing the implications;
f) selecting the leading indicators and signposts for monitoring purposes.

Another reference author is Michel Godet, from the Laboratory for Investigation in Prospective Studies in Paris (Godet, 1993). He begins the scenario development process by constructing a base image of the present state of a system. In his perspective, this image is described as broad in scope, detailed, and comprehensive, dynamic, and descriptive of forces for change.

The base image is built up by delineating the system being studied, including a complete listing of the variables that should be taken into consideration. It should also take into consideration the subdivisions of these variables (for example, the internal and external variables, as descriptive of the general explanatory environment). This step is followed by a search for the principal determinants of the system and their parameters, often using structural analysis. The scenario process involves examining the current situation and identifying the mechanisms and the leading actors (influencers of the system, through variables) that have controlled or altered the system in the past (Godet, 1993). This process continues with the development of actors' strategies. Construction of the database is then followed by construction of the scenarios. This author combines various futures research techniques in scenario development. For example, he finds that morphological analysis can be used in scenario construction since scenarios are, in essence, a configuration of identified components.

Both futures studies and strategic management are in favour today within most forward-thinking organizations, but these two complementary research traditions have grown in logically separate ways. Godet seeks to show that there are powerful synergies between the two approaches, since all types of strategic planning and goal-setting presuppose a prior exploration of possible, probable, and desirable futures.

The frequent errors that occur in forecasting, and the noticeable absence of forecasts of crisis events, bear witness to the crisis within forecasting itself. Causes of errors include inaccurate data coupled with unstable models, lack of a global and qualitative approach, and explanation of the future in terms of the past. The future must be studied with a view to illuminating the present, which is the basic idea that inspires futures thinking, or foresight (*prospective*). "Foresight is neither forecasting nor futurology, but a mode of thinking *for* action and *against* fatalism, which supplies a key to understanding and explaining crises. In a world characterized by uncertainty and by the risk of trends being disrupted, intellectual investment in undertaking *la prospective* is more necessary than ever" (Godet, 1985).

Godet's study also includes a critique of forecasting, pluralism and complementarity, the scenarios method, identifying key variables with the MICMAC method (*Matrices d'Impacts Croisés*, a French version of the cross-impact matrix developed by Godet in 1973), analysis of past and future plans (showing why the first oil crisis was predictable), expert consensus methods to reduce uncertainty, the SMIC method (French acronym for Cross Impact Systems and Matrices), principal concepts of strategic management, internal auditing and external assessment, the choice of strategic options, reappraising strategic planning ("The main focus of planning is not the plan, but the process of reflection and concentration which leads to it"), the secrets of excellence (citing Peters and Waterman), and three methodological recommendations to avoid errors of diagnosis: 1) ask the right questions—do not hesitate to think against the grain; 2) the key to success in seeking excellence is as likely to be found in the human factor as in the technological and financial factors; 3) consider methodologies not as ends in themselves but as tools to stimulate thought and communications.

Other authors, in a book edited in 1992 (by Joseph F. Coates and Jennifer Jarratt) entitled *The Future: Trends into the Twenty-First Century*, organised topics that have received substantial attention from future scientists, planners and strategic decision makers. This study demonstrated the richness of approaches in futures studies. The authors identify six streams of development in the study of the future: science and technology, military interests, business, sociology, history, and the literary tradition. They however also underline methods to explore the future, i.e., the identification of key elements of the system being studied, the identification of driving forces toward change or to maintain stability, the assessment of the force and direction of these trends, the development of alternative futures that include preferable visions, the consideration of "wild cards" low-probability, and the identification of appropriate actions. Coates and Jarratt point out the benefits of a good futures study: it should reveal and test assumptions, widen the scope of thinking about the future, and enable interpretation of events and developments.

Nevertheless, one knows that many forecasts eventually fail. The authors justify that on the grounds of different limitations: the existence of mechanical extrapolation of trends, or unexamined assumptions, but also problems of limited expertise and (with similar weight) lack of imagination. In the beginning of the 90's they recognised that four global trends would become more critical in the next decades: women status and gender issues, international relations, population growth, and the impact of information technologies.

The methods used for the purpose of foresight on policy making can be classified in the following way:

Table No. 1 – Forecasting methods

	By technique		By purpose	
Method	Quantitative	Qualitative	Normative	Exploratory
Environmental scanning	X	X	X	X
Cross Impact Analysis	X	X	X	X
Decision Analysis	X		X	
Decision Models	X			X
Delphi		X	X	X
Econometrics	X		X	X
Futures Wheel		X	X	X
Gaming and Simulation	X	X	X	X
Genius Forecasting		X	X	X
Morphologic Analysis		X	X	
Participatory Methods		X	X	
Relevance Trees		X	X	
Scenarios	X	X	X	X
Statistical Modelling				X
System Dynamics	X			X
Structural Analysis		X		X
Technology Sequence Analysis		X	X	X
Time Series Forecasts	X			X
Trend Impact Analysis	X	X		X

SOURCE: Gordon, Theodore (1994)

Thus, "scenarios" (as well as "environmental scanning" and "cross impact analysis") rely on either qualitative or quantitative techniques, and are normative or exploratory in terms of their purpose. In fact, in contrast with exploratory forecasting, forecasting *tout court* can be distinguished as being normative. Normative work is based on norms or values. Exploratory forecasting explores what is possible regardless of what is desirable.

Hence *normative* uses of futures methods answer the following type of questions: what is the desirable future? What do we want to become? Decision analysis, participatory methods or morphological analysis, for instance, are explicitly normative. Conversely, *exploratory* uses of futures methods answer the question: what are the possible futures - whether they are desirable or not? Decision and statistical models, system dynamics, time series forecasts or trend impact analysis, for instance, are explicitly exploratory.

At this point we can conclude that forecasting studies are not being developed in isolation, but in the context of a policy-making process. In most cases, they are integrated as key instruments in this type of decisional process. An exclusive emphasis on formal methods of forecasting, particularly on complex quantitative methods, will often prove self-defeating. Other authors, as William Ascher and William H. Overholt (1983), seek to do the following:

a) to locate forecasting as one logical component of the decision-making or strategic planning process;
b) to analyse the psychological and bureaucratic relationship between the forecaster and the decision-maker;
c) to identify the properties of different analytic methods in the context of different purposes and organisational settings;
d) to emphasise the importance of political assumptions in non-political forecasting;
e) to show how to interrelate political and non-political factors;
f) to offer an organisational approach to political forecasting that is systematic but non-quantitative;
g) to recommend the use of systematic scenarios and an emphasis on forecasting as heuristics, rather than an excessive emphasis on predicting discrete outcomes;
h) to describe how to present forecast results so as to ensure their maximum effective use.

A few forecasting techniques enable one to include perceptions about such events, thus modifying an otherwise deterministic extrapolation, for example Trend Impact Analysis (TIA). The technique produces a range of outcomes rather than just a single value. It begins with an extrapolation of a time series. This is taken to be a "baseline forecast"; that is the future of the variable if there were no future trend-changing developments of the sort listed above. Next a list of such developments is constructed, using the analysts' imagination, literature search, Delphi[3], or any other technique. These developments might include unique technology, societal changes, political actions or any other change that may affect the future course of the variable. Each development on the list is expressed in terms of its expected probability of occurrence over the future time interval of concern, and, were it to occur, its impact on the variable under study.

Although it may present a more realistic view of the future, this technique involves great over-simplification. For example, it omits any interaction among the future events (the occurrence of one may well affect the probability of other events); the list of future events will certainly omit some that in retrospect will be seen as having been important; the variable is taken to exist in isolation but in reality will be affected by other variables. Another means for improving the forecasts of the variables would be to include a cross impact analysis – or possibly some variation of QCA of fuzzy sets analysis (but this hasn't been attempted as yet), as such techniques lay a key emphasis on the interaction or combination between variables.

Taking these examples one can establish a stepwise sequence for the scenario building process:

- Definition of the *scenario space.* A scenario study begins by defining the domain of interest. This can include visions and scenario topics and themes. These emerge from the identification of trends obtained by the theoretical framework.
- Within each scenario, certain *key measures* must be described. These measures include forces such as economic growth, political and legislative organizational environment, technology infrastructures, or labour market dynamics, among others.
- A *list of events* will also appear in each scenario. Of course, the probabilities of the events are different in each scenario, and for example, it can make certain policies (technological, educational, employment, etc.) more or less likely to be successful.
- Although some authors prescribe the need for probability analysis and quantitative forecasting for each measure, the contrast of implications of the *alternative futures* can be considered as sufficient.

THE TECHNOLOGY FORESIGHT IN JAPAN (TOWARD THE YEAR 2030)

The Ministry of Education, Culture, Sports, Science and Technology (MEXT) [4] has conducted a technology forecast survey to ascertain the future direction of technology in Japan from a long-term viewpoint which is regularly conducted once every five years since 1971. After the first Delphi experiences in the 60s in USA , these regular surveys confirmed the rising importance of such a tool for the decision-making process in the field of science and technology. The latest survey (2000-2001) is the seventh in the series.

Incorporating more than a thousand topics, Japan's technology forecast survey is indeed extensive, ranging from the elucidation of principles to the practical use of technologies in all kinds of fields. For the survey, MEXT established a steering committee within NISTEP, and the Institute for Future Technology (IFTECH) established 14 "technology field" and 3 "needs field" subcommittees headed by members of the steering committee. The technology field subcommittees comprised technological experts in the appropriate field, and the needs field subcommittees comprised experts in the cultural and social sciences.

In contrast with the Futur project (Germany), the steering committee examined the overall structure, such as the survey plan and implementation guidelines, and studied the survey results across all fields. The technology field subcommittees set the survey topics, selected survey participants, and analyzed the survey results in their respective fields of expertise. The needs field subcommittees identified possible future trends in socioeconomic needs over the next 30 years. After analyzing the results, the "technology field" subcommittees compiled reports for their respective survey fields. In a similar way, the "needs field" subcommittees compiled reports summarizing the results from a needs perspective.

The technology subcommittees set the topics, taking into account the consolidated needs items by the respective subcommittees that examined the future socioeconomic needs. First, the technology subcommittees set the scope of the survey in each of the fields, examined the future direction of technological development, and prepared a framework that would also ensure that the important topics were not omitted. They then drew up a list of topics. They finally settled on 1065 topics for the survey. The survey fields of the Japanese Delphi exercise were the following: a) Information and communications, b) Electronics, c) Life science, d) Health and medical care, e) Agriculture, forestry, fisheries and food, f) Marine science and earth science, g) Space, h) Resources and energy, i) Environment, j) Materials and processes, k) Manufacturing, l) Distribution, m) Business and management, n) Urbanization and construction, o) Transportation, and p) Services.

A conventional Delphi method was applied. In this sense, it was also a method of consolidating respondents' views by repeatedly submitting the same questionnaire to a large number of people. In the second and subsequent questionnaires the respondents received a feedback of the results of the previous questionnaire so that they could reassess their answers to the questions in the light of the overall trend of views.

The respondents were selected on the basis of the recommendations of members in each of the technology subcommittees, i.e. a cross-section of representatives from industry, the government and academia. The second questionnaire (December 2000) asked respondents about the same topics as in the first questionnaire (August 2000), and included the results of the first questionnaire for reference.

As is mentioned in the final report of the 7th Delphi application in Japan, "from our experiences in past technology foresights, we know that respondents tend to give higher priority to technologies in their own expert domains (professional bias). So in designing survey fields, there is a need to exercise caution when adopting narrow domains as independent fields. At the same time, though, we also know from past results and comparisons of the degree of importance of topics between fields that the results tend to be rational, and there are hardly any cases where the true importance of topics that have been ranked highly has been difficult to comprehend" (NISTEP: 2001, p. 13).

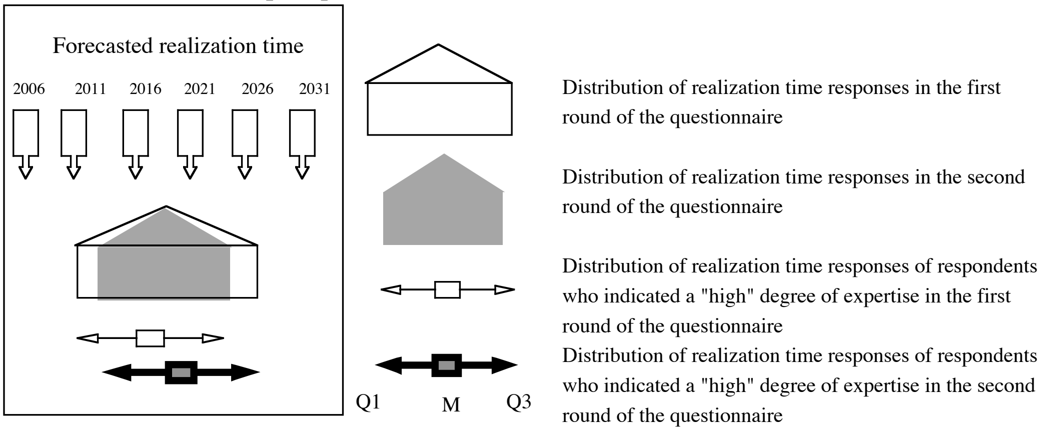
For this Delphi exercise in Japan, 3809 round 2 questionnaires were sent out, and 2849 responses (response rate of 74.8%) were received on the following question: "Considering Japan's future, what fields of science and technology do you believe should be given a high priority?" In the second round, the respondents were able to reassess their views after looking at the aggregate results from all respondents belonging to their own particular fields. With regards to the coming 10-year period, "Earth science and environment technology", "information technology" and "life science technology" were the top three current priority science and technology fields, while "material technology", "manufacturing and management technology" and "social infrastructure technology" were the three lowest rated technologies, barely managing to score a third of the responses of the top three. However, responses changed for the question on "priority science and technology fields after 2010". The proportion of responses indicating "earth science and environment technology" and "life science technology" rose, as more than 90% of respondents judged these two as priority fields. Response rates for "social infrastructure technology" and "material technology" increased 50% over their corresponding rates for "current priority fields", indicating a perceived need to increase the weight of research and development in these fields as well over the long term. On the other hand, the response rate for "information-related technologies" dropped by about 60%. Only about half of the members of the information experts group chose information related technologies, while among the other five groups, the percentage was no more than about 30%.

In terms of scenario topics, the top ranking topic was "Development of technology capable of forecasting the occurrence of major earthquakes (magnitude 7 or above) several days in advance" from the marine science and earth science field. It jumped from 7th position in the previous survey. Next was "Major advances in technology for disposing of disused manufactured products, leading to the emergence of commercial services capable of reducing the final disposal volume to one-tenth the current level" from the services field; followed by "Practical use of technology for the safe disposal of highly radioactive solid waste" from the resources and energy field; "Identification and classification by the molecular etiology of the genes related to diabetes, hypertension, and arteriosclerosis, which are typical lifestyle diseases that exhibit multiple-factor hereditary traits" from the life science field, and "Widespread use of highly reliable network systems capable of protecting the privacy and secrecy of individuals and groups from the intrusion of ill-intentioned network intruders" from the information and communications field. All top-ranking topics related to aspects of high social concern.

It is worth mentioning that the distribution of all 1065 topics was carried out according to the forecasted realization time, which was operationalised as the realization year corresponding to the response at the 50th percentile after the realization times were arranged in chronological order from the earliest to the latest. Half of all responses fell within the five-year 2011–2015 period, and 82% were forecasted to take place in the 2011–2020 period. In terms of fields, fields covering information technologies and their applications, such as “Information and communications”, “Distribution”, “Business and management”, and “Services”, were expected to be realized relatively early, while “Life science”, and “Resources and energy” were expected to be realized relatively late.

The next figure shows the relationship between forecasted realization time and range of forecasted times. Here the “range of forecasted times” is the width between Q1 in the figure below (forecasted realization year of the response at the 25th percentile of all responses) and Q3 (forecasted realization year of the response at the 75th percentile of all responses). The median 50% of responses fall within this range. A narrow width indicates a strong consensus among respondents. However, the values used for calculating forecast range include decimal values, so there may be some discrepancies between the pentagonal shape showing distribution and the values in this section. This survey looks at technologies up to 2030, so topics for which Q3 in the second round questionnaire (R2) is 2031 or later have been excluded. The number of topics covered was 1033.

Fig. No 1. Representation of distribution of realization time responses in first and second round of a Delphi questionnaire.



The survey also examined the extent to which a consensus had been formed among respondents, and how forecasted realization times changed from R1 to R2. The Japanese report used the range of forecasted times as an indicator of the extent of consensus. As is mentioned in the Delphi exercise report, “a convergence ratio [was calculated] for each topic as an indicator to determine the extent to which a consensus had been formed through repetition of the questionnaire. A smaller convergence ratio indicates a stronger consensus. For example, in the case of ‘Practical use of biocomputers based on a new algorithm’, the first topic in the information and communications field, the range of forecasted times was 11.5 years in R1 and 9.0 years in R2, giving a convergence ratio of 9.0/11.5 = 0.78. This comparison excludes topics in which Q3 (75th percentile of the R1 or R2 forecasted realization time) is 2031 or later. The number of topics covered was 1029” (NISTEP, 2001, p. 35).

All Japanese technology forecast surveys have focused on the period running from the present-day situation to 30 years in the future. Already more than 20 years have passed since the first (1971), second (1976) and third (1981) Japanese Delphi surveys were carried out, so it is now possible to assess whether the topics forecasted in those three surveys have been realized or not. Indeed an assessment of the results of the first and second surveys was carried out during the sixth survey, but it is now four years later and we believe it is important to reassess those results in the light of developments that have taken place since then.

Thus, of the assessed topics in the first survey, 185 are now (as of 2004**) “realized”, 222 “partially realized” and 209 unrealized”, resulting in a combined realization and partial realization rate of 66%. By field, “industry and resources” and “information” displays high realization rates, while “social development” displays a low realization rate. Of the assessed topics in the second survey, 151 are now “realized,” 244 “partially realized” and 218 “unrealized”, resulting in a combined realization and partial realization rate of 64%. Fields with a high realization rate are “industrial production”, “information”, “space development”, and “labor”, while those with a low realization rate are “software science”, “forest resources”, “transportation”, and “environment”. Finally, of the assessed topics in the third survey, 135 are “realized,” 348 “partially realized” and 196 “unrealized”, resulting in a combined realization and partial realization rate of 71%. The realization rate is prominently high in the two fields of “space” with 54% and “communications, information and electronics” with 37%.

These results also enable one to confirm that the information and communication technologies (normally mentioned as “information”, or alternatively as “communication and electronics”) are the better know topics in terms of forecast, whereas “social development”, “environment”, “forest resources”, etc., are less known.

THE EXPERIENCE FROM THE “FUTUR” PROGRAMME

The experience of foresight in Germany is one of the most interesting from the methodological viewpoint, as several innovations were brought to the conventional Delphi method[5]. Germany ran its first foresight exercises with the Japanese Government (through NISTEP) in 1983, and a new exercise (2002-2006) is on the run. In the summer of 2001, the Federal Ministry of Education and Research (BMBF) initiated the “Futur” research dialogue with the aim to identify research priorities of the future (towards the year 2020) by means of a broad dialogue.

The key question was ‘What is needed?’ for the national science and technology system, i.e. in which areas must the German scientific community conduct research today, in order to fulfil society’s needs tomorrow? Over 1500 economic, scientific and social experts have identified topics in areas that can play a decisive role in the development of German society.

Within this foresight programme, the visionary ideas for research programmes are developed in the form of interdisciplinary and problem-oriented (lead) visions. In spite of its target-orientation (lead visions), the so-called “Futur process” is open to new results. In comparison with existing programmes, Futur can operate in an interdisciplinarity way. Innovative links are drawn between complex subjects, and visionary thinking is stimulated.

The *lead visions* were developed through discussions involving a large number of actors from a broad variety of interdisciplinary backgrounds. The participating actors were motivated by the possibility to contribute to the development of BMBF research funding programmes, and hence put a lot of effort into theme development. The process started out openly, offering the participants the possibility to introduce themes they considered as being important for the future. In the course of the process, promising themes were selected and their discussion was deepened in focus group sessions. From the executive team of the Futur project, the major objectives of the process were achieved as mentioned in an assessment report). Nevertheless, BMBF is still on the way of evaluation of this process and several lead visions for research policy have since 2001 been created and are now being implemented in BMBF research support programmes. As minister Bulmahn stresses “only when we recognize and exploit our future opportunities at an early stage will we be able to optimally react to the challenges of tomorrow. This is why Germany needs a participatory foresight process such as Futur”.

Lead visions are interdisciplinary and oriented towards societal needs. To stimulate innovativeness of themes, "visionary workshops" can be applied early in the process, and a targeted analytical input might be introduced on time. In the future, it is planned to introduce one lead vision every year so that there will be more time for topic preparation and development work in the focus groups.The structure of the lead visions is based in the following steps:

1. The Aim and the Vision
2. Description of the Topic and Its Significance for Economy and Society
3. Scenario
4. Future Research Priorities
5. The Present State of Research and Current Research Support Priorities

The first round themes were based on a common topic: Inventing the Future. 21 topic packages were defined and discussed (for example, "Young Life in the World of the Old: New Worlds of Living for Old and Young", "The Choice of Employment", "Understanding Thought Processes: Capacities of the Brain", "Germany as an Integrated Society of Different Cultures", or even "Mobility: Individually Attractive and Socially Sustainable?").

The second round established 12 topic packages, discussed in a new phase. These topics re-elaborated the first-round ones. The topics were as follows:

- Farsighted Planning and Organisation of Satisfactory Work in the Knowledge Society
- Germany as a Place of Learning: the Learning Society as a Factor of the Future
- Living in a Networked World: Individual and Secure
- Promotion of Intercultural Potentials
- Dealing with Knowledge
- Sustainable Mobility
- Individual Medicine and Health Care 2020
- Ways of Developing a Sustainable Nutrition Culture in a Changing Society
- Sustainable Agricultural Production With Global Responsibility
- Global Change/Regional Change: Recognising the Challenges and Opportunities of Global Change and Shaping Them Regionally
- Decentralisation/A Strategy for Sustainable Ways of Life and Work?
- Intelligent Products and Systems for Tomorrow's Society

The BMBF then selected 6 out of these 12 topic packages, so as to develop the process to the "lead visions": "Individual medicine and health 2020", "Access to the world of learning, Living in a networked world: personalised worlds of interaction", "Efficient processes of knowledge", "Intelligent processes" and "Understanding Thought Processes". From these topics, the future visions were established in the following way:

- Understanding Thought Processes
- Creating Open Access to Tomorrow's World of Learning
- Healthy and Vital throughout Life by Prevention
- Living in a Networked World: Individual and Secure

In fact, new research programmes from the science and education ministry were launched following the topics discussed: Microsystem Technology 2000+, Nanotechnology, Basic Communications Technologies, Optical Technologies and Information Technology Research 2006. The last selection of the topics for the lead vision process took place in winter 2003: both the Futur participants and the BMBF submitted their vote. The final decision was made by the BMBF at the end of that year: The favourite topics were "The bionic house", "Needs-specific consumer products and innovation through cooperative customer integration" and "Healthy nutrition". These lead vision were further developed and supplemented by expertises and scenarios in creative workshops and Focus group meetings. The completed lead visions shoul be recently available.

A factor that had an important influence on the course of the whole process was the time frame, which can be important for the improvement of the Delphi method. One and a half years is a relatively short time span, especially considering the pioneer status of the process, and also considering that no themes were pre-defined, but the process was initiated without preconceived results in mind. Due to the complex demands of the task (which participants, how to select the themes, what expertise is necessary, etc.) more time was needed in order to properly plan and organise the different phases of the process.

One can agree that, because the participants of the Delphi process stem from different disciplinary backgrounds (for example, in our study on fisheries in Portugal – the MARHE project) cf. Moniz et al. 2000), they were coming from biology, sociology, economy, engineering, [verb missing] as well as stakeholders, as trade unions, business associations, public administration), and because the lead visions are interdisciplinary, this topic (interdisciplinarity) should be regarded carefully. In other words, too much interdisciplinarity and focal dispersion can hinder the discussion and the individual motivation of participants, which in turn may alter** the discussion results. This being said, the interdisciplinary composition of the groups is usually stimulating for the discussions, supporting the development of research themes across disciplinary boundaries

Besides careful consideration in the selection of participants,, targeted expertise should be added in order to support the debates. This is a general problem, also experienced in other Delphi exercises; we have the Portuguese experience to confirm this (MARHE, IS-Emp, TeleRisk and WorTiS projects). Thus, one can conclude that more innovativeness of the lead visions has to be implemented into the process. Some authors underline the need for the application of stimulating visionary methods in the process of theme generation, by fitting in information in a provocative way and by improving the consensus mechanism prevailing in the discussion groups. Others prefer not to intervene in this process moment. Furthermore, as the general selection procedure constitutes a sensitive phase in a participatory process; the role of the different actors should be clear and transparent.

Eventually, the Delphi process stimulated the discussion of the themes from multiple perspectives, which constitutes one of the most important dimensions of the knowledge process of foresight. This discussion integrated different disciplines as well as different actors of the discussion process. Another interesting issue is that the planned implementation of the lead visions enforced that traditional actors (researchers, public administration technicians) had to recognise the achievements made at the research level (mostly technological ones) and integrate them into their work. Some of most updated technological developments could be connected to unusual application field, and discussed much more closely to the stakeholders needs. This proved to be a very difficult step, but a decisive one. This being said, traditional actors did play a role in the selection process of the themes, and provided external expertise. This was true for the case of the fisheries Delphi project in Portugal. In the German Futur project, the lead visions which were developed also took socio-economic dimensions into account (besides scientific-technical dimensions), and were need-oriented.

The focus groups in Futur were composed of persons from different circles and communities (scientific, economic and social experts, innovative thinkers, researchers, established scientists and young scientists, they were co-operating in developing concepts and ideas relative to key future topics), in order to focus on a topic of common interest for these persons while working on different questions (need for research, sub-themes, status of research, visions in the themes etc.). The focus groups were established during the Open-Space Conference in 2001. These groups were adequate instruments to perform the expert work, especially for scenario planning, i.e. to mediate between specialist expertise and interdisciplinary perspectives. This procedure was seen as preventing that technology and science lobbyists could prevail in the choice of the research topics needs. These theme profiles were used as basis for the lead visions. The work of the facilitators and thematic tutors was usually very much appreciated by the participants.

According to the organisers of the Futur project, this process is conceived as a participatory process. The participants were selected following the “co-nomination” method. As mentioned before, they stemmed from a broad variety of professional backgrounds (e.g.

science, academic sector, private business sector), and a majority of them hadn't previously been involved in such processes. The participants developed lead visions, which are supposed to be implemented. As those participants in the various project-related activities were experts from different disciplines, this lead to a *reciprocal "inspiration"* of various perspectives. The positive effect was emphasised by all actors questioned during this Futur exercise. In spite of the fact that the facilitators supported the communication within the heterogeneous groups, the discussion groups needed more time to overcome communication problems and to reach agreement on themes.

The *co-nomination* method makes it possible to assemble expertise in the width and depth necessary for the process, even if this implies that no theme-specific nomination is possible. This creates an interdisciplinary circle of participants, in which "new" actors also take part (e.g. not the usual participants in such activities). As mentioned by the project team, the co-nomination method proved a good means to spark off the process, but additional database searches was necessary to add specific expertise in the course of the process. The participants were very interested in the process and therefore motivated to contribute their knowledge. They put a lot of effort into the activities. The phases of the process were structured along a continuous logic: theme generation, consolidation, profiling, focusing/enriching.

On one hand, workshops on future issues (or topics) enabled visionary ideas to be developed, extending beyond pure extrapolation and proving helpful for further work in focus groups, as well as for the development of lead visions. On the other hand, scenarios were helpful for the development and visualisation of lead visions. They could be developed on the basis of the results of the focus group sessions and the lead vision discussion workshops. The aim was that scenarios should be integrated into the lead visions, thus visualising the core theme of the lead vision.

Following this method, the workshop participants were asked to write down, on a mind map, what they thought society might look like in the year 2020. The second step was about how they think about how their own field might develop, to be written down in a kind of brainstorming (not methodologically strict) session. This part of the process was called *trend collection*. After the workshops, trend clusters were identified. After the definition of 12 most-wanted topics, focus groups were later formed and were given the task of re-focusing their topic according to pragmatic criteria, identification of perspectives, driving factors and frame conditions of their area. Building upon this material, consistent scenarios had to be elaborated and highlighted as "pictures of the future". More recently (June 2004) a seriesof fourteen workshops were held, in which the "Futur" participants defined the direction of the future thematic work in the German research dialogue. The aim of that activity was to further develop the existing theme proposals and define their profile. The topics for discussion were chosen through an online voting procedure (in late 2003), in the course of which the participants were able to select and rate the various topics. In the individual work groups, the experts generated ideas which, after further development, were meant to become potential lead visions.

The use of various methods should be integrated in such a process, as they complement each other reciprocally, and as they may foster a continuous discussion. These methods were sufficient to develop the lead visions and scenarios, while also being stimulating for the participants. Additional visionary phases changing with more rational and information-based phases might be realised in future conferences of this process. Nevertheless, when the subjects (scenarios) are clarified, the topics have to be deepened (in terms of rationally, of information-based structure, and analytical form). This clarification should be made in order the research questions of the future can be assumed by the research stake-holders.

The design and the questions posed by the methods (workshops, open-space conference, workshops on the future research and focus groups) were on the whole suited to identify particularly innovative approaches for research. The questions presented to the experts and participants were target-oriented (method, situation, workshops); this should be generalised to other foresight exercises, once it can be understood as an innovative methodological issue related to participatory foresight platform.

The questions for the Delphi questionnaires in the Futur exercise in Germany were also specific enough to be worked out in the different workshops (the most recent at the Congress 2004 already mentioned). It was sometimes difficult to do so, often due to the missing focus of the subjects. Some of the leading visions were too generic, loosing some links between the possible research applications and the future trends designed in those vision topics.. The vocabulary used in the process had to be simplified and to be clarified through examples. From the point of view of the persons in charge of this German foresight exercise (Futur co-ordination committee, BMBF officers), the visionary methods had to be used to generate the themes, which were then elaborated further by discussion groups.

The selection criteria of themes were also used for the selection of visionary ideas (not dependent of existing "lobbies" in the research and academic arena). These criteria were also supportive to select and develop interdisciplinary and demand-driven themes. Exists the possibility of online voting. In this case, the slection criteria had to be translated early into clear and simple questions. They had to be designed in such a way that rankings (e. g. via indexing and weighting of the criteria) could be computed.

To sum up, the Futur process was considered as a means of priority-setting for future innovation-oriented research policies (mainly aimed at the BMBF policy). The new innovative element of this programme is that it is oriented towards the identification and inclusion of societal needs in future research agendas. The foresight process was based on surveys or workshop panels. It was also an iterative process which could be modified, should experiences make this necessary (reflexivity). In addition, it was conceived as a participatory process, and the participants were selected by the co-nomination method. The sketching of "pictures of the future" and "leading visions" (*Leitvisionen*) now constitute a guide to innovation-oriented research policy decisions of the German Ministry (a major decision-maker in the process). Thus, a link to implementation is included.

THE UNITED NATIONS "MILLENNIUM" PROJECT

The Millennium Project of the United Nations University (UNU) is a global participatory futures research think tank involving foresight experts, scholars, business planners, and policy makers who work for international organizations, governments, corporations, NGOs, and universities. This international project produces the annual "State of the Future", a series on "Futures Research Methodology", and specific studies such as the Future Scenarios for Africa, Lessons of History, Environmental Security, Applications of Futures Research to Policy, and other annotated scenarios bibliographies.

It was initiated in 1996 by the Smithsonian Institution, The Futures Group International, and the UNU. The first phase of the feasibility study began in 1992 with funding from the US Environmental Protection Agency (EPA) to identify and link futurists and scholars around the world to create the initial design of the Project and conduct a first test on population and environmental issues.

In 1993-94, during the second phase, a series of reports were produced on futures research methodology and long-range issues of importance for Africa, funded by the United Nations Development Program (UNDP). The third phase was conducted in 1994-95 under the auspices of the United Nations University/World Institute for Development Economics Research (UNU/WIDER) and funded by United Nations Educational, Scientific and Cultural Organization (UNESCO) through the American Council for UNU, and was concluded with the final feasibility study report.

It was in 2001 that the Millennium Project introduced the State of the Future Index (SOFI). This index is a statistical combination of key indicators and forecasts (such as the well-known Human Development Index (HDI), also from UN), gathered in 19 variables. Building upon the previous work of the Millennium Project (including direct forecasts of important future developments and developments that appeared in various scenarios), a list of some 80 future developments was assembled and, when appropriate, extended and sharpened. The developments were chosen on the basis of their apparent potential to affect the future course of the 19 SOFI (State of the Future Index) variables.

According to a UN Millenium research report, “the goal of generating scenarios is to understand the mix of strategic decisions that are of maximum benefit in the face of various uncertainties and challenges posed by the external environment. Scenario building, in conjunction with a careful analysis of the driving forces, fosters systematic study of potential future possibilities—both good and bad. This forecasting approach enables decision makers and planners to grasp the long-term requirements for sustained advantage, growth, and avoidance of problems” (1999, p.3).

The SOFI differs from other indexes in several important respects. All indexes that have been reviewed deal with with the present or past, whereas this one is designed to measure the promise of the future. Further, in contrast with most existing indexes that are cross sectional and are designed to compare countries to countries or various groups of countries at some point in time (usually as recent as possible), this index is longitudinal and is designed to track and forecast change over time. Since the SOFI is to display** future as well as historical values, it is necessary to forecast each one of the series. A 10-year time horizon was selected, a period half as long into the future as the historical database once this database has the reference of 10 years (1991 and 2011).

The time series of each variable contains information which can be used to gauge uncertainty intrinsic to the SOFI forecast. For example, the observed errors between the “best fit” curve and the actual data points (i.e. “residuals”) provide a measure of scatter, and one can assume that the residuals of the sort that existed in the past will also surround the extrapolation (Gordon, 2002, p. 56).

The methodology for the study on the 2002 State of the Future on science and technology research established a first step where it was asked “What are the most important questions to ask about science and technology, given our interest in emerging issues and forces that are likely to influence the future of science and technology programs and their management?” The research strategy in this case is not to start with the question “What is needed?” but trying to identify the main questions.

To this end a meeting was organized with Science Attachés. It resulted in the choice of a set of initial lists of questions. These were further discussed with the Millennium Project Planning Committee and rated by this study’s Steering Committee. Based on this feedback, round 1 was designed. In this round 1, the panel was asked to rate the questions in terms of both their global importance and the priority to their own country. In addition panelists were asked to suggest other questions and to judge some staff-generated answers/actions to address these questions in terms of importance, likelihood and confidence, and, most importantly, to add questions to the list. The final section asked the respondents about science and technology priorities in their countries.

In the report of the last exercise, the authors confirm that “better means should be explored for forecasting the variables, including perturbing extrapolations with future developments and cross-impacts among the variables. In addition, for at least some of the variables, agent modeling and multi-equation feedback models should be considered” (Gordon, 2002). In fact, using past work of the Millennium Project (including direct forecasts of important future developments and developments that appeared in various scenarios) a list of some 80 future developments was assembled, and when appropriate, extended and sharpened. The developments were chosen on the basis of their apparent potential to affect the future course of the SOFI variables. These developments were used to modify the forecasts of the variables. The analysis method produced not only a new median forecast but also the range of the variable in view of the developments that were expected to affect it.

The computation of SOFI involved the use of judgments of the Global Lookout Panel in 2001 about what the best (norm) and worst (dystopic) state was for each indicator in 2011, and about the importance of reaching the norm or dystopic state. The criteria for assigning a high weight to a variable were:

a. the number of people affected;
b. the significance of the effect;
c. whether some groups seem to be affected differentially;
d. the time over which the effect will be felt;
e. and whether the effect is reversible.

The computation also involved the scaling of the data by assigning the value of 100 for the most desirable (normative state in 10 years) and 0 for the least desirable values (dystopic state in 10 years). Finally, the computation involved the weighting of the data using an S-shaped function that allowed the weight of a variable to vary with the value of the variable.

The following table summarizes pertinent information about the 2002 baseline forecasts:

	Variable	Fit Equation	R^2	Number of Data Points
1	Infant Mortality Rate (deaths per 1,000 live births)	NA: Used US Census Bureau Projection	NA	NA
2	Food availability Cal/cp Low Income Countries	Linear	.968	20
3	GDP per capita, PPP (constant 1995 dollars)	Linear	.775	20
4	Percentage of Households w/ Access to Safe Water (15 Most Populated Countries)	S Shaped	.612	6
6	Mean Monthly Carbon Dioxide in Atmosphere (ppm)	S Shaped	1.00	22
7	Annual population additions millions	NA: Used US Census Bureau Projection	NA	NA
9	Percent unemployed	Linear	.749	20
10	Literacy rate, adult total (% of people aged 15 and above in low and middle income countries)	S Shaped	.996	20
14	Annual AIDS deaths (millions)	Power Function	.976	20
15	Life Expectancy (World)	NA: Used US Census Bureau Projection	NA	NA
23	Number of Armed Conflicts (at least 1000 deaths/yr)	Exponential	.218	21
24	Debt to GNP Ratio: (%) Developing Countries	Power Function	.943	9
25	Forest Lands (Million Hectares)	Linear	.801	10
26	People living on less than $2 per day (Billions, less China)	Power Function	.932	4
27	Terrorist Attacks, number of people killed or wounded	S Shaped	.266	21
28	Violent Crime Rate, 17 Countries (per 100,000 population)	Inverse V	.294	20
30	Percent of World Population Living in Countries that are Not Free	Linear	.379	20
38	Net school Enrollment, secondary (% school age)	Inverse V	.294	20
39	Percentage of population with access to local health care (15 most populated countries)	S Shaped	.856	5

These baselines were then modified using trend impact analysis (TIA) to account for the impacts of possible future developments towards 2012. Thus, the 2002 SOFI was estimated given all of the variables forecasted in full consideration of the future developments that could affect their course.

CONCLUDING REMARKS

Foresight is a process of studying the future. In other words, it is the study of potential change. It can be applied either to technology, or to social relations systems. That does not mean only to establish trends, but what is likely to make a systemic or fundamental difference over the next 10 to 25 years or more. In this sense, the interest for policy (in the field of science, or technology development, economy, or even public administration) decision making is evident. The future analysis, in scientific terms, is not simply economic projections or sociological analysis, or even technological forecasting. Instead, as the three examples above can demonstrate, it is a multi-disciplinary examination of change, in order to discover the interacting dynamics that are creating the next generation. As Grunwald underlines, "in many fields, it is not a question of prognoses as predictions of future outcomes, but of scenarios as illustrations of *possible futures*, in order to structure the spectrum of further developments, identify 'worst'- and 'best' cases, and to gain strategic knowledge for drawing up action strategies" (Grunwald, 2004, 152).

Futures research (or future studies) is not a scientific discipline; it rather utilizes information from all of the sciences. A value of futures research is not discovering new factual knowledge as the scientific disciplines, but producing perceptions, visions and insights to that body of knowledge. A specific value can be understood when these perceptions and visions are a basis for political analysis. The possible use of "futures" studies for political forecasting is still challenging, but still weak in its formality.

This approach can be based on some causal chains of decisions and circumstances that lead from the present, emerging dependent variables. The display of the variable conditions can reveal the quantitative dimensions that will enrich the narrative of those "futures". Defining a large number of alternative worlds is often neither necessary nor desirable. In the final selection of "future worlds", one should consider it sufficient to present a range of opportunities and challenges. Nevertheless, this range should be small enough in number to handle. Four to five scenario "worlds" seems ideal to capture that range.

The concept of "causal complexity" presented by Charles Ragin (1987, 2000, 2004) illustrates the possible use of causal analysis for the construction of scenarios, when in a relation between two variables, no cause is either necessary or sufficient. Then one is in presence of asymmetric causation (i.e. when a variable leads to an output, this does not mean that its reverse leads to the reverse output), where QCA or fuzzy-set analysis can play a significative role. And here the construction of possible scenarios is a field for QCA and fuzzy-set applications. There is probably more potential for the fuzzy-set method here (instead of QCA), as it allows to integrate the kind of "richer" (more fine-grained measurement) data which is most often used in futures research.

The key measures and variables need to be selected with care. Every scenario must include projections of the same measures in order to clarify the implications for decisions. For instance, in the field of technology forecasts, the significance of such forecasts lies in the fact that, through assessment and analysis of realization time and importance of various technologies, they give an indication of the direction and objectives of research and development, which in turn provides basic data for the promotion and development of science and technology. While the national Delphi exercises in Japan and Germany presented here are suitable examples of this, it is not so evident in the case of UN Millenium project.

The goal of generating scenarios is to understand the mix of strategic decisions that are of maximum benefit in the face of various uncertainties and challenges posed by the external environment. Scenario building, in conjunction with a careful analysis of the driving forces, fosters systematic study of potential future possibilities — both good and bad. This forecasting approach enables decision makers and planners to grasp the long-term requirements for sustained advantage, growth, and avoidance of problems.

In Portugal, after four Delphi exercises (in the fisheries social-economical system, on information society and employment, on tele-working and on the automotive sector), just two had a two-round survey. That means that those two exercises were further developed using the same experst panel and an in-depth evaluated scenarios. This was the case for the fisheries system, and for the information society and employment linkage. The other two exercises were important experiences, but would need a further step, re-evaluating the scenarios topics with an enlarged panel.

And the policy action developed by stake-holders based on some of the main conclusions of these foresight exercises was evident. For instance some incentives system programmes (with the support of European funds) were designed taking into account some of those conclusions. One reason thereof could lay in the political significance of some consensual futures. The other reason is that some policy makers were themselves involved in the foresight process, and hence they have also integrated some of the conclusions in their own activity, especially in two of the above-mentioned cases: fisheries (MARHE project) and information society and employment (IS-Emp project). In these cases a national operational programme on fisheries (MARE) was integrating some of the main recommendations of the mentioned project, and the Ministry of Labour integrated in the policy agenda some of the IS Emp project recommendations. This means that to some extend the policy making strategy can use features from the scenario building methods. This has been the main practice for most cases illustrated in this article.

Bibliography:

Ascher, William; Overholt, William H.: *Strategic Planning and Forecasting: Political Risk and Economic Opportunity***,** NY: Wiley-Interscience, 1983, 311 pp

Bell, Daniel (ed.). *Toward the Year 2000*. New York, NY: Houghton Mifflin Co., 1968.

Cuhls, Kerstin: "Futur – foresight for priority-setting in Germany", *Int. Journal of Foresight and Innovation Policy*, Vol. 1, No. 3/4, 2004, pp. 183 – 194.

Cuhls, Kerstin; Blind, Knut and Grupp, Hariolf: *Innovations for our Future*, Physica publishers, Heidelberg, 2001.

Eto, Hajime: "Obstacles to the acceptance of technology foresight for decision makers", *Int. Journal of Foresight and Innovation Policy*, Vol. 1, No. 3/4, 2004, pp. 232 – 242.

Glenn, Jerome C.: *Introduction to the Futures Research Methodology Series***,** AC/UNU Millennium Project, Washington, 1994

Glenn, Jerome C. (ed.), *Futures Research Methodology - Millenium Project*, Washington, AC/UNU, 1999.

Glenn, Jerome C.; Gordon, Theodore J., *2002 The State of the Future*, Washington, UNU, 2002.

Godet, Michel. *A Handbook of Strategic Prospective*, Paris: UNESCO, 1993.

Godet, Michel. Integration of Scenarios and Strategic Management: Using Relevant, Consistent, and Likely Scenarios. *Futures*, Vol. 22, No. 7, September 1990, pp. 730-739.

Godet, Michel: *Prospective et Planification Stratégique*, by Economica Press, Paris, 1985.

Gordon, Theodore Jay: "The Delphi Method" in *Futures Research Methodology,* AC/UNU Millenium Project, Washington, AC/UNU 1994.

Gordon, Theodore J. *Methods Frontiers and Integration*, Futures Research and Studies Methodology Series, produced by UNU Millennium Project Feasibility Study - Phase II and published by UNDP/African Futures, 1994.

Gordon, Theodore J.: *2002 State of the Future*, AC/UNU Millenium Project, Washington, 2002.

Grimm, Heike; Gamse, Robert: "Entrepreneurship Policy and Regional Economic Growth: Exploring the correlation", paper presented at the ESF Exploratory Workshop on *Innovative Comparative Methods for Policy Analysis*, Erfurt, 25-28 Sept. 2004.

Grunwald, Armin: "Strategic knowledge for sustainable development: the need for reflexivity and learning at the interface between science and society", *Int. Journal of Foresight and Innovation Policy*, Vol. 1, No. 1/2, 2004, pp. 150 – 167.

Kuhlmann, Stefan: "Future governance of innovation policy in Europe – three scenarios", *Research Policy*, 30, 2001, Elsevier, pp. 953 – 976.

Lizaso, Fernando; Reger, Guido: "Linking roadmapping and scenarios as an approach for strategic technology planning", *Int. Journal of Technology Intelligence and Planning*, vol. 1, No. 1, 2004, pp. 68 – 86.

Loveridge, Denis: "Experts and foresight: review and experience", *Int. Journal of Foresight and Innovation Policy*, Vol. 1, No. 1/2, 2004, pp. 33 – 69.

Meadows, Donella, Meadows, Denis, et al.: *The Limits to Growth.* New York: Universe Books.

Moniz, António B.; Godinho, M. Mira: "Cenários prospectivos para as pescas: resultados da aplicação do método Delphi" in *Pescas e Pescadores: Futuros para o emprego e recursos*, A.B. Moniz, M.M. Godinho and I. Kovács (orgs.): Oeiras, Celta Editora, 2000, pp. 25 – 38.

Moniz, António B.; Godinho, M. Mira: New Methodological Approaches for Change in Traditional Sectors: The case of the Portuguese fisheries socio-economic system, *Économies et Sociétés* (Série "Dynamique technologique et organisation"), nº 5, 5/2000, pp. 63 – 77.
Moniz, António B.; Kovács, I. (orgs.): *Sociedade da Informação e Emprego*, Lisbon, DGEFP-MTS, 2001.
Moniz, António B. (org.): *Futuros do Emprego na Sociedade da Informação*, Lisbon, DGEFP-MTS, 2002.
Moniz, António, "Provisional results of the 1st round of Delphi WorTiS exercise," MPRA Paper 5936, University Library of Munich 2004.
Moniz, António B.: *Temas de prospectiva para o sector automóvel,* rpt_Delphi_03, IET/FCTUNL, 2003
NISTEP: *The Seventh Technology Foresight: Future Technology in Japan toward the Year 2030*, Tokyo, 2001 Ragin, Charles C. *The Comparative Method. Moving Beyond Qualitative and Quantitative Strategies*. Berkeley, University of California Press 1987.
Ragin, Charles C. *Fuzzy-Set Social Science*. University Chicago Press 2000.
Ragin, Charles C.: "innovative Causal Analysis and Policy Research", paper presented at the ESF Exploratory Workshop on *Innovative Comparative Methods for Policy Analysis*, Erfurt, 25-28 Sept. 2004.
Schwartz, Peter. *The Art of the Long View: Planning for the Future in an Uncertain World.* New York: Doubleday, 1991.
Smits, Ruud; Kuhlmann: "The rise of systemic instruments in innovation policy", *Int. Journal of Foresight and Innovation Policy*, Vol. 1, No. 1/2, 2004, pp. 4 – 32.
Spreitzer, Astrid; Yamasaki, Sakura: "Beyond Methodological Tenets – The worlds of QCA and SNA and their benefit to Policy Analysis", paper presented at the ESF Exploratory Workshop on *Innovative Comparative Methods for Policy Analysis*, Erfurt, 25-28 Sept. 2004.
Von Reibnitz, Ute. *Scenario Techniques.* Germany: McGraw-Hill, 1988.

NOTES

[1] This pape ris based on the presentation with the title "Methods for Scenario-building: it's importance for policy analysis". The author wish to thank all the observations, comments and suggestions made particularly by Benoît Rihoux and Heike Grimm to this article, and to the participants that made interventions on this topic at the ESF International Workshop on "Innovative comparative methods for policy analysis. An interdisciplinary European endeavour for methodological advances and improved policy analysis/evaluation" in Erfurt (Germany) from 25 until 28 September 2005. None of them are, of course, responsible for the errors and mistakes that can be eventually found in the text. Later, a new version was published in B. Rihoux and H. Grimm: *Innovative Comparative Methods for Policy Analysis. Beyond the Quantitative-Qualitative Divide*, New York, Springer, 2006, pp. 185 - 209.

[2] In 1967, this study was developed under the Commission on the Year 2000 and sponsored by the American Academy of Arts and Sciences

[3] The modern renaissance of futures research began with the Delphi (word taken from the Greek island where took place the oracles for forecasting events) technique at RAND "think tank" (at Santa Monica, California) in the early 1960s. These researchers explored the use of expert panels to address forecasting issues. The principle was based on the idea that experts, particularly when they agree, are more likely than non-experts to be correct about questions in their field. Thus, the key to a successful Delphi study lies in the selection of participants. These regular exercises were very soon followed in Japan by the Ministry of Industry and Technology, and later in Germany by the Ministry of Education and Research. Nowadays, this foresight methodology is used in most countries for policy making.

[4] And called the Science and Technology Agency until December 2000.

[5] Here I would like to mention the proficuous talks and exchanges of ideas that I could benefit from during my sabbatical leave at ISI-FhG (Karlsruhe) during 2003, specially within the department (TI) lead by Prof. Stefan Kuhlmann, and also all the support that I still can find from these colleagues after that period.