



Technology ForeSight Initiative

TEXT BOOK

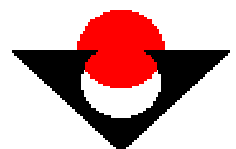
# Technology Foresight for Organizers

**TRAINING COURSE**  
for Black Sea Economic Cooperation Countries  
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# Foreword

The transformation in technological base of our societies has also led to a transformation in aims and means of science and technology policies. In a rapidly changing environment, it becomes extremely important to anticipate future changes and developments. A key element of strategic action and policy-making is now to recognise the possibility of alternative futures, and to implement policies that make the best alternative possible. The policy making in this era also needs to be based on systematically gathered information with the active participation of all the stakeholders. It is, therefore, no coincidence that **Technology Foresight (TF)** activities have proliferated in the last decade. Another factor behind the growing interest in TF is the need to set priorities in R&D in the context of the increasing cost of research and the tightening of public budget for it. R&D efforts also need to be directed towards fulfilling social needs at the same time as providing sources of innovations that contribute to sustainable growth, competitiveness and job creation. TF is a tool that can be used to match future needs of societies with the supply of science and technology. TF has recently gained widespread acceptance all over the world and across Europe, not only as a policy instrument used in formulating science and technology strategic plans, but also as a means of promoting the foresight culture in the society.

UNIDO Regional Initiative on Technology Foresight for Central and Eastern Europe (CEE) and the Newly Independent States (NIS) aims at providing assistance to the region in view of developing a mid- and long-term vision for industrial growth and competitiveness, as well as bringing a more technology oriented focus into the relevant innovation policies and R&D programmes.

Following the recommendations of the Regional Conference on Technology Foresight (4-5 April 2001, Vienna), UNIDO has established training programmes on TF in selected institutions in the CEE/NIS region. These programmes aim at providing an overview of TF methodologies and practical experience on applying these methods and related techniques in national, regional and supra-national TF exercises. The target audience varies from one event to another, covering decision makers, TF organizers and practitioners from governments, academia and corporations.

The training programme being held on 8-12 December 2003 in Ankara, Turkey, has been designed for TF organizers from the Black Sea Economic Cooperation Countries and the Newly Independent States. The programme consists of four blocks of activities:

- BLOCK I: Role of Foresight in Science, Technology and Innovation Policy Formulation
- BLOCK II: Technology Foresight Techniques
- BLOCK III: Case Studies
- BLOCK IV: Practical Sessions

This text book includes the contributions of the experts taking part in this programme, in the form of lecture material to be presented to the participants within the first two blocks.

# Foresight as a Policy-making Tool

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The “Foresight” or “Technology Foresight” is one of the most frequently used expressions nowadays among the technology policy masters in Europe. This tool, which was applied for the first time many years ago far away from our continent, has become slowly part of the policy formulation process in the post industrialized nations, and some of the accession countries have also launched or are planning to launch such programmes. After more than 10 years of foresight exercises in Europe, we have traditions and lessons, success and failure stories, useful knowledge and the necessary political attention related to this activity.

What does this magic world “*foresight*” mean? How is it understood inside the European technology community? Why has it become not only popular, but widely used in the past 15 years, as well? Is it a panacea, which helps to react positively and successfully to the challenges, our societies face at the time of transition from industrial to learning economy? How may the countries in Central and Eastern Europe consider this tool in preparing different policies during their present dynamic changes and catching-up phase? What is it good for and where are its limits?

These are questions, we try to find answers in order to make it understandable how this tool might serve best the art of policy formulation.

## 1. GLOBAL CHANGES AND INNOVATION

In this paper, we consider innovation as the process, which leads to discover, experiment, develop, imitate and adopt new products, new production processes and new organisational set-ups. [Dosi (1988)]

### *1.1. Globalisation and innovation*

Since the 1970s, we have witnessed major changes related to the role of innovation in social and economic activities. The intensification of competition and the importance of technical changes have resulted in a fast integration of product, service and financial markets at a global scale. The globalisation has a strong impact on companies’ business activities both in traditional industries and new, high technology-intensive sectors (like biotechnology, information and communication technologies). The technical changes are identified as the driving force behind this process. Especially the developments in transportation and communication technologies have contributed to making the exchange of information and transport of people and goods easy and cheap on a global scale. The accessibility of individuals, regions, organisations and firms has become a competitive factor. Regions may win or lose because of having good or bad transport and/or communication infrastructure. This may explain in more and more cases the polarisation of regions and losing positions by individuals at the labour

market. This is the reason why countries/regions with similar physical infrastructure and economic structure can not show up the same economic performance.

Among major changes related to globalisation, one significant character has remained extremely stable: the unbalanced development of nations and regions. Some countries could successfully catch-up (Ireland, Finland, South Korea etc.), but in general the differences among nations have grown during the past 30 years by economic performance and living standards. Borrás and Lundvall explain it by the fact that “*the most important limit of globalisation is the spatial mobility of knowledge.*” [Borrás, Lundvall (1997)] This is the reason why countries/regions with similar physical infrastructure and economic base can show up highly different performance.

In time when the learning capabilities of firms and other organisations, individuals and communities determine their market position and their dynamics, the innovation should be considered as decisive factor of economic and social performance. Countries should improve such skills of citizens and public and private organisations, while they have to cope with the so-called polarization challenges caused by the transition at both social and regional level.

The learning process aims at enriching the information and knowledge stock both at organisational and individual level and contributes largely for developing new skills. Organisations may get the required skills by developing themselves through education or other type of learning (slower process) or by acquiring the necessary knowledge (much faster). The ability to integrate new skills into the existing organisation has high importance and improving this ability is one of the key targets of the learning process.

The so-called tacit knowledge (which is impossible or very hard to be coded and difficult to transfer) gives real power to firms in the global competitive environment. The role of this kind of knowledge is becoming more and more significant. Knowledge embedded into organisations and/or individuals are not transferable easily, so now it is one of the crucial factors, which may create differences between firms and regions. The technical innovations are strongly rooted into cultural/social structures which underlines its local and regional aspects.

The innovation process has gone through major changes since the 1970s. Borrás and Lundvall identify four main trends:

- acceleration of the technical changes (shortening the interval from knowledge production to commercialization),
- networking of firms (growing number of strategic alliances, higher level of collaboration),
- functional integration inside firms (more emphasis on inter-departmental cooperation and horizontal communication, higher importance of flexibility and interdisciplinarity), and
- collaboration with knowledge creation centres (new dimension of academy-industry links). [Borrás and Lundvall (1997)]

## ***1.2. Impacts on national policy formulation***

The globalisation has resulted in a higher level of integration at EU level. It has changed the autonomy of governments in different policy areas. The manoeuvring

power is much less in several policies, which were traditionally administered at national level (foreign affairs, defence, trade, finance, monetary, standardisation etc.). This fact has increased the importance of some policy areas, which have growing importance at the knowledge/learning society: education/training, labour, science and technology, and innovation. [Borrás, Lundvall (1997)]

50 years ago nobody dealt with innovation policy, politicians and the general public did not use this expression. At that time there was a strong consensus on that public efforts should have been given to scientific research, but technology was out of the scope of government activities. Governments more or less believed that the market and its actors might determine the game. There were only some activity lines, where the public efforts were considered as appropriate during the development/application phase (environment, health, defence).

Some economies (first Japan in the 50s and 60s, then Korea in the 70s) realised that their less developed markets and weaker private industries were not able to cope with the growing challenges the acceleration of technical changes and their new dimension had resulted in the global competition. These nations decided to put technology-driven economic policy into the centre of their catching-up strategies. Not only the large number of policy documents, that appeared on a regular base at both parliamentary and government level, indicated this orientation, but the structure of public administration also reflected this approach. New agencies were also formed with responsibility of implementing technology policies.

Another group of countries also started national-level technology policy formulation still back to the late 60s, early 70s. The centrally planned economies with state-owned industries launched large technology programmes, mostly focusing on specific targets (mission-orientation). COMECON, the international organisation of socialist countries for harmonising and developing economic relations, coordinated such actions. New government agencies were set up, usually consisting of two independent parts: the traditional public administration (agency) and the body (committee) with strong representation of academia, industry and government.

The attention of industrialised nations to innovation policies has become intensive when the dimension and scope of technical change became crucial in international competitiveness, and the market failures in innovation indicated, that the traditional approach of rather neutral public attitude would not appropriate any more.

The early day technology policies targeted mostly the development and application of new technologies by mainly financial incentives and regulating the technical development process in order to minimize the risks from health and environment point of views. The public administration could also be active in supporting large scientific/technical facilities, decreasing the technological dependencies mostly for military purposes (like in the case of the semiconductor industry in the US in the 1980s). Especially in Europe and in Japan the maintenance of global competitive position of industries was also argued as good reason for state intervention into technology development (for example the fifth generation computer program in Japan, or the Airbus, Concorde or HDTV programs in Europe). The technology and research policies had some, but not strong and explicit interrelations, and they were not considered as integral part of social and economic development strategies. The initiative of EUREKA in the middle of the 80s was a clear signal that European level efforts need in the field of technological development. The initiative aimed at combining public and private resources on a bottom-up way.

The approach of public administrations has slowly followed the changes in the process of innovation. The procedure, however, was slow and non-consistent. Governments had (have) two reactions to these challenges. The traditional reaction was (is) the structural approach: setting up new offices, ministries, agencies dealing with these otherwise horizontally manageable businesses. Looking back to the 90s, the large number of restructuring actions related to R&D, information society and innovation in most of the European nations may demonstrate the embarrassment how governments try to find solution for successful reaction to strong social demand. The other response is (would be) to improve the policy coordination at EU, national, regional and local level.

Many experts in Europe share the opinion that majority of the governments in the EU mostly followed the old-fashioned linear model of innovation still at the end of the 90s. The new concept of European Research (and Innovation) Area has initiated a wider public debate, and probably a more appropriate understanding of innovation in the “learning society age”. Now all the governments have introduced innovation policy, which comprises all the policies aiming at facilitating innovation (new products, new processes, new services at the market and new organisational solutions serving this).

Why does it take so long and what is the reason behind this hesitation to find appropriate solutions for such organisational challenges? One of the most important aspects of innovation policy is its horizontal character, which resulted in some troubles, since governments are traditionally organised on a vertical way. Presently we are very far from the original organisational model of the US government 200 years ago, in which a single organisation, called government, consisted of separate units (called departments) headed by secretaries. Now only the names remained the same. Today’s ministries (departments) act as very individual organizations, with very strong organisational culture and relatively high autonomy.

One of the most challenging tasks of the today’s governments is how to coordinate and harmonise the activities of such huge and complex system with very low flexibility, and how to improve the synergy inside it. Both policy formulation and implementation related to the information and communication technologies and innovation cannot be managed successfully by the existing system, which tries to react to challenges by applying traditional tools.

Effective innovation policy can not be designed without taking into consideration policies in three different lines: “(1) *policies affecting the pressure for change (competition policy, trade policy...)*; (2) *policies affecting ability to innovate and absorb change (human resource development, including education, R&D and health)*; (3) *policies designed to take care of losers... (social and regional policies with redistribution objectives)*.” [Borrás, Lundvall (1997)] The successful adjustment of such policies will much more determine the quality of governing than having high-quality, but independent sector specific policies. The integral, systematic and organic approach is most wanted in the modern public administrations.

### ***1.3. Challenging the decision making process***

Not only business entities, but other actors of societies should also become learning organisations in the modern societies. The performance of national or regional governments largely depends on their learning capacities.

At the age of globalisation and transition to learning society the role of networks has become crucial. The large number of networks in a modern society can diffuse and

modulate policy, and create the necessary social infrastructure for strong involvement of such interest groups into policy formulation. Governments should assist in creating and maintaining a complex system of networks (network of networks) and design possible policies that can be adapted and implemented via networks. This is the major challenge these organisations face in time of today's transformation process.

Traditionally there is a policy cycle how the decisions at public administrations are made. The formal decision making phase is followed by the implementation, then the impacts are measured (evaluation phase). The evaluation gives inputs for designing the necessary modifications or new policy decisions. This more or less linear approach functioned effectively for a long time. Nowadays, when the political, social and economic environment around government decisions is under major changes and the process itself has accelerated, this rigid, phase-based approach does not serve well the learning organisation concept in public administrations.

In many cases still at the phase of decision preparation or implementation, the ongoing reflection of actions may have a high value for giving chance adjusting the procedure in time to the actual conditions and demands. The public administrations, as learning organisations should develop a system of ongoing feedback and analysis, and the ability to act in time. The quality and time factors should be taken into consideration parallel during the whole process in order to optimise its effectiveness.

## 2. INNOVATION AND PUBLIC POLICIES

In the OECD countries there are some trends related to innovation policy formulation matters: [Borrás and Lundvall (1997)]

- More focus is given to the national systems of innovation, innovation has become an integral part of industrial (economic) policy and technology as a separate policy area has less significance.
- Governments provide special support for firms in assisting their internationalisation (technology intelligence and forecasting, intellectual property right protection etc.).
- Industrial (economic) policies have less focus on sector-specific issues and more on technology areas or clusters.
- There is a wider understanding that not only technologies themselves, but also their cultural and social environment are important to get the required impact of policy measures. This fact draws attention to learning, knowledge creation and dissemination.
- The supply orientation of technology policies is under change. First many countries turned their strategies toward technology diffusion-orientation, but now the demand-driven approach is becoming widely applied by most of the post industrialist nations and many accession countries. These new strategies deal with not only technology, but innovation, as well. These changes reflect that policy makers and public administrators have already understood that innovation and learning are interactive in which both the producers and the users are equally important actors.

The new policy paradigm, as Borrás and Lundvall summarizes, “*focuses on creating adaptable innovation systems.*” There are three interrelated targets of such policy: improving the learning capacities and abilities of organisations and actors,

developing policies for facilitating innovation, and creating the necessary environment for policy formulation, which serves the adjustment to the constantly changing conditions. [Borrás and Lundvall (1997)]

## ***2.1. Challenging the S&T and innovation policy formulation***

The science and technology administrations were among the first to realise these challenges of network-based governing and they tried to react effectively and in time. There are three dimensions of changes related directly to S&T and innovation policies, which has stimulated the development of policy formulation methods and techniques [Barré (2001)]:

/1/ The S&T and innovation policy area is very complex and multi-layered. On one side, policies are developed at supranational (EU), national and regional level, but some measures and actions are taken at local level, as well. The elements of this system are strongly interrelated and interdependent, which emphasises the need to have an improved, well-functioning communication among them and a clear intention for getting synergic impacts. On the other side, innovation policies must be coordinated and harmonised with other important policies (education, environment, labour, industry, trade, financing etc.).

/2/ The innovation process itself has gone through major changes, as we discussed above. It is now much more around competencies. The number of actors being involved into innovation has grown drastically, the networking capabilities are sometimes more important than having the necessary knowledge inside an organisation.

/3/ As the impact of technical changes has become more decisive on all areas of living, the number of social, environmental, economic concerns related to technologies has also drastically increased. We may find areas for intensive political and social debates from health to international security and from environmental protection to ethical questions. At this time societies are much more sensitive on such issues, than ever, which has created a strong demand for higher level of transparency in policy formulation.

The acceleration of technical change generally, and the hard predictability of technological progress in several important areas (like information and communication technologies) specifically underlined the need for refining the traditional policy analysis and decision-preparation process. These trends highlighted that a growing number of social conflicts should be managed in an appropriate way mostly by reaching the necessary level of consensus with an active and much wider social participation.

Government policies for science, technology and innovation need to be considered as an integrated package of measures. One of the mistakes, governments and the scientific communities usually make is to cut artificially the innovation process to its formal stages (basic and applied research, technology development, demonstration, production and marketing/selling). The science and technology policies traditionally focus on scientific and technological knowledge creation, technology transfer and human development (mostly higher education and educating the future's scientists, like PhD programs). These policies can enjoy a certain independence of other policies. Their implementation is relatively easy, because the targeted programmes and applied measures may fit better to the vertical structure of governments. One or two ministries (usually those being responsible for education and/or science and for industry or economic affairs) should be strongly involved in both policy formulation and



implementation. Some funding agencies under the supervision of these ministries may cover the implementation, mostly the public funding tasks and may provide inputs to policy formulation. In most of the cases the missions of such agencies follow the linear model of innovation (basic science fund, technology fund, higher education fund, etc.). Usually the communication among these agencies is poor and ad hoc.

In our new age of learning societies, however, the low synergy among such policies will result in inappropriate allocation of resources in the knowledge creation and application process and will lead to success at society level just by accident. The main targets of innovation policies are much more general and complex than just improving the capacities of the national research base, or creating transfer networks for SMEs etc.

The modern innovation policies usually do not put high emphasis on solving specific problems, but create favourable conditions for improving social and economic competitiveness and welfare on a longer-term. Since innovation and learning determine the competitive position of individuals, firms, regions and nations, innovation policies should be derived from the scenarios of the society concerning its future.

## ***2.2. Changes in innovation policies***

Based on their traditions the R&D and innovation policy formulation and implementation procedures were adjusted to these requirements in most of the post-industrialist countries. The main directions of changes are as follows:

- The S&T and innovation policy formulation is traditionally an open procedure, not only public administrators and public servants participate in it, but large number of experts from both academic and business representatives, as well. The advisory-like bodies at the highest level have become typical in almost all OECD and accession countries. Many of them are combining government members and private individuals (both from academia and business), and led by the prime minister.
- The S&T committees in the national parliaments also play significant role in regulation, facilitating socio-political discussions on innovation and providing platform for interdisciplinary analysis including other committees and committee members. Many of the European parliaments followed the US and set up their technology assessment units or separate organisation in order to invite more (usually independent) expertise into their decision making process.
- The monitoring and evaluation of national R&D and innovation programs (and projects) have become daily experience in most of the developed countries, and are more and more widely applied by the candidate states as well. The monitoring simply compares the original plan with the results, while the evaluation not only registers the performance, but makes analytical work and draw conclusions for further policy formulation. As reacting to the changing role of innovation and technological changes, the traditional set of scientific evaluation criteria is broadening toward socio-economic aspects. The monitoring and evaluation methods are highly internationalised, however there are big variability among national practices based on the differences in administrative and political culture, social dimensions and economic environment. The networking between the national agencies for the implementation of technology/innovation policies has also been intensified

since the early 1990s, which has created effective platform for benchmarking evaluation and monitoring techniques. In Europe the EU has special function in this game. In some countries the EU regulation determines the national monitoring and evaluation activities because a significant part of the national R&D expenditures comes from different EU funds.

- Many of the post industrialist countries launched foresight programmes during the 1990s. What is the reason behind this? The traditional tools for increasing the social participation in policy formulation work well, but they are not satisfactory in generating a much broader and permanent communication with the major interest groups of a given policy area. The technology/innovation policy should be based on longer visions than the usual 4-year parliamentary election cycle. The major stakeholders, in broader sense, (the academic and business communities and the civil society) are not only ready, but well prepared for such social debates, as well. Foresight has become so popular, because it satisfies this demand and offer. It can stimulate this wide social communication and create a stable platform for ongoing professional public debates, improve the quality of policy formulation and ensure the acceptance of innovation/technology developments.

### **2.3. Challenges for accession and candidate countries (ACC)**

The countries in transition went through significant changes during the 1990s. This process influenced both the demand and supply sides of innovation and technology development. The framework conditions, the social and business environment, and their interrelations changed so dramatically, that both the old and new actors were challenged how to adjust to this new situation. The fast privatisation, the management of deep social and macroeconomic crises resulted in a long-lasting short-termism in all these nations. Some of the main symptoms of such policies are as follows:

- Sharp cut in both public and private R&D spending, and serious diminish of the traditional science base (cuts in the number of institutions and scientists) – as Havas calls it “*planned, policy-assisted destruction*” [Havas (2003)]
- Lack of strategic and long-term thinking, negative social approach concerning any kind of planning activities (considering them as typical *practice of socialism*)
- Low attention for issues, which have longer-term impacts (environment, health, human resources development, corruption, etc.)
- Less developed capital market (low interest and experience in financing projects with high risk), poor links between academy and industry
- Few, if any, long-term planning documents at both government or ministry level (papers titled as ‘strategic’ or ‘policy’ usually did not meet even the minimal requirements against such documents by Western European standards)
- Underdeveloped social framework for permanent communication among the interested communities

“*In less developed countries typically the links between science and technology and society is weaker and public policies are less rationalised*”. [Tavares (2002)] The autonomy of scientific research is over-emphasised, there is a strong resistance against

prioritising R&D. The role of governments in this process is interpreted by the academic communities in a narrow way ('give support, and leave us to set the rules and allocate the resources alone').

Based on historic experiences the most serious danger the catching-up economies face now is to copy techniques and procedures of innovation policy formulation without any criticisms. Tools, which work effectively in one country, does not function automatically well in another one. It is important to study the exercises of other nations, but in launching policy formulation process every government should combine its knowledge on the local situation, the views of the society on its potential futures, and the values, limits and relevance of the application of different policy tools. This knowledge may form a strong base for deciding what methodology and tools should and may be selected in preparing policy decisions. The best practices learned internationally have their own value, but when they are applied somewhere else they always need to be adjusted to the local environment. The automatic copying as a strategy brings unnecessary challenges and leads usually to failure.

There is another danger the countries in accession may face. Parallel with the growing activism of the EU in the fields of R&D and innovation (the ERA concept, the coordination of the relevant national policies, increasing funding sources for the RTD framework programmes etc.), the countries during their preparation period for the membership are extremely motivated to follow the Commission's policies. The importance of the framework programmes in their total R&D funding is much higher than in most of the member states. These factors puts an emphasis on simplifying the R&D and innovation policy formulation. Many experts think, that the framework programmes set national priorities as well, so there is no need to put lot of efforts at national base and to run complex and sometimes politically complicated exercises, like foresight.

Copying the EU is the usual 'lazy' reaction of politics, which prefers to avoid conflicts (no matter it is necessary or not) and aims at solving challenges with the lowest cost (no matter what is the real social cost for longer term). But this strategy is obviously not appropriate and not effective.

### 3. FORESIGHT AS THE TOOL?

There are a large set of tools in the hand of policy masters, foresight is not the only one for technology and innovation policy formulation. Policy analysis, strategic planning and future studies form an integral part of such exercises. Countries, regions and companies also apply technology forecasting and technology assessment in preparing their strategic decisions.

**Technology forecasting** aims at identifying technologies with promising future application. This is based on a continuous and global monitoring. The forecasting takes into consideration social and economic aspects, but it doesn't go into details. The result of this process draws the attention of decision makers on technology areas for further development. It is frequently used by companies.

**Technology assessment** (TA) focuses mostly on the social, economic and environmental aspects and consequences of the application of new scientific and technological breakthroughs. TA is a kind of interdisciplinary research with a clear aim to use its results for decision-making. Its approach is much wider than in the case of forecasting and the results may assist decision makers to have broader view on the framework conditions and the real social and economic impacts of exploiting new

technical results. It supports decision-making by introducing potentials created by new knowledge and technical results.

**Technology foresight** (TF) is much broader in the sense of areas involved and interest groups participated in. It addresses cross-cutting issues (like the application of information and communication technologies or the environmental consequences of technical developments etc.). *“The process is highly interactive, open and has a bottom-up spirit in order to identify breakthroughs and explore hypothesis that support strategy-formulation.”* [Tübke (2001)]

In this document we use the following definition: *“foresight is a systematic, participatory, future-intelligence-gathering and medium-to-long-term vision-building process aimed at present-day decisions and mobilising joint actions.”* [EC (2001)]

### **3.1. Historic background of technology foresight**

From historical point of view technology forecasting first was applied as policy preparation tool still back to the late 1950s and early 1960s in the US, specifically in the defence sector.

Later, in 1970 Japan decided to launch a 30-year national forecast exercise on the future of S&T. Its aim was not selecting priority areas, but giving advises for both public and private decision-makers by a broader direction-setting based on deep analysis of long-term trends. Thousands of experts were involved into this consensus building process, which was repeated every five years until 1991.

In Europe France ran the first foresight-like programme (in the early 1980s), then Sweden and Norway followed. In the 1990s many European governments decided to apply (and test) this tool. [STI Review (1994)]

### **3.2. Positioning technology foresight in the government decision making system**

Foresight is a policy-making tool, a process, which aims at developing a collective learning platform with permanent communication among business, academic, governmental and other social actors. Its perspective is always mid- or long-term, the process is typically bottom-up and transparent and it looks for alternatives, optional ways for development, providing a menu for selection for decision makers. It has always a strategic character.

What is the linkage between the government decisions and foresight exercises? What should be this linkage in order to get the optimal results? The answer is not as easy as it looks like. The first (traditional) answer would be to put directly all the TF activities into the governmental decision making process and leave it working. There are, however, two major reasons why this solution is very rarely applied.

First of all, governments in the modern democracies are always too much influenced by daily politics, which does not support long-term visionary thinking and a broad social acceptance of the recommendations resulted by the foresight exercise. One of the most common characters of all governments is to prefer actions for short-term and on ad-hoc base. These are not that kind of organisations, which have strong forward-looking nature.

Secondly, one of the main characters of the foresight process is to have well-balanced interactions among different actors. In the area of technology or innovation many stakeholders must be equally represented in the foresight process from the bottom

to the top. Public servants, especially from the R&D and innovation administration are very important agents of the process, but not the only ones. The equally active contribution of the business and academic communities, and the civil society is crucial. There is no hierarchy among these stakeholders, just high-level dialogue and real discussion on key questions may result in cross-fertilisation impacts.

The organisational infrastructure, which may serve this procedure best, should not be close to any of the actors in order to provide a neutral environment for running the process. It could give the necessary guarantee for high quality and fair operation. The government should realise the need for launching a foresight exercise, making decisions on its timeframe and its objectives, then creating the necessary conditions and framework. It participates in the implementation, as one of the key actors, and supports it (usually as co-sponsors). It is also an important role of governments to build links between TF programmes and public decision-making. The TF exercises had usually no direct linkage with the relevant governmental decision making bodies.

If the foresight activities are not directly embedded into the governmental policy decision-making procedure, what is the proper distance between these two structures? It is hard to give an answer, which is valid for all the countries and actions, because it depends largely on the local administrative and political culture. Generally it can be said that foresight exercise should be close enough to the government to address relevant questions and to find channels for effectively communicating the recommendations of the final documents, but it should be far enough to be separated from the official decision-making procedures and to keep its freedom for raising alternatives and finding answers for its questions. [Barré (2001)]

### **3.3. TF programmes and cultural/social deficits in ACC**

Public administrations play significant role in any foresight exercises. The culture of governing, how public bodies and administration work, how they form an integrated system and how they formulate and implement policies are factors, which directly influence the follow-up process of foresight programmes. These factors should be taken into consideration still during the programme. The recommendations and other outcomes of foresight should be fit into the later action-capabilities and capacities. Otherwise, the final documents will remain only nice papers and no efforts can be mobilised in order to give life written statements.

*“The co-operative culture” in the public administration in most of the CEE countries “is very poor, the tasks and functions of individual organisations are not well defined, the system itself is not transparent enough. The organisational learning and innovative capabilities are weak. The technical and managerial competence, creativity and strategic thinking are not highly valued, the loyalty is much higher prioritised as requirement for employment than the professional knowledge and expertise” [Nyiri (2002)]*

Government offices in these part of the continent do not consider, that accountability, working under defined rules and in a transparent way, delegating tasks and responsibility into an optimal, usually lower level inside the vertically organised hierarchy are high priorities in their daily operation. Co-ordination and co-operation among the different ministries and government agencies is a very challenging job and it is run effectively if it serves the positioning of the given agency in the power game of the administration.

Some challenges the foresight promoters should face in launching a programme in less developed countries:

- The time horizon of foresight is always far beyond the interest of the decision makers (both in the administration and in the political life).
- There are different understandings inside the stakeholder groups and the policy makers about the process of innovation and the links between innovation, economic performance, quality of life and competition. It is much easier to follow the linear model of innovation. The very complex approach of new innovation theories is hard to sell. That is the reason why it is extremely important to find appropriate language in formulating the final recommendations.
- The public administration dealing with R&D and innovation is under constant restructuring in most of the European countries, including the CEE region. In addition, the ministries responsible for R&D and innovation are not considered as “hard ministries” (like defence, finance, foreign affairs or trade and industry), their position is rather weak inside the governments. These two factors make difficulties for the foresight promoters in forming the necessary coalition behind foresight exercise.

As discussed above, foresight is a complex process, with large number of interrelations, with high level of communication in both quantity and quality, with a strong multidisciplinary and interactive character. The local environment may determine the success of the process. The aims of the exercise, the applied methodology and tools should be selected after deeply studying this environment. One of the success factors of foresight programmes is how the process will have changed this local social environment. (In many cases the major target of foresight programmes is to improve the networking and communication among all the stakeholders.)

One of the most important parameters, which should be taken into consideration before starting the design of a foresight programme, is the actual **decision-making culture** around the programme. In the practice of the post-industrialist countries the so-called *reflexivity* is a very important element of the decision making process. Reflexivity means a regular and systematic collection of data in order to measure the outcomes of any actions. These data serve the analysis, with the aim of further improving the performance of an organisation. It is a key element of the learning process. Both monitoring the outcomes and evaluating the performance are integral part of such decision making culture. Most of the political decisions are supposed to be based on experts' knowledge and the process intends to involve all the stakeholders.

The less developed countries (like all the nations in CEE) have a big deficit in this area. The social implication into decision-making process is weak and it is not based on broad participation of the stakeholders. Performance indicators are usually not applied as tools for learning (their use is not an organic part of policy programming). The concept of reflexivity is poorly understood. Political programmes are usually declaratory, and priorities are either not set or set without practical implications for budgeting. The weight of public servants and governmental politicians is over-emphasised. The data collection does not support analytical purposes, but they are used as arguing for decisions already made. As discussed above, this culture does not favour foresight approach, but foresight may put positive and effective impact on changing this culture.

The **social infrastructure** in the less developed countries is also much weaker and less supportive from foresight point of views than in the post-industrialist nations. All social systems in Central and Eastern Europe “*appear to be highly localised and particularised. The different parts of the system have started to operate independently of the rest which among other features is characterised by restricted/non-existent flow of information between the parts, lack of co-operation and, in some cases, excessively high levels of competition.*” [PREST/FhG ISI (2000)] These societies are traditionally vertically structured, the civil societies are weak, the groups of different stakeholders are badly organised and the public administrations, as bureaucracies are rather strong. The platforms for social dialogue are missing or under-developed. The social infrastructure in these countries is fragmented and poorly networked. This situation may limit the efficiency of foresight exercise, which by its nature does not tolerate rigid structures and hierarchical thinking.

Another important aspect, linked directly to the social infrastructure, is the well-balanced **participation of major stakeholders**. It is an issue, which should also be given special attention in the new democracies in Europe. These countries are in transition in both economic and social sense. There is a danger, that the foresight exercises in these nations are dominated by the academic community in lacking the critical mass of globally thinking and future oriented business participants. At this early phase of market economy the number of such business leaders is limited. That is why the strong involvement of industry in such policy formulation procedure should be given high priority and special attention through the whole process.

The **communication** is key element of all the foresight programmes (sometime it is one of the targets). It has many functions. Communication does not mean only the flow of information, but a real dialogue among different stakeholders, as well. It creates a new language, which are equally spoken by all the participants. It makes possible the formulation of new networks and improves the relationships among them. Last, but not least it serves one of the most important tasks of foresight, the consensus building process. The communication culture of a country, where technology foresight is launched, should be carefully studied before starting the exercise. It is one of the most important tasks of the preparation phase.

In the ACC region, especially in the new market economies, foresight may play special, significant social function in this regard. It may improve the communication among different stakeholders, who otherwise do not speak the same language, it may create new tool for further social debates, and finally it may develop the internal linkages of the national system of innovation. The importance of such benefits can not be over-estimated in economies, where the innovation system is highly fragmented and the links between the actors are poor or non-existing.

### ***3.4. Limits of foresight***

Technology foresight is not a tool, which may provide solutions to all the problems an organisation faces in strategic decision-making. It has major limits, which should be taken into consideration; otherwise, the cost/benefit ratio of such exercise may be far from the expectation.

TF is a complex procedure, which needs long preparation and analysis of conditions. One of the most important pre-condition is to have a common public understanding of the necessity of changes. This environment is very important to successfully launch and implement the exercise. In lacking this, the process may not bring the expected results and it is closer to the usual “wishful thinking” (but with much higher costs).

TF integrates many policy tools (analysis, future studies, scenario building, etc.), but it does not replace them. All these tools have their own relevance and their appropriate application may bring wisdom into governing. The process is known as the art of policy formulation.

The TF exercises are always long-terminist. The recommendations focus on the future far beyond the end of the programme. The fast technical changes increase the uncertainty of these recommendations. The longer is the timeframe of a given message the higher is the uncertainty. In managing this problem, many countries decided to launch periodically foresight exercises in order to provide the necessary inputs for adjusting the recommendations to the actual economic, social and global environment. A single foresight exercise has only limited impacts.

In many cases, the TF exercises aim at defining technology areas, which should be used for priority-setting in public resource allocation policies. It is, however, very dangerous to apply it, if there is no highly sophisticated monitoring and evaluation system in function. In such cases foresight may act much more as a process, which monitor the impacts and the technology changes at global markets and provide feed back for policy makers in order to set up flexible priority setting process.



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# Technology Foresight: An Introduction

*Michael KEENAN*

## Introduction

The 1990s have witnessed an explosion in technology foresight activities across the world, with most industrialised countries now conducting national foresight<sup>1</sup> exercises of one sort or another. By the late 1990s, this wave of foresight activity had started to wash over other levels of government, from international bodies such as the EU and UNIDO, down to regions, municipalities and cities. The reasons for this increase in activity are manifold, and include new regimes for the production of knowledge, the belief that governments should better target their R&D spending, and even simple policy transfer (bandwagon effects) from one territory to another.

This chapter provides a brief introduction to foresight, beginning with a discussion of some of the more popular definitions. This is followed by a summary of some of the main rationales for conducting foresight. Next, we provide a brief historical account of the modern foresight family tree, and describe how foresight is used today. Finally, we discuss emerging developments that are set to shape the way we practise foresight in the coming few years.

## What is Technology Foresight?

Two popular definitions of foresight are provided by UK-based researchers. The most-oft quoted is that from Ben Martin (1995) at SPRU, who describes *research* foresight as “the process involved in systematically attempting to look into the longer-term future of science, technology, the economy and society with the aim of identifying the areas of strategic research and the emerging generic technologies likely to yield the greatest economic and social benefits.” Similarly, Luke Georghiou (1996) at PREST describes technology foresight as “a systematic means of assessing those scientific and technological developments which could have a strong impact on industrial competitiveness, wealth creation and quality of life.”

There are five important aspects to these definitions:

1. Attempts to look into the future must be systematic to be called ‘foresight’. This distinguishes foresight from the endogenous scenario building that we are all engaged in when planning our everyday lives.

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<sup>1</sup> We will use the terms “technology foresight” and “foresight” interchangeably in this paper. The former has been largely superseded among policy makers by the plain label of “foresight”, on account of the increasingly wide application of these sorts of techniques to non-technological domains. Indeed, there is even wide recognition that technology foresight exercises often take as much account of economic, social and cultural issues as they do technology developments, thereby rendering the label “technology foresight” as somewhat misleading.

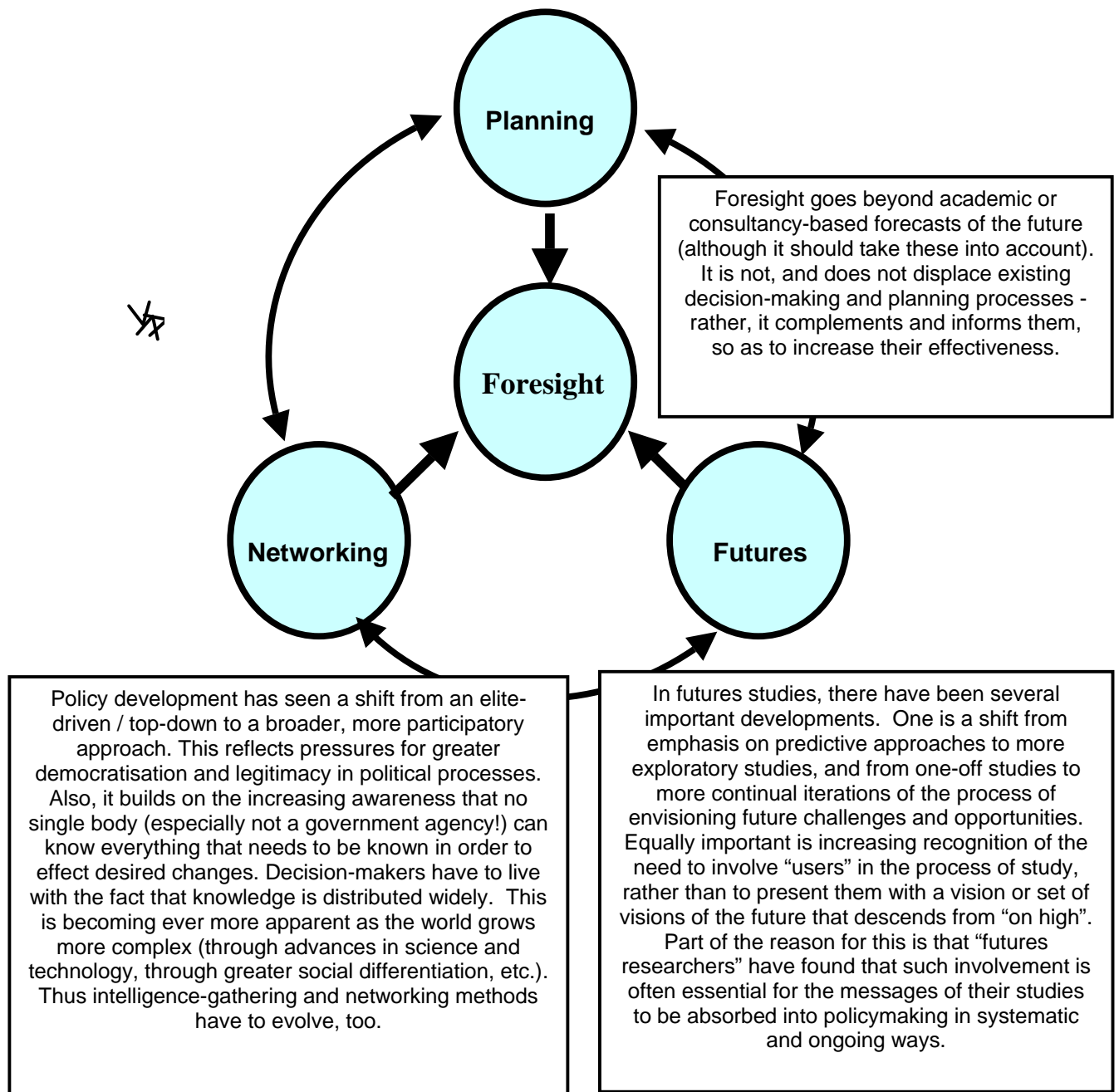
2. Foresight must be concerned with the longer term, which is generally considered to be beyond normal planning horizons. Foresight time horizons therefore typically range between five and thirty years.
3. Science/technology push should be balanced with market pull. Whilst this is a rather crude way to think about the innovation process, the point is that technology foresight should not be dominated by science and technology alone. Attention also needs to be paid to socio-economic factors that are well-known to shape innovations.
4. Foresight concentrates on emerging generic technologies where there is a legitimate case for government support. This is because companies are often unwilling to fund the strategic research that underpins emerging generic technologies.
5. Attention must be given to social impacts, not just those concerned with wealth creation. This has led some recent foresight exercises to adopt more problem-oriented perspectives from the outset, for example, focusing upon issues such as crime prevention, education and skills, ageing societies, etc.

These aspects have been somewhat superseded in recent times, with definitions of foresight tending to place more emphasis on system building and process benefits. For example, according to the FOREN *Practical Guide to Regional Foresight*, foresight is said to involve five essential elements (2001: 4):

1. “Structured anticipation and projections of long-term social, economic and technological developments and needs.
2. Interactive and participative methods of exploratory debate, analysis and study, involving a wide variety of stakeholders, are also characteristic of Foresight (as opposed to many traditional futures studies that tend to be the preserve of experts).
3. These interactive approaches involve forging new social networks. Emphasis on the networking role varies across Foresight programmes. It is often taken to be equally, if not more, important than the more formal products such as reports and lists of action points.
4. The formal products of Foresight go beyond the presentation of scenarios, and beyond the preparation of plans. What is crucial is the elaboration of a guiding strategic vision, to which there can be a shared sense of commitment (achieved, in part, through the networking processes).
5. This shared vision is not a utopia. There has to be explicit recognition and explication of the implications for present day decisions and actions” (emphasis original).

**Figure 1: Positioning Foresight**

In strategic planning, there has been a move from a “rational” approach aimed at achieving equilibrium and stability, to more evolutionary approaches. This follows recognition that high levels of uncertainty are the norm, not the exception, and that economic progress is more a matter of disruptive innovations than of the pursuit of equilibrium. In much modelling and rational planning it was assumed that we can grasp the dynamics of social and economic life on the basis of quantitative changes within stable structures: Qualitative changes frequently undermine such assumptions, and traditional “long-term planning” has been discredited. But the long-term still has to be taken into account in many decisions, and planners have sought better ways to do so.



Foresight is often confused with other future-oriented activities, such as forecasting, futures studies, and strategic planning. Foresight should not be confused with forecasting, which tends to be more fixed in its assumptions on how the future will unfold. Indeed, forecasters aspire for precision in their attempts to predict how the world might look at some point in the future. By contrast, foresight does not seek to predict: instead, it is a process that seeks to create shared visions of the future, visions that stakeholders are willing to endorse by the actions they chose to take today. In this way, foresight is not concerned with predicting the future; rather, it is concerned with creating it.

With regards to futures studies and strategic planning, Figure 1 sets out their relationship with foresight. The important thing to note is that foresight does not replace forecasting, futures studies, or strategic planning. Each activity has its role, which in many instances can be mutually supportive.

### **Why is Technology Foresight considered to be important today?**

To begin to answer this question, it is worth revisiting some of the early writers who argued for the use of foresight in a national setting. Prominent among these are Ben Martin and John Irvine, who published books in the 1980s on *research* foresight (Irvine & Martin, 1984; Martin & Irvine, 1989). They offered the following rationale for research foresight:

“Research foresight is one response - and in our view the only plausible response - to resolving conflicts over priority-setting caused by escalating experimental costs, limited resources, complexity in scientific decision-making and pressures to achieve ‘value for money’ and socio-economic relevance. (...) Foresight provides, at least in principle, a systematic mechanism for coping with that complexity and interdependence as it affects long-term decisions on research, in particular facilitating policy-making where integration of activities across several fields is vital” (Martin & Irvine, 1989: 3).

Writing more recently and referring to *technology* foresight, Martin has sought to explain national foresight’s rapid diffusion through the 1990s. He has identified the following three drivers (Martin & Johnston, 1999; Martin, 2001):

1. ***Escalating industrial and economic competition*** – for industrialised countries to compete in the global economy, knowledge-based industry and services are becoming ever more crucial. These are reliant upon innovation and the development of new technologies, which in turn are underpinned by strategic research. According to Martin (1996),

“The primary rationale [for doing foresight] is the widespread recognition that emerging generic technologies are likely to have a revolutionary impact on industry, the economy, society and the environment over coming decades. These technologies are heavily dependent for their development on advances in science. If one can identify emerging technologies at an early stage, governments and others can target resources on the strategic research areas needed to ensure rapid and effective development.”

2. ***Increasing pressure on governmental spending*** – science and technology, with their dependence upon public funding, have been subject to the same probing questions as other areas of public spending. At the same time, escalating costs mean that governments cannot afford to fund all areas of research and technology that their

scientists and industrialists would like them to support. This demands selection, with technology foresight seen as a process for systematically assessing the choices that have to be made. In other words, technology foresight is presented as a process that helps in the identification of funding priorities.

3. ***Changing nature of knowledge production*** – Gibbons et al (1994) have argued that a far wider range of knowledge producers are now implicated in the innovation process. This so-called ‘Mode 2’ form of knowledge production is characterised by its application-orientation and growing trans-disciplinarity. According to Martin & Johnston (1999):

“These developments point to the increasing need for communication, networks, partnerships, and collaboration in research, not only among researchers but also between researchers and research ‘users’ in industry, government, and elsewhere. (...) [F]oresight offers a means for developing and strengthening those linkages.”

Martin and Johnston (ibid.) develop this theme further by arguing that technology foresight is a useful means for ‘wiring-up’ and strengthening national systems of innovation (NSI). It is perhaps worth saying a few words about systems of innovation before presenting the arguments associated with foresight’s systemic benefits. The concept of systems of innovation has proved popular with academics and national policy-makers alike over the past decade, and is now also being picked up by regional and sectoral players. Rather than focusing upon the constituent actors within the system, the strength of the NSI approach is said to lay in its emphasis upon the relationships and linkages between the actors. If we accept the Mode 2 thesis, this emphasis on linkages and networks is important. Thus, a NSI marked by actors that are not “particularly strong, but where the links between them are well developed, may operate more effectively (in terms of learning and in generating innovations) than another system in which the actors are stronger but the links between them are weak” (Martin, 2001).

This brings us to perhaps the most commonly cited rationale for technology foresight today – that of correcting ‘system failures’. The foresight process itself is said to enhance communication between actors within a system, providing a means of coordination and generating commitment to action. As Martin and Johnston (1999) contend,

“Technology foresight offers a means of ‘wiring up’ and strengthening the connections within the national innovation system so that knowledge can flow more freely among the constituent actors, and the system as a whole can become more effective at learning and innovating.”

Knowledge flows and system-wide learning are important to emphasise here. For instance, knowledge of other actors’ strategies and positioning vis-à-vis a given issue (e.g. through foresight) can reduce uncertainties, thereby enhancing a system’s innovative capacity. The potential for system-wide learning, which is also said to enhance a system’s capacity for innovating, is related to the level of interdependence between the various system actors. The degree of interdependence is, in turn, dependent upon *processes* that stimulate, nurture, encourage, and strengthen interactions between actors so that they become more permanent – processes such as technology foresight (ibid.).

We might also identify other drivers to explain the wide adoption of foresight:

- ***Emergence of new styles of policy-making*** – it could be argued that the 1990s have witnessed the emergence of a new, more inclusive style of policy-making, partly in an effort to bridge the perceived ‘implementation gaps’ associated with previous era policy interventions. This development is also being driven by a growing realisation that, as the world grows more dynamically complex, it is impossible for any one organisation to know everything that is needed for successful policy intervention. In other words, many governments have recognised that the requisite knowledge for successful policy intervention is *distributed* across a wide and varied landscape of actors, and that this landscape has a role to play in policy formulation and implementation. This is sometimes described as a shift from top-down government to a more distributed ‘governance’ model. Foresight exercises, with their inclusiveness and emphasis on processes, would seem to be part of this shifting trend.
- ***Increasing desire for anticipatory intelligence*** – an oft-cited rationale for conducting foresight, especially at the sectoral and regional levels, concerns the development of anticipatory intelligence amongst system actors. This is a common rationale found in foresight exercises associated with industry cluster development, or with the competitiveness of SMEs, though it tends to be implicitly assumed in virtually all foresight exercises. It refers to the objective of widening perspectives, both spatially (e.g. to cover unexplored domain areas, untapped potential markets, etc.) and temporally (e.g. to encourage longer-term thinking than might normally be the case). These new perspectives offer insights into possible opportunities and threats that might otherwise remain invisible. Armed with this strategic knowledge, system actors, be they companies, or policy makers, or others, are believed to be better placed to implement flexible and robust strategies that have the responsiveness and agility to deal with multiple futures. In other words, and to use the common jargon, foresight allows companies and bureaucrats to be better “future-proofed” against a whole range of future eventualities.
- ***Building advocacy coalitions*** – an often overlooked but increasingly important rationale for conducting foresight is its ability to mobilise disparate groups of actors around a particular vision. For example, if a particular issue is believed already to be strategically important, foresight can be used not only to raise awareness of its importance, but also to mobilise the key stakeholders into taking strategic collective action. Collectivity is important here – to be taken seriously and to attract resources, actors usually need to coalesce within more or less organised coalitions in order to better argue for (or advocate) support of their particular area. Indeed, as history has demonstrated time and again, those who are organised tend to rule, whilst those who are disorganised tend to be ruled. With this in mind, foresight is often used to organise advocacy coalitions around issues of particular strategic importance, since such groupings are better placed to enact strategic change than the lone academic, entrepreneur, or bureaucrat. In some instances, foresight has even been used in this way to broaden the coalition of interests that advocate a central role for research and innovation in the wider political-economy.
- ***Bandwagon effects*** – as one country has undertaken a foresight exercise, ‘competitor’ countries have felt the need to follow suit. The same phenomenon can be seen in sub-

national regions. Foresight ‘promoters’ have told good stories along the lines of those outlined by Martin and other academics (including this chapter’s author), and these have proved irresistible to those who do not want to be ‘left behind’. In addition, the activities of international organisations, such as UNIDO (e.g. in Latin America and the former Soviet Republics) and the EU (e.g. in Eastern Europe), have played no small part in this diffusion process.

- ***The ‘Millennium Effect’*** – governments all over the world have sought at least to appear to be preparing for the new opportunities and challenges that lay ahead in the twenty-first century. This could explain an explosion in futures-type studies in the run-up to the new Millennium but probably cannot fully account for foresight’s continuing popularity in the post-Millennium era.

To conclude, there is a wide variety of rationales offered for conducting technology foresight, and rarely a single reason.

### **Historical and Contemporary Uses of Technology Foresight**

The modern-day interest in technology foresight can be traced back to the Japanese 30-year technology forecasts initiated in 1970. The Japanese government were interested in obtaining views of future technological and societal developments in order to identify those areas of development that would be critical to Japanese competitiveness in the future. They had gone on a fact-finding mission to the United States in the late 1960s, where a few federal government departments (e.g. Defense) and many large companies (e.g. Honeywell) were using a variety of technology forecasting tools to aid their planning. Amongst these tools was the Delphi technique, which is used when uncertainty about the future is great. It depends upon eliciting the views of a cohort of experts. The method also has the distinct feature of providing experts with an opportunity to change their views in light of the group result. The latter was viewed as especially important, since it meant that the Delphi would also inform experts in the system (many of whom came from industry) of any consensus on future developments. In effect, such consensus would act as signposts for companies, banks, bureaucrats, etc. to follow in their strategic planning. If these actors did act in light of this consensus, a sort of orchestration of the system could be achieved, with the experts’ forecasts becoming, in a sense, a self-fulfilling prophecy.<sup>2</sup>

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<sup>2</sup> This phenomenon is well known in the case of Moore’s Law. In the 1960s, it was predicted that the computing power of microprocessors would double every 18 months per dollar. This prediction, known as Moore’s Law, has been proven right, not because of any internal technological dynamic, but because chip manufacturers believe competitors will aim to follow the Law and produce more powerful chips. In other words, the prediction itself guides the innovation behaviour of the chip companies.



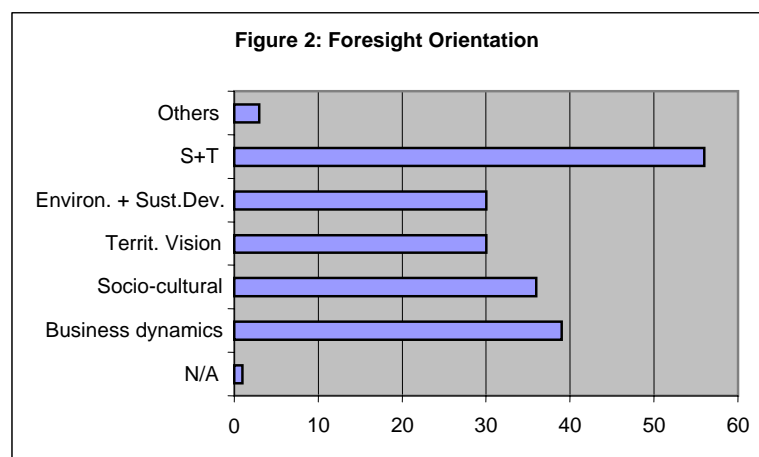
**Table 1: Genealogy of modern-day technology foresight at the national level**

Year	Delphi	Mixed	Panel/scenario
1970s -	30 years in Japan		
1989			Ministry of Economic Affairs Netherlands
1990	1 <sup>st</sup> German		Critical Technologies USA
1991			New Zealand
1992			Technologies at Threshold of 21 <sup>st</sup>
1993	South Korea		Century Germany
1994	France Japan/ Germany Mini Delphi	1 <sup>st</sup> UK TF Programme	
1995			100 Key Technologies France
1996	Japan – German Delphi		Australia Foresight Steering Committee Netherlands 1 <sup>st</sup> Italy Industry Foresight
1997		OPTI Spain	Ireland
1998	Austria	Hungary	South Africa New Zealand Sweden
1999			2 <sup>nd</sup> UK TF Programme FUTUR Germany
2000			2 <sup>nd</sup> French 100 Key Technologies Portugal Industrial Association 2 <sup>nd</sup> Italy Industry Foresight
2001	7 <sup>th</sup> Japanese Delphi		Czech Republic Malta, Cyprus, Estonia
2002		Turkey	Bulgaria Romania 3 <sup>rd</sup> UK TF Programme

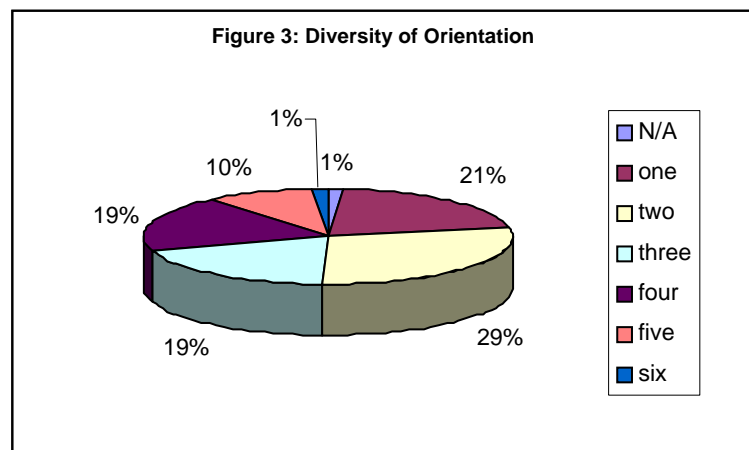
Things were somewhat slower to take off in Europe (see Table 1). During the 1980s, France and the Netherlands initiated limited technology foresight exercises. But the real surge of interest came about in the early 1990s, when the Germans and then the British began to use technology foresight. The Germans opted for using Delphi and decided at first to translate the Japanese questionnaire. In subsequent Delphi exercises during the 1990s, the Germans collaborated with their Japanese counterparts in developing and implementing national Delphi studies. The British also used Delphi in their first technology foresight exercise, but were largely disappointed with the results and have not used it since. The British approach was, however, quite different from that of the Japanese and Germans, since they established free-standing expert panels to conduct the foresight exercise. By contrast, the Germans and Japanese had used groups of experts to determine the Delphi topic statements, but had then dismantled these groups and conducted the Delphi centrally. In other words, groups of experts were used to service the German and Japanese Delphi studies, whereas in the British case, the Delphi was used to service panels of experts. Indeed, the British foresight panels have been described as the “hubs” of the national technology foresight exercise, since nearly all foresight activity passed through them. This model was to be later emulated in many countries around the world.

By the turn of the Millennium, virtually every Member State of the EU had undertaken a national technology foresight exercise, as well as a few Candidate Countries. Even in those EU countries where a national exercise has not happened, e.g. Finland, foresight is being used extensively in sectors and/or regions. Moreover, through the activities of international organisations, such as UNIDO, several countries in Latin America and other parts of the world have been experimenting with technology foresight.

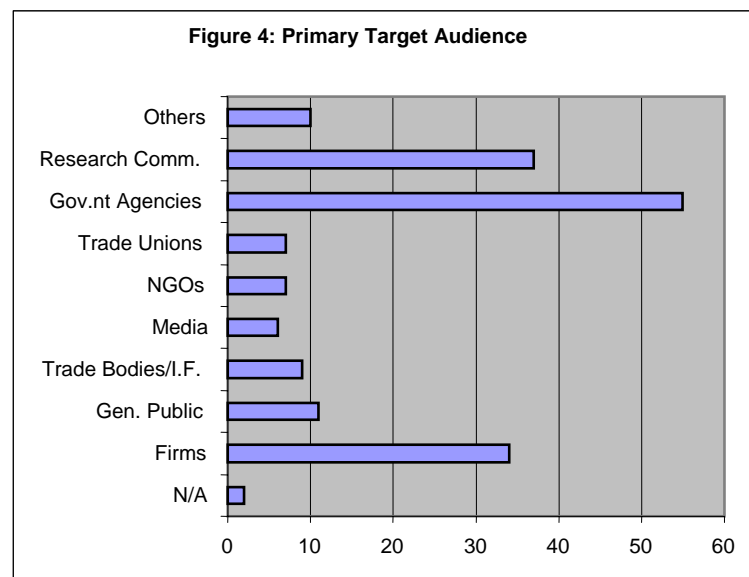
As we have already mentioned, not all foresight activities necessarily focus on science and technology (S&T), although a recent review of 84 foresight exercises in Europe (see Keenan et al, 2003) showed that S&T predominates (Figure 2).



The results of this review show that the next most popular orientation was business dynamics, followed closely by socio-cultural issues. Territorial vision and environment & sustainable development were both seen in 30 exercises each. Thus, we can conclude that a wide variety of orientations are in evidence. It should also be noted that most foresight exercises have more than one orientation. This is borne out by analysing the pattern of orientation across the 84 exercises reviewed. As the chart below shows, only 21% of exercises reviewed had a single orientation (usually Science & Technology), whilst the remaining 80% or so had two or more. Exercises with two orientations are the most numerous, although those with 3-5 orientations account for almost 50% of the total reviewed.

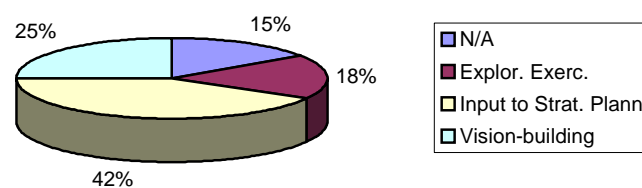


As for the customers of foresight, Government agencies are by far the most popular primary target audience, followed by the research community and firms. Again, this is borne out by the results of the European review of 84 foresight exercises (Figure 4).



We have already highlighted the importance attached to action in foresight, and unsurprisingly, this action-orientation is reflected in the results of the review. The chart below shows that in more than 40% of exercises reviewed, foresight was judged to be a direct input to strategic planning. In a further quarter of cases, it was used as a basis for vision-building. In only 18% of cases was an exercise judged to be explorative, that is, not formally linked to a process of decision making.

Figure 5: Direct action orientation



## Emerging Developments

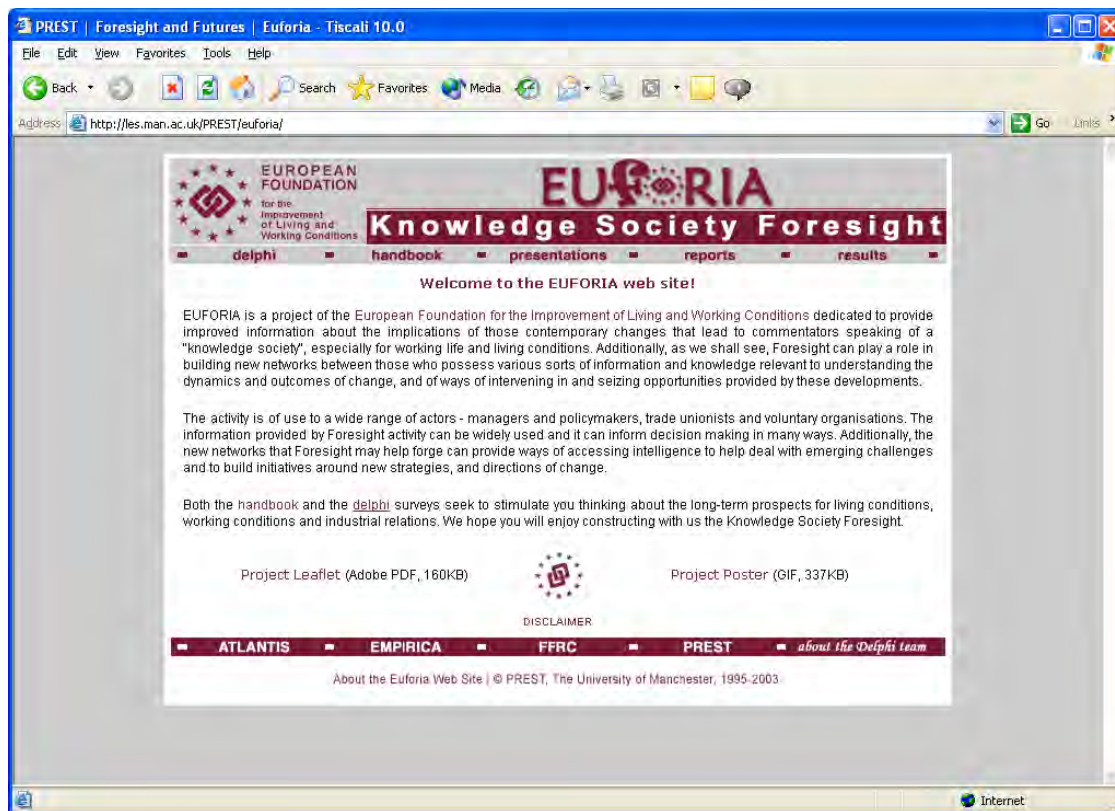
There is much to learn from existing examples of foresight exercises, but this does not mean that they should be emulated. In this regard, we would like to highlight a series of what we believe to be emerging developments in foresight in Europe.

The first of these is the increasing distributed nature of foresight. In many west European countries, foresight is now practised at various loci, including national, regional, municipal, organisational, and sectoral. It remains unclear how these relate to one another, but some people believe that they could have mutually supportive and coordinated roles. A further 'level' of activity from international institutions has also emerged over the last few years. Supranational foresight is still relatively new, but the actions of the EU and UNIDO are likely to see an increase in activity over the next 2-3 years.

A second development is the way we now view foresight exercises. Rather than being seen as one-off activities that might indicate spending priorities, foresight is increasingly viewed within a wider Strategic Intelligence & Future Oriented Participative (SIFOP) practice that is embedded in policy and innovation landscape. Other sorts of SIFOP activity include evaluation and technology assessment (for example, see Kuhlmann et al, 1999).

A third emerging development concerns the increasing use of ICTs in foresight. This ranges from the use of online Delphi tools, as in (i) the recent national Turkish foresight exercise and (ii) the European Foundation's four-country Euforia project (see figure 6), to the use of online tools for scenario workshop facilitation (e.g. Web-COUNCIL). Electronic libraries of visions and scenarios have also been developed in some exercises. Finally, online discussion groups and forums are increasingly popular in foresight studies.

**Figure 6: the online Delphi tool used in the Euforia project**



A fourth development concerns the de-reification of expertise in foresight studies. Foresight is now for “the masses”, with participation widened to include key stakeholder groups and even citizens in some instances. This shift has witnessed the use of different techniques, with expert-based tools like Delphi and cross-impact analysis less popular. In their place, scenario and visioning workshops have become ever more popular, since these tend to be more accessible to non-experts if used properly.

## Summary

This paper has sought to introduce some of the main features of foresight. It has provided various definitions of foresight, emphasising its systematic nature and future-orientation. Our understanding of foresight has shifted over the last decade, with much more emphasis now placed on the process benefits. This is reflected in the sorts of rationales offered for conducting a foresight exercise, which include addressing system failure and developing advocacy coalitions, among other things. The modern technology foresight family tree can be traced back to the early 1970s, with the activities of the Japanese government. Foresight approaches became popular in Europe only during the 1990s, where they are used at various loci. As an area of work, foresight does not stand still and is continually evolving. The paper finishes with a brief discussion of emerging developments that are currently having an impact on the field of foresight.

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# Socio-economic and Developmental Needs: Focus of Foresight Programmes

*Attila HAVAS*

## **ABSTRACT**

Emerging economies in the CEE/NIS region – faced with a number of similar or same challenges when trying to find their new role in the changing international settings, while still characterised by their own distinct level of socio-economic development, set of institutions, culture and norms – can benefit significantly from conducting foresight programmes. Yet, foresight should not be conducted for its own sake – just because it is becoming “fashionable” throughout the world, and currently being promoted by the EU. On the contrary, there should be a strong link between foresight, decision preparation and policy-making. In other words, foresight should be used in the context of (adequately identified) policy needs. Its focus (e.g. purely technological, techno-economic or broad socio-economic orientation) is, therefore, largely determined by the perceived socio-economic and developmental needs. Further, its focus, broad objectives, geographical scope (level), themes, time horizon, methods and participation are closely interrelated, and thus a careful – but flexible – project design is needed to assure coherence among these constituents. It should be borne in mind, however, that foresight is only one of the available policy instruments, and definitely not a panacea.

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## **INTRODUCTION**

The increasing number of foresight programmes suggests that it can be a useful policy tool in rather different national innovation systems. Emerging economies in the CEE/NIS region – faced with a number of similar or same challenges when trying to find their new role in the changing international settings, while still characterised by their own distinct level of socio-economic development, set of institutions, culture and norms – can also benefit significantly from conducting foresight programmes. Foresight has now reached a point, at which different approaches can be compared to highlight ‘good practices’: what has worked in certain circumstances (level of development, challenges and hence policy aims), and thus what set of tools and approaches are likely to be useful in different environments. In other words, foresight should be used in the context of adequate policy needs – actually, it can also contribute to identify/reformulate those needs. Its focus (e.g. purely technological, techno-economic or broad socio-economic orientation) is, therefore, largely determined by the perceived socio-economic and developmental needs. Further, its focus, broad objectives, geographical scope (level), themes, time horizon, methods and participation are closely interrelated, and thus a careful project design is needed to assure coherence among these constituents.

This chapter is aimed at discussing the relevance of foresight for emerging economies in the CEE/NIS region. In doing so, first the rationale of conducting foresight is summarised: what policy challenges can be tackled by applying foresight? Then different types of foresight programmes are identified, in terms of their focus, orientation and geographical scope. Following upon that, the relationships between focus, themes and time horizon are analysed, pointing to different approaches to the same topic (theme), and emphasising the importance of cross-cutting issues. The next section highlights the pros and cons of various approaches (foci) and foresight techniques in the context of emerging economies. Then the benefits of, and potential for, co-operation among emerging economies are discussed. The concluding section

summarises the major lessons, but also presents some policy and methodological dilemmas.

## **POLICY CHALLENGES: WHY TO CONDUCT FORESIGHT**

Foresight (or the use of some other methods to assist future-oriented thinking) is important to emphasise the possibility of different futures (or future states, as opposed to the assumption that there is an already given, pre-determined future), and hence the opportunity of shaping our futures, to enhance flexibility in policy making and implementation, broaden perspectives, encourage thinking outside the box (“think of the unthinkable”). A number of major trends affect all countries and most areas of policy-making, thus a new *culture of future-oriented thinking* is needed.

The increasing number of national foresight programmes suggests that foresight can be a useful policy tool in rather different national innovation systems. As a growing body of literature analyses this surge, the major factors explaining the diffusion of foresight can be summarised in a telegraphic style:

- Globalisation, sweeping technological and organisational changes, as well as the ever-increasing importance of learning capabilities and application of knowledge have significantly altered the ‘rules of the game’. Thus, policy-makers have to take on new responsibilities (as well as dropping some previous ones), while firms must find new strategies to remain, or become, competitive in this new environment.
- Given the above factors our future cannot be predicted by any sophisticated model. Planning or forecasting of our future becomes more and more ridiculed in light of rapid and fundamental changes. History also teaches us valuable lessons about the (im)possibilities of planning and predicting the future. Therefore, flexibility, open minds for and awareness of possible futures are inevitable. Diversity is a key word: diversity in scope (in terms of possible futures, differing analyses etc), as well as diversity in solutions or policy options.
- Decision-makers face *complex* challenges: socio-economic and technological factors interact in defining issues of strategic importance, e.g.
  - education and life-long learning (new demands on education systems; new, mainly IT-based tools and methods for teaching and learning; the growing need for interaction and co-operation with businesses);
  - environmental issues;
  - quality of life (health, education, demographic changes, especially the growing share and special needs of elderly people, living and working environment, social conflicts, crime prevention, etc.);
  - competitiveness (at national and EU-level for attracting talents and capital, at firm level maintaining and increasing market shares nationally and internationally, etc.);
  - regional disparities.
- Most policy problems no longer have ‘self-evident’ solutions. Governments are forced to make use of ‘evidence-based policies’, policies based on knowledge/insight into what works and what does not. This does not mean that values are no longer of importance. Values are still very important, but have to be considered in the context of a given issue.



- Policy-makers have to learn to cope with growing complexity and uncertainty of policy issues themselves. Thus the precautionary principle is of a growing significance.
- New skills and behaviour are required (e.g. problem-solving, communication and co-operation skills in multidisciplinary, multicultural teams meeting more often only “virtually”, as well as creativity) if individuals or organisations are to prosper in this new setting. This, in turn, creates new demands on the education and training system (see above).
- Clusters, networks (business – academia, business – business, both at national, international levels) and other forms of co-operation have become a key factor in creating, diffusing and exploiting knowledge and new technologies, and therefore in satisfying social needs and achieving economic success.
- There is a widening gap between the speed of technological changes and the ability to formulate appropriate policies (which requires a sound understanding of the underlying causes and mechanisms at work.)
- Given the growing political and economic pressures, governments try hard to balance their budgets, while cutting taxes, and hence they need to reduce public spending relative to GDP. In the meantime accountability – why to spend taxpayers’ money, on what – has become even more important in democratic societies. Public R&D expenditures are also subject to these demands.
- Policy-makers also have to deal with intensifying social concerns about new technologies (mainly ethical and safety concerns in the case of biotech or nuclear technologies, and fears of unemployment and social exclusion caused by the rapid diffusion of information and communication technologies).
- Even the credibility of science is somewhat fading. Scientific research no longer stands for ‘true’ in itself. The ‘objectiveness’ of policies based on scientific research is questioned (by citizens, interest groups, etc.) as scientists themselves are known to have different opinions and come to different conclusions on the same issue.
- More generally, individualisation, as a major recent trend, has several repercussions. The ever more mature and independent citizens want to be catered to their needs; this calls for ‘mass customisation’ not only in manufacturing and services, but to some extent also in policy-making. They are also more and more informed about possibilities, possible negative effects, and will not hesitate to voice their preferences. On top of this the social bases for decision-making are quickly eroding. The ‘usual’, erstwhile social groupings to which people belonged (e.g. churches/ religions, socialists, entrepreneurs, workers) no longer provide relevant, sufficient guidance for all areas of decision-making. People can, and nowadays do, belong to a multitude of different interest groups; they are not bound by the traditional ‘pillars’. Thus, the role of the traditional intermediaries (political parties, unions etc) is becoming less dominant. More and more specific interest groups (new intermediaries, e.g. NGOs) have sprung up, and become increasingly important. This can be seen as a supplement to democracy; citizens are exercising ‘voice’ in new ways (not just once in 4-year election periods). Therefore decision-making is becoming ever more complex. Coalitions (not those of political parties, but of stakeholders) are not fixed, they tend shift issue by issue. All this calls for openness on possible futures, flexibility, and room for diversity as mentioned above.

Besides the above trends, there are other specific, policy-relevant methodological reasons to apply foresight. First, it can offer vital input for ‘quantum leaps’ in policy-making in various domains. Usually policies evolve in a piecemeal way, in incremental, small steps. From time to time, however, a more fundamental rethinking of current policies is needed. In other words, policy-makers occasionally need to ask if current policies can be continued: do they react to signs of changes, block or accommodate future developments?

The parable of the boiling frog illustrates this point ‘vividly’: put a frog in a cooking pot with cold water, and start heating the water. The frog will not jump out, because it does not alerted by the slowly rising temperature. It will boil alive.

Second, foresight can also help in picking up *weak signals*: weak but very important signals that a fundamental re-assessment and re-alignment of current policies are needed. In other words, foresight can serve as a crucial part of an *early warning* system, and it can be seen as an instrument for an adaptive, ‘learning society’.

In sum, participative, transparent, forward-looking methods are needed when decision-makers are trying to find solutions for the above challenges. Foresight – as a systematic, participatory process, collecting future intelligence and building medium-to-long-term visions, aimed at influencing present-day decisions and mobilising joint actions – offers an essential tool for this endeavour. (EC DG Research, 2002) It helps in making choices in an ever more complex situation by discussing alternative options, bringing together different communities with their complementary knowledge and experience. In doing so, and discussing the various visions with a wide range of stakeholders, it also leads to a more transparent decision-making process, and hence provides a way to obtain public support. The foresight process can reduce uncertainty, too, because participants can align their endeavours once they arrive at shared visions. Many governments have already realised the importance of foresight activities, and thus this relatively new, and innovative, technology policy tool is spreading across continents.<sup>1</sup>

The above general considerations apply in catching-up countries in the CEE/NIS region, too.<sup>2</sup> Quite a few pressures – especially the need to change attitudes and norms, develop new skills, facilitate co-operation, balance budgets – are even stronger than in the case of advanced countries. Moreover, most of these countries also have to cope with additional challenges: the need to find new markets; fragile international competitiveness; relatively poor quality of life; brain drain. These all point to the need to devise a sound, appropriate innovation policy, and even more importantly, to strengthen their respective systems of innovation. Foresight can be an effective tool to embark upon these interrelated issues, too, if used deliberately in this broader context.

Foresight can also contribute to tackle yet another challenge of emerging economies: most of them are struggling with ‘burning’ short-term issues – such as pressures on various public services, e.g. health care, education, pensions and thus

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<sup>1</sup> For a detailed and systematic analysis of the rationale for foresight and description of national exercises see the articles, papers and books listed in the References.

<sup>2</sup> The term of CEE/NIS region denotes Central and Eastern European countries, Black Sea Economic Cooperation (BSEC) countries and the Newly Independent States (NIS). The notions of emerging economies and catching-up countries are used interchangeably throughout this chapter, and refer to BSEC countries and NIS (i.e. the case of other emerging countries e.g. in Africa, South America or South-East Asia is not discussed here).

severe budget deficit; imbalances in current accounts and foreign trade; unemployment; etc. – while faced with a compelling need for fundamental organisational and institutional changes. In other words, short- and long-term issues compete for various resources: capabilities (intellectual resources for problem-solving); attention of politicians and policy-makers who decide on the allocation of financial funds; and attention of opinion-leaders who can set the agenda (and thus influence discussions and decisions on the allocation of funds). These intellectual and financial resources are always limited, thus choices have to be made. A thorough, well-designed foresight process can help identify priorities, also in terms of striking a balance between short- and long-term issues.

Further, foresight can offer additional “process benefits” in the CEE/NIS region. By debating the various strengths, weaknesses, threats and opportunities of a country posed by the catching-up process, and the role of universities and research institutes in replying to those challenges, the process itself is likely to contribute to realign the S&T system (including the higher education sector) to the new situation. An intense, high-profile discussion – in other words, a wide consultation process involving the major stakeholders – can also be used as a means to raise the profile of S&T and innovation issues in politics and formulating economic policies. (Georghoiu, 2002)

To conclude, foresight should not be conducted for its own sake – just because it is becoming “fashionable” throughout the world, and currently being promoted by international organisations. On the contrary, there should be a strong link between foresight, decision preparation and policy-making: foresight should be used as a policy tool to address major socio-economic and political challenges. It is not a panacea, however; it cannot solve all the problems listed above, and cannot solve any of them just on its own. Obviously, other methods and tools are also required, as well as an assiduous implementation of the strategies devised either at national, regional, sector or firm level.

## **LEVEL AND FOCUS OF FORESIGHT**

The ‘maturity’ of foresight reached a point, at which it can be classified. (Barré, 2001, 2002, Johnston, 2002, Renn, 2002) In other words, no ‘optimal’ approach or any form of ‘best practice’ can be identified, yet, taxonomies can be developed to highlight ‘good practices’: what has worked in certain circumstances (level of development, challenges and hence policy aims), and thus what approaches and set of tools are likely to be useful in different environments.

Foresight programmes can be either holistic, or just concentrate on particular technologies or business sectors. Holistic programmes, in turn, may have rather dissimilar foci, ranging from the identification of priorities in a narrowly defined S&T context to addressing broad socio-economic needs. They can have different geographical scopes, too, i.e. they can be conducted at international (group of countries, collaborating regions transcending national borders), national, regional, local, sectoral or firm level.

Foresight programmes can be product or process-oriented, depending on the policy needs to serve, e.g. informing specific decisions with analytical reports, list of priorities, recommended actions vs. facilitating networking, communication and co-operation among key players. The separation of the products and the process, however, is somewhat artificial. Without a lively and constructive, creative process we cannot talk

of foresight, because in that case it would not be a participatory programme, on the one hand. Moreover, wide participation is likely to improve the quality of the 'final product'. (The process should be well-organised and focussed, of course, otherwise the more people are involved, the less coherent and concise report would be produced.) Without inspiring 'semi-finished products' – background papers, draft visions and reports –, on the other hand, the 'process' cannot be triggered at all. Experts would not attend meetings, workshops in a sufficient number as they would not feel being intellectually rewarded for their time and efforts.

Foresight programmes can be supported by a number of analytical and participatory methods ranging from desktop research, expert discussions and brainstorming, SWOT- and trend analyses, scenario-building, Delphi-survey, to various forms of stakeholder involvement (workshops, consensus conferences). Some of them are exploratory in their nature (starting with the present situation and then identifying potential future states), while others are normative ones (describing desirable futures and asking what paths could lead there). In certain contexts, for certain purposes quantitative methods are more relevant, whereas in other cases qualitative ones can or should be used. (see the methodological chapters in this volume, as well as Cuhls *et al.*, 2002, FOREN, 2001)

Following Georghiou (2001) and (2002), three 'generations' of foresight – or rather, prospective/ strategic technological analyses – can be identified. The first generation is the classical technological forecasting. It is still around in many reports, and as its name clearly suggests it is aimed at predicting technological developments, based on extrapolation of perceptible trends. These predictions are produced by a relatively small group of experts: futurologists and/or technological experts (that is, other types of expertise or actors are not sought after in the process of forecasting). The main objective is to predict which S&T areas are likely to produce exploitable results. Forecast results, in turn, are used in economic planning, either at firm or macro level.

In a second-generation foresight programme a different set of actors is involved: researchers working on various S&T fields and business people, bringing knowledge on markets into the process, as the main aim becomes to improve competitiveness by strengthening academy-industry co-operation, correcting the so-called market failure<sup>3</sup> and trying to extend usually too short time horizon of businesses. Accordingly, futurists and technological 'gurus' play hardly any role in these exercises. These programmes are organised by following the structure of economic sectors (various industries and services).

A third-generation foresight programme further broadens the scope in terms of the major issues to be tackled and thus participants: the focus shifts to broad/er/ socio-economic challenges, and hence besides researchers and business people government officials and social stakeholders are also involved. The shift in focus is reflected in the structure, too: these programmes are organised along major socio-economic concerns (e.g. health, ageing population, crime prevention as in the case of the Hungarian, first Swedish or second UK foresight programmes). A new element in the underlying rationale can also be discerned, the so-called systemic failure argument: the existing institutions (written and tacit codes of behaviour, rules and norms) and organisations are not sufficient to improve quality of life and enhance competitiveness, and thus new institutions should be 'designed' by intense communication and co-operation among the

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<sup>3</sup> In short, private returns on R&D are smaller than social returns (as firms cannot appropriate all the profits stemming from R&D), and thus firms do not invest into R&D at a sufficient – socially optimal – level.

participants. In other words, the existing gaps should be bridged by new networks, appropriate policies aimed at correcting systemic failures and relevant organisations. A foresight programme, based on this rationale, can deliver solutions in various forms: by strengthened, re-aligned networks as ‘process’ results of the programme, as well as by policy recommendations.

The above brief description, of course, only depicts ‘idealised prototypes’: an actual foresight programme might combine certain elements from various “generations”. As learning is rather intensive in this field, too, one can easily detect elements of a given programme applied in another one, with a slightly different rationale. In most cases, however, one type of rationale would be chosen as a principal one – it thus would underlie the more detailed objectives and structure of a programme, as well as the choice of its participants – otherwise it would likely to lead to an incoherent – even chaotic – exercise, characterised by tensions between (a) the various objectives, (b) elements of its structure, (c) the objectives and methods, (d) the participants and objectives, and/or (e) among the participants themselves. A certain level of tension might be quite useful – or even essential – to produce creative, innovative ideas and solutions, of course, but too intense and too frequently occurring – structural, inherent – conflicts would most likely tear a foresight programme apart.

To illustrate the above general considerations it is worth recalling that in the CEE region so far two countries have concluded holistic foresight programmes at a national level, albeit following different approaches. Hungary took a broader approach, focussing on socio-economic issues, relying on both visions (scenarios) and a large-scale, two-round Delphi questionnaire, and producing a broad set of policy recommendations to strengthen the national innovation system (correct the systemic failures). (Havas, 2003a, [www.tep.hu](http://www.tep.hu)) The Czech programme, on the contrary, aimed at identifying S&T priorities, and thus applied a modified version of the so-called key (or critical) technologies method. ([www.foresight.cz](http://www.foresight.cz)) This difference has confirmed that context does matter: even countries with a more or less similar history, facing similar challenges on the whole and being broadly at a similar level of development can opt for different foresight approaches/ methods. Other emerging economies in the CEE/NIS region might consider taking somewhat different routes, given their own specific circumstances and goals. It all depends on the policy challenges, as well as on the policy environment: if decision-makers strongly favour a certain approach, it is definitely not a good idea to try to push through a drastically different programme design – even if it might seem to be relevant from an abstract theoretical/ methodological point of view.

## **THEMES AND TIME HORIZON**

At a first glance, the focus of a foresight programme determines the themes to be discussed/ analysed to a large extent. For instance, as already alluded, typical themes for a technology forecast program would be specific fields of science and technology, such as microelectronics, communications, bioinformatics, energy technologies, new materials, bio- and nanotechnology. These topics have been dictated to a non-negligible extent by ‘fashion’ or fads, too: earlier much had been written on nuclear and space technologies, then came ICT to yield significance and notice more recently to fields denoted by prefixes of ‘bio-’ and ‘nano-’. The time horizon can be driven by the dynamics of a given discipline or the imagination (agenda) of the futurist. For the latter, perhaps an extreme example is when Molitor (2000) predicts the weight and height of

human beings in 3000. He has also published a book entitled *The Next 1000 Years*. It is not uncommon, however, to try to predict major events in a 50-100 years time horizon.

The so-called critical or key technologies method is also concerned with technological fields – as its name clearly indicates – but in this case the time horizon is much shorter, usually 5-10 years, as it is derived from policy-makers' needs to set mid-term priorities.

A typical second-generation foresight programme, e.g. the first UK one, deals with economic sectors, such as chemicals, construction, financial services, food and drinks, leisure and learning, retailing and distribution, transport, as well as technological fields, such as aerospace and defence, communications, IT and electronics, life sciences, materials. The time horizon in this case was 15-20 years, similar to a number of other national foresight programmes.

At a national level only a handful of third-generation foresight programme have been conducted so far. As already mentioned, these are concerned with broad socio-economic issues, such as human resources, health, ageing population, crime prevention, usually with a time horizon of 20-25 years.

**Box 1: UK1 and UK2 foresight themes**

**UK 1<sup>st</sup> round (1994-99)**

*Science driven sectors:*

Chemicals  
Defence and aerospace  
Health and life sciences  
Materials

*Exploitation sectors:*

Communications  
Financial services  
Food and drink  
IT and electronics

*Policy driven sectors:*

Agriculture, natural resources and environment  
Energy  
Retailing and distribution  
Transport

*Human resource and management driven sectors:*

Construction  
Leisure and learning  
Manufacturing, production and business processes

**UK 2<sup>nd</sup> round (1999-2002)**

*Thematic panels*

Ageing population  
Crime prevention  
Manufacturing 2020

*Sector panels*

Built environment and transport  
Chemicals  
Defence aerospace and systems  
Energy and natural environment  
Financial services  
Food chain and crops for industry  
Healthcare  
Information, communications and media  
Marine  
Materials  
Retail and consumer services

**Box 2: Hungarian and Swedish foresight themes**

**TEP, Hungarian Foresight Programme (1998-2000)**

Human resources  
Health (life sciences, health care system, life style, pharmaceuticals, medical instruments)  
Natural and built environment  
Information technologies, telecommunications, media  
Manufacturing and business processes (new materials, production processes and management techniques, supplier networks)  
Agri- and food businesses  
Transport

**Swedish Foresight Programme**

Health, medicine and care  
Biological natural resources  
  
Society's infrastructure  
Production systems  
Information and communications systems  
  
Materials and material flows in the community  
Service industries  
Education and learning

### **Different approaches to the same topic**

A premature conclusion from the above examples would suggest a mechanistic link between the focus and themes of a given foresight programme, as well as between themes and time horizons. A more detailed look, however, would reveal there is no strict one-to-one relationship in either case. E.g. information and communication technologies (ICTs) are usually analysed by all sorts of foresight programmes – with important differences, of course:

- in a critical (key) technologies programme the emphasis would be on specific technological terrains of this broad field, usually with a 3-5-year time horizon, and hardly any attention would be devoted to social issues (e.g. exclusion – inclusion of certain social groups; gaps between generations, regions cities vs. villages; e-democracy; regulations on, and incentives for, different types of content; etc.);
- technology forecasters would also put the emphasis on – usually positive, glorious – technical aspects (including perhaps also the overall impacts on the society in general, i.e. not differentiated/ elaborated by social strata; but no impact the other way around, that is, how socio-economic needs and trends would shape technological developments). They opt, however, usually for a significantly longer time horizon (20-25 or even 50 years, because the intention is to predict big events, technological breakthroughs) than the one used in a critical (key) technologies programme.
- a second-generation foresight programme is likely to focus on broader technological fields – as opposed to specific sub-fields analysed by the critical technologies approach or forecasters. (Yet, in the first UK programme, IT, electronics and communications were not integrated into a single panel.) It would pay much more attention to the economic (market) aspects than the above ones, and perhaps would discuss some social factors, too, as they shape demand, but not much elaboration can be expected on social challenges (either dealing with the new ones caused/ accentuated by ICT or asking how ICT can contribute to tackle existing social challenges). The usual time horizon is around 10-15 years when this approach is chosen.
- a distinctive feature of a third-generation foresight programme is the marked, deliberate shift towards precisely to those socio-economic aspects which are neglected by all the other approaches, and thus mentioned above as “negative examples”. Technical aspects, however, are not ignored by this approach, either, but discussed in a different context (also usually in a more integrated way, e.g. ICT and various types of media are understood as a complex, closely inter-related entity): other types of questions are asked, and new drivers and shapers come to the forefront. The time horizon, therefore, is also determined by the socio-economic issues identified by the programme: it would depend on the amount of time required to change the underlying settings, to influence the major shaping factors so as to achieve a certain (desirable) future state. (In other words, the time horizon cannot be shorter than the period of time needed for a change aspired by the programme.)

ICT has been used as an example here because it is – by definition – a technology, and as it is a significant one, it is no surprise at all that various generations of technology foresight programmes would deal with this issue. Non-technological topics

– such as human resources, crime prevention, etc. – on the contrary, are only addressed by third-generation programmes as major issues. (This is not to be mistaken with the fact that some socio-economic factors might be included in a second-generation foresight programme as shapers influencing market dynamics – as mentioned above.)

Finally, it goes without saying that some inherent features of a given topic to be analysed also have repercussions on the time horizon. Usually changes take much more time e.g. in the field of agriculture (classical breeding), environment, education or in demographic trends than in rapidly evolving technologies, such as ICT or biotechnology. These determinants should not be ignored, and various themes/ topics of a given foresight programme, therefore, might have somewhat different time horizons. The sponsors and the managing team should be prepared for that.

### **Cross-cutting issues**

As already mentioned, third generation foresight programmes put emphasis on broad socio-economic issues, as opposed to organising the panels either by scientific branches or economic sectors. For instance, TEP, the Hungarian Foresight Programme has brought together various issues treated separately in most other foresight exercises, and put more emphasis on socio-economic needs, than on science and technology ‘push’.<sup>4</sup>

An important lesson of various second-generation foresight programmes has been, however, to put a strong emphasis on the so-called cross-cutting (cross-panel, or horizontal) issues. Taking TEP again as an example, it was a conscious effort, in spite of defining broad fields as panel topics to be analysed. Panels were encouraged to identify, and adequately deal with these issues when analysing major trends and developing alternative visions for their fields.<sup>5</sup> A workshop was also organised to analyse these issues when the first drafts of the panels’ visions were completed.<sup>6</sup>

Although TEP panels were set up around broad issues, real-life cases proved to be even more complex, of course. They require expertise from many disciplines and economic sectors: e.g. our health is influenced by a number of factors, among others by one’s life style (eating and drinking habits, if one smokes or not, time and efforts for active recreation, etc.), social status, diet, housing and employment conditions, as well as the level of the medical care system and the environment. All these issues belonged to different TEP panels, i.e. a close and well-thought collaboration was required to carry out a reliable, thorough analysis and formulate sensible policy proposals. Having

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<sup>4</sup> For example, the *Health and Life Sciences* panel has encompassed life sciences, related fields of biotechnology, the health care system, pharmaceuticals and medical instruments industries, but all from the point of the health of the population. Some of these issues were not analysed at all in the foresight exercises known when TEP started, e.g. the health care system. Others were treated in separate panels, e.g. life sciences (a ‘stand-alone’ panel in the first UK foresight programme), pharmaceuticals (as part of the *Chemicals* panel in the same programme). Also, *agriculture and food processing* belong to a single panel in the Hungarian foresight programme (as opposed to the first British one). Similarly, *IT, telecom and media* were brought under the same ‘roof’.

<sup>5</sup> A list was developed at the very beginning of TEP, including, among others: education, training and re-training; impacts, threats and opportunities of IT; environmental issues; accession to the EU; competitiveness; social cohesion; the role of large (multinational) and small and medium-sized (indigenous) firms; control and self-control of different systems and sub-systems; research and development, manufacturing (services), marketing; new materials.

<sup>6</sup> TEP Office staff prepared matrices of issues, actions to be taken, etc. panel by panel. Face-to-face, ‘bi- or trilateral’ meetings of respective panel secretaries and members were also organised during and after the workshop.



recognised that need, some panels joined forces, i.e. their budget, and commissioned together a group of experts to analyse cross-cutting issues from different points of view.<sup>7</sup> Given the legacy of the planned economy – that is, strong ‘departmentalism’ – and the inherent isolation of various disciplines, it can be regarded an achievement in itself.

Some of these cross-cutting can be further analysed by a specifically designed Delphi survey. In the case of TEP, two cross-cutting issues were also put into the Delphi questionnaire as variables, namely impacts of a given event/development on the environment and lack of skills as a potential constraint. There were a number of ‘cross-cutting’ Delphi-statements, too, e.g. those concerning environmental issues but formulated by other panels (e.g. Health; IT, telecom and media; Manufacturing and business processes). TEP Office staff collected these statements, and the respective panels were urged to analyse them, i.e. both those panels that had formulated these ‘cross-cutting’ Delphi-statements and those which are ‘affected’ by these statements.

In sum, although there is a great deal of overlap in terms of broad themes discussed by various types of foresight programmes, a closer look clearly shows that these apparently same topics are dealt with in rather different manners. A different focus means different approaches are applied when analysing seemingly similar issues: a different set of questions are asked, and hence various – social, technological, economic, environmental and political – factors and values are taken into account to a different degree (some of these factors not at all in certain foresight programmes) by a different set of participants (futurists, technology gurus, business people, researchers, policy-makers, lay people). The time horizon, in turn, is determined to some extent by the inherent (technical, social, etc.) features of the various themes, but also by the focus (main objectives) of the programme in which these topics are taken up. Even in a case when panels are set up to discuss broad socio-economic issues, it is inevitable to devote systematic efforts – and probably more sophisticated methods than currently known – to deal with the so-called cross-cutting issues. Further, there is also an obvious need to find appropriate – efficient, convincing – ways and means to convey these complex ‘messages’ to decision-makers and opinion-leaders.

## **CHOOSING APPROPRIATE METHODS: THE DESIGN AND USE OF VARIOUS FORESIGHT TECHNIQUES IN EMERGING COUNTRIES**

The propositions below are formulated in the conceptual framework of the so-called innovation system approach. This understanding of the innovation process emphasises the importance of communication, mutual learning and co-operation among various actors (e.g. scientists and engineers, business people and policy-makers), strengthening the existing – and building new – institutions, formal and informal networks conducive to innovation. It is systemic as well, in the sense that a successful innovation process encompasses not only technological elements (inputs, actors and factors) but economic, organisational and social ones as well. (Lundvall and Borrás, 1998; OECD, 1998)

Given the challenges of the catching-up process, it seems to be more appropriate to start with a holistic foresight programme at a national level. Then, relying on the various results achieved this way – including not only the information collected and analysed, reports published, but also the skills and experiences accumulated, as well as the so-

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<sup>7</sup> *Health and Agri- and food businesses* panels set up two such task forces to analyse jointly healthy diet and allergy.

called process results – sectoral and/or regional foresight programmes can be launched with a higher probability of success. Some countries, however, might find it more relevant to launch sectoral or regional programmes as pilot projects to ‘test’ the willingness of potential participants, collect experiences about various techniques, etc., that is, to use these pilot projects as ‘on-the-job’ training and preparation for their future national foresight programme.

In any case, the organisation and the management of any foresight programme are crucial:

- The design of the programme should take into account the level of the socio-economic development; the size of the country in question; in many emerging countries the socio-psychological legacy central planning, too, as it used to be their way of organising economic activities; the overall communication, co-operation and decision-making culture (norms, patterns, written and tacit rules); the legal, organisational and institutional framework, etc.
- The focus and thus the main objectives should be formulated clearly at the very beginning. To juxtapose two quite different positions, a foresight programme can be:
  - confined to assist the decision-making process of setting narrowly defined R&D (as mentioned above, that was the case in the Czech Republic, and accordingly the ‘key technologies’ method was used); or
  - geared towards broader socio-economic needs and problems of a country in question, i.e. what is the role of S&T developments, various policies and regulation in solving these broader problems, what are the responsibilities of the various actors: government, scientists and researchers, businesses, NGOs, families, individuals? (that was the approach taken in Hungary)

Given the challenges of catching-up in general, and the very nature of the systemic changes of transition countries in the CEE/NIS region, ‘visions’ (‘futures’, or fully fledged scenarios) are of high relevance both at panel (i.e. micro or mezzo) and macro levels. Visions (scenarios), however, have been mainly used at micro level so far (e.g. in the case of the UK, Portugal, Sweden and Spain), with the exception of Hungary and South Africa. Yet, it is not an elementary, evident task to combine micro and macro visions. An inherent difficulty is that panels analyse a certain field, with its specific structure (players, institutions, norms, values and attitudes), socio-economic and technological dynamics, etc., while the macro visions deal with issues at a different level, by definition. For this reason alone, there are obvious constraints to harmonise macro and meso (panel) visions.<sup>8</sup> Obviously, there is a need for methodological innovations in this respect.

If the panel method is to be applied, the decision on the issues for panel discussions/reports is also crucial in terms of the expected output. One possibility is to set up panels to analyse various disciplines and/or economic sectors (e.g. the first UK foresight programme). A different approach would be to analyse broader socio-economic issues, like human resources, health, environment, business processes, of course with a strong emphasis on technological drivers/ opportunities, too, in that context (see e.g. the Swedish and the second UK foresight programmes). Again, taking into account the various challenges of the catching-up process, the latter approach seems to be more

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<sup>8</sup> For a more detailed account of these, and related, difficulties in the Hungarian case, see Havas, 2003a.

appropriate for emerging economies – but as already stressed, only in the case when this view is shared by at least the majority of stakeholders.

The catching-up process also calls for explicit policy recommendations (as opposed to, e.g. the German and Japanese foresight exercises). Again, the decisions on the focus (if the foresight programme should be concerned with technological priorities or broader socio-economic issues), objectives and methods would influence the issues for policy proposals (e.g. S&T priorities *vs.* human resources, various fields of regulation, competition, innovation, FDI and regional development, institution- and network-building).

Besides panel discussions/ reports, a Delphi-survey can also be useful in emerging economies. Its benefits are threefold: (i) it collects information (experts' opinion), but (ii) also disseminates those pieces of information, and by doing so, contributes to consensus building or identifies dissenting views, and (iii) usually it involves more participants in the process (as opposed to the case when only panels are included). However, it should be carefully designed, and certain aspects need to be considered thoroughly. Just to give a few examples:

- Are there a sufficient number of technical/ technological experts to conduct a large-scale postal survey, or is it better to use it as a supporting tool at experts' meetings?
- What structure is more appropriate: the traditional one aimed at collecting opinion or a more decision-oriented version (e.g. the one used in Austria)?
- What is the appropriate balance between the strictly technological and non-technological issues in the Delphi-statements (rows of the questionnaire)?
- What are the appropriate questions, i.e. the column headings in the questionnaire, taken into account the focus and objectives of a given foresight programme? How to create consistency among the questions (column headings), the nature of statements/ issues (rows in the questionnaire) and the country characteristics?
- What is the appropriate size of the questionnaire (the number of statements and questions)?

For a successful, effective foresight programme a strong emphasis should be put on organising awareness raising seminars in the first stage, and then on continuous, wide-ranging dissemination, discussions in parallel with the analytical activities. It is needless to say that without a carefully designed dissemination and implementation most of the efforts and resources committed to the programme (time of experts, tax-payers' money to cover the organisational and publication costs) would be wasted.

In sum, it is not only the 'products' – i.e. the different documents, final reports, policy recommendations – that are important results of a foresight programme, but also the 'process' itself, namely disseminating a new, participatory, transparent, future-oriented decision-making method; intensified networking, co-operation and institution-building activities. In other words, a foresight programme can contribute to the strengthening of the national system of innovation in two ways: through reports, recommendations as well as via facilitating the communication and co-operation among various professional communities.

## **CO-OPERATION AMONG EMERGING ECONOMIES**

There is an obvious scope for co-operation in the CEE/NIS region. Most of these countries are relatively small, and have not accumulated much experience with foresight, while facing a number of similar structural challenges. Thus, it can be extremely useful to exchange experiences on methods applied in various countries, as well as identifying success and failure factors. Moreover, some analytical activities on issues going beyond national borders might also be harmonised if there is a mutual interest in doing so. In other words, it cannot, and should not, be imposed upon the region (or group of countries in the region) by any national or international player. However, various international organisations, notably the EU and UNIDO, as well as national governments and professional associations might play a crucial role in facilitating this co-operation, contributing significantly to achieve synergies and economies of scale in a number of ways.

A well-designed co-operation among the players would assist local (national) capacity building and regional (trans-border) networking by

- promoting interactive learning through joint, tailored workshops (i.e. not a one-way flow of codified knowledge at traditional training seminars) to develop skills and generate shared tacit knowledge. The most important issues are the benefits and drawbacks of various foresight techniques (methods) in the context of catching-up.
- facilitating future co-operation among major players by establishing good, mutually beneficial working relations, i.e. building trust through actual co-operation during the national/ regional foresight programmes.

This type of regional co-operation can also help in exploiting economies of scale (compensating for insufficient intellectual resources in highly specialised fields, be they technical, socio-economic or policy expertise). Some possibilities to kick-off this co-operation are:

- producing (commissioning) joint background studies on major technological and socio-economic drivers (relevant for the co-operating countries). More in-depth, context-specific analyses, of course, should be conducted and policy conclusions should be drawn as part of the national foresight programmes.
- devising scenarios on European/ global developments (if scenarios are to be used in the various national programmes);
- building partially aligned scenarios (the structure of scenarios might be partially co-ordinated, in other words some 'variables' might be the same, while their actual 'value' would differ country by country).

A more close co-operation might address jointly identified and/or trans-border issues, e.g.

- issues of relevance for cross-border regions: enhancing competitiveness by building/ strengthening clusters, synergies among firms, regional S&T base, and higher education; tackling environmental, region-specific health problems, etc.
- 'emerging-country' problems, such as critical mass in RTDI; the role of, and opportunities for, emerging countries in international co-operation in general, and with the enlarged EU in particular.

Once co-operation starts, other issues to be discussed jointly and further possibilities for building capabilities and sharing resources, exploiting economies of scale are likely to be identified by the participants themselves. In other words, any rigid 'blueprint' for

this co-operation might be counter-productive: insisting on a detailed plan (methods and milestones) might cause more harm than good.

International co-operation, however, poses a significant challenge, too: the broader the geographic scope of a programme is, the more difficult and costly is to maintain its participatory character. Moreover, when participants are coming from different countries – in terms of level of development, norms, ways of thinking, values, behavioural routines – it is not only a question of travel time and costs to organise and facilitate meaningful workshops. In that cases potential communication problems should be taken into account carefully when preparing these meetings: possible gaps should be identified in advance, and efforts have to be made to bridge them as well as to remove other obstacles to fruitful discussions. Of course, not all the problems can be envisaged, i.e. some ‘slack’ (e.g. extra time for clarification, reconciliation, other means to exchange ideas) should be allowed for that.

Another important direction to advance methodology – mainly via experimentation, i.e. including ‘action research’ – is to develop and test various methods e.g. for virtual meetings; electronic discussions; arranging and exploiting feedback from a series structured, ‘aligned’ meetings held separately across various countries on the same set of problems (allowing for somewhat different approaches, and yet following the same broad lines of discussions); on-line questionnaires with (almost) real-time (‘instant’) feedback; etc.

## **CONCLUSIONS**

To conclude, foresight can be a useful tool for emerging countries to devise adequate strategies for the coming years when they continue to be faced with the multiple, complex challenges of restructuring in the CEE/NIS region (notably how to deal with a significantly enlarged, new EU either as a member or a partner), while fundamental changes occur in the global structures, too. However, the success of any foresight programme depends on the match between its context (level of development, and hence the policy challenges of a given country), focus, goals, geographical scope (level), themes, time horizon, methods and participation. Although one can come up with a large number of combinations of these constituents on paper, only some of them are feasible in practice: they cannot be ‘mixed’ freely. In other words, relevant policy needs should be addressed by applying appropriate tools, and involving relevant players. Given the wide choice of aims and techniques, it is of utmost importance to develop a clear programme concept at the outset, and then design a consistent, thorough project plan.

It is still likely, though, that some important methodological details would evolve throughout the programme, and that some objectives will have to be revisited and revised. This is in line with the general observation that foresight is predominantly a learning process, even in advanced countries with more experience in foresight, as reflected by the recent changes for instance in the UK and Germany. Moreover, a trade-off seems to exist between the ‘methodological sophistication’ of a programme and willingness to participate. Potential foresight participants might be ‘deterred’ by advanced, demanding methods, especially when foresight conducted for the first time in a country. (Of course practically any method can be taught at training seminars. Yet, foresight participants tend to be respected, and hence busy, researchers or business people who find difficult to attend even the “usual” panel or Steering Group meetings.

Thus it might be hard to convince them to attend yet more meetings so as to learn certain sophisticated methods.)

Further, it is crucial to prove the relevance of foresight for decision-making: its timing and relevance to major issues faced by societies, as well as the level of its 'products' – reports and policy recommendations – are critical. Only substantive, yet carefully formulated proposals can grab the attention of opinion leaders and decision-makers, and then, in turn, the results are likely to be implemented. Otherwise all the time and efforts of participants put into a programme would be wasted, together with the public money spent to cover organisational and publication cost. The so-called process results – e.g. intensified networking, communication and co-operation among the participants – still might be significant even in this sad case, but they are less visible, and much more difficult to measure. Thus, the chances of a repeated programme – when it would be due again given the changes in the circumstances – are becoming really thin.

Foresight can be relevant even in a small country, being not in the forefront of technological development, but rather somewhere in the semi-periphery. A number of factors seem to contradict this conclusion at the first sight. It is costly in terms of time and money, but even more so in terms of the participants' time required by meetings, workshops and surveys. Moreover, rich(er), more developed countries, whose experts, in turn, know more about the leading edge technologies regularly conduct their foresight programmes, and the 'products' – reports, Delphi-survey results – are readily available. Yet, only a national programme can position a country in the global context, and discuss how to react to major trends. Similarly, a SWOT of a given country would not be analysed by others, let alone broad socio-economic issues. Process benefits cannot be achieved without a national programme either. Without these, a country would not be able to improve the quality of life of her population and enhance her international competitiveness.

Yet, it is important to highlight some dilemmas, too, which are partly to do with policy, and partly methodological in character:

- How to solve the inherent contradiction between the long-term nature of foresight issues (policy recommendations), on the one hand, and the substantially shorter time horizon of politicians (and some policy-makers), on the other?
- What organisational set-up is necessary to ease another inherent contradiction between the need for a strong (but 'reserved') political support (or 'embeddedness') for a foresight programme on the one hand, and for enjoying intellectual, organisational, financial independence from any government agency, on the other?

International co-operation can enhance the chances of success by sharing lessons, easing the lack of financial and intellectual resources through exploiting synergies and economies of scale. Yet, its more ambitious form, i.e. a joint foresight exercise on trans-border issues also necessitates methodological innovations. International organisations can also facilitate foresight programmes in emerging countries, and more specifically collaboration among them. It is crucial, however, to maintain the commitment of local actors, e.g. in terms of time and funds devoted to the programme, willingness to implement of the results. In other words, the main forms of foreign assistance should be the provision of knowledge-sharing platforms and other fora to exchange experience (among emerging economies as well as with advanced countries), monitoring and evaluating foresight initiatives in the CEE/NIS region.

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# Organising a Technology Foresight Exercise<sup>1</sup>

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*Ian MILES*

## **Introduction**

Much of this volume is given over to presenting and elucidating specific methods commonly associated with technology Foresight exercises – scenarios, Delphi, expert panels, critical technologies, etc. Often hidden and forgotten is consideration of the methods associated with organising and managing a technology Foresight exercise, yet these are crucial to the success of Foresight. For example, how are participants identified and engaged in a technology Foresight exercise? Who decides on the areas to be covered and how is this done? And what methods should be used to do what? Such questions are largely addressed at the outset of a technology Foresight exercise in a process known as “scoping”. In this chapter, we will explain the process of scoping and its constituent elements. Accordingly, the chapter is divided into two main sections. The first deals with the process of scoping technology Foresight – why it is necessary, how it is done, and who to involve. The second section is more extensive, presenting a set of elements against which a technology Foresight exercise can be scoped. Twelve elements are presented in all, ranging from the starting point of an exercise through to consideration of policy intervention. Throughout, interdependencies between elements are discussed in order to show that choices made have consequences for other parts of an exercise. The intention is to provide a strategic framework (platform) that will allow the reader to construct coherent technology Foresight options.

## **1. The Scoping Process**

Deciding on what you want to achieve from technology Foresight, on who should be involved, on the areas that should be covered, on the methods to be used, etc. are matters for debate and negotiation within a process we have called “scoping”. In this section, we provide a definition of scoping, summarise its benefits, set out how and when it could be done, and suggest who should be involved.

### **1.1 What do we mean by “scoping”?**

By the term “scoping”, we refer to those processes of research and deliberation that contribute to the shape and timing of a given technology Foresight activity. Technology Foresight can come in many shapes and sizes, and can be conducted over a long or shorter time period. Deciding an appropriate design requires research into what others have done, consulting people on what could work in a given setting, and elaborating options (or scenarios) for the conduct of the technology Foresight exercise. The manner

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<sup>1</sup> This chapter is based largely on Miles I, Keenan M, and Kaivo-oja J (2003), *A Handbook for Knowledge Society Foresight*, European Foundation for the Improvement of Living and Working Conditions (EFL), Dublin

in which these tasks are carried out depends, to some extent, on the local circumstances. Nevertheless, it is possible to provide guidelines on the conduct and content of any scoping exercise, something we will do in this chapter.

## **1.2 Why is scoping necessary?**

Scoping is important for several reasons:

- To review and perhaps pilot foresight options – there are many different ways to conduct Foresight and setting out some of these options can be useful. In some instances, for example, where Foresight has not been used before, it may be worth piloting some of the possible methods.
- To assess current and past arrangements – what is done already and what are its strengths and shortcomings?
- To assess requirements against capabilities – Foresight exercises can sometimes be resource-intensive, in terms of human, social and financial capital. Not all Foresight approaches are suited to all situations. Therefore, it is necessary to formulate a Foresight approach that takes account of existing opportunities and limitations.
- To establish the need for any new structures or arrangements that will have to be put in place – existing structures and/or routines may not be readily adapted to the participatory and creative environments demanded by Foresight. In such circumstances, new arrangements may need to be put in place.
- To generate a flexible (and responsive) blueprint for the exercise that uses the most appropriate methods – it is important for scoping to lead to an exercise plan that is responsive to changing conditions. Indeed, scoping should broaden options rather than constrain, and should engender an understanding of interdependencies between strategic choices.
- To make the case for Foresight – a well-written report that demonstrates an understanding of Foresight and sets out the various options can be a powerful tool for convincing others of the merits (and limitations) of undertaking an exercise. Moreover, because scoping is a process, it has the potential to accommodate participation from the outset, thereby engendering ownership of Foresight early on.

## **1.3 How is scoping carried out?**

Scoping technology Foresight involves three main tasks:

1. **Gathering background information** – technology Foresight should not be undertaken without research into past and ongoing activities of a similar nature. Organisers may also have in mind a particular methodological approach, which again should be researched. Research typically takes the form of literature reviews through books, journals, reports, and web sites.
2. **Eliciting views and advice** – more often than not, expert consultation is also relied upon – for instance, advice is often sought from practitioners involved in other similar technology Foresight exercises, some of who may come from overseas. But the target audience of a technology Foresight exercise, including

those who might be expected to participate in the process and/or to act upon the results, will also need to be consulted. This may be done through scoping workshops and even open conferences, but more often than not, it first involves private bilateral discussions with key stakeholders. The aim is to gather ideas, obtain commitment of future support and participation, and to begin the process of securing buy-in to the results of the exercise.

3. **Articulating and presenting options** – once background information has been gathered and views elicited, options for technology Foresight should be set out in some sort of report. This may be openly published, for example, as a consultation document, or may remain a private document to be circulated only amongst sponsors and key stakeholders. It should set the background and rationale for technology Foresight, highlight examples from other countries, regions, organisations, etc. (whichever is most comparable), and describe a set of possible options for technology Foresight. The scoping elements described in Section 2 of this paper provide one possible framework for constructing these different options. We would recommend that 3-4 different exercise “blueprints” are generated using these scoping elements and used in further discussions with sponsors and key stakeholders.

#### **1.4 When should scoping be carried out?**

Some initial scoping will be carried out naturally by technology Foresight champions, mostly in the form of reading about exercises in other places and but also through conversations with others who may share a similar interest. In other words, informal scoping occurs right at the outset of an exercise. Our interest in this chapter is with the formal scoping *process*, of which the informal is a part. As we have suggested above, such a process involves gathering data, eliciting the views of stakeholders, and preparing options for Foresight. It is usually done before any Foresight activities get underway. Since some commitment of human and financial resources will be required to conduct a scoping process, the political decision to initiate an exercise may already have been taken, although this is not the case frequently. Instead, scoping often constitutes a sort of intelligence gathering to see whether technology Foresight is appropriate. The decision may be taken not to proceed with a technology Foresight exercise, and indeed, this option should in any case be considered in the scoping process.

Once a “blueprint” has been agreed upon, an exercise can be initiated. However, this “blueprint” will need to be responsive to its environment, i.e. adaptable to unfolding events during the course of an exercise. Thus, some sort of informal scoping process tends to be continuously operating during the conducting of an exercise. In some instances, this may even be formalised into periodic reviews that set the future course of an exercise at key stages.

#### **1.5 Who is normally involved in scoping?**

Whether the aim is to set up a process-based or a product-based Foresight activity, one of the main features of Foresight activities must be the active involvement of the various stakeholders from initiation and throughout all the stages of the activity. This is a core factor differentiating Foresight from more narrow futures and planning

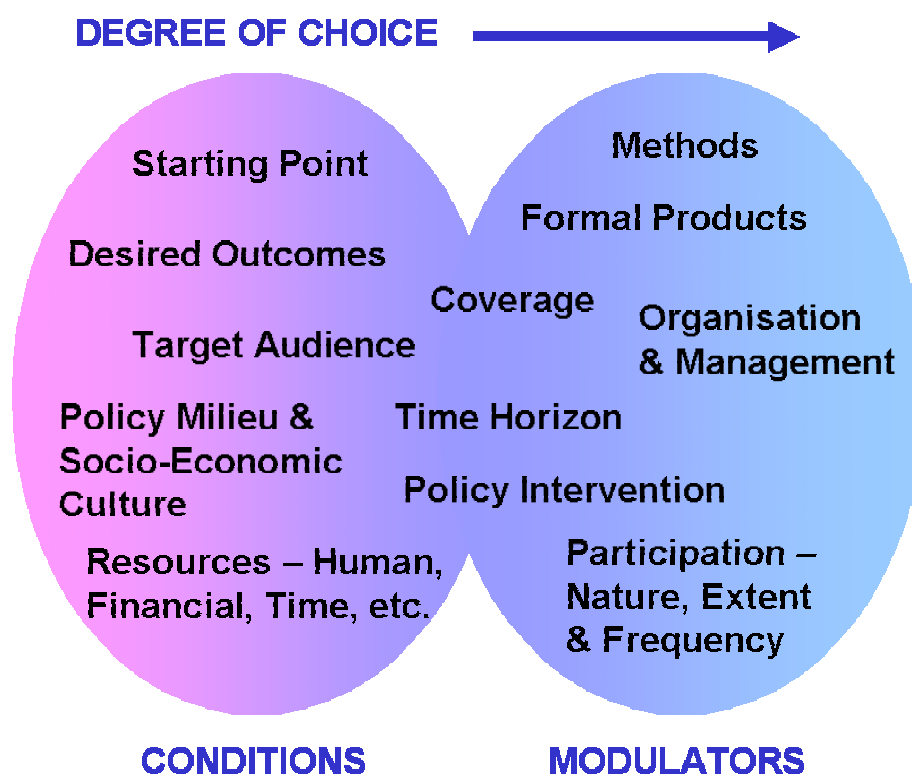
approaches, and is an important determining factor in Foresight's organisation and management. This means that key stakeholders should be consulted as part of the scoping process.

As to who orchestrates the scoping process, this might be done by prospective sponsors and/or Foresight "champions". However, it is not uncommon for consultants or academics to be drafted in to lead the scoping process, not least since they tend to be viewed as neutral players (although they may not be!).

## 2. The Scoping Elements

Below, we present twelve elements around which Foresight can be scoped. Most of these elements provide opportunities for strategic choice in Foresight, although some of them will offer more or less room for manoeuvre than others, as shown in Figure 1. The elements on the left-hand side, the so-called "conditioners", are usually (though not always) pre-determined and largely non-negotiable. These include the starting point of an exercise (national, supranational, sub-national, company, etc.), its desired outcomes (usually politically determined), and the available resources for conducting the exercise. They represent the conditions under which the technology Foresight exercise is to be conducted. On the right-hand side are the "modulators". These (usually) offer much greater scope for variation and include the methods to be used, the degree of participation, and the organisational structure of the exercise. Each of these elements is now discussed in detail below.

**Figure 1: The twelve scoping elements of technology Foresight**



## **2.1 Starting point**

Given the pervasiveness of technology in all our lives and the impacts of technological change on our cultures and societies, technology Foresight can be undertaken at almost any location of decision making. Up until now, it has been most prominent at the national level, with national governments in many parts of the world organising wide-ranging exercises that cover several technologies. Such exercises are typically located in science ministries, research councils and/or academies of science. Technology Foresight has also been used by international organisations, such as the European Commission (EC), e.g. the FAST programme during the 1980s and early 1990s, followed by the activities of the IPTS since the mid-1990s; and UNIDO since the late-1990s, e.g. the support for technology Foresight activities in Latin America. More recently, the sub-national level has seen an increased interest in Foresight processes, though much of this is not focused primarily on technology but on other issues such as business cluster development and democratic renewal. Sub-national regions where technology Foresight exercises have taken place include the Basque region (Spain), Bordeaux Aquitaine (France), Lombardy (Italy), and Liege (Belgium). Non-governmental actors, such as professional associations and industry federations, have also been active in technology Foresight, with exercises on areas like agriculture, the automotive industry, and aerospace having taken place since the late-1990s.

The starting point for technology Foresight tends to be largely determined from the outset by the institutional setting of any given exercise. All institutions are defined by the 'levels' of governance at which they operate and the domain areas they cover. These defining factors institutionally 'position' the technology Foresight, and have a determining impact on the territorial levels and domain areas to be addressed. Nevertheless, even within these confines, there is normally considerable room for choice in an exercise's focus. To take a national health ministry as an example – it may decide to use technology Foresight as a policy making tool, but could focus upon any one of hundreds of disease groups, or upon sites of a particular service delivery, or upon the implications of certain technological developments, e.g. nanotechnology. It may also decide to collaborate with other health agencies in its own country or even internationally. So, whilst the institutional positioning of technology Foresight has a large effect on its scope and shape, even here there is considerable room for choice.

## **2.2 Policy milieu and socio-economic culture**

Technology Foresight does not take place in a political, techno, or socio-economic vacuum. Rather, as we have noted above, it is positioned within an institutional setting. The term 'institution' in everyday language refers to distinct bounded organisations that are easily identified. But such institutions themselves are situated in wider policy milieu and socio-economic cultures (themselves termed 'institutions' in some political and sociological academic writings). These settings will need to be taken into account when designing a technology Foresight exercise. For example, it may be that a particular economic sector or policy area is characterised by extensive conflict between stakeholders – what implications does this have for technology Foresight in such an area? Similarly, other areas may be characterised by cosy relations amongst key stakeholders that might breed a certain degree of complacency. Again, what are the implications for technology Foresight in such a situation? To give a brief answer, in areas of conflict, technology Foresight should have the objective of (a) stretching perspectives into the future (if possible, beyond the reach of current disputes), (b)

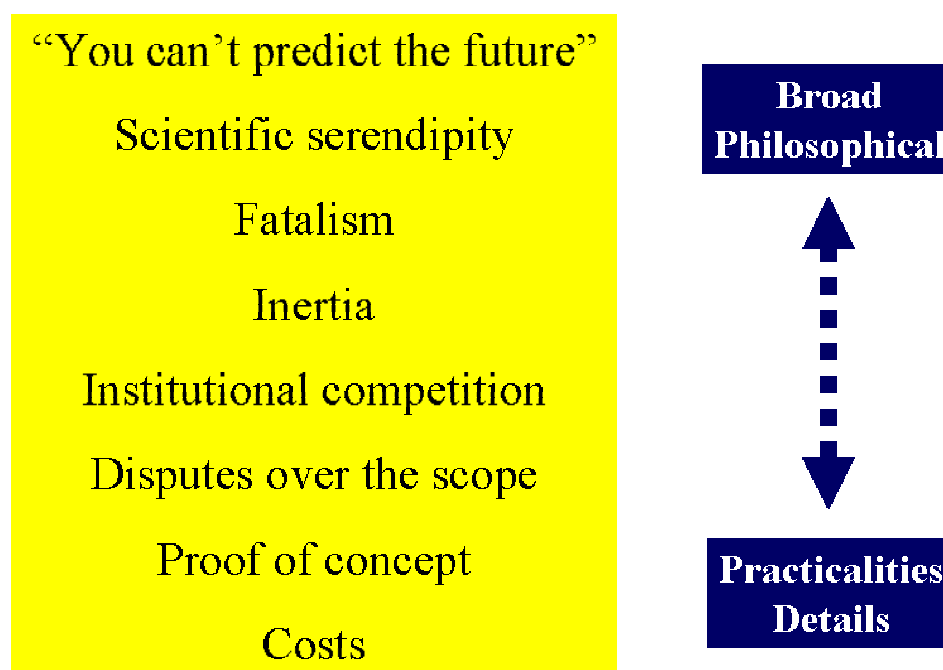
developing mutual understanding of and respect for different positions, and (c) laying the foundations for continuous long-term strategic conversations. By contrast, in areas of complacency, emphasis should be placed upon (a) introducing new perspectives and/or data that call into question current assumptions, and (b) instilling a sense of urgency (or even crisis) that demands immediate collective action.

Other issues that might be considered when scoping technology Foresight include (a) cultures of collaboration; (b) the presence or otherwise of a forward-looking tradition; and (c) the presence of other policies and programmes that profess to take a strategic view of future developments and actions. The latter can be especially important – a stand-alone technology Foresight exercise may not be an appropriate choice if there already exists such strategic programmes. Instead, it might be better to introduce Foresight into these existing strategic processes.

Several further barriers to initiating technology Foresight might be anticipated, as shown in Figure 2. These range from broad philosophical objections to more practical and down-to-earth difficulties.

The first objection, “you can’t predict the future”, results from a misunderstanding of Foresight, which is not about *predicting* the future. Rather, Foresight is concerned with *anticipating* a variety of possible futures. It is also about *creating* desirable futures through the actions we choose to take today.

**Figure 2: Some of the barriers facing technology Foresight**



The second objection is centred on scientific serendipity and is somewhat related to the first. Here, it is argued that we should not try to direct the course of science since we can never know in advance what benefits might accrue to society from scientific discoveries further down the line. Lasers are often cited as a technology discovered

decades ago with few initial applications but that are now widely used in thousands of products and processes, from consumer electronics to military hardware. As in the first objection regarding prediction, this argument against using technology Foresight is also flawed:

1. Technology Foresight has never been used to prioritise all of the scientific enterprise of a nation state. Rather, it has been used to identify emerging (often interdisciplinary) areas of research that hold promise for socio-economic *and* scientific developments. Such areas of research are often overlooked by the traditional disciplinary organisations of science.
2. Most science is funded through public taxation or shareholder profits and should be accountable, just like other areas of expenditure. In other words, science should be able to at least demonstrate promise, if not immediate worth.
3. Something that is often missed by proponents of the serendipity argument is the fact that technology Foresight can help science and technology better connect to the socio-economic goals of public and private actors. This can be especially important under conditions of severe fiscal constraint when science budgets may come under threat.
4. Finally, who is to say that the science supported as a result of priorities emerging from a technology Foresight exercise will not result in similar widespread applications as the laser? We suspect that the real issue underlying the serendipity argument is one of control – who sets the direction of what scientists do, the scientists themselves or society? In fact, technology Foresight does not force us into such stark choices. Rather, it provides an *additional* forum where scientists can discover new ideas and opportunities from other scientists and other social actors.

The third objection to Foresight is informed by a fatalistic view of the world that basically equates to a hopelessness for intended action to make any difference. Many nation states, regions, and communities exist under appalling conditions of dependency upon those who are stronger. For example, the strong set the terms of global trade, often at a disadvantage to the weak. Although these structural impediments to self-determinacy are real enough, they can also lead to a semi-mythical helplessness that seeps into the consciousness of individuals and the routines of bureaucracies, which in turn breed inaction and even corruption. Under such conditions, a collective social activity like Foresight may appear irrelevant and difficult to initiate. But Foresight could be a first (admittedly tentative) step in better understanding dependencies, in initiating strategic conversations between key actors within society, and in agreeing and acting upon collective solutions. The role of Foresight “champions” with authority and vision could prove decisive in whether Foresight is initiated and effectively implemented. Alone, Foresight is unlikely to have much impact, but when organised in tandem with other broadly-based emancipatory policies, it could make a real difference.

Linked to a fatalistic view of the world is the view that things will carry on as they always have without the possibility for enacting change – a sort of state of inertia. Here, political systems (in the widest sense of the word, to include, for example, national science regimes) are believed to have a certain (often bureaucratic) logic of their own that defy change and reform. There are undoubtedly elements of this in all political and administrative systems, whether in the public or private sectors. However,

such challenges can be particularly acute in autocratic systems with little operational transparency. Again, there are no easy solutions here – the role of Foresight “champions” is likely to prove decisive, and there will be a strong need for Foresight to introduce a sense of crisis within such systems. The latter can be achieved in part through benchmarking with competitors, trend extrapolation, and the use of scenarios.

The fifth barrier to technology Foresight – institutional competition – has been observed by the authors in nation states and regions in Europe and Latin America, and even within the European Commission. This is where institutions compete to be the “authority” on and location of technology Foresight. Such competition can lead to open conflict and eventually to nothing being done, as has happened in one Central European country over the last 3-4 years. It is difficult to advise on such situations in a generalist way, but it is something that proponents of technology Foresight need to be aware of. The problem seems to be most acute under conditions of financial resource constraint where there may be competition to be the “owner” of Foresight. Where finance is not a problem, there is nothing preventing several institutions from organising their own Foresight exercises, a situation commonly found in North-west European states, e.g. Denmark, Finland, and the Netherlands.

Linked to institutional competition is the sixth barrier – disputes over the scope of technology Foresight. The scoping process may generate intractable disagreements that could prevent or delay an exercise being launched. In such instances, the temptation might be to limit access to the scoping process, but this has the significant danger of excluding stakeholders who may prove to be key to an exercise’s successful implementation. Again, it is difficult to provide generalist advice on such disputes, which will be specific to the given political situation. But it will be near-impossible to satisfy everyone, so disappointment and complaints should be expected.

The seventh objection centres on technology Foresight’s “proof of concept”. By this, we refer to the evidence base that demonstrates the effectiveness of technology Foresight. We will say more on this below. For now, we note that little evaluation of technology Foresight has been conducted that demonstrates its effectiveness. Moreover, the processes of technology Foresight remain poorly understood. Evidence of Foresight’s worth is therefore largely anecdotal and focused mostly upon apparent success stories in other countries or regions.

The final objection – cost – is also dealt with more fully below. Just to say here that the authors are aware of planned technology Foresight exercises that were either scaled back or postponed due to the unavailability of necessary financial resources. When scoping technology Foresight, it is possible to generate project plans that demand different levels of funding. However, the limitations of cut-price exercises and the benefits of more extensive programmes should be made plain to prospective sponsors.

## **2.3 Target audience**

Since technology Foresight should be a participatory process involving time and commitment from stakeholder representatives, activities must carry a stamp of approval strong enough to assure participants that they are engaged in a worthwhile endeavour. Such endorsement can be obtained in part by involving leading figures from science, industry and government. The Foresight process should also be clearly explained,



transparent and involve the key stakeholders. Moreover, there should be a commitment from the outset to follow-up and act upon Foresight findings and outputs, otherwise stakeholders are unlikely to give the exercise a second chance. Similarly, care must be taken not to promise too much to too many players.

Communication is a key activity in technology Foresight. Arguments for a Foresight activity, instructions on how to participate effectively, and dissemination and implementation of results – all of these involve communication to potential supporters, participants and users. Various tools can be used to promote widespread appreciation of, and participation in, Foresight activities, including:

- Publications and traditional communications tools (databases, newsletters, etc.) aimed at widespread promotion of the activities to be carried out and, thus, identification of players interested in participating.
- A remote communications Forum designed to disseminate information and promote the activities carried out and completed by Foresight. Websites are being used to increasingly good effect in Foresight activities, and can provide an important way of reaching people remotely.
- Initiatives aimed at encouraging participation, such as conferences, workshops, and other meetings. These may be mainly oriented toward dissemination of decisions already taken and preliminary results, or they may constitute more active consultation as to the aims and activities of technology Foresight. They may be tied to the actual work of Foresight in terms of generating visions and gathering knowledge. It is often helpful to work together with specific intermediaries and sectors of activity (academies of science, trades unions, research centres, industry associations, government ministries, etc.), whose aim is to encourage participation and promote a more active and knowledgeable involvement among their members or clients.
- Illustration of Foresight ‘success stories’ in organisations and/or areas characterised by similar problems and objectives.

The communication tools used will depend upon the target audience for the technology Foresight exercise, but most of those listed above are likely to be useful in any instance.

## **2.4 Desired outcomes**

What are the arguments for conducting Foresight? These will be dependent upon the organisations (especially the sponsor) and communities involved. Rationales for technology Foresight will tend to emphasise how things can be done better with the help of Foresight. They may also point to other places or areas where Foresight has been successfully deployed as exemplars.

A sense of social or political crisis, or the anticipation that break points are undermining established trends, often gives rise to demands for Foresight (and/or similar strategic futures activities). It can be helpful to interpret the situation in terms of challenges, and to identify the critical challenges that should set the main thematic orientation of the Foresight exercise. But there must be a good measure of shared agreement as to the nature of these challenges established at an early stage in the Foresight activity. Once the challenges have been identified in broad terms, then it is important to consider the

extent to which the organisations involved in Foresight, be they public or private, are able to influence or respond to such challenges:

- Some issues are best addressed by the private sector. But this does not preclude public administration from leading or facilitating a Foresight exercise, for example as a forum helping private businesses reach consensus on what actions they might need to take around particular technological developments.
- Other issues will have a global reach and therefore the crux will be to identify the appropriate perspective to take, and to consider how Foresight considerations might be linked to these broader plains.
- The challenges to address may be highly pertinent to a particular organisation, country, etc. - but the political competence to deal with the issues may or may not reside in that organisation or the state, and other players will have to be brought on board very early on if the chances of connecting to critical users are to be maximised.

These are just a few of the considerations to bear in mind. However, the underlying questions of competence, prerogative and authority, are absolutely vital, and should inform the objectives of a technology Foresight exercise.

Objectives tend to exist at several levels – for instance, an immediate objective of those managing a Foresight exercise is its smooth execution. But there will also be higher-level objectives that relate to the rationales offered for conducting Foresight, so formal objectives tend to be dictated by the organisations and communities involved. Of course, objectives may shift over time and it is not unusual for different actors to hold different objectives for a Foresight exercise. Nevertheless, it is good programme practice to set verifiable objectives, i.e. objectives where it is possible to verify whether they have been met. All too often, this is not done, mostly because technology Foresight is new to many exercise sponsors and managers and they are unsure of what to expect.

## **2.5 Resources**

The resources needed for technology Foresight are often equated with finance, yet this misses the whole picture. Besides financial resources, the scope of a Foresight exercise will be dependent upon other resource factors, such as time, political support, human resources, institutional infrastructure, and the culture in which the exercise is embedded. We will now briefly deal with each of these in turn:

- **Financial resources** – the cost of a technology Foresight exercise depends primarily upon the nature and scale of involvement of participants and its duration. We address each of these issues below, but obviously the shorter the exercise and the fewer people involved, the cheaper it is likely to be. The financial burden of Foresight activities are typically borne by a wide range of players, not least by the participants themselves, who usually provide their thoughts and time for free. ‘Official’ sponsors can be from the public or private sectors, as well as from the ‘third’ sector (e.g. trade unions, voluntary groups, etc.). It is not unheard of for Foresight to be co-sponsored by all three (see Table 1). As for costs, little indicative financial data exists on Foresight exercises in general. Core, and usually centralised financial costs are most likely

to result from such elements as (a) the running of a project management team; (b) the organisation of meetings and events, travel and subsistence of at least some of the participants (some participants may even have to be paid to give up their time for the Foresight exercise – this is uncommon, but in some places, it might be necessary); (c) the production and dissemination of publicity material; (d) the operation of extensive consultation processes (e.g. questionnaire surveys); and (e) other activities, both routine and one-off, associated with an exercise.

**Table 1: Examples of sponsors of national technology Foresight exercises**

Exercise	Sponsor
Delphi Report Austria	Federal Ministry of Science and Transport
Norway 2030	Ministry of Labour and Govt Administration
French Key Technologies 2005 exercise	Ministry of Industry
German FUTUR project	Federal Ministry of Education and Research
Dutch Biology Foresight	Royal Netherlands Academy of Arts and Sciences
Portuguese Engenharia e Tecnologia 2000	Three sponsors from business, science, and engineering
Swedish Teknisk Framsyn	Three sponsors from industry and strategic research bodies

- Time** – this is nearly always a resource in short supply in technology Foresight. Whether a public or private sector exercise, the results of Foresight are usually required by a particular date to feed into policy and/or investment decisions. Typically, national technology Foresight exercises take 1-2 years to complete, depending upon financial resources and political imperatives. Private sector exercises are normally shorter, mostly on account of being more focused. Clearly, the available time for an exercise will have major implications for its organisational structure and the overall methodology. Foresight can also become a “continuous” activity, perhaps in the form of a continuous horizon scanning activity or as a ‘rolling’ programme of mini-foresight exercises focused upon targeted areas.
- Political support** – without the support of those in authority, technology Foresight is unlikely to get off the ground, let alone make a difference. It is therefore essential that Foresight receives political commitment throughout the lifetime of an exercise and, importantly, is *seen* to receive such commitment. Political commitment can be demonstrated in a number of ways, for example, through institutionally locating an exercise at the heart of power (e.g. in a Prime Minister’s office, within Parliament, etc.). More modestly, it can be helpful if

someone in position of authority (e.g. a government minister or company CEO) opens and attends workshops and conferences.

- **Human resources** – technology Foresight requires domain expertise in the areas under consideration, as well as expertise in the use of Foresight methods. Dealing with the latter first, in almost every country on Earth, some expertise in using some Foresight methods is present. Much of this expertise can be found in state planning departments and universities. However, it is more than likely that these methods have been used in forecasting, which is a rather technocratic practice, as opposed to Foresight or strategic futures, which are more participative processes. The implications of these different settings should not be under-estimated, since forecasting experts often fail to understand the differences with Foresight and may not see the value of participation and public deliberation. It is therefore typical for less experienced actors to become involved in facilitating Foresight, and these tend to gain their expertise through trial and error, as well as through international learning (e.g. through the use of international advisors). Moving on to domain expertise, technology Foresight should be informed by the best available experts. In some countries, regions, or companies, this may mean looking outside for such experts. But if such expertise is unavailable, then the focus of the technology Foresight should be reviewed.
- **Infrastructural resources** – these refer to the existing institutional landscape around a given area, such as research councils, academies of science, universities, science ministries, professional associations, industry federations, consumer groups, banks, etc. In other words, infrastructural resources refer to the organisation and network capacity of potential stakeholder groups in a given area. In virtually all countries, there will be an institutional ‘thickness’ in some areas but less in others. In a generalist way, the implications of such thickness are unpredictable. For instance, a rich institutional landscape can greatly smooth the way for Foresight, providing useful data inputs, knowledgeable participants, and forums for dissemination and implementation of Foresight’s findings. But institutional ‘thickness’ can also act as a barrier to Foresight – institutional rivalry is not uncommon whilst institutional worldviews may be rather static and difficult to openly question. Moreover, an exercise is far more likely to be subject to intensive lobbying by well-organised groups of interests. Appropriate strategies for dealing with such opportunities and threats will have to be informed by a deep understanding of those areas to be covered by the Foresight exercise. The Foresight exercise should then be designed in such a way as to be responsive to different institutional landscapes.
- **Cultural resources** – these refer to a rather ill-defined and broad set of conditions that are likely to have an important impact on the conduct of technology Foresight. They include the propensity to take risks, the extent and degree of collaboration between industry and academia (as well as between competitors), and the extent to which actors already understand and position themselves vis-à-vis the long-term. It would seem that some countries and some industrial sectors are endowed with more favourable cultural resources than others. The same may also be said of some areas of science and technology. Again, the implications for technology Foresight are rather difficult to spell out in a generalist way. But where such resources are largely absent, Foresight should aim to begin the process of building them.

## **2.6 Coverage**

It must be recognised from the outset that it is impractical to set out to cover all possible themes and/or sectors in any given technology Foresight exercise. This means that some sort of selection is inevitable. Yet how such selection has been made in existing Foresight activities is rarely made explicit. Methods ranging from ‘recycling’ existing strategic priorities to undertaking SWOT analyses have played an important part. Even fads and fashions probably play a role here, as in many other organisational decisions. Lobbying by interest groups is another influence. A review of national technology Foresight exercises conducted in the last decade show a commonality in the areas covered, with ICTs, Transport Technology, Biotechnology (primarily applied to healthcare and agriculture), Nanotechnology, and Energy Technology featuring in almost all such exercises.

The definition of areas to cover should be a process where consultation of key regional players is likely to pay dividends, both in identifying themes of concern and through increasing the likelihood of commitment to later stages in the exercise. Nonetheless, difficult decisions will perhaps have to be taken when there is demand for more themes and/or sectors to be addressed than resources or time will allow.

## **2.7 Time Horizon**

Foresight is centrally concerned with increasing the time horizon of planning activities. This is not just a matter of ‘stretching’ existing horizons, extending familiar planning and intelligence-gathering into a longer-term future. A major point about the longer-term is that it brings into relief trends, countertrends, and possible events that are of limited concern in the short term. Such developments may well not be crucially important to one’s immediate prospects - but if they are not taken into account until the problems start to be highly manifest, then it may be too late to adapt effectively, or the costs of coping with change may be higher than they would be otherwise. Consider, for example, the question of developing a base of skills to cope with economic or technological change: this is often a matter that will require years to put into place.

In practice, the time horizon of Foresight activities will differ considerably, since what is thought of as the ‘long-term’ varies considerably across different issues and different cultures. The average time horizon for national and regional Foresight exercises seems to be around 10-15 years, although it may be as long as 30+ or as short as 5 years (see Table 2). There is some evidence that the time horizons adopted tend to be related to Foresight’s objectives and orientation. In other words, time horizon tends to depend upon the uses to which Foresight is to be put. An apparent paradox of Foresight is that whilst a long time horizon provides the opportunity to develop a broad vision, most players’ expectations are for short-term policy and/or investment responses. In fact, there is no paradox here – Foresight should be instigated in order to think about possible futures, with a view to changing what we do today for the better. Foresight is therefore about readjustment, in the present, to create more agile organisations, cultures, etc. for the future.

**Table 2: Time horizons used in a selection of national Foresight exercises**

Time Horizon	National Foresight Exercises
5 Years	French Key Technologies
10 Years	Netherlands Technology Radar, Czech Foresight
15 Years	Belgium, German FUTUR, Ireland, Spain (OPTI)
20 Years	Portugal, Sweden, UK, Hungary
> 20 Years	Delphi Austria, Norway 2030, German Delphi studies

## 2.8 Methods

As this volume is given over to summarising some of the main methods used in technology Foresight exercises, we will not cover these here. Instead, we will briefly consider how methods can be used together, both in parallel and in sequence, to constitute a coherent exercise. To do this effectively, we need to (a) outline the key steps in a technology Foresight process, and (b) understand the requisite inputs, processes, and outputs associated with leading Foresight methods. The temptation with (b) is to classify methods according to some envisaged function (e.g. Graham May's foreseeing, managing and creating futures methods typology), or according to the sorts of outputs generated (e.g. quantitative and qualitative data, or explorative and normative futures), or according to their preferred time horizon. However, such typologies are often problematic, since many Foresight methods are rather flexible and defy easy classification. We will therefore set out some of the key steps in technology Foresight and then suggest possible methods that might prove useful.

To begin, it is worth noting that consideration of Foresight methodology should not be confined to approaches for thinking about the future e.g. Delphi, scenarios, etc. Rather, Foresight methodology is far broader, taking into account the important tasks of coalition building, project scoping, organisation and management, implementation, etc. As we have already discussed these wider tasks in other parts of this chapter, we will largely omit them here. Instead, we will focus only on the core futures methods.

When starting to think about the future, we need to achieve an understanding of the past and the present. This can be achieved through examining datasets, conducting literature reviews, benchmarking performance against that of other countries, regions, companies, etc., and eliciting the views of experts and other commentators (e.g. through surveys, interviews, and expert panels). This information can be analysed, synthesised, and consolidated into a baseline report of "where we are now and how we got here".

Quantitative datasets and qualitative trends can then be extrapolated into the future. Cross-impact analysis might also be used to better understand the interactions between

key trends and issues. Wild cards and anticipated discontinuities can be introduced at this stage to generate multiple views of the future (scenarios). These may be informed by weak signal analysis, which in turn is dependent upon some form of environmental scanning and issues management. Where there is extensive uncertainty on future developments, as there is in much Foresight work, methods such as Delphi, which rely upon the views of a cohort of experts, can be used to elicit expert judgement. Alternatively, causal models can be developed that explain some aspect of the world. Using such models, future time series simulations can be run (usually on a computer) to assess the impact of alternative developments in key variables.

Extrapolation of futures, as described above, is nearly always accompanied by normative approaches to thinking about the future. The focus here is on identifying and deliberating upon desirable futures. Common techniques include brainstorming, visioning exercises, creative imagery, scenarios, and futures workshops. Normative approaches tend to be more open to widespread participation, although by no means exclusively so. Attention to the visualisation and presentation of results is also especially important at this stage.

Once anticipated and/or desirable futures have been visualised, strategies of avoidance and/or realisation are typically developed using techniques such as backcasting and technology road-mapping. These methods tend to be highly participatory since the aim is to secure buy-in to the conclusions and recommendation of the technology Foresight by as many groups as possible.

To reiterate, many of the aforementioned methods can be used in a variety of ways. Selection of methods will depend upon several factors, most notably available time and financial resources, although increasing use of ICTs in these methods has the potential to lower time and monetary thresholds.

## **2.9 Participation**

Who participates in a technology Foresight is a central concern of exercise managers, not least because of a perceived need to produce results that are widely considered to be legitimate, robust, and relevant, although the need to implement these results is also an important consideration, given the process benefits associated with Foresight. Who participates depends upon other elements of Foresight's scope, including objectives, orientation, the themes/sectors covered, and the intended audience. Some exercises are quite limited in their breadth of participation, both in terms of actual numbers and the types of actors engaged. Others, on the other hand, have set out to directly involve widely disparate groups, including citizens.

“Stakeholder analysis” has been developed as a tool for participatory planning, and involves listing stakeholders and attempting to identify their interests in the activity. One may attempt to infer from experience or available evidence, or to find out via interviews or even surveys, answers to such questions as:

- What stakeholders specifically expect of the activity? Are these realistic and well-informed?
- What benefits might they experience, and how might these be affected by participating in the activity rather than leaving it up to others?

- How can this be communicated?
- What resources could or should stakeholders contribute?
- Do they have interests or objectives that might conflict with the activity?
- What are their attitudes to each other – are there conflicts to resolve or manage?

Broad classes of stakeholders should first be identified – a simple starting point is to consider the roles of scientist, governmental, non-governmental organisation (NGO), industry, other professional, and citizen groups. It is important not to be too restrictive in identifying, for example, the sort of government department or firm that should play a role. Different levels (national, regional) and sizes of organisation might be required. What is important is to recruit gifted individuals who are prepared to learn and share, and not just present their organisation's official positions.

Methods for locating such individuals involve search through databases and web resources, or seeking advice from other informed people. *Representative* approaches can involve asking scholarly, professional and industry organisations for names – but here it has to be stressed that the people sought are not to act solely as representatives of their bodies, rather they are being recruited to give a representative sample of opinion. *Reputational* approaches, for example, questionnaires asking informed sources to nominate particularly knowledgeable people in required areas of expertise (snowball surveys and co-nomination methods are particular versions of these) are also commonly used in Foresight.

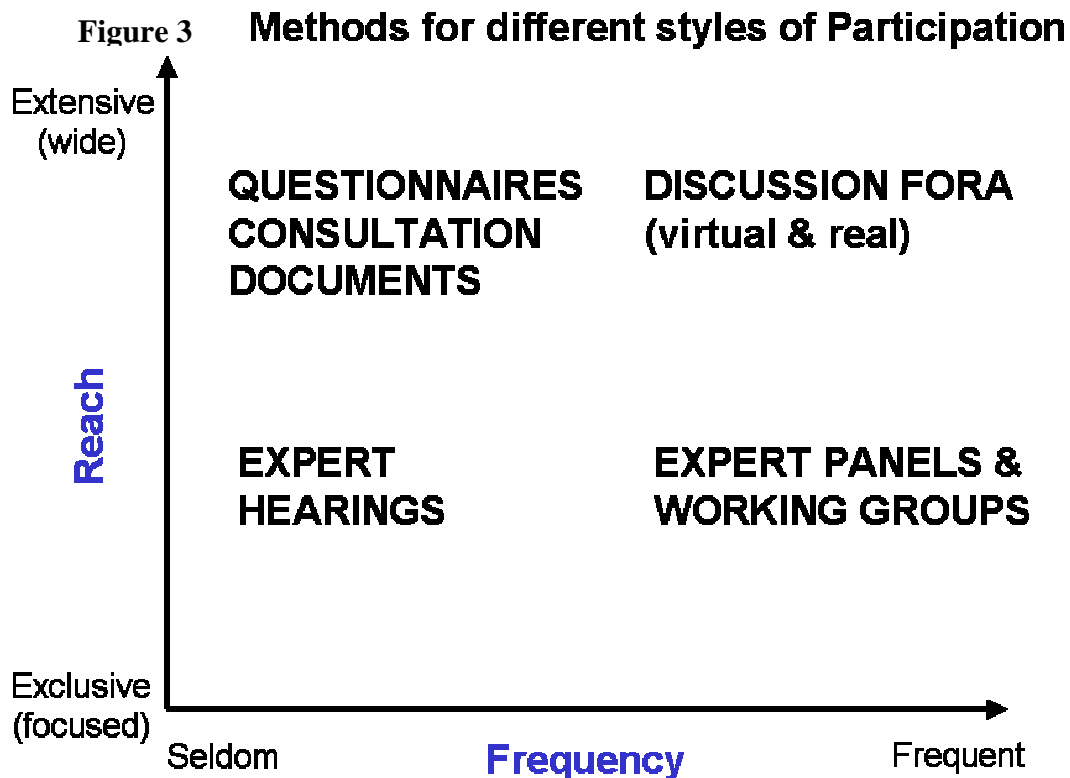
The more formal methods are important for reaching beyond the “usual suspects”, but approaches such as co-nomination are time-consuming. Any methods can be limited by the choice of initial informed sources, so it is important to cast the net widely here. If the area under consideration is large, many new names may be generated by such approaches. In smaller areas, there may already be little to learn, since most players are likely to be already well-networked. It may be important to ensure representation of women (gender balance is often highly skewed in such activities) and ethnic minorities, people from regions, etc.

Identifying participants is, of course, only part of the picture – how they are actually engaged in the Foresight exercise is of paramount importance. Such engagement can be thought about along two dimensions: the ‘frequency’ of participation and its ‘reach’ (see Figure 3). Considering ‘frequency’ first, an exercise might be largely desk-based with wider views of stakeholders elicited only seldomly at discrete points in the process. Alternatively, an exercise might largely constitute an ongoing dialogue or ‘strategic conversation’ between stakeholders, with panels and working groups set up for an indefinite period of time to deliberate on the future of an area.

Moreover, it is often thought that the issue of participation is associated with only the elicitation of expert/stakeholder views on the future, for example, through Delphi or scenario workshops. However, there are a number of points in a Foresight exercise where views might be elicited – for example, during the scoping process, during deliberation on the implications of Foresight's results, etc. These can often be the most significant (yet often forgotten) consultation points, since they allow participants to make strategic choices about an exercise, which, in theory, should engender greater ownership of the process and its outputs.



Who is to be consulted at each round of consultation is covered by our second dimension – ‘reach’. A total pool of participants may be identified, but it is likely that different stakeholders will be engaged at different points of the process. In this respect, reach can be considered to be either ‘extensive’ or ‘exclusive’, with different methods typically used for different situations. Although there are no hard and fast rules for selecting any particular consultation approach, the choices made have implications for the credibility of the outcome of a Foresight exercise, for the time needed for its completion, and for its eventual cost.



In terms of ‘how’ to ensure wide and in-depth consultation, promotional activities, such as those suggested previously, offer opportunities to elicit views on the conduct of Foresight. Moreover, many of the methods used in Foresight require inputs (e.g. data, visions, etc.) from participants. In other words, Foresight activities ‘naturally’ offer a number of opportunities to consult stakeholders – it is up to project managers to decide how to take full advantage of these.

## 2.10 Organisation and management

A structure for any Foresight activity needs to be thought through, including the assignment of roles to working groups, panels, committees, sponsoring agencies, trainers, etc. The tasks assigned to such parties are linked to the type of Foresight planned. Common characteristics include, for example, the vital initial step of establishing a steering committee and management team. Many activities also make use of ‘expert’ groups or panels that focus on particular issues. Thus, common organisational elements include:

- A **Steering Committee** that will tend to approve the objectives, the focus, the methodology, the work programme, validate the strategy and tools for communication, and help to promote the results. It will define / adjust the assessment criteria and review the deliverables. It will monitor the quality assurance process for the whole project. The Steering Committee can also be a key actor to raise awareness, mobilise experts, and to nominate them to various panels.
- A **Project Team** that will manage the project on a daily basis, with tasks such as:
  - Leading the project on a daily basis;
  - Maintaining regular contacts with the stakeholders and the Steering Committee to ensure that the project direction is maintained;
  - Keeping accurate records of costs, resources and time scales for the project;
  - Ensuring integration of Management Reports and their presentation to the Steering Committee;
  - Checking that the project maintains its technical objectives; and
  - Ensuring that the project maintains its relevance to wider activities, initiatives, and policies.
- Securing high **political support** early on, which demonstrates that the exercise is taken seriously. If key people are first targeted and won over, a momentum can be established. It would be helpful if ‘**champions**’ or ‘ambassadors’ could be enlisted early on to put forward the arguments for Foresight. Such figures are vital to seeing projects through difficult times; but there are sometimes risks of rivalry (e.g. between agencies), or of divergent expectations.
- **Expert** work, which is more often than not organised around expert panels/working groups. Expert work is highly significant in terms of:
  - Gathering of relevant information and knowledge;
  - Stimulation of new insights and creative views and strategies for the future, as well as new networks;
  - Diffusion of the Foresight process and results to much wider constituencies; and
  - Overall impact of Foresight in terms of follow-up action.

The mechanics of setting up these groups need to be thought through very carefully, since their membership will influence the whole exercise. Moreover, the management style of these elements will need to be defined – for example, will working groups be given the freedom to make many of the decisions associated with methodology for themselves? (This is a definite possibility if the exercise is to be sponsored by more than one organisation.) Alternatively, a central Project Team or Steering Committee might define the terms of conduct to be followed (this is more common). Tasks and responsibilities will have to be assigned to the different groups appointed.

Setting up simple tools that allow the Project Team to monitor the Foresight exercise constitutes what is now considered good practice in project management. Monitoring consists of continuously observing and ensuring that the resources foreseen for each step are used effectively as defined in a project blueprint; that work schedules are respected; and that outputs actually materialise. It will help the project team to control and focus the implementation of the project. On-going monitoring involves:

- Observing the activities undertaken during the implementation of each step in the project in order to compare them, in real time, against the targets set.
- Continuously adapting the project plan to its environment. As new knowledge is gained and stakeholders are activated, the vision or process of the Foresight exercise may need to be altered: technology Foresight projects are not expected to be rigid.

The monitoring methodology should involve a set of selected indicators that are designed to provide relevant actors with specific and topical data that allow them to follow the course of the project.

## 2.11 Formal products (including processes)

Many commentators have noted a fundamental distinction between contemporary technology Foresight exercises in that national programmes may stress *products* or *processes*, or seek to synthesize the two. **Product-oriented approaches** are generally oriented toward achieving tangible outputs, such as reports embodying a scenario; a ‘critical list’ hierarchy of priorities (e.g. areas for R&D expenditure) or of key technologies, a Delphi report, etc. Such approaches often involve small expert groups, and/or highly formalized methodologies for eliciting and combining expert opinion (most notably, Delphi). French and German national exercises have taken this form, for example. Tangible outputs are often what some people refer to as “codified” knowledge, in that the knowledge generated through the process has been turned into information that can be circulated widely, without necessarily requiring face-to-face interaction.

**Process-oriented approaches** are more focused on achieving better networking and exchange of opinions among actors. The idea is that a shared focus on longer-term developments will help those involved to identify emerging issues and the carriers of relevant knowledge about these issues, to share understanding about each others’ expectations and the strategies that are liable to be pursued, and to forge enduring networks for collaboration. The Dutch and the second UK exercises are examples. (There are also some regional level activities – for example in the UK’s North-East – which focus almost exclusively on developing capabilities and institutional support for regional actors to undertake their own Foresight, without the felt need for a central programme producing codified outputs.). Such ‘soft’ outputs are more difficult to grasp, because these typically take the form of knowledge embodied in people’s practices and approaches to issues. Though these may be harder to identify and quantify than documentation, they represent a very important aspect of the benefits of technology Foresight.

**Mixed approaches** attempt a deliberate synthesis of the above. The creation of products is seen, in practical terms, as a helpful device to encourage people to work together and network effectively. It also provides, more politically, a legitimating tool to convince auditors that money is being spent well. Furthermore, networking provides a wider range of inputs and this wider participation itself gives social legitimacy to the process. The first UK exercise is generally seen as a good example of such a mixed approach.

**Table 3: Some types of output from Foresight**

	<b>Formal outputs</b>	<b>Informal outputs</b>
<b>Material for long-term reference and dissemination activities beyond those organisations directly involved in the Foresight</b>	Reports, books, electronic records (videos, web resources)	Networking with Foresight activities and actors in other settings, etc.
<b>Dissemination within those organisations directly involved</b>	Workshops, newsletters, press articles, web sites	Visions developed in workshops, results & evaluation circulating within networks
<b>Networking</b>	Institutionalisation of networks e.g. through formation of permanent organisations and meeting places	Development of new networks or new links established within existing ones
<b>Strategic Process</b>	Formal incorporation of results within strategic processes, e.g. through use of lists of key priorities as a framework for assessing projects and plans.	Informal incorporation of results and knowledge of networks and key sources of knowledge, within strategic processes

Table 3 outlines some of the types of outputs that can be expected. In general, the outcomes of Foresight activities are likely to address different audiences. In starting a Foresight exercise, project managers need to be able to define who the interested groups are that might benefit from the outputs. Thus, and to reiterate, it is a useful (and essential) thing to involve members of various user groups in the Foresight process. Members of user groups can help to define the targeted outcomes that should be foreseen for the various user groups.

## 2.12 Policy intervention

How are the results of Foresight to be followed-up with action? This tends to be a neglected consideration, with project managers often overly preoccupied with getting the Foresight process ‘right’. Getting the process ‘right’ can indeed increase the chances of successful follow-up action, but political awareness of the possibilities for follow-up action should ideally be considered from the outset. In most instances, successful implementation involves follow-up action by actors that may not have been directly involved in an exercise. This is particularly challenging, and it is probably wise to ensure that these actors have some sort of involvement in the process at some stage.

Action plans are common outputs from Foresight exercises. These are simply lists of actions that should follow from the identification of problems and possible solutions through Foresight. Action plans should not be “wish lists”, nor should they simply specify end points and objectives. They should indicate actions and responsible agents, ways of monitoring progress, and indicators with which to assess the degree of success attained (“verifiable objectives”).

Considerable skill and inside knowledge may be required to formulate these in terms that can be accepted by decision-makers. Yet it is important to link actions to the people responsible for executing them, but at the same time avoiding setting goals that are unrealistic (either because of being too ambitious, or due to an absence of either political will or effective sanctions on the part of those responsible). Of course, successfully linking decision-makers with actions is more likely to be achieved if they have been involved in the Foresight process.

Rather than (or in addition to) providing a list of numerous actions, it may be possible to incorporate a number of actions in a demonstrator project. This can be a highly visible instance of the application of Foresight, and may arguably be particularly effective where technology or infrastructure issues are concerned. However, the time taken to establish a demonstrator, and for its impacts to become visible, may mean that the success of the demonstrator in increasing the visibility of Foresight may be limited. There are also dangers of putting eggs into one basket, as well as having people associate the Foresight activity with *only* the demonstrator (this happened in the first UK national Foresight exercise, where a competition for demonstrator projects distracted attention away from other important dissemination and implementation initiatives).

The outcomes desired from Foresight may vary across actors – some may hope for a focus on certain types of work, others on particular sectors of the economy or on certain social groups, and so on. Some expectations as to outcomes can be unrealistic, in that they will be informed by too optimistic a view as to how great an emphasis will be placed on certain issues, how far decision-makers are liable to heed the inputs from Foresight in dealing with such issues, and how rapidly to expect change.

For these reasons, it is helpful to have a clear notion of the sorts of benefit that can reasonably be expected. This needs to be conveyed as part of the Foresight activity. It needs to be communicated by capturing relevant information, and putting it into a form suitable for stakeholders to examine. As the Foresight activity proceeds and better understanding is gained as to what it can and cannot hope to accomplish, there may need to be some modification of these expectations, too.

Arrangements should be put in place to obtain some measure of whether the exercise has met its objectives – a process known as summative evaluation. But the novelty of Foresight, especially as applied to the areas of living conditions, working conditions, and industrial relations, means that some formative evaluation may also be useful. The latter is not so concerned with outputs and outcomes as it is with processes – a better understanding of these can be used to improve the conduct of future exercises.

Gaps in implementation can be very discouraging. These may occur where recommendations have been prepared, but there has been no mechanism to check on their follow-up; and where networks that were working productively have been allowed to dissolve. This is why this paper has stressed the need to link Foresight to action: Foresight is not a matter of free-floating visions. It is a participatory process of constructing better understanding of what desirable and feasible futures could be, and how different socio-economic partners need to work together to create them. This is a demanding task, and it cannot be achieved without serious inputs of time and effort

from many parties. Perhaps the most crucial message in managing expectations is the following: **Foresight is not a quick fix.**

### **3. Concluding remarks**

This chapter has sought to introduce some key elements for scoping technology Foresight that can be used at national, regional or company/organisation levels. These scoping elements have already been employed widely in Foresight exercises across Europe and underpin recent European guidelines on the use of Foresight. We have also sought to raise awareness of Foresight's limitations, arguing that expectations should be realistic. Planned appropriately, and with sufficient political support, technology Foresight can be a real force for good. But Foresight is never easy, and those who wish to pursue the use of such policy instruments need to be prepared for the long haul.

Technology Foresight should not be used if there is no possibility to act on the results that it will generate. 'Wishful thinking' is not enough to sustain a Foresight exercise: those involved are likely to feel that their expectations have been raised unduly, and their time wasted. A minimal degree of political, economic or cultural leverage is required – even if it is recognised that the Foresight activity is likely to have to battle with entrenched opposition to achieve any significant impacts.

Nor is 'me too' a good basis for technology Foresight. The simple imitation of issues and methods (not to mention the uncritical "borrowing" of results) from elsewhere is liable to be counterproductive. For example, a predominantly rural agricultural region or state cannot 'Foresight' its way to becoming a high-tech nanotechnology or even biotechnology hub. Neither can a Foresight activity that has been designed for a region or state that is accustomed to wide public participatory debates necessarily be (immediately) deployed in one which public opinion is handled through more traditional routes – surveys, press, political party representation, etc.

If there is no possibility for careful preparation and tailoring of Foresight to specific national or regional characteristics, then it probably should not be implemented. We should be explicit in acknowledging that Foresight cannot solve all of the social, economic or political problems that beset a state, region or organisation. Foresight can generate visions. Ideally, large elements of these will be shared visions, and ones that are well-founded on knowledge of the relevant developments in social or technological affairs. This ideal is not as utopian as it may at first seem: some national and regional exercises have succeeded in achieving quite widespread consensus behind their results.

But Foresight is not a 'magic wand' with which to impose consensus in situations where there are profound disagreements. Political discretion also needs to be exercised in cases where conflict is inevitable between certain sectors on highly contentious issues. Skills at mediating conflictual discussions are liable to be required! In some situations, unfortunately, there is a strong probability that the conflict-resolution powers of Foresight methods will be insufficient, and that conflict may even be exacerbated by embarking upon Foresight at this moment. In such cases, Foresight should not be undertaken, or at least taken up in a very cautious way. Foresight *may* help find areas of agreement shared between opposing factions, but it can become mired in disputes between entrenched antagonists, especially when the focus of Foresight is on topics that

divide these groups – which will often involve issues of social welfare, governance, and the like.

Furthermore, and to reiterate, Foresight should not be seen as a “quick fix”. A Foresight exercise may provide the information (e.g. a priority list) needed for a particular policy to be implemented. But the sorts of longer-term analyses that Foresight involves, and the new networks and capabilities that it can forge cannot be expected to achieve results overnight. Often the processes of interacting around ideas of what opportunities might be seized, how particular challenges might be confronted, etc. will take a long time to result in widely-accepted notions of the way forward. The problems we wish to address have often matured over many years – effecting significant change is often going to require long preparation, and considerable groundwork to prepare people for the change.

# Overview of Methods used in Foresight

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## **1. Introduction**

This chapter sets out to summarise some of the formal methods used in technology Foresight exercises. Formal methods, whilst not strictly essential to the conduct of a Foresight exercise, are nevertheless typically used in such exercises, often in combinations. It is therefore useful to know and understand the full range of formal methods available. Selection of methods will depend upon several factors, most notably available time and financial resources, and the objectives of the exercise. Unfortunately for the novice, no simple recipe book exists for selecting and combining methods. This is because many of the methods can be used in a wide variety of ways to serve a variety of functions within a Foresight exercise. Moreover, the wide variety of contexts in which Foresight might be applied further complicates any attempts to provide generic guidance. We hope that by setting out the main methods in a single chapter, the reader will begin to discern the most appropriate methodological approach for their own circumstances.

The first part of the chapter is given over to discussion of selecting Foresight methods. With so many methods to choose from, we highlight some of the criteria used (often implicitly) by Foresight practitioners. Next, we discuss three key ‘dichotomies’ that characterise formal methods – their explorative/normative nature, whether they use/result in quantitative/qualitative inputs/outputs, and the extent to which they are expert-based/assumption-based. Against this background, we suggest a basic typology of formal methods that, for sure, could be contested. However, at least for presentation purposes, we require some sort of grouping of the various methods, and have opted for four groups that reflect a typical function within a Foresight exercise: (a) issue identification (environmental scanning, SWOT analysis, issue surveys); (b) extrapolative approaches (trend extrapolation, simulation modelling, genius forecasting, Delphi); (c) creative approaches (brainstorming, expert panels, cross-impact analysis, scenarios); and (d) prioritisation (critical technologies, technology roadmapping). The main body of the paper is therefore given over to providing brief descriptions of each of these methods.



## 2. Selecting Foresight methods

Except in cases of rapidly conducted panel-based exercises, or programmes with a strong emphasis on large-scale face-to-face interaction and bottom-up approaches, formal methods are likely to be quite prominent in Foresight. Generally speaking, formal methods have some useful benefits, including (among others):

- Making the Foresight process more systematic;
- Increasing the transparency of inputs, processes, and outputs;
- Constituting “hybrid forums” for interaction and communication between various system actors; and
- Aiding the visualisation of possible and/or desirable futures.

Thus, the question is not so much *whether* to use formal methods, as *which* to use, and *how* to use them. There are several possible criteria that are used for selecting amongst formal methods. Amongst these are the following:

- Resources, especially time and money, are significant factors in selecting formal methods. Large scale surveys, for example, can be expensive and time-consuming.
- Desired breadth and depth of participation by experts and stakeholders in the Foresight exercise. Some methods, such as Delphi, are good for engaging many people, though this engagement will tend to be rather fleeting. By contrast, expert panels achieve in depth deliberation, but typically amongst a much smaller cohort of people than can be achieved through a survey process like Delphi. Combinations of methods are therefore favoured.
- Suitability for combining the method with other methods, both as feeders and as a complement to the results of other methods (triangulation). Formal methods are rarely, if ever, used alone. Rather, they are combined in a variety of ways. Unfortunately for the Foresight novice, there are no simple recipe books to follow, since (a) different topic areas and audiences require different approaches; and (b) formal methods are rather versatile, resisting simple classification according to their (assorted) roles in the Foresight process.
- Desired outputs of the Foresight, which may be more or less process or product oriented. The former orientation might see a focus upon methods that nurture dialogue and interaction between disparate groups, for example. A more product orientation will ensure that methods are used that generate ‘hard’ results, such as critical technologies.
- The quantitative/qualitative data requirements of various methods are also an important determining factor, especially where data may not be readily at hand. We will say more on this below.
- Methodological competence is often a key factor, with individual Foresight practitioners often tied to particular tools, having limited experience of other approaches. This is especially true of consultant practitioners, where there is often the temptation to offer the same methodological solutions to a variety of customers.

### 3. Three key characteristics of Foresight methods

A fundamental distinction in futures and forecasting studies is commonly drawn between exploratory and normative methods. This terminology is well-established, but rather misleading (since both approaches involve exploration, of course, and both call into play questions about norms and values). Still, the distinction is useful:

- **Exploratory** methods are “outward bound”. They begin with the present as the starting point, and move forward to the future, either on the basis of extrapolating past trends or causal dynamics, or else by asking “what if?” questions about the implications of possible developments or events that may lie outside of these familiar trends. Trend, impact, and cross-impact analyses, conventional Delphi, and some applications of models are among the tools used here. The majority of forecasting studies are mainly exploratory, though when these result in alarming forecasts, there may well be an effort to locate turning points or policy actions that could create a more desirable future.
- **Normative** methods are, in contrast, “inward bound”. They start with a preliminary view of a possible (often a desirable) future or set of futures that are of particular interest. They then work backwards to see if and how these might futures might or might not grow out of the present – how they might be achieved, or avoided, given available constraints, resource and technologies. The tools used here include various techniques developed in planning and related activities, such as relevance trees and morphological analyses, together with some uses of models and some less conventional uses of Delphi such as “goals Delphi” methods. A fairly recent development is the use of “success scenarios” and “aspirational scenario workshops”, where participants try to establish a shared vision of a future that is both desirable and credible, and to identify the ways in which this might be achieved.

There is little evidence as to when each of these approaches is most valuable, and again in practice we often find Foresight involving a mixture of the two. It may be that more normative approaches are most likely to be effective where there is a widely shared goal already in existence, and where Foresight can then help elaborate the implicit vision of the future. For example, a common long-term territorial goal will be for more rapid and equitable economic development in the territory; or where S&T issues are at stake, it may be to achieve a secure grip on at least some niches of technology innovation, production and use. In such cases, normative approaches can be powerful inputs into priority-setting and other elements of decision-making (and help provide road-maps and indicators that can be used to monitor progress towards the desired future). In other cases, normative approaches may be considered insufficiently objective, or there may be a lack of consensus as to shared goals, at least in early stages of the Foresight process. Exploratory methods can then be expected to dominate.

A second important distinction is between quantitative and qualitative methods:

- **Quantitative** methods place heavy reliance on numerical representation of developments. These have considerable advantages (e.g. ability to examine rates and scales of change). They also have notable disadvantages (limited grasp of many important social and political variables, dangers of spurious precision, problems of communicating with less numerate audiences, etc.). Often quantitative methods implicitly or explicitly use simple models of some sort.

More complex models relate variables together so their mutual influences can be tracked. Some quantitative approaches involve experts putting numerical values to developments, or creating such values on the basis of the numbers of people agreeing with particular statements or forecasts (as in Delphi).

- **Qualitative** methods are, of course, often employed where the key trends or developments are hard to capture via simplified indicators, or where such data are not available. In addition, various forms of creative thinking are encouraged by such qualitative approaches as brainstorming, utopian writing and science fiction. Methods for working systematically with qualitative data are becoming more widely available with the development of Information Technology – tools for “mind mapping” and “conversation analysis”, etc. – which can also be helpful devices for facilitating meetings and workshops.

The exact mix of methods is highly dependent on access to relevant expertise, and on the nature of the problems being studied. They represent different approaches to handling information, and can contribute powerful insights in their own ways. There is a strongly-rooted tendency to place more weight on statistical information (or quantitative data that may not really merit the term “statistical”). This is misguided: such data can be invaluable in giving a broad overview, in demonstrating the incidence of phenomena, the representativeness of case studies or opinions, and the like. But they can rarely probe the dynamics of a phenomenon in any depth, and are restricted to concepts and indicators that are usually quite limited and liable to give only a partial hold on the issues at stake. In practice Foresight work can never be completely dominated by quantitative methods and their results. The task is to establish an appropriate role for such methods.

A third critical distinction is between methods that centre on examining and articulating the views of experts, and those based more on investigating the consequences of assumptions:

- **Expert-based** techniques seek to draw out informed opinion and the evidence that underlies expert judgements. They seek to articulate views about the future, of the trends and contingencies that may give rise to alternative futures, and of goals that should be striven for and the critical priorities and strategies here. The approach may involve large-scale surveys of opinion (such as Delphi), or much smaller and more detailed elaboration of visions (such as cross-impact analysis, scenario workshops, etc.). Where the issues tackled in Foresight are ones of wide concern, and especially where they deal with social change, the “experts” may be effectively the whole population - representative views may be developed from samples of the general public. Results may be presented in quantitative form (e.g. Delphi estimates of the date at which particular developments will manifest), or qualitatively (e.g. narrative scenarios).
- **Assumption-based** techniques are ones that elaborate visions and priorities on the basis of knowledge that is usually already public (available statistics, published analyses of likely breakthroughs or other developments and contingencies). Sometimes shortage of relevant data may lead to a special activity to generate relevant statistics. Assumption-based techniques are often more reliant on expert practitioners than on more interactive approaches. For instance, technical expertise is required to set up a simulation model to describe an issue of interest.

It would be easy to imagine that assumption-based methods are mainly quantitative in form, but this would be a mistake. For example, Delphi surveys are expert-based and yield quantitative results, while some sorts of scenario work are mainly qualitative but highly assumption-based. The key issue at stake here is how far we are able to rely upon data and knowledge of processes and relationships that has already been codified and subject to some scrutiny, as opposed to having to elicit opinions and guesstimates from experts as to what might be the state of affairs now and in the future. The nature of the topics considered in Foresight is such that a combination of the two will almost invariably be called for. Expert judgements have to be deployed where we are considering rapid change, qualitative breaks, and social and technological innovations. The questions that arise are more ones of *how* to use such opinion than *whether* to.

#### 4. Typologies of Foresight methods

Typologies of Foresight methods are often problematic, since many methods are rather flexible in their application and defy easy classification. Nevertheless, we have chosen to present the various methods in four groups, as shown in Table 1. In all, we describe 13 methods, which cover some of the main approaches used in Foresight studies over the last decade.

**Table 1: The methods described in this chapter**

Group	Method
Identifying Issues	Environmental Scanning SWOT Analysis Issue Surveys
Extrapolative Approaches	Trend Extrapolation Simulation Modelling Genius Forecasting Delphi
Creative Approaches	Brainstorming Expert Panels Cross-Impact Analysis Scenarios
Prioritisation	Critical (and Key) Technologies Technology Roadmapping

#### 5. Identifying Issues for Foresight

It is common for Foresight studies to begin with some sort of scanning and framing activity, which together identify and inform the issues on which the Foresight will focus. Amongst the most popular methods used are environmental scanning, SWOT analysis, and Issue Surveys. Each is now briefly described.

## 5.1 Environmental Scanning

A large number of approaches are in use to help identify important developments in the environment of organisations. Issue surveys provide one approach, based upon polling experts. A variety of multiple “genius forecasting” may be employed, for example by requesting a number of experts or well-informed commentators to select and write about topics that they believe will be important for the future. We say more on these approaches below.

Other approaches typically involve systematic analysis of some documentary source. Media coverage of issues is commonly used, where typically a team set about locating and classifying, and then working through and presenting, material on a large number of social trends relevant to the future of work. This activity is referred to as environmental scanning and can take a number of forms:

- **Passive scanning:** reading newspapers, magazines and periodicals relevant to our interests and watching television, without really thinking about it. It is how we keep up to date with whatever is our particular concern;
- **Active scanning:** particular sources are regularly scanned, perhaps making an effort to extend the scope beyond the area we normally cover in a more formal process; and
- **Directed scanning:** often organised within a team, this implies a much more organised and selective approach to scanning for a particular purpose.

These sorts of approaches are particularly useful for addressing emerging themes that conventional trend analysis might find it hard to spot – often because there are as yet no established data on the issues of interest.

There are several developments of interest here. With the growth of the Web, it is now possible to use electronic means to search for or chart the emergence of press coverage of various themes, and to experiment with classifying the material in different ways. There are also several organisations offering trend-spotting services. Some of these provide regular digests of a wide selection of what they believe to be important developments for the future; others focus on specific areas (such as possible trends in fashion and tastes).

There are also more specialised types of data source that can be examined, and methods of analysis to track developments. These are particularly well developed for examination of science and technology issues. For example, bibliometric approaches may be used – examining the number of journal articles that are addressing particular themes. Patent analyses are used to look for areas of interest in technology development. Such data are used to provide early warning of activities that may provide technological challenges to the established modes of operation of an industry, for example.

## 5.2 SWOT analysis

SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis is an analytical tool used to categorise significant internal and external factors influencing an organisation’s or territory’s strategies – or, in the case of Foresight, its possible futures. SWOT analysis involves the collection and portrayal of information about internal and

external factors that have, or may have, an impact on the evolution of an organisation / territory. It generally provides a list of an organisation's strengths and weaknesses as indicated by an analysis of its resources and capabilities, plus a list of the threats and opportunities that an analysis of its environment identifies.

The SWOT is often portrayed as a 2x2 matrix, which presents an overview of major issues to be taken into account in developing strategic plans for an organisation – and in preparing Foresight studies in expert panels and workshops. The idea is that such an appraisal will enable strategies to be developed that match strengths with opportunities, while warding off threats and overcoming weaknesses where feasible. SWOT is thus not a static analytical tool, but a dynamic part of management, business development, and organisational learning.

SWOT analysis requires knowledge sufficient to support definition and prioritisation of factors. Thus it is necessary to access sufficient relevant expert knowledge. For this reason, SWOT analyses are usually prepared by an expert team using a variety of data sources and often a programme of interviews. Evidence is drawn from various sources – expert opinion as revealed through interviews, or statistical or benchmarking comparisons, for instance. Opinion as to SWOT issues can even be derived from Delphi studies (it is quite common for such surveys to ask respondents to indicate how one's country or organisation compares to others in various ways, for example).

### 5.3 Issue Surveys

Issue surveys are used to consult a wider range of expert opinion than could readily be accommodated in face-to-face meetings, to find out what they consider to be important developments in their areas. Such surveys, using post or email (or, in one case that we know, telephone interviews) can be used to inform the development of Delphi studies, background information on important developments, or scenario workshops.

The surveys may be fairly open-ended ones, in which the experts are allowed to elaborate on the issues in their own style, often supplying relevant documentation and the like. However, such material can be hard to process, and many respondents are very reluctant to embark on such an open-ended exercise (its time requirements are practically endless!). Thus more structured approaches are common. One approach used effectively in the UK Foresight Programme in the mid-1990s involved a four-page questionnaire, in which respondents were successively asked to specify, in their own words:

- What are the major drivers and shapers in the area of interest (thus for *transport* the drivers might be environment and congestion);
- What sorts of problems and need do these create (e.g. specific pollution problems, waste of time, safety risks...);
- What sorts of solution and innovations might be applied to these (shifts to public transport, new types of engine, better traffic information systems...); and
- What sorts of research, knowledge, or capability might be needed to achieve these (research into systems that allow rapid shift across transport modes without wasting people's time or incurring extra expenses, use of fuel cells in designated urban areas, improved transport telematics software, user interfaces, devices...).

Such approaches can draw on a wide knowledge base, allowing many more people to contribute their insights. They can provide more time for reflective inputs than would be possible in workshops, and engage people who would not be able to commit time to a longer involvement in Foresight.

## **6. Extrapolative approaches**

Although Foresight is a distinct activity from forecasting, some of the methods of the latter have been borrowed by Foresight practitioners. Foremost amongst these are the extrapolative approaches of trend extrapolation and simulation modelling. These are statistical approaches based upon well-defined assumptions. Also covered in this section are genius forecasting and Delphi, which are methods also borrowed from the world of forecasting. But in contrast to extrapolation and modelling, these methods rely upon the opinions of experts to generate their results.

### **6.1 Trend Extrapolation**

Trend extrapolation is one of the most widely used of all forecasting techniques, and many forecasts that stem from expert judgement are probably actually achieved by an impressionistic trend extrapolation of one sort or another. A trend refers to historical data, such as that concerning population growth, economic development, social attitudes, etc. Extrapolation means that these data are projected forward. This may be done impressionistically or by fitting a curve or straight line to a series of data points by hand; or, more usually in contemporary analyses, by mathematical or statistical equation-fitting.

Trend extrapolation is widely used, and fairly easy to employ and explain. But in order to assume that a trend will continue to evolve into the future, we need really to have a good reason to believe that it will persist rather than change its course. Thus it is wise to identify just what forces are driving a trend; then one can consider whether these are liable to persist, and to have the same effects. If we do not think this through, then trend extrapolation is unconsciously founded on the assumption that such forces will continue to operate in familiar ways. It is better for such assumptions to be explicit.

Formal statistical methods of trend extrapolation have been developed, of varying degrees of sophistication. Fitting a curve to a series of data points by hand is often a good way of gaining insight about the development of a trend. But we are liable to make errors of various kinds when doing this, not least by seeing patterns where there are none, or arbitrarily ignoring data points that do not correspond to the trend we anticipate. Curve-fitting by hand is particularly difficult where there is a lot of “noise” in the data, or where we are dealing with cyclical phenomena (e.g. the business cycle may make long-term growth trends obscure). Various statistical techniques enable straight lines or a variety of curves to be fitted to a set of data points, and projected into the future. Various statistical techniques also exist that allow us to fit S-shaped curves (e.g. logistic curves) to trend data. Such methods are frequently used for examining and forecasting phenomena such as the diffusion of consumer products – or the spread of contagious diseases – in a population. Where there is an obvious ceiling, such approaches can be very powerful, but in the case of many social phenomena there is a

good deal of guesswork in deciding where the ceiling might lie or when it might be reached.

## **6.2 Simulation Modelling**

Computer simulation models are a popular tool in forecasting, allowing a system to be represented in terms of its key components and relationships. More significantly, computer simulation can be used to project how the system will operate over time, or as a result of specific interventions. The wide availability of low-cost computing over the last decade has meant that such tools are slowly becoming a more familiar and less mystifying activity.

There are several major advantages, and also certain drawbacks, associated with modelling. In its favour, the approach can force us to think systematically about our assumptions concerning the dynamics of a system, and make us search for relevant data with which to test, explicate or elaborate such assumptions. It can also allow us to explore alternative starting conditions, events and interventions, and even allow us to experiment with changing assumptions and to compare the behaviour of models of the same system based on different understandings of how it operates. Perhaps most significantly, it allows us to deal with a much larger number of variables simultaneously than ordinary people are able to, and to process the material in a systematic and meticulous way, with innumerable calculations. It can even be the case that outcomes will be achieved that were unexpected or unpredicted by the simulation's designers – this is particularly the case in the more evolutionary models involving games, agents, and genetic algorithms. Finally, computers enable us to present results in detailed graphical form – graphs, charts etc. – allowing us to compare results for different times or conditions.

On the downside, whilst models of social, political and cultural change have been produced for decades, our understanding of how these systems work is incomplete and hotly debated, with very different worldviews being brought into play. It can also be hard to identify and locate appropriate data on key variables, let alone to estimate the relationships between them. Clearly, the quality of a model is only as good as that of the assumptions it is based on (and the data with which it has been calibrated). While this is more widely understood than in the past, a continuing problem is that, especially in the case of large and complex simulation models, it can be difficult for non-experts to identify and critique the assumptions that have been built into them. Many large models are subject to little independent inspection, and the details of some are commercially confidential.

## **6.3 Genius Forecasting**

The rather misleading term “genius forecasting” is used to describe the generation of a vision (or several visions) of the future through the insights of a gifted and respected individual. Some individuals can provide fresh thinking to foresight, and can take up perspectives that may otherwise be neglected in the work of committees and panels. While some such individuals will be working as solitary academics, journalists, or activists, gathering and honing their insights over years of experience and study, it is also common for futurists to draw on the work of many colleagues. We have “genius forecasting” rather than more conventional futures studies where such figures synthesise these ideas of larger study teams in new ways, stamping their own strongly-held views



on them. Influential examples here could include Alvin Toffler's Future Shock and The Third Wave, or John Naisbitt's Megatrends.

However, caution needs to be exercised in using such work. The nature of such visions is that they tend to ride on particular hobbyhorses, and to present views that are rather one-sided (emphasising particular technologies or social problems, viewing these in a monochrome positive or negative light, etc.). Moreover, it is likely that few individuals have the span of knowledge required to cover the whole range of factors that may change the future. Thus it is helpful to place them in the wider context – of other genius forecasts, and of futures efforts that use rather more transparent methods. Indeed, if such studies are used critically – are seen as the work of gifted but fallible visionaries, rather than as the supernatural revelations of prophetic gurus – they can be used for indicating drivers and scenarios that may be useful to consider.

## 6.4 Delphi

The Delphi method is so widely identified with Foresight that it is easy to forget that even among national Foresight programmes, several make no use of the method. It was originally developed in the United States in the 1950s by the RAND Corporation and involves a survey of opinion – in principle this should be expert opinion. But it is a survey that is designed to feed information back to its respondents, not just to provide material for processing by data analysts. What makes Delphi different from other opinion surveys is the way in which this is accomplished. Delphi does not just involve a one-off posing of questions. The survey is circulated, to the same set of respondents, at least twice. Together with the same set of questions, the respondents in later rounds receive feedback on the structure of responses from previous rounds. The purpose of providing this feedback, and offering the chance for respondents to modify their judgements in its light, is to promote exchange of views and information – and in the case of Delphi forecasting, to allow people to see how far their forecasts and expectations correspond to those of a wider pool of respondents.

The anonymity of the survey is, furthermore, intended to reduce the dominance of discussions and the exercise of influence by the loudest or most senior figures. Indeed, the Delphi method was designed to encourage a true debate, independent of personalities. Further, to eliminate the force of oratory and pedagogy, the reasons given for extreme opinions are synthesised by the researchers to give them all equal 'weight' and then fed back to the group as a whole for further analysis. Ideally, they should receive information on *why* judgements, and especially extreme judgements, were made. The idea is that all respondents should thus be able to have access to special information that only a few possess, but which can inform judgements that diverge from the average.

The most common application of Delphi has been to investigate when particular developments might happen, requesting judgements usually about the most likely time period in which a particular development might occur. An alternative, that has been used less often but that may be more useful for some purposes, is to enquire about how far a development might have occurred by a particular point in time. Often, alongside these forecasting questions, there will be other survey questions about possible driving, constraints and facilitating factors, or about the economic or social implications, of particular trends.

Delphi studies provide impressive results when conducted well. This will require careful and laborious planning in terms of the choice of participants, preparation of questions, and provision of feedback. Delphi surveys are fairly time-consuming and labour intensive. Drop out rates among respondents may be high, and persuading them to fill in successive questionnaires is troublesome (which is one reason why few iterations has become the norm.). Some so-called Delphis do not reiterate the survey or provide adequate feedback to respondents, and their value is thus compromised.

## **7. Creative methods**

Foresight is, above all else, a social and creative process that relies upon more than just issue definition and extrapolation. Interactive processes that nurture new and interesting knowledge combinations are key to the success of Foresight. Amongst these is the popular and versatile method of brainstorming. Much interaction and knowledge generation also takes place within expert and stakeholder panels, which may employ methods such as brainstorming. A more formal and often statistical method is cross-impact analysis, whilst perhaps the most versatile of all Foresight methods, scenarios, is now extremely popular. Each of these methods is described more fully below.

### **7.1 Brainstorming**

Brainstorming is one of the best-known of methods for generating novel solutions to problems. It has been extensively used in futures work because it aims to reduce inhibitions about generating “wild” ideas, and thus to stimulate creativity and novel (or previously unarticulated) viewpoints. The term is applied loosely to any free-ranging discussion, but the ‘classical’ definition refers to a specific process involving two main steps:

1. A period of freethinking, which is used to articulate and capture ideas, with no critical comments. This can be organised as a group activity, with people speaking ideas out loud and a facilitator or group member capturing them on a whiteboard or on a PC linked to a display; or there can be a preliminary step at which group members are requested to work alone and jot down several ideas on their own notepads or PCs (this is supposed to reduce the pressure to think along a track established by the group). Once ideas are being articulated, members should be able to ask for clarification of anything that is obscure, and to build on previous ideas. The main rule is that they should not snipe at others or critique ideas at this stage.
2. The early stage of idea-generation is followed by more rigorous discussion of these ideas. This typically involves clustering them (usually through a process of group discussion concerning which ideas can be combined together) and prioritising the most important themes. This latter activity could involve voting. At this stage it is legitimate for group members to introduce considerations that may render some ideas unworkable or irrelevant, though it is important to maintain a friendly spirit and not to personalise criticism.

There are many ways in which these steps can be organised – the core common feature is that the facilitator should provide an encouraging and optimistic ambience, and prevent group-think. Increasingly, brainstorming is supported by computer tools,

though the classical implementation through use of flipcharts on which to capture ideas is extremely effective.

Brainstorming is only a starting point. It should not normally be expected to generate output that can be directly used in reports, etc. – though sometimes reproduction of a long list of ideas can be useful for future group work. It is typically applied directly to the topic at hand, for example to brainstorm ideas about important trends, about drivers and inhibitors of a specific development, etc. It may be a useful technique to use in establishing the future work of expert panels, e.g. to pinpoint the topics that will need to be addressed at successive meetings, and the decisions that will need to be taken.

## 7.2 Expert Panels

Technology Foresight is, by definition, a participative, discursive activity that should be based upon the best available evidence and judgement. These conditions make the use of (expert) panels a natural choice in the Foresight practitioner's methods toolbox. Panels not only open up the Foresight process to potentially hundreds of individuals, they are also ideal forums for in-depth discussions and debate. For these reasons, panels are the "process centres" in many Foresight exercises.

Panels come in many shapes and sizes, though the common conception is of a "Bunch Of Guys Sat Around a Table" (BOGSAT). Such a panel normally consists of 12-15 individuals and is mandated to use its collective expertise in addressing a particular problem or set of issues. Experts meet face-to-face, normally in private session, at regular intervals over a fixed time period. During this time, they use their judgement in interpreting available evidence. Panels have often been given very tight briefs, e.g. to arrive at  $n$  number of Delphi topic statements within  $t$  months. Once the brief has been completed, they are usually disbanded. In many cases, panels produce their own published reports. Whether this happens or not largely depends upon the overall methodological design of the technology Foresight exercise.

The benefits of using panels in technology Foresight are manifold and widely acknowledged, as evidenced by their extensive use in Foresight exercises. For example, the ease with which panels can complement other methods used in technology Foresight is an important advantage. Indeed, with some methods, panels are a near necessity for the generation of inputs, the interpretation of outputs, and/or the overall conduct of the method. Other benefits include deep interaction and the networking of disparate groups.

## 7.3 Cross-Impact Analysis

Like Delphi, cross-impact analysis is an expert-based method producing quantitative results, though there is a more complicated statistical processing of the data required to reach these results. One of the major applications of cross impact analysis is in the preparation of scenarios. The approach is to ask the experts to rate the likelihood of various events occurring - and furthermore, to rate the likelihood of each event occurring *if* each of the others does or does not occur. The cross-impact method forces attention to chains of causality: 'x' affects 'y'; 'y' affects 'z'. This creates a matrix of conditional possibilities. This matrix can be subject to mathematical analysis (via specialised software programs) to assign probabilities of occurrence to each of the possible scenarios resulting from the combinations of events.

Cross impact analysis seems to be a logical step beyond methods like Delphi, which treat events as completely independent of one another. By examining the relationships between events, cross-impact analysis allows us to approach dynamics more closely. However, in practice, relatively few people use the method regularly, and there has been only limited independent analysis of its utility, probably because of two main limitations. First, it is very demanding of the experts, who have to make a fairly large number of difficult judgements about combinations of events. And second, because the number of judgements involved doubles with each new variable added, only a small number of key variables can practically be examined. Any influences not included in the event set will be completely excluded from the study. The choice of events is thus crucial.

## **7.4 Scenarios**

Scenarios consist of visions of future states and courses of development, organised in a systematic way as texts, charts, etc. They may be used as inputs to kick-start discussion and idea generation in panels, as tools for working groups to marshal their arguments and test the robustness of policies, and/or as presentational devices that can communicate Foresight results to wider publics. They may be used more as an element of the Foresight process, with their major contributions involving the exchange of visions and thus the deepening of linkages in networks, or as products of the activity that can be circulated to broad audiences. They may be exploratory focusing on what might happen under various circumstances, or aspirational asking how specific futures can be achieved (or avoided).

Often, creating scenarios has been compared to the process of writing a movie script where a main idea is formulated and characters are developed around it. There are a number of questions that are considered in scenarios building: What are the driving forces? What is uncertain? What is inevitable? Around these questions, a number of steps can be defined: (1) identify the focal issue or decision; (2) identify the key forces and trends in the environment; (3) rank the driving forces and trends by importance and uncertainty; (4) select the scenario logics; (5) flesh out the scenarios; (6) assess the implications; and (7) for monitoring purposes, select the leading indicators and signposts.

The ways of producing scenarios vary immensely – from the outputs of simulation models, through the work of small expert teams, to the undertakings of workshops and the delineation of different views in even wider samples of expertise. A popular approach for producing scenarios is through workshops, and this is briefly described here. Firstly, a small group will be typically constituted – or sometimes, parallel small groups will explore different scenarios. A process will be used to obtain views as to critical choices and drivers that could differentiate or lead to distinctive futures. The most important of these will then be selected and used as the basis of an elaboration of the sorts of events that can unfold, and the sorts of end-states that might be reached. The group will then typically be requested to consider what the strategic options might be for the specific scenario to be achieved, or for the key actors to be able to cope with the situation represented.

Scenarios provide planners with one point estimates of innumerable possibilities of what the future holds. In doing so, they help participants to radically alter the way they think about the future: optimisation against a specific future target is replaced by a balanced evaluation of the range of strategies that may be required. Participants understand better the alternative needs of futures and are able to develop better-informed strategies and policy options.

## 8. Priority-setting

Foresight studies are often conducted with the primary aim of identifying priorities for technology development and/or research spending. Such priorities are often inferred from some of the methods already described in this chapter. However, there are also dedicated approaches to identifying priorities. The critical (or key) technologies approach has been used extensively for this purpose in the United States, France, the Netherlands and the Czech Republic. A more recent but increasingly popular method for setting research and technology directions is offered by technology roadmapping. Both approaches are often used independently of Foresight exercises and sometimes are described as Foresight exercises in their own right. Each is outlined more fully below.

### 8.1 Critical (or Key) Technologies

Critical, or key, technologies is a particularly useful approach for assessing various technologies (or research directions) when selection of priorities is the major task of a Foresight exercise. It is especially useful in situations where straightforward “discrete” recommendations for discussion at the political level are the prime objective. The sorts of questions that typically characterise a critical technologies exercise include:

- What are the key areas of R&D?
- What are the critical technologies (key research directions) that should be preferentially supported from (public) resources?
- What criteria should be applied to choose critical technologies?
- What are the most important measures that should be discussed at the policy level to enable implementation of the results?

A useful definition of critical technology should meet the following requirements:<sup>1</sup>

1. *Is it policy-relevant?* It should indicate where the points of potential policy intervention in the linked processes of R&D, commercialisation, diffusion and utilisation of a given technology are to be found;
2. *Is it discriminating?* It should be able to discriminate unequivocally between critical and non-critical technologies. It should be as consistent as possible in level of aggregation and in clarity of classification;
3. *Is it likely to yield reproducible results?* It should be sufficiently functional to enable the panels or agencies employing it to develop tests and methods that will prove to be functional, robust, and accessible to those not directly participating in the exercise.

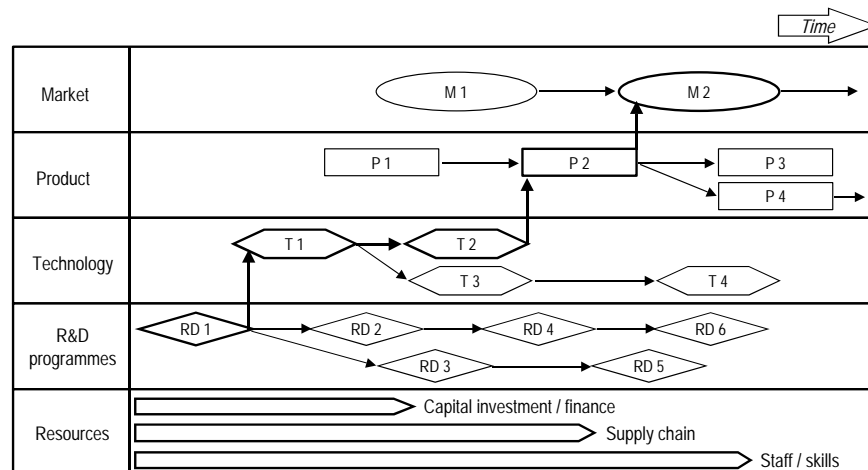
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<sup>1</sup> Bimber, B and Popper, S (1994) What is a Critical Technology?, RAND paper DRU-605-CTI, Santa Monica

The method is based on four generic steps. First, it is necessary to locate and select a cohort of experts for consultation. Secondly, an initial list of technologies is generated – this can be produced starting from existing lists (e.g. from previous Foresight studies), or the list can be produced by a combination of brainstorming and bibliography searches. In other cases, panels of experts are used in combination with patent analyses, bibliometrics and other studies. The third step involves clustering and prioritising the list of technologies. This is typically done through discussion and often voting procedures. It is at this stage that the criteria of criticality are applied. Finally, the fourth step is to assemble the final list of critical technologies. The final list may be accompanied by “ID sheets” of identified critical technologies, specifying their main characteristics, application areas and the critical problems to be addressed. The outcomes of the exercise do not constitute final decisions; rather, they formulate important recommendations by experts to policy makers.

## 8.2 Technology Roadmapping

Technology roadmapping (TRM) is used widely in industry to support technology strategy and planning. Increasingly, the approach is being applied in foresight studies, especially in those exercises that are focused upon particular industrial sectors. Technology roadmaps can take many forms, which can be attributed to the flexibility of the roadmapping concept. In general, however, roadmaps are comprised of multi-layered time-based graphical charts that enable technology developments to be aligned with market trends and drivers (see figure 1). In this way, research and other development directions can be established and actions determined in a goal-oriented manner.



**Fig. 1 - Schematic technology roadmap, showing how technology can be aligned to product and service developments, business strategy, and market opportunities (Phaal, 2003)**

## **9. Summary**

This chapter has set out to summarise some of main formal methods utilised in Foresight exercises. In doing so, it has briefly described those methods used for identifying issues on which the Foresight will focus, those methods used for extrapolative forecasting, those methods that are used to nurture creativity and interaction, and those methods used to set priorities. The chapter has necessarily been selective in its overview, though most of the main methods found in contemporary Foresight exercises are essentially covered. Most methods are more extensively described in other chapters in this textbook or in the UNIDO textbook 2 on Foresight methodologies.

# Using Expert and Stakeholder Panels in Technology Foresight – Principles and Practice

*Michael KEENAN*

## **Introduction**

Any review of technology Foresight exercises conducted over the last decade or so will show the almost universal usage of ‘expert’ and/or ‘stakeholder’ panels. These are typically collections of 12-20 individuals who are given 3-18 months to deliberate upon the future of a given topic area, whether it be a technology (e.g. nanotechnology), an application area (e.g. health), or an economic sector (e.g. pharmaceuticals). Despite their ubiquity, there is surprisingly little in the Foresight literature on the use of expert panels. Instead, the literature focuses upon the use of more esoteric methods such as Delphi and scenarios, presumably because the organisation and management of expert panels is considered to be routine and unproblematic. Yet, years of advising technology Foresight programme managers in many parts of the world has demonstrated to the author and his PREST colleagues that the organisation and management of expert panels is far from routine and unproblematic. For example, practical and conceptual issues surrounding panel composition and the conduct of panel work are regularly raised. We therefore believe it timely that some guidelines be set down on the use of expert and stakeholder panels in technology Foresight.

We begin the chapter with a description of what a Foresight panel might look like and explain why such groups are deployed in technology Foresight. We then move on to some of the practical issues associated with using panels to include: specification of a panel’s mandate; challenge of identifying and assembling panel members; how to get started and how to organise a panel’s work; generating consensus and priorities; and reporting and dissemination. The chapter is rounded off with some summary conclusions.

## **1. What are expert and stakeholder Panels?**

Expert and stakeholder panels come in many shapes and sizes. The common conception is of a “Bunch Of Guys Sat Around a Table” (BOGSAT), reflecting experiences in Europe and North America, where such panels are typically composed of white, middle-aged, middle-class, professional males who are considered to be “experts” in a given field. Such a panel normally consists of 12-15 individuals and is mandated (usually by a public authority) to use its collective expertise in addressing a particular problem or set of issues. Experts meet face-to-face, normally in private session, at regular intervals over a fixed time



period. During this time, they use their judgement in interpreting available evidence. They report their findings, usually through a written report that is later disseminated and, in ideal situations, acted upon.

This is the ‘typical’ model of a panel, but there are many deviations. For example, ‘expert’ panels may include ‘lay persons’. In fact, panels may not be ‘expert’ at all (at least not in the traditional, professional sense of the word). Instead, such panels may be composed of ‘stakeholders’, i.e. individuals (sometimes representing an organisation) with a stake in the outcomes of the panel process. The practical life experiences of such individuals are typically taken as criteria for membership. Another deviation concerns the interaction of panel members, which need not be face-to-face. Indeed, some panels never meet at all. In such cases, interaction may be through the Internet or through a survey process, e.g. a Delphi. This also means that panel numbers need not be limited to 12-15 members but can be much larger. Panels can also meet in public sessions, although this tends to be reserved for those instances where panels wish to consult with a wider public. Finally, panels can, in some instances, be constituted for an indefinite period of time. This often occurs where the desire is to establish an ‘independent’ authority for dealing with long-standing challenges, e.g. global warming. Such panels report periodically, often on a specific topic or theme.

In technology Foresight exercises conducted over the last decade or so, ‘expert’ panels have tended to be the norm, although there is now a discernible shift towards incorporating more stakeholder-type panels. This reflects a move away from science and technology oriented panels to ones that are focused upon business sectors, e.g. automotive industries, and policy challenges, e.g. ageing society. Panels have often been given very tight briefs, e.g. to arrive at  $n$  number of Delphi topic statements within  $t$  months. Once the brief has been completed, they are usually disbanded. Foresight panels typically meet face-to-face, although the Internet has been used in some cases. Sessions tend to be in private, with meeting minutes and background documentation often published. In many cases, panels produce their own published reports. Whether this happens or not largely depends upon the overall methodological design of the technology Foresight exercise.

## **2. Why use Panels in technology Foresight?**

Technology Foresight is, by definition, a participative, discursive activity that should be based upon the best available evidence and judgement. These conditions make the use of (expert) panels a natural choice in the Foresight practitioner’s methods toolbox. Panels not only open up the Foresight process to potentially hundreds of individuals, they are also ideal forums for in-depth discussions and debate. For these reasons, panels are the “process centres” in many Foresight exercises.

The benefits of using panels in technology Foresight are manifold and widely acknowledged, as evidenced by their extensive use in Foresight exercises. Some of these benefits include:

- Availability of expert judgement ‘on tap’ at the centre of an exercise, which can be particularly important when dealing with the uncertainties associated with the future;

- In-depth and meaningful interaction and networking between different scientific disciplines and areas of expertise that would otherwise be difficult to organise;
- The ease with which panels can complement other methods used in technology Foresight. Indeed, with some methods, panels are a near necessity for the generation of inputs, the interpretation of outputs, and/or the overall conduct of the method;
- Credibility and authority lent to the technology Foresight exercise through the profile of panel members and the visibility of expert/stakeholder panels; and
- The moulding of influential individuals (panel members) into Foresight ambassadors and change agents in support of panel findings.

There are of course other well known ‘tried and tested’ means of eliciting expert and stakeholder views, including the use of interviews/witness hearings and questionnaire surveys. Whilst these are likely to be cheaper to deploy and may take less time, they lack many of the benefits associated with panels as listed above.

### **3. Defining a Panel’s mandate**

Expert and stakeholder panels are commonly important components in the design of a Foresight exercise, conducting specific tasks within a given timeframe. What these tasks are, how they should be done and by when needs to be specified, not least so that panel members understand what is expected of them. In addition, panels can be held to account against such specifications, thereby providing some leverage on their activities. However, before the mandate of a panel can be set, the rationale and objectives of the Foresight exercise must be clearly understood and agreed upon. To achieve this, careful consultation with key stakeholders is necessary through a process of Foresight scoping. The scoping process is described elsewhere in this volume and will not be covered here. All we will say here is that the mandate and composition of expert or stakeholder panels should naturally reflect the scope of the Foresight exercise in question. In this respect, the preparation of two documents can be foreseen:

1. **Proposals** covering what the panel will do, why they will do it, and who (which experts/stakeholders) should be involved; and
2. **Terms of Reference** for the panels, setting out what they should do, how it should be done, and when it should be completed.

The proposal should be derived from the Foresight scoping process. It should begin by covering the rationale for using panels in the Foresight exercise and should state the kinds of products and process benefits that are expected. Essentially, the proposal should include all relevant information that will allow sponsors, key stakeholders, and the project management team to see the technical approach, the plan of action, and the time (including milestones) and resources required to complete the work. It should also indicate the sorts of expertise that will need to be represented. In other words, the proposal should constitute a blueprint for executing the panel work.

The panels' terms of reference document should draw heavily on the proposal, but will be directed at guiding the panels in their tasks. An example of a terms of reference used in the first UK Technology Foresight Programme in 1994 is provided as an annex at the end of this chapter. It is a short and succinct document that is divided into four parts:

1. Background, which provides some background on the UK Technology Foresight Programme and the purpose of the terms of reference document;
2. Description of each of the three phases of the programme, setting out (i) what needs to be achieved, (ii) how the panel should go about its work, and (iii) a series of milestones;
3. Description of the way in which the panels' work fits into the overall Programme; and
4. Account of the human, infrastructural (including training) and financial resources available to the panels in support of their work.

This document was distributed to all panel members in the Programme and was used by the sponsor and project management team to monitor progress of the panels. Similar terms of reference have been used in other technology Foresight exercises.

#### **4. Assembling a Panel**

Once the panel remit has been formulated, the task of assembling members can begin. The first step is to develop a profile of the panel, i.e. to identify the sorts of expertise and/or stakeholders that should be represented in light of the panel's remit. There are two interrelated considerations to take into account when profiling panels:

1. **Composition** – what mix of knowledge is required to address the panel remit?
2. **Balance** – what mix of views / positions / value judgements / scientific disciplines should be represented on the panel to ensure even-handed analysis and conclusions?

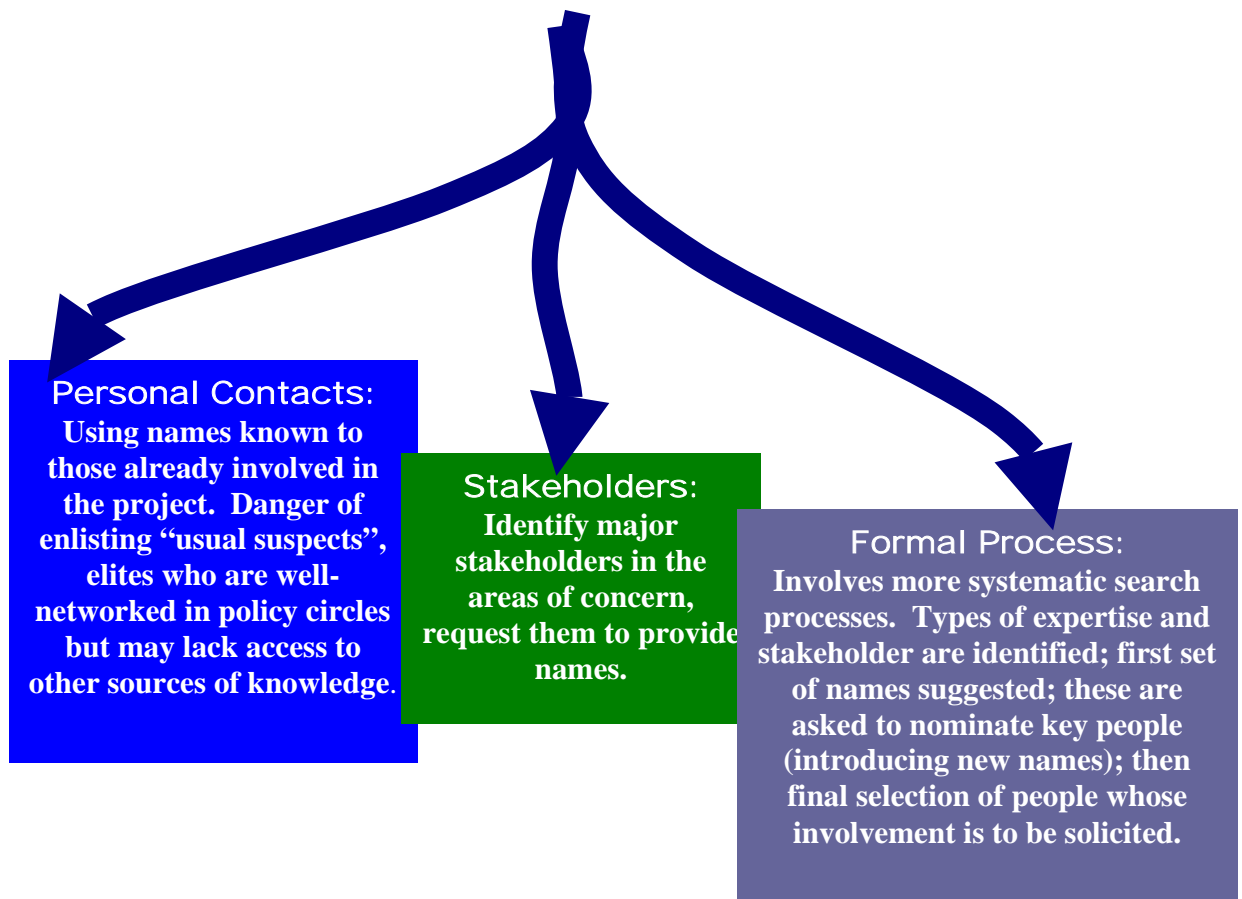
These are major concerns in technology Foresight, since panels must be perceived to be technically qualified and even-handed if the exercise is to achieve authority, credibility and legitimacy. It must, however, be acknowledged that panel members will bring their own interests and biases to the table and to pretend otherwise is unrealistic. Indeed, expertise in a given area normally means that an individual has some sort of stake, whether financial, professional, political, &c. in that area. With stakeholder panels, this link is typically even more obvious. Interestingly, there is little or no reporting of the effects of conflicts of interest or bias in technology Foresight panels in the literature. This is perhaps because very little research has been carried out on Foresight panels. But it can also be attributed to the safeguards that are typically put in place in technology Foresight to prevent undue influence by vested interests, e.g. the requirement of verification of panel findings through wider consultation processes and the use of reference panels; transparency in the Foresight process itself; and methodological design, which should encourage people to think 'out of the box' and to leave organisational and/or professional affiliations out of the frame.

Nevertheless, some good advice on achieving balance is offered by the Royal Society of Canada in its manual on expert panels:

“Sometimes balance can be achieved by having opposing views represented in the panel membership. In other circumstances, particularly when the opposing views are strongly held and not subject to a factual test, it can be better to seek members who are not strong proponents of the contending perspectives. The panel profile in such cases should aim for more balance in each member and rely on briefings, workshop presentations, &c., to bring forward the best evidence and arguments from the strongly opposed sides.”

On a practical level, there are a number of approaches for actually identifying individual participants. In the figure below, these have been divided into ‘personal contacts’, ‘stakeholder involvement’ and ‘formal processes’ (e.g. co-nomination, which is a form of snowball sampling). All three should be investigated for their suitability. It is likely that several approaches will be drawn upon when identifying possible panel members.

### **Three ways of recruiting members & participants**



The initial aim is to generate a long list of candidates for panel membership. This list will then need to be cut down to a short list of primary nominees and alternates. As we have already mentioned, key stakeholders typically contribute to the composition and procedural

design of expert panels, which helps ensure that those stakeholders will find panel results credible. Stakeholders include sponsors of the Foresight exercise as well as those organisations that might be expected to act in light of the exercise's findings. But this panel shaping by stakeholders and sponsors may extend to the power of veto over panel membership, particularly over the key role of chairmanship. This is what happened in the UK national Technology Foresight Programme, where the sponsor and a small number of interested ministries and research councils were essentially given the right of veto over panel membership lists.

Clearly, having people on panels that are acceptable to organisations responsible for implementing Foresight findings is important for policy impacts. On the other hand, some care needs to be taken to avoid situations where panels are solely composed of an elite of 'usual suspects'. Technology Foresight should be about interaction between different communities, disciplines, and ideas. This aim is seldom best served by filling a panel solely with nominees from, for example, a sponsoring ministry. This is why many national technology Foresight exercises have used co-nomination approaches to broaden the knowledge base, by bringing new faces into the Foresight process.

#### **The co-nomination approach**

The UK Technology Foresight Programme was the first to use co-nomination in 1993. Around 600 people were first identified through traditional nomination methods and their contact details entered into a database. A mailshot questionnaire was then distributed to this group, inviting them to (a) describe their own areas of expertise, and (b) nominate up to six other names who could provide relevant expertise to the Foresight exercise. The new names nominated were then entered into the database and the same questionnaire sent out again. An average response rate of 40% was achieved across the two iterations of the questionnaire, with 1400 returned forms generating an additional 5200 new names for the exercise. Of these, 17% were nominated more than once, with multiple nominations an important (though not exclusive) criterion for the identification of panel members. Although the Programme Steering Group ultimately selected the Panel Chairs and Vice-Chairs, in thirteen out of the fifteen panels, at least one of these had been identified through the co-nomination exercise. Since the successful British use of co-nomination, similar surveys have been used in support of Foresight exercises in many countries, including Hungary, Czech Republic, South Africa, and Austria.

When the shortlist is agreed upon, nominated individuals must be sounded out on their willingness to serve on a Foresight panel. Such approaches are typically done by the project manager through a telephone call. During this initial contact, the exercise should be described to the nominee, explaining clearly why it is being carried out. The remit of the panel should then be summarised, indicating the key tasks and, most importantly, the time and effort needed. Evidence from past Foresight exercises suggests that most people are flattered to be asked to serve on such panels and typically accept the invitation, especially if the exercise has a high profile and political backing. Those individuals that are unable to accept or those that are not approached to serve as panel members may be used in other parts of the exercise, for example, as recipients of questionnaires and consultation documents and/or invitees of workshops and other consultation fora.

A special mention should be given to the choice of panel chairperson. Two main criteria are typically used for selecting such people in technology Foresight – their profile and standing, and their time commitment. Having someone who is well known and (more importantly) well respected in a given community (or even nationally) will provide an invaluable boost to a panel's work, lending it authority and legitimacy. People will be more inclined to respond to surveys and to read a panel report if the chair is well respected. Unfortunately, many of the really good people are too busy to chair a technology Foresight panel, which requires probably at least twice as much commitment in time than being simply a panel member. However, it is not impossible to attract really good people but it does require a lot of effort on the part of project managers. Further considerations on the suitability of an individual to serve as panel chair (in addition to the ones already mentioned for panel members more generally) is an ability to lead a team, good project management skills (especially given the time constraints common to most technology Foresight exercises), and political skills for dealing with sponsor and stakeholder organisations.

A further concern when organising technology Foresight exercise centres on the number of panels to appoint. There is no fixed rule here – some exercises appoint a relatively small number of panels – perhaps only 6-8 to cover the whole S&T base – whilst others may appoint 15-20 for the same purpose. The decision on the number of panels to appoint has resource implications, e.g. financial costs, exercise management tasks, &c. The fewer the panels, then the lower the costs, although this calculation depends upon what a smaller number of panels are expected to do. A larger number of panels allows for more focus and in-depth consideration of issues but suffers the risk of fragmenting an exercise to the point where communication between different foci may become difficult.

*Table: Number of panels in a selection of European national S&T Foresight exercises*

<b>Exercise</b>	<b>No.</b>	<b>Orientation</b>
Austria	7	Society/Technology
French KT 2005	9	Society/Sector/Technology
German Delphi 93	15	Sector/Technology
Hungarian TEP	7	Sector/Technology/Society
Ireland	8	Sector/Technology
Portugal	23	Sector
Spain	8	Sector
Sweden	8	Society/Sector
UK1 (1995)	15	Sector/Technology
UK 2 (2000)	15	Sector/Society

A related issue concerns the number of panel members to appoint to each panel. Most Foresight exercises have opted for 12-25 individuals per panel, with the average number being around 15. Typically, a small number of individuals are absent from each panel meeting, and this needs to be taken into account when deciding on the final number.

Financial and co-ordination costs must be taken into account when appointing panels. Time is needed for assembling the panel and any support staff, holding meetings, using methods such as Delphi or scenarios, preparing reports, and disseminating the final results. Financial costs include the following possibilities:

- Honoraria may be paid to panel members and/or the panel chair. This has not been common practice in technology Foresight up until now – the prestige associated with being a panel member in a high profile exercise has usually proved to be sufficient reward. A notable exception is the Czech Technology Foresight exercise (2001) where honoraria were paid to panel chairs and panel members. The amount paid represented a token of appreciation rather than a payment for services at normal professional consulting rates. But it did seem to encourage a great amount of commitment from panel members and is an issue that probably deserves closer attention.
- Panels tend not to run themselves but are typically supported with facilitators and/or secretaries. Secretarial support, for instance, minute taking and document preparation, may be provided by staff from the sponsor or the organisation awarded the contract for running the exercise. Facilitation of meetings is largely carried out by the panel chair, but additional specialist facilitation is also often required in technology Foresight, e.g. for the running of scenario sessions, the writing of Delphi topic statements, &c. Such skills may reside in the organisation managing the exercise, although often this is not the case and other contractors must be brought in.
- Research and technical services will probably be needed to support the work of the panel. Some of this can often be prepared before the panels start their series of meetings, but other research and technical assistance demands are likely to emerge as the panels undertake their work. Research and technical services can often be provided 'in-house', for example, by the sponsor or the project management team. In other instances, however, it will be necessary to bring in outside expertise to write specialist reports, collect and analyse data, &c.
- Travel costs and other communications (telephone, document courier, &c.) also need to be factored for. In some countries, most expertise resides in the capital city and meetings are held there. But even in such situations, some people will have to be brought in from elsewhere, though costs are likely to be quite low. In many Foresight exercises, expertise or stakeholders are more geographically dispersed, e.g. in Germany and the UK. Here, meetings may be held in many different locations with perhaps most panel members having to travel. Some countries have two dominant centres between which meetings may be split. South Africa (Cape Town and Johannesburg) and Turkey (Ankara and Istanbul) are two examples where national technology Foresight panel meetings were largely distributed across two centres.
- Rental of facilities may also be necessary, especially if panel meetings move about. It is normal for the sponsor to make its premises available for meetings. Sometimes panel members' own organisations may offer similar facilities for free (this

happened extensively in the UK national Programme, but it should not be taken for granted). If meetings stretch over a day or more, it may also be necessary to pay for hotel accommodation.

- If panels are to carry out questionnaire surveys and/or organise workshops, materials will need to be provided. Moreover, reports will have to be published and disseminated.

Realistic estimates must be made of the time and costs required to complete these tasks. This can prove difficult at the outset, and it is common to underestimate, especially with respect to the time needed. Indeed, it is not uncommon for technology Foresight exercises to overrun – usually by only a few months, but sometimes it can be longer.

## **5. Getting started**

Once the panel chair and other panel members have been appointed, they will need further detailed briefing on the task at hand. This can be done face-to-face at the first panel meeting. But face-to-face briefing may also be supported by the prior distribution to panel members of more detailed project plans, summaries of the methods to be deployed, and brief résumés of the other panel members. This means that panel members will have reasonable knowledge of the exercise by the time they arrive at the first panel meeting. Many national technology Foresight exercises have also used training workshops to acquaint panel members with working practices and the methods they will be using. This is strongly advised if panels will be using unfamiliar futures or forecasting techniques. Training sessions should be run by experienced trainers/facilitators.

It is imperative that the panel gets off to a good start, necessitating special attention be paid to the first panel meeting. A suggested architecture for the first panel meeting is shown in the box below. After brief introductions, the panel chair and/or project manager should lead discussion of the Foresight exercise's scope and the panel's remit within it. This might be followed by discussions with the sponsor, although this often does not happen – instead, the project manager may articulate the views and expectations of the sponsor. Discussion could then be widened to include consideration of the expectations of a wider group of stakeholders, especially of those who might be expected to act in light of Foresight findings.



**Typical First Meeting Architecture** (adapted from Royal Society of Canada)

1. Discussion of the origin, background, task statement, and objectives of the terms of reference, led by the chair or the project manager involved in preparing the original exercise proposals.
2. Discussion with sponsor(s) of the terms of reference, and their views on origins, context, schedule imperatives, objectives, and so forth [OPTIONAL].
3. Expectations of other important audiences, especially key stakeholders who might be expected to act in light of Foresight's findings.
4. Discussion of panel composition and balance. Full presentation by each panel member and project management team of her/his background as it relates to the study.
5. Initial immersion in the subject matter of the Foresight study, often through briefings by sponsors and others on subjects of major importance to the study and/or through brainstorming amongst panel members.
6. Discussion among the panel and project management team of the study approach and plan, resulting in an agreed-upon approach and plan.

Some further time will need to be spent on fuller introductions, where panel members spend a few minutes setting out their interests and experiences in more detail. At this point, panel members may decide that there is a need to appoint additional members to cover anticipated knowledge gaps. Generally speaking, this should not be encouraged – eliciting views of the necessary experts can usually fill knowledge gaps without the disruption of introducing new panel members. However, if it is deemed necessary, then new members will need to be appointed by the time of the second meeting.

All of these procedural tasks are likely to take up 2-3 hours of a whole day meeting. But it will also be important to get panel members to start to think about the issues they will need to consider in their work. This can be done through presentations and panel brainstorming sessions. Whilst the process and content of sessions will depend on the remit of the panel, likely outcomes of panel discussions will probably include formulation of preliminary questions and issues for further discussion. Issues surrounding data access and the panel's research needs may also begin to emerge at this early stage.

Finally, 2-3 hours will need to be set aside to formulate the overall approach to the task. In many technology Foresight exercises, panels are given quite tight terms of reference that clearly specify the methods to be used and the types of outputs to be produced by certain fixed dates. In other instances, panels have a greater degree of freedom in how they go about their work and in what they produce, although even here, milestones are likely to be set. The sorts of things that will need to be discussed and decided upon include:

- Working practices and panel structure – for example, will the panel work as a whole or through sub-groups? Will particular panel members be assigned to lead on specific areas?
- What methods will be used? What are the data and research requirements in using these methods? How will data be collected and analysed? Who will conduct research

(project team, consultants, panel members, &c.)? What wider consultation will be carried out? What facilitation will be required for specialist methodology? Panels will need experienced Foresight practitioner help to be able to answer these questions effectively.

- What will be the schedule of panel meetings? This includes the total number of meetings and their frequency. These can vary widely between panels, even within the same technology Foresight exercise. The panel (or project team) may also decide to prescribe the topic for each meeting – for example, ‘meeting no.3’ might be scheduled to deal with SWOT analysis or the like.
- What will be the schedule of panel outputs, including the final report? In order to track and monitor progress, an agreed-upon milestone chart will need to be formulated (if not already specified a priori in the terms of reference).

## **6. Conducting Foresight work**

The purpose for and manner in which technology Foresight can be undertaken is rather variable, as is the role of expert and/or stakeholder panels in such exercises. It is therefore difficult to be precise on panel methodology in this section. In some cases, panels are the main process centres (‘hubs’) of a technology Foresight exercise, gathering and analysing data and community opinions, employing a wide variety of Foresight methods, such as scenarios, and formulating priorities and recommendations for action. In other cases, they are given very specific tasks within a much wider process, for example, commenting upon weak signals picked up in environmental scanning or formulating Delphi topic statements. However, some general principles are worth highlighting or even reiterating.

First amongst these is the challenge of getting panels to think creatively about (a) the future, and (b) the means of getting there. People seem to find this difficult, partly due to the unfamiliarity of thinking in this way – our faster worlds tend to dictate short-termism and a reactive positioning to unfolding events. It is therefore imperative to ensure that panels take sufficient account of (a) the long-term (short-termism is a common weakness in panels and workshops) and (b) a wide variety of perspectives on any given topic.

Creativity courses and handbooks, as well as tips from several creativity Internet sites, can help project managers to encourage out-of-the-box thinking within panels. Inspirational or even controversial speakers can be brought into some meetings to stir things up. Provocative ‘think-pieces’ (e.g. essays) can also be prepared for panels to read. Some of the major Foresight methods, borrowed from the worlds of forecasting and futures studies, are also useful in encouraging creativity. A number of these methods are described in other chapters of this volume so will not be covered here. But popular approaches in expert panels include brainstorming and scenario-writing. A panel composed of members from diverse backgrounds should also help, particularly for encouraging consideration of different perspectives. As a general rule, panel members are expected to behave as individuals rather than advocates of the ‘corporate’ views held by their particular organisation.

At the same time, panels should not stray into the realms of wishful thinking – their analyses and recommendations need to be based upon sound data of the past and present, as well projections of those trends that can be projected with reasonable confidence of accuracy, e.g. demographic change. SWOT analyses, reviews, and trend analyses are therefore commonly used. Much of this information can usually be readily found if one knows where to look. However, some further research and data analysis is usually required, which can be carried out by members of the project team, external consultants, or even panel members. But careful considerations need to be given to the commitment required from panel members to deal with such data. Foresight panels are usually composed of volunteers who tend to be extremely busy people with little time for collecting and analysing data. Much of this work will need to be out-sourced to project managers and/or technical consultants, with analyses written-up in attractive formats for panel members to easily digest.

A further general principle that should be highlighted is the necessity and benefits of wide consultation. The temptation might be for panels to settle for internal discussion – things tend to get done more quickly, and greater control over the scope and direction of deliberations is possible. But panels that talk only amongst themselves risk missing important information and perspectives, even when members come from diverse backgrounds. Moreover, consultation lends a panel visibility, which can be important if findings are to be effectively disseminated. And stakeholder commitment to a panel's results, garnered through direct involvement, should not be underestimated. Of course, consultation should not be done for its own sake – it should have a clear purpose in the overall methodological approach used by a panel. Neither should it be confined just to those communities served by the panel. A Foresight exercise should provide space for interactions with other communities, most obviously through developing linkages between the various panels set up within a Foresight exercise. In general, consultation can be conducted through a wide array of mechanisms, including workshops, questionnaire surveys, expert hearings, Delphi, consultation documents, Internet mail groups, &c.

We have already mentioned that panels can carry out their work through various organisational configurations, and a popular approach makes use of sub-groups within panels. These might focus upon a particular topic or task, with their small size (typically 2-5 members) allowing for more concentrated effort through the assignment of specific roles to individual panel members. However, to reiterate an earlier point, consideration will need to be given to the time requirements of such work, since panel members tend to be busy people.

The overall governance of volunteer panels is relatively straightforward when tightly specified terms of reference are provided. Panels meet a fixed number of times within a well-defined framework to carry out a particular task. But many panels in technology Foresight exercises are given wider remits whereby they have the freedom and relative autonomy to decide on their own approach and the substance of their reports. In these instances, the role of the chair and her/his relationship with the project manager are crucial. For instance, prior to all panel meetings, the chair should discuss the meeting agenda and any documents or analyses to be presented with the project management team. It is important that the chair and project manager come to an understanding on all meeting items

so that they can be mutually supportive in the panel meeting. This is not to say that the chair should stifle debate – on the contrary, the chair should encourage expression and discussion of diverse viewpoints. Fairness and flexibility should be employed toward the goal of achieving a group consensus view where possible. But panels work within budget and time constraints and the chair must ensure that the panel effectively meets its remit within these constraints.

Increasingly important considerations for panels and other public committees are accountability and transparency. In this regard, the substance of discussions within closed panel meetings may be publicly reported, although the norm is to keep these confidential. In this way, panel members have the relative freedom to express opinions without having to publicly account for them. Meetings should be transcribed and minutes prepared – the latter could be made publicly available on a web site if personal opinions are sufficiently anonymised. Panel members should also respect this confidentiality and should not brief the media or other groups without the expressed permission of project managers and/or the panel chair. Indeed, relations with the media should be carefully managed and an information dissemination strategy developed. The panel chair should act as the official spokesperson for the panel and its reports in dealing with the media, sponsors, and audiences.

Project managers should publish brief progress reports at regular intervals – perhaps every 4-6 months, depending upon the duration of an exercise – whilst analyses prepared for or by the panels, e.g. SWOT analyses, literature reviews, &c. could also be made publicly available. In this way, the evidence base (and assumptions) upon which a panel is working can be scrutinised. Such reporting may also be used as an opportunity to consult with wider communities of actors. Thus, in many technology Foresight exercises, interim reports containing preliminary analyses and findings are published and feedback invited.

## **7. Reaching consensus and identifying priorities**

One of the chief aims of appointing panels in technology Foresight is to nurture deliberation amongst a group of recognised experts and/or stakeholders around a set of issues with a view to generating enlightenment and policy advice. Analyses and discursive debates, whether within a panel or across a wider community, are good at generating enlightenment. But policy advice is usually requested in ‘neater packages’ than this, for example, as priorities and recommendations. These clearly set out what needs to be done and why, and in the case of recommendations, suggest who should take action.

In some technology Foresight exercises, panels may not be required to reach consensus or to identify priorities, let alone outline recommendations for policy and investment. Their tasks might be confined to analysis and comment (although it should be acknowledged that the focus and framing of such activities implies agreement on certain choices and assumptions somewhere down the line). But where priorities are requested, these should be determined in a transparent and systematic manner if they are to be credible. For a panel to arrive at priorities, it must reach some level of consensus and closure. This is usually achieved through the power of analysis and panel debate. If serious disagreements between

panel members remain, these should be highlighted rather than obfuscated. Where panels must prioritise large lists of topics, for example, in critical technology exercises, voting procedures are commonly used. Voting is nowadays done online, as in the Czech Technology Foresight Programme (2001), and can in theory be opened up to invited individuals from outside the panel.

It is one thing to identify priority areas but quite another to formulate recommendations for action. Recommendations set out actions that need to be taken in light of the priorities identified by a panel and tend to be directed at named organisations. This means that they are highly political in nature. For this reason, many technology Foresight exercises chose either not to make any recommendations at all or they at least clearly separate panel analysis and priority-setting activities from the task of setting recommendations. In such situations, panels do not get involved in formulating recommendations. If recommendations are to be set, special forums of stakeholders are organised to consider the implications of panels' analyses and priorities.

There are technology Foresight exercises where panels do make policy and investment recommendations. There are, however, risks with this approach, since the potential for upsetting organisations is great. To minimise such risks, a panel might first consult named actors in order to gauge their response to being highlighted in a panel recommendation. There is then always the danger that panels find themselves engaged in political negotiations, acting almost as lobbyists for policy change. This situation can be somewhat avoided if a panel opts instead to list the various policy options that are available to decision makers and then, without endorsing a single choice, identify and explain the policy implications of each option. In this way, panel reports remain explicitly politically relevant but also relatively 'neutral'.

## **8. Reporting on the Panel process and findings**

Panels will need to report on their findings, both at the end of their work and in interim. The main rationale for reporting is to disseminate analyses and findings and to present priorities and recommendations for further action. Reports should therefore be tailored to their intended audiences. Reports are also used to demonstrate that panels conducted their work with integrity, drawing upon the best available evidence to support their findings.

Report preparation should be given early and careful attention and not just left to the end of a panel's tenure. It is advisable to define the report architecture early on, no matter how tentatively, and to refine this later on. This tends to be easier to do when panels are given very specific tasks, but can be more difficult when panels have greater scope and freedom. Annex B shows the final report template given to sector panels in the first UK Foresight Programme (1994). This was distributed to panels somewhat later than it should have been (about six months after panel work had started and only two months before draft reports had to be delivered to the sponsor). It indicates the need to include:

- An Executive Summary

- Background material – a description of the topic area being covered, and an account of the panel’s approach to its task
- Foundations – benchmarking data on the relative strengths and weaknesses of the topic area, and a review of trends and assumptions on where the topic area is likely to be heading in the next 10-15 years
- Topics – an account of the topics deliberated on by the panel, a description of barriers and opportunities, and the presentation of a set of well-founded priorities
- Recommendations – outline of practical steps to be taken in response to priorities
- Summary conclusions that reflect upon the Foresight exercise and its future

Panel members can take responsibility for writing the final report themselves, but it is more usual for the panel secretary (who will be part of the project management team) to lead on this and to consult panel members in the process. More often than not, the panel chair plays a pivotal role in report drafting. The Royal Society of Canada, in its manual on expert panels, makes the following observation in this regard:

“The chair should review all drafts of the report and ensure that the report as a whole is consistent, well reasoned, and coherent. The chair's intellectual leadership should be exercised through analysis, constructive criticism of the contributions of others, and recommendations for improvement, rather than by overruling objections or seizing control over the report's message. Whether the chair should take responsibility for initial drafts of major sections or stay with the role of assessing, revising, and integrating drafts prepared by others will depend on several project-specific factors. Tying up the chair’s time as initial drafter may diminish her or his ability to act as architect and integrator of the entire report. On the other hand, if a chair brings special expertise to the panel, she or he may be the best choice for initial writer on those topics.”

The project management team might also decide to assign a technical writer to draft the report, not only to ensure one consistent style but also to present the panels findings in as an attractive way as possible. Before being published, panel reports should be peer reviewed to check for (i) factual or analytical errors, (ii) coherence in analysis that shows convincingly how priorities and recommendations were arrived at, and (iii) overall readability and visual appearance of the report. The criteria used by reviewers to assess the panel reports in the first UK Foresight Programme are shown in the box below. Draft reports are also normally sent to the sponsor for review.

**Criteria for assessing UK Foresight panel reports (1995)**

**Sectoral Context:** Does the report explain the significance of the sector to the UK (and global?) economy? Is its relationship to other sectors in the economy clear?

**The Story:** Is there a coherent account of how the Panel approached its task and developed its vision(s) of the future? Has an adequate range of social, technological, economic, environmental and political factors been assessed?

**Prioritisation:** Have the priorities criteria (economic and social benefits, technological opportunities, industrial capability and science base strengths) been (a) adequately considered, and (b) sensibly applied in deriving priority recommendations?

**Recommendations:**

- (1) Do the recommendations flow naturally from the priorities?
- (2) Are there clear and actionable messages to funding and policy customers, i.e. Research Councils, Higher Education Funding Councils, Other Government Departments, EC Framework Programme managers, the private sector, charities, &c.?
- (3) Are the recommendations on a reasonable scale and is there a sense of a timetable embedded in the report (urgent actions, medium term rolling programme, independent initiatives over the long term)?

**Network Futures:** Does the report have a clear vision of how the sectoral networks will function in the future?

**Supporting Material:** Is there adequate supplementary material annexed (or provision for companion papers)?

## **9. Dissemination of Panel findings**

All too often, consideration of a dissemination strategy for a panel's findings is left to near the end of a Foresight exercise. This is not advisable – dissemination and implementation should be considered from the outset and the panel's approach designed with this in mind. Dissemination should also be budgeted for, both in terms of time and costs, particularly as it is likely to involve at least some panel members (especially the panel chair) in further activities. As the sponsor is likely to play a significant role in dissemination activity, the panel chair should consult them on their strategy for diffusing the messages contained within the panel report. In instances where panels have been assembled to carry out a specific task as part of a wider process, there may not be a panel report produced that is suited for wide dissemination. Instead, the sponsor alone may take full responsibility for disseminating the findings of the whole exercise later on.

On their publication, panel reports are typically announced in a press release. The panel chair normally promotes the report and addresses any questions or queries on substance, at least in the first instance. After some time, the sponsor may become the chief spokesperson for the panel's findings. Report summaries may be produced that are targeted at the media and/or high-level decision makers who may not have the time to read the whole report. Every panel report has its own audience depending on the topic area being covered and the recommendations made (if any). The panel report should be interesting to its audience and clear on the message it wants to convey. But this may not be enough in itself, and it is quite common for panel reports to be formally presented at meetings and conferences and for recommendations and implications to be discussed and debated at workshops. Panels may even be retained after their reports have been published in order to promote dissemination of their findings and implementation of their recommendations. This is, however, quite rare, with the UK Foresight Programmes being the notable example.

## **10. Summary conclusions**

This chapter has sought to explicate some of the issues surrounding the use of expert and stakeholder panels in technology Foresight. Implicitly, it has mostly focused upon using traditional expert panels and has not sought to discuss the peculiarities associated with panel variations, such as web-based forums, learning circles, citizen juries and the like. Specifically, the chapter has dealt with the rationales for using panels, arguing that they have key advantages over other approaches such as interviews and questionnaire surveys. It has set out procedures for assembling panel members and for organising the first panel meeting. It has also provided advice on how to get panels thinking ‘out-of-the-box’ and has recommended an evidence-based approach complemented by consultation with the wider community. The pros and cons of identifying priorities and recommendations for action have also been discussed, as have procedures for reporting and disseminating a panel’s findings. Whilst the chapter has been unable to address all issues associated with the use of expert panels in technology Foresight, it does provide the prospective project manager and panel member with useful pointers for getting started.



## **Annex A: Terms of reference for sector panels in the first UK Technology Foresight Programme (Issued to panels by the exercise sponsor, the Office of Science and Technology, in April 1994)**

### **Background**

1. On 28 February 1994 the Chancellor of the Duchy of Lancaster [the science minister] announced the 15 sector panels which will carry forward the main work of the Technology Foresight Programme. The Programme has three phases. These are:-
  - (a) initial foresight work (April – August 1994);
  - (b) wider consultation about the results of this initial work (September – December 1994); and
  - (c) in the light of (a) and (b) an assessment of priorities within and between sectors, taking account of relative strengths and weaknesses in the UK industrial and science and engineering base (benchmarking) (January – March 1995).
2. The purpose of this note is:-
  - (a) to make clear what work sector panels need to undertake and on what timescale; and
  - (b) to clarify how the work of panels fits into the Programme as a whole, including in particular their relations with the Chief Scientific Adviser, Office of Science and Technology (OST), and the Technology Foresight Steering Group.

### **PHASE 1: INITIAL FORESIGHT WORK (APRIL – AUGUST 1994)**

3. Each panel will wish to start considering at the outset of its work:-
  - (a) how best to access and make use of work already undertaken in its sector (e.g. databases on markets and technologies, other relevant foresight work); including work of the research councils and professional bodies in its area;
  - (b) key economic and social trends likely to affect market developments in its sector over the next 10 to 20 years;
  - (c) what new products, processes and services might emerge over the next 10-20 years;
  - (d) what developments in science and technology will be needed to enable the UK to remain at the forefront of technological innovation in its area; and
  - (e) technological possibilities within the sector.
4. Each panel should prepare a brief progress report to the OST and the Steering Group on the work above by the end of May 1994. The Steering Group and the OST will liaise with the panels on how best to take forward work during the remainder of phase one.
5. The aim of this first phase is for each sector panel to produce by the end of August 1994 a preliminary report about possible market and technological developments in its sector over the next 10-20 years. This report will be submitted to the Steering Group and the OST. Once the Steering Group and the OST have commented, these reports will then serve as the basis for the formal consultation which each panel will undertake in Phase 2 of the Programme (September – December 1994).

### **Working Methods of the Panel during Phase 1**

6. It will be for each panel to decide how it carries out the tasks above and it will be given flexibility, under the chairman, on how it takes the process forward. In some cases, much work will have been done

already. In others, the panels will be starting more or less from scratch. Each panel might wish to consult a sample (say 30-50 representation) of the wider pool of experts (i.e. experts in that sector not selected for panel membership), relevant trade associations, professional institutions, Government Departments and Research Councils, Research and Technology Organisations OST and networks identified during the co-nomination process.

7. Panels may wish to establish working groups on specific tasks or commission studies on particular issues. Each panel will wish to establish arrangements to exchange views with panels in related or overlapping sectors.
8. To aid discussion across panels, panels may wish to follow similar formats when drawing up questions and issues to be addressed during the consultative phase of the Programme. A template survey form will have been introduced to chairmen and panel members during March/April. Panels can then adapt this template to the individual circumstances of their sectors.

#### **PHASE TWO: WIDER CONSULTATION PHASE (SEPTEMBER TO DECEMBER 1994)**

9. In the light of comments by the Steering Group and the OST, each panel should submit its preliminary report to wider consultation through the Delphi process and regional workshops. Using the Delphi process, which the OST will manage on behalf of the panels, the findings of the preliminary report will be put to experts from all the sector panels to make sure that all cross-sectoral aspects are properly considered. Sector panels will undertake consultation through the regional workshops.
10. This wider consultation should be undertaken on the following timetable:-
  - (a) each panel receives initial responses from consultees in the Delphi process by the end of September;
  - (b) each panel should complete their series of regional workshops by the end of October;
  - (c) each panel should have received the second round of responses from consultees in the Delphi process by the end of October; and
  - (d) each panel should summarise the results of this wider consultation phase and submit a report to the Chairman of the Steering Group by the end of 1994.

#### **PHASE THREE: ASSESSMENT OF PRIORITIES (JANUARY TO MARCH 1995)**

11. In the light of comments from the Steering Group and the OST on the report submitted by the panel during December, each panel should deliver to the chairman of the Steering Group by the end-January 1995 a final report covering:
  - (a) the factors it considers important in future markets, including some assessment of their relative importance;
  - (b) an assessment of the most promising opportunities for matching new technological advances to future markets; and
  - (c) the panel's perceptions of the strengths and weaknesses of the UK industrial, scientific and technological base as identified during Phase 2 and as identified in the benchmarking work of the OST's foresight team.

#### **HOW THE WORK OF THE PANELS FITS INTO THE FORESIGHT PROGRAMME AS A WHOLE**

12. Chairmen and members of sector panels are appointed by the Chief Scientific Adviser and Head of the OST, taking account of advice from the Technology Foresight Steering Group, the results of the co-nomination process, and other representations.
13. The main point of contact between each panel and the OST on day-to-day matters will be the Technical Secretary (see paragraph 16 (i) below). In addition, the OST central foresight team will keep on touch with the chairman of each panel.

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– Principles and Practice / Michael Keenan

14. Each panel has assigned to it one or more members of the Foresight Steering Group who will serve as assessors and who will act as a point of contact between the sector panel and the Steering Group. Relevant Government departments will also have an observer on each panel.
15. When panel reports are at the draft stage, the OST central foresight team will arrange for them to be circulated to other panels, to Steering Group members, and to relevant Government Departments. Final reports should be delivered to Professor W D P Stewart as Head of the OST and Chairman of the Steering Group.

**Resources Available to Panels**

16. Panels will have a Chairman AND Vice-Chairman, and:
  - (i) A Technical secretary who will provide executive support to the work of the panel (for example the panels' meetings, drafting and circulating papers, taking forward action outside meetings in consultation with the Chairman;
  - (ii) A facilitator, hired by the OST on a consultancy basis, with some knowledge of the particular sector. The facilitator will be available to panels to provide advice on Foresight methods appropriate to work in their sector during Phase 1 of the programme;
  - (iii) One or more Assessors from the Steering Group.
17. Additionally, the OST will provide each panel with information about Foresight work which has been carried out previously in its sectoral area, if any. The OST will also make available to each panel a small budget (£10,000 approximately) to enable the panel to commission consultancy assistance.

The OST will stage a series of Foresight Information Days during March and April to give panel members a working knowledge of how their work will fit into the Foresight Programme as a whole and to provide suggestions on how panels might wish to organise their work.

## **Annex B: Framework for final reports from Technology Foresight sector panels (OST, October 1994)**

### **Guidance on Length and Style**

- Executive Summary: [1 page]
- Main Text: 25-30 pages (preferably 25 pages).
- Minimal technical jargon.
- Appendices and Annexes no restriction on length or style.
- Descriptive Summary (published separately for wide distribution): 3-4 pages.

### **Structure of Final Report**

#### **1. Executive Summary.**

#### **2. Introduction.**

##### *2.1 Description of the Sector and its Characteristics*

Including, for example, size, traditional relationships with the science base and Government, potential for creating wealth and improving the quality of life, user or supplier of technology, part of the technological or commercial infrastructure, &c.

##### *2.2 The Panel and its Programme of Work*

Including, for example, working techniques, consultation methods (including Delphi questionnaires, regional workshops and written submissions), relations with other sectors, drawing other expertise into the programme, &c.

#### **3. Foundations.**

##### *3.1 Benchmarking.*

For example, describing the relative size and strength of different parts of the sector. Describing the strengths and weaknesses of the sector relative to other sectors in the UK.

Describing the strengths and weaknesses of the sector in the UK to similar sectors in other countries.

This section may be supplemented by an appendix.

##### *3.2 Scenarios.*

Working assumptions, scenarios and predictions about the future and how they underpin and inform the recommendations. Also cover major driving forces which shape the future.

This section may be supplemented by an appendix.

#### **4. Topics.**

##### *4.1 Priority market, technology or product opportunities.*

Identify and describe the priority opportunities, relating them to benchmarking and scenarios where possible.

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4.2 *Priority setting*

The approach and criteria used.

4.3 *Barriers to progress.*

Identify and describe threats and barriers to progress which might stand in the way of the opportunities already identified. This might include areas of current activity which could be scaled down to make way for new initiatives.

4.4 *Key priorities.*

A small number [say 6] of priority opportunities or barriers to progress which reserve particular attention because of their high level of impact.

**5. Recommendations for Implementation.**

5.1 *Practical steps which should be taken in response to the priorities and key priorities already identified.*

This might include, for example, a description of the administrative framework which could be used to take forward a recommendation.

5.2 *Key recommendations.*

5.3 *The Future of Technology Foresight in the XYZ Sector.*

**6. Conclusions.**

Brief observations about the Technology Foresight Programme, the priorities and recommendations.

**References, list of appendices and list of separate publications.**

# SCENARIO BUILDING\*

*Ian MILES*

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## ABSTRACT

The term "scenario" is used to cover a wide range of different activities, even within Foresight programmes. Scenarios may be used as **inputs** to kick-start discussion and idea generation in panels, as **tools** for working groups to marshal their arguments and test the robustness of policies, as **presentational** devices that can communicate Foresight results to wider publics. They may be used more as an element of the Foresight **process**, with their major contributions involving the exchange of visions and thus the deepening of linkages in networks, or as **products** of the activity that can be circulated to broad audiences. They may be **exploratory** focusing on what might happen under various circumstances, or **aspirational** asking how specific futures can be achieved (or avoided). And the ways of producing scenarios vary immensely - from the outputs of simulation models, through the work of small expert teams, to the undertakings of workshops and the delineation of different views in even wider samples of expertise.

This paper explicates some of these issues, and examines some examples of how scenarios have been used in (technology) Foresight. It will indicate the methods used in main approaches, and then focus more specifically on the approaches used in scenario workshops. A comparison between two main types of workshop will be undertaken (one more exploratory, one more aspirational), and the sorts of technique used to mobilise participants and structure inputs and outputs. Finally, lessons will be drawn as to the application of scenarios within Foresight exercises. What sorts of scenario approach might be used effectively in different contexts, and what sorts of planning, capability, and resources could be required? What are the pitfalls and problems, as well as the advantages and utility, of these approaches?

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\* *Prepared by Ian Miles*

## INTRODUCTION: SCENARIOS

### Definitions

The term “scenario” has many uses. In this paper we use the term in the sense of a *vision of future possibilities* – and particularly, a vision or set of visions (a) that has been derived and presented in a fairly systematic way and (b) that strives for some holistic sense of the circumstances in question. Thus we do not use the term to refer to some wish-list of what might be in store; nor to refer to quite restricted visions (e.g. the effects of running a narrow econometric model with assumptions of 2% as opposed to 5% growth rates). The “holistic” element implies that we go beyond simply profiling the future in terms of one or two key variables, to present a more fleshed out picture, linking many details together. Typically these will mix quantifiable and non-quantifiable components. They may be presented in discursive, narrative ways (illustrated with vignettes, snippets of fiction and imitation newspaper stories, etc.) or tabulated in the form of tables, graphics, and similar systematic frameworks.

Such scenarios have been used widely in futures studies from the 1960s on (e.g. in the work of Herman Kahn, Michel Godet, Peter Schwartz, etc.)<sup>1</sup> The methods used in scenario generation vary, the static or dynamic emphases of the scenario receive more attention, the uses and styles of presentation vary considerably. Here we shall examine some of the main varieties of scenario in use in Foresight work today.

### Histories and Images

An important distinction may be drawn between scenario visions that are more or less dynamic or static. The former concern events or trend developments (“future histories”), whereas the latter are more focused on a point in future time (“images of the future”). We can find whole books, for example, that present a view of a future without a great deal of explication of how we got from here to there. Sometimes there is a future history, but it has unrealistic elements. For instance, Gerard O'Neill's 2081 describes a visionary and highly-detailed picture of a future with space colonization, in which numerous technological elements worked perfectly together – with practically no hint of the failures, errors, disasters that almost inevitably dog any large-scale human enterprise. Even at the time of publication this seemed overdone – with the subsequent catastrophes that have befallen manned space flight, and other large technological enterprises like nuclear power, it looks almost like hubris. It is rarer to find studies that emphasise the history without spelling out the type of future that might be arrived at, but cases in point may be Freeman and Jahoda's 1978 study, World Futures: The Great Debate and its successor, Cole and Miles' Worlds Apart (1985). These start with a set of alternative futures (some more desirable, some less so) and examined the paths which might lead to them in some detail.

### Normative/Exploratory and Inward/Outward Bound Scenarios

A long-established distinction in futures and forecasting studies is between more or less “exploratory” and “normative” approaches. The former methods essentially involve starting from the present and posing “what if” questions: What if the growth rate is  $x\%$  or  $y\%$ ? What if events W or Z happen? What if we pursue one or other strategy?

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<sup>1</sup> Ringland (1998) gives a brief history of the approach, rooting it especially in developments in the Second World War.

In contrast, the latter methods can be seen as starting from a point in the future, and asking "how" questions: What would it have taken to have reached a future where the parameter of interest is x% greater than its current value? What would have led us to situation Y? .

Because all scenarios are full of normative content - including the choice of "what if" and "trend rate" variables - I prefer to term these two orientations "outward-bound" and "inner-directed", respectively. It is unlikely that decades of usage will be shifted overnight, however.

Both orientations can be used in scenario analyses. Often we see a combination of methods used in practice. Sometimes a set of "inner-directed" scenarios is used more as a thinking tool than in order to identify desirable development paths and their prerequisites, for example. Thus the scenario approach often taken by the Institute for Alternative Futures (IAF) involves working with a small number of "archetypal" scenarios. A scenario that is very much a matter of received wisdom about what is likely to happen ("best guess") is contrasted with a scenario where there are difficulties and problems for the organisation or area under investigation, and a pair of scenarios representing more positive courses of development – one framed very much within existing strategies and trajectories, one based on rather more radical patterns of change ("paradigm shift"). Material on the central topic are prepared in the framework of such scenarios, and used in a workshop setting in which participants discuss the range of options implied by the scenarios, and the implications for action that follow from these.

In recent UK work, we have run workshops that use are both focused on multiple scenario development and on more inner-directed approaches ("success scenarios"). The common aim is to formulate priorities, targets and indicators. But each type of workshop has been preceded by some development of multiple scenarios. In some workshops we have elaborated these as the major device for exploring the issues, as will be described below. In others, we concentrate in the workshop more on developing an aspirational scenario based on workshop participants' views of the developments that are feasible and desirable, given the range of possibilities explicated in the previous work.

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## **SINGLE OR MULTIPLE SCENARIOS?**

### *Singular Visions*

Some scenario studies are focused on a single vision of the future. Such a singular scenario can be useful as a means of:

- illustrating and communicating features of forecasts and future-relevant analyses,
- providing a framework in terms of which views of different aspects of future developments can be integrated and their consistency or otherwise examined.
- structuring and guiding discussion so that visions, elements of visions, and the assumptions that underpin such visions, can be explicated and elaborated.

Scenario workshop methods are particularly relevant to this latter objective. The process of dialogue can be used to generate organisation-relevant scenarios (products



that can be used later and communicated to others), and also to support a creative exchange of views and information among workshop members. The scenario workshop process can yield benefits to participants in terms of improved understanding and networking, as well as providing products such as reports and priorities.

But most authors discussing scenario analysis recommend the use of multiple scenarios. The future is uncertain, and analysis of just one scenario does little to communicate much about the range of opportunities and challenges liable to confront us. Often scenario analysis is identified with **multiple scenario analysis**, and the use of several alternatives is held up as offering opportunities to:

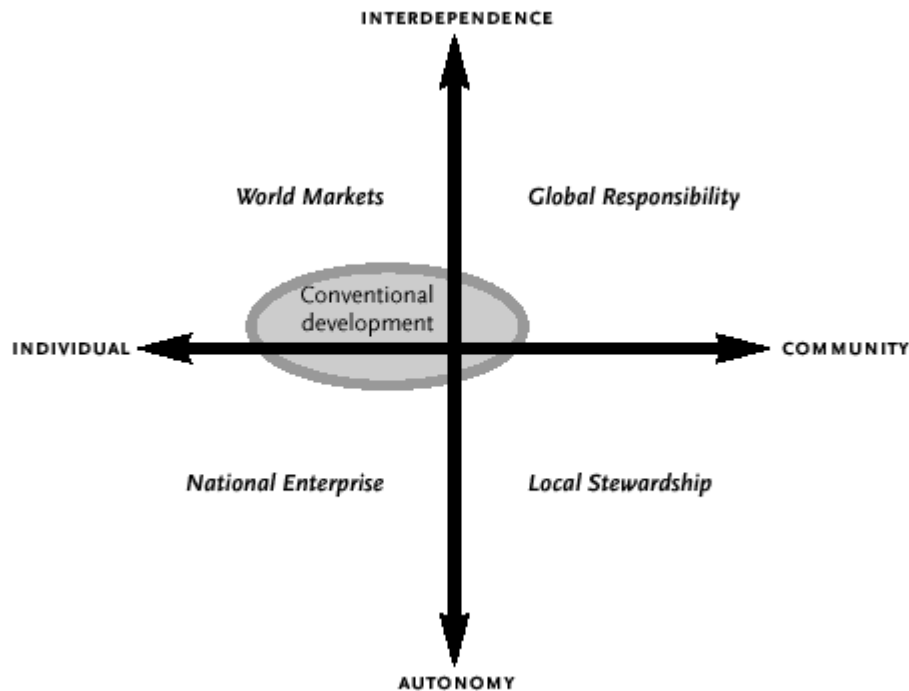
- Challenge received wisdom by demonstrating the plausibility of several diverse futures.
- Give more sense of how different trends and countertrends might unfold and interact, what the implications would be of variations from the standard account of these developments.
- Allow for some test of the robustness of policy and strategy conclusions across different paths of development, and possibly yield some guidance as to signals that we are on one or other path.
- Introduce substantially different "worldviews" concerning what drivers of change are and how they are related together, and allow for dialogue among proponents of different viewpoints as to the results of, or the requirements for, various events materialising.

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## UK FORESIGHT “ENVIRONMENTAL” SCENARIOS

There are many studies involving multiple scenarios. Perhaps the best-known scenario analysis in the UK Foresight programme is one designed initially to be able to deal with environmental issues, though it has been used in a much wider range of contexts. The discussion below draws on a summary of this work by Berkhout and Hentín (2002), which is also interesting in that it talks of some of these uses.

This study elaborated scenarios on the basis of two dimensions, concerning social and political **values** and the nature of **governance** (see the [Figure 1](#) below). The ‘values’ dimension reflects underlying principles driving the choices made by consumers and policy-makers. At the ‘individual’ end of the spectrum private consumption and personal freedom dominate. Governance is mainly limited to regulating markets and securing law and order. At the ‘community’ end of the spectrum, more concern for the common good, the future, equity and participation is the norm. Civil society is strong and resources are allocated through more heavily regulated markets. The ‘governance’ dimension captures structures of political and economic power. At the ‘interdependence’ end of the spectrum power to govern is distributed away from the national state level. The ‘autonomy’ end of the spectrum retains high levels of economic and political power at national (*National Enterprise*) and regional (*Local Stewardship*) levels.

**Box 1: UK Foresight "Environment" Scenarios**

Brief histories of the future (called "storylines" in this study) and a fairly elaborate tabular comparison of the four cells formed by these two dimensions are developed. Berkhout and Henttin summarise a wide range of studies and policy activities in which these scenarios were used, and the present author can testify to their continuing resonance within such UK policy bodies as the Environment Agency. They also seem to have had some impact on scenarios developed in later projects. For instance the scenarios developed in workshops by the FUTMAN project in 2002<sup>2</sup> have considerable similarity to the ones described above.

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**SCENARIOS IN FORESIGHT**

Scenario analysis is a well-known method in futures studies in general - but has been far less prominent in Foresight work. Consider the UK experience. In the first cycle of activity, individual panels were circulated with a stimulating scenario essay by Oliver Sparrow<sup>3</sup> - but this was barely used, since it came out of the blue and did not seem particularly relevant to many of those to whom it was provided. Each panel was requested to develop alternative scenarios for its sphere of analysis, but this task was more or less submerged by the mass of other duties given the panels, and very cursory results were obtained. The question of scenarios was raised intermittently, however. For example, when discussing the Delphi results obtained in my panel (Transport), one

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<sup>2</sup> See [http://europa.eu.int/comm/research/industrial\\_technologies/27-03-03\\_futman\\_en.html](http://europa.eu.int/comm/research/industrial_technologies/27-03-03_futman_en.html)

<sup>3</sup> He had been a scenario planner for Shell, whose experience in this field is legendary (see for instance, Mendonca, 2001). For Sparrow's current activities see the Challenge Forum, <http://www.chforum.org/ohgs.html>

commentator pointed out that the pattern of answers suggested that quite distinct scenarios were implicitly being used to guide the responses of different respondents. (In principle survey data can be analysed to yield different scenarios based on viewpoints articulated by different respondents, but this was not pursued here.)

Scenario workshop methods were promoted to business users of Foresight in documentation produced for the national programme. A quite useful guidebook on conducting such a workshop was produced for consultants and industry associations. The suspicion is, however, that this was more the result of contracting out the work of preparing a small business Foresight guide to a contractor whose expertise lay in scenario methods, than in a clear strategic decision.

As we have seen, the second round of UK Foresight invested substantial resources into developing, and displaying on its website and video resources, a set of alternative future scenarios. The "environmental" scenarios are still featured on <http://www.foresight.gov.uk> as all-purpose scenarios, and have been used surprisingly widely. The social scenario study was also widely circulated, and probably proved highly satisfactory to those industrial participants who wanted Foresight to tell them about future consumer markets. But we see little systematic development of scenario approaches in the UK programme.

This does not seem to be an inherent feature of Foresight exercises, but probably has more to do with the origins of the approach out of Japanese national programmes. Whereas the current Japanese effort is intended to develop multiple scenarios, this has not previously been the case - the emphasis has been more on building consensus in industrial-scientific networks around a vision of the future. Irvine and Martin's *Foresight in Science* (1984, London: Pinter) described a range of approaches to bringing long-term perspectives into research policymaking, putting much weight on the Japanese experience. Such approaches were widely applied to improving national government decision-making (especially in the area of S&T) from the mid-1990s on. Foresight involves thinking about emerging opportunities and challenges, trends and breaks in trends, and such factors – like familiar futures studies. Systematic methods are used to develop better insights and visions concerning future possibilities. But Foresight differed from the majority of traditional futures studies in two ways (as we have described in the second edition of the FOREN *Practical Guide to Regional Foresight*,<sup>4</sup> on which the following account draws.

1. Foresight is highly related to decision-making. It brings together key agents of change and sources of knowledge, in order to develop *anticipatory strategic intelligence*. Beyond the preparation of specific plans and lists of priorities, guiding strategic visions are elaborated. These can enable a shared sense of commitment (achieved, in part, through the networking processes described below), and should be more robust to changing circumstances than are particular plans or priorities. This strategic vision is not a utopia: it must combine feasibility and desirability, and to be explicitly related to present-day decisions and actions.

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<sup>4</sup> The first edition of the Guide is available from <http://www.forenc.jrc.es> and the second edition – available in various languages and country versions, is at <http://foretech.online.bg/docs/CGRF.pdf> See also M Keenan, I Miles, Jari Koi-Ova 2003, **Handbook of Knowledge Society Foresight**, European Foundation, Dublin, available at: <http://www.eurofound.eu.int/transversal/foresight.htm>

2. Foresight stresses eliciting wide participation. This may be purely a technocratic effort, in which central decision-makers are using methods such as consultations and Delphis to access knowledge that is located at a variety of locations in the society. It may be more of a democratic effort, seeking to involve a wider spectrum of the population in decision-making (or at least, in decision-influencing). And it may be oriented towards building more of a “Foresight culture”. Foresight is often explicitly intended to establish *networks* of knowledgeable agents, that possess improved anticipatory intelligence – and self-awareness or reflexivity, in the sense of enhanced awareness of the knowledge resources and strategic orientations of network members. Such networks should be able to respond better to emerging challenges; and one of the objectives of some Foresight programmes has been to establish improved networks among firms, policymakers, entrepreneurs, financiers and scientific and technical experts, with the aim of revitalising national innovation systems. Thus the application of interactive, participative methods of debate, analysis and study of such developments and needs, involving a wide variety of stakeholders (often going well beyond the narrow sets of experts employed in many traditional futures studies), does not just result in better reports and policies. It should also involve forging new social networks. Foresight programmes vary in their emphases here: some use networks merely to help develop their formal products (such as reports and lists of action points); others take network establishment to be an equally, or even more, important achievement in its own right.

The term “Foresight” is applied to all sorts of activities -, as is the fate of any popular term. Thus, we use the term “Fully-Fledged Foresight” to distinguish activities which combine (1) long-term orientations with (2) networking activities and (3) strong links to planning and decision-making.

Scenario methods – especially the well-known scenario workshop approaches – can be highly relevant to the networking goals of Foresight. The process of scenario construction in workshops can yield important benefits here, in terms of exchange of views about developments, strategies, and the like. However, the origins of Foresight have meant that such methods have been used relatively rarely and unsystematically. This is changing, with, for example, the heavy emphasis on scenarios in Norwegian work and several other recent or ongoing studies.<sup>5</sup> The interesting challenge is to reconcile the workshop-based development of scenarios with their wider use in a Foresight process in which numerous panels and issue groups will be active.

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<sup>5</sup> See, for instance, the CD-ROM produced as a result of the EC/EFTA workshop in June 2002: The Norway 2030 Seminar and Workshop on Foresight to Scenarios - Methodology and Models available from DG Research.

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## SCENARIO GENERATION - METHODS

Scenario may be developed by many different methods. They may emerge from workshops or be prepared by small expert groups, they can be derived from Delphi or from other survey results, they can be constructed on the basis of different worldviews (as in the Freeman and Jahoda 1978 study). Practically any forecasting or Foresight approach can be the occasion for a scenario generating exercise.

- Individuals presenting their informed speculations about the future (“genius forecasters”) can use scenarios as a template for illustrating and enlivening their accounts.
- Expert panels can establish a framework of scenarios on the basis, for example, of literature review or conceptual analysis.
- Survey results can be analysed to determine if there are different clusters of views about the future that can be considered representative of different scenarios.
- Cross-impact and similar methods can be used to identify the most probable of all of the scenarios logically possible from a combination of variables (again from expert judgements – or in the case of Monte Carlo simulations, for instance, from repeated runs of a probabilistic computer model).
- Workshops may be used to construct or elaborate on scenarios in a process of intra-group dialogue.
- Online methods are being explored, as are techniques using computers to support face-to-face (F2F) workshops.

The focus of the remainder of this paper is on scenario workshop methods. These methods are particularly relevant for Foresight in that:

- They allow for sustained analysis of alternative futures that are relevant to the key decisions that are confronted, and allow for the generation of reasonably articulate and consistent visions of these futures.
- They can be used as the trigger for such inputs to planning as identification of priorities, setting of objectives and targets, defining useful indicators of progress, etc.
- They network people together and allow for the integration of the knowledge that they possess; furthermore, by involving key actors in scenario generation, they can mean that decision-makers have deeper understanding of the underlying processes and key strategies, and a sense of identification with the choice and elaboration of the scenarios.

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## SCENARIO WORKSHOPS

Scenario workshops are frequently used to build or to elaborate on scenarios. The aim is usually not just to achieve a finished scenario as a product. There are also benefits from involving members of an organisation or community in futures exercises or more specifically in a Foresight process. Such workshops bring together a range of

knowledgeable and experienced participants, usually stakeholders of one kind or another, within a structured framework of activities.

This framework allows the participants to:

- exchange information, views and insights,
- identify points of agreement, disagreement and uncertainty
- create new shared understandings
- develop action plans and other instruments so as to help mobilise future activity.

Since the scenarios produced in such workshops are a product of the participants' own interactions, they are, in the management jargon, more likely to have "ownership" of them. To deconstruct this, they should:

- understand the logic much better than if presented the material in a standard report;
- have deeper insight into the considerations that have gone into the scenarios;
- be better-equipped to be "carriers" of the scenarios to the outside world.

The scenarios should also possess greater legitimacy than those produced by a smaller expert group or visionary guru, at least if the workshop has drawn upon a reasonable range of participants.

Scenarios may be generated from scratch in the workshops, or developed, in at least a rough form, in an earlier scenario generation activity. Some workshops use "off the shelf" scenarios prepared in other work (possibly even published ones) as a starting point for the workshop activity.

In scenario workshops we typically have periods of extensive exchange of ideas and debate about them, and periods where ideas are being written down and listed, where different lists are combined, and so on. The process usually involves much dialogue, and use of such instruments as whiteboards and flip charts, though computer-based ("groupware") tools are now beginning to be used effectively. Scenario workshops usually extend over at least one day, and may involve several dozen participants (with "break-out groups" of say 6 to 12 people exploring different scenarios in detail). The workshop will be conducted with inputs from at least one facilitator, and often other helpers will take notes, record material from flip charts, and deal with logistic issues as they arise. Typically such facilitators have acquired their skills through involvement in these and similar group activities; they may have received some training in workshop methods (from T-groups through management workshops to academic seminars), but to date there has been little analysis of the processes in terms of knowledge development, and the skills are typically the "task" and "emotional" skills of classic groupwork, but this is too many to work on a scenario in detail.

*Before the Workshop: Design and Background Material*

Before the scenario workshop is implemented, it has to be designed - in more than a rudimentary fashion. For example, an earlier **scenario design workshop**, drawing on a range of expert and interested parties, may be constituted to help:

- identify participants for the scenario workshop – it is vital to include the right range of knowledge and expertise, and as far as possible key end-users of the results.
- determine what background research might need to be conducted, or materials collated, to provide participants with some common informational resources.
- define the workshop procedures (what scenario methodology is to be deployed; what areas of study within the domain of interest should be selected, what specific questions might be used in the workshop.)

It is typical for a scenario workshop to begin with participants reviewing some background material that has been prepared especially for it, or more generally for a larger Foresight or futures exercise it is set within. This might be a SWOT analysis of the organisation's position in the area of concern. The SWOT or benchmarking input may involve comparing the region, country or organisation with relevant others in the various subdomains. The comparison should be able to identify trends and dynamics, and the systemic elements of the domain. It should be prepared in such a way as to indicate what informants and available literature suggest might be possible. Other inputs might include statistics of research related to this area; relevant Delphi material; results of computer simulations and econometric analyses.

Some scenario workshops are kicked off with a set of background scenarios or other forecasts prepared by an expert team. This can provide one way of presenting the results of background studies in an absorbable way: a small set of scenarios dealing with the development of the domain. This provides the workshop participants with a base against which to frame their own preferred scenario. They may proceed to elaborate these, criticise them, or use them as a launchpad for constructing aspirational scenarios.

#### Case Study 1: Multiple scenarios

The ESRC (Economic and Social Research Council) commissioned CRIC and the Institute for Alternative Futures (IAF) to run a workshop in January 2002, to inform its decision-making process concerning priorities for social research on genomics, and the selection of a centre to conduct such research. A set of four scenarios were presented to the workshop participants, each outlined in a couple of pages of text. This used an approach developed by the IAF, who deploy four archetypal scenarios: a “best guess” extrapolation, or “official future” scenario; a hard times scenario; and two “structurally different” scenarios (at least one of these is to be visionary, marking a paradigm change or an aspirational future). In the workshop, the four scenarios – featuring the application of genomics achieving very different degrees and patterns of success – were:

- **Genomics, Inc.** benefits primarily for the developed countries, the affluent, and corporations
- **Genomics for All** genomics applications developed to increase equity and sustainability
- **Broken Promises** genomics applications work poorly in general, failing for a variety of reasons

- **Out of Control** genomics is an international and environmental destabilising force.

An account of each was produced by the research team, and the scenarios document was one element of a package of documents supplied to participants (others included, for example, discussions of drivers of genomics applications and explication of the nature of the genomics revolution.). A set of break out groups focused on one or other of these scenarios. In line with the workshop objectives, these small groups considered the key contributions that social research might make in the event of the given future occurring. What would the critical demands for knowledge be? What sorts of pressure might social science be under?

Each group was requested to discuss its scenario, in particular, orienting its discussion around the questions:

- a. Assuming this scenario will occur, what is the optimal contribution of social science research can make (your 3 to 5 top priorities)?

Signposts: What would indicate movement toward this particular scenario, expressed, for example, as headlines in the media?

This process yielded a large number of specifications of opportunities for research. It was one of a number of approaches to the question of research priorities that were employed in the workshop.<sup>6</sup>

Box 2 illustrates some examples of the contributions that social research might make in the different scenarios, and “signposts” that the scenarios were? on the way to realisation. The material was captured in real time by use of COUNCIL groupware – each participant was equipped with a laptop PC with wireless modem, and a technical expert managed the structuring and collation of material. A great deal of on-the-fly facilitation was required to synthesise the mass of detail that rapidly appeared.

The scenario analysis was one important step in the process used in this exercise, which took the participants through a number of exercises that led them to develop and prioritise urgent themes for social research in the genomics area. (The workshop also noted aspects of the organisation of research that went beyond topics for study – for example the need to improve interdisciplinary training and working, and dialogue between social and natural scientists.)

### Case Study 2: Success Scenarios

The “success scenario” method has been applied to issues of science and technology policy in the UK<sup>7</sup> - the underlying principles can be applied in many other domains. The workshops described here focused on a more short-term future than usual for such approaches – 5 to 10 years – on account of sponsor requirements, though inevitably longer-term prospects were also discussed.

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<sup>6</sup> Full reports of the workshop are provided on the CRIC ([les1.man.ac.uk/cric](http://les1.man.ac.uk/cric)) and IAF ([www.altfutures.com](http://www.altfutures.com)) websites. The discussion here draws on text produced by Clem Bezold and colleagues.

<sup>7</sup> ICT and biotechnology scenario reports are reported on the CRIC (<http://les1.man.ac.uk/cric>) and DTI (<http://www.ost.gov.uk/policy/futures/ict/intro.htm>; [www.ost.gov.uk/policy/futures/biotechnology/scenario.htm](http://www.ost.gov.uk/policy/futures/biotechnology/scenario.htm)) websites as ICT in the UK a scenario for success in 2005, and Biotechnology in the UK a scenario for success in 2005. CRIC also presents the background analyses for these studies. The nanotechnology scenario report has just been placed on the DTI website, under the title: New Dimensions for Manufacturing: A UK Strategy for Nanotechnology, at <http://www.dti.gov.uk/innovation/nanotechnologyreport.pdf>



The Office of Science and Technology commissioned CRIC, together with the National Physics Laboratory and the Institute of Nanotechnology, to run a workshop on UK prospects and potentials in the field of nanotechnology, in the autumn of 2001. In the OST Nanotechnology exercise, there was no overall effort to sketch out scenarios in advance of the workshop, and break-out groups were again constituted around subdomains of the technology field. There was some background information constituting a scenario or roadmap of the most probable technology path in each subdomain.

## BOX 2 Some Outputs of Genomics Scenario Workshop

- **Genomics, Inc.** *Research contributions:* “impacts” of genomics on various sectors of society, the concepts of well-being, ethics and health service use of genomics, the new industrial structure and property rights, growing and new social divides. *Signposts* include continuing mergers, increasing divide between public and private sectors, and inequalities among individuals.
- **Broken Promises**, *Research contributions:* re-evaluation of the notion of progress; reflexive social science to research alternative lifestyles and product use; better understanding of political change; the reconceptualisation of risk including the inevitability of “normal” disasters and the need to prepare for them. *Signposts* include Greens winning in an archetypically conservative UK town, a big biotech company like Monsanto going bust, and Golden Rice burned in India because of unforeseen side-effects.
- **Out of Control**, *Research contributions:* the comparative advantage and disadvantage of states and their relations to MNCs, the nature of international organisation. *Signposts* include China buying a big biotech company like Monsanto, and protestors attacking Greenpeace.
- **Genomics for All** *Research contributions:* applied research supporting the development of international institutions that can regulate bio weapons, and the identification of genomic products and applications that will support equity and sustainability. Comparative analysis of scientific and political change (e.g. comparing IT and genomics revolutions, undertaking historical research on international institutions), understanding how cultural creatives unite politically and affect corporations, developing value impact assessment for new technologies. *Signposts* as such were not developed by this break-out group, but discussion suggested some events that might be important here – for example loss of US hegemony (and possibly the break-up of the country), negative mobilising events stimulating change in trajectories of genomics use (examples included serious diseases associated with genomics innovation).

These lines of work were discussed in plenary sessions, which emphasised social science research stances and styles that are critical, visionary and historically informed; research to probe critical political and moral constructs, (e.g. the meaning of development and wellbeing); innovation studies on global issues; global actors and changing industrial structures; and ecosystem impacts of genomics and public processing of ecological knowledge.

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<sup>8</sup> ICT and biotechnology scenario reports are reported on the CRIC (<http://les1.man.ac.uk/cric>) and DTI (<http://www.ost.gov.uk/policy/futures/ict/intro.htm>; [www.ost.gov.uk/policy/futures/biotechnology/scenario.htm](http://www.ost.gov.uk/policy/futures/biotechnology/scenario.htm)) websites as ICT in the UK a scenario for success in 2005, and Biotechnology in the UK a scenario for success in 2005. CRIC also presents the background analyses for these studies. The nanotechnology scenario report has just been placed on the DTI website, under the title: New Dimensions for Manufacturing: A UK Strategy for Nanotechnology, at <http://www.dti.gov.uk/innovation/nanotechnologyreport.pdf>

The heart of the process is a scenario workshop. As outlined above the design of the workshop has to be carefully prepared, members recruited, and background research prepared. The design process extended over time, with a series of meetings between the sponsor and the scenario team that were extremely important for “tuning” the design and making sure that the sponsor was fully behind the approaches being used in the workshop.

There are two elements to a success scenario. It combines:

- **Desirability.** The scenario captures a vision of what could be achieved or aspired to, by the sponsoring organisation or a wider community that it represents.
- **Credibility.** The scenario is developed with the assistance of, and validated by, a sample of experts in the area, chosen to reflect a broad range of interests (and usually including both practitioners and researchers).

Each of these elements is informed by the background research, providing a common information base for the experts to work with in workshop and other settings. Developing success scenarios has a number of functions:

- The **process** of discussing research results, debating and agreeing upon goals and indicators, and identifying feasible actions is valuable for creating mutual understanding and sharing of knowledge. This can establish platforms for further interaction and efforts to put in place the actions proposed.
- The scenarios form a **stretch target**, to challenge those concerned to aim for excellence, to think beyond the boundaries of “business as usual”.
- The development of **indicators** moves the scenarios beyond vague aspirations, and allows for clarity as to what precisely is being discussed and whether and how far goals are being achieved.
- Finally, **action** points are developed and priorities may be established, with the merit of having been derived from a participative process.

An interview programme was carried out to benchmark UK activity in various application areas against the experience in competitor countries. There was no effort at modelling or substantial statistical analysis, due to the relatively novelty of the technology, and similarly there is little by way of serious social science to draw upon that deals with nanotechnology. Six application areas where it was accepted that nanotechnology would have a major influence, were focused on, namely:

- drug delivery,
- informatics,
- instrumentation, standards and metrology
- novel materials,
- sensors and actuators, and
- tissue engineering and medical devices.

An effort was made to identify main trends, drivers, and the most probable future in terms of technology developments in each of these areas. Participants were allocated to areas and asked to ensure that they had read at least the appropriate part of the material.

There are many ways in which a success scenario workshop may be organised, but the approach used in these workshops involved, with minor variations, a sequence of stages such as described below. The various stages outlined below mainly involve activity in working groups, usually constituted to cover each of the areas already identified in the domain under investigation. Plenary sessions precede, follow, and sometimes intersperse these working group sessions. The nanotechnology workshop lasted for a day, the other two for two days (presentations on background topics preceded the workshop proper.)

After various introductory matters have been tidied up – setting out the mission statement for the exercise, introducing each other, etc – the work begins in earnest. A common starting point in scenario workshops, used in the model described here, is to examine “drivers and shapers” – factors that could be critical to influencing the course of events, promote one or other sort of development, and lead to distinctive futures.

In many scenario workshops the STEEPV approach – in which people are asked to identify factors and issues under the headings Social, Technological, Economic, Environmental, Political, and Value-Based factors – is used. This can be a useful prompt and way of ensuring that a broad range of issues is considered; it is also a helpful classification framework. But in our cases the workshop itself may be asked to come up with a grouping of “shaping” factors at an early stage of its work.

The discussion of drivers is inherently interesting and its output can be usefully decision-making intelligence. But the process is equally important. What typically goes on here is that participants become more familiar with working with the background material, and with working together. They deepen their understanding (and possibly critique) of the material as ideas are chewed over, conceptual frameworks given a first airing, etc. They develop common groundrules for working, language in which to express ideas, etc.

Typically the discussion will at least in part be conducted in subgroups who are requested to work systematically through a range of factors that are liable first, to drive, and then, to shape the development of the domain. They may be asked first to concentrate on drivers, and then on shapers of the area. They may be provided with lists of potential factors as part of the background material, and be asked to critique these, add new ones if appropriate, and – especially - to indicate how important each might be, and why.

This workshop relied on paper-based rather than computer-supported methods (though some participants were spontaneously making use of laptops and even digital cameras in the most recent workshop). The groups are provided with written instructions. A facilitator/note-taker for each group was even given suggested timings for each task. The discussions were captured on posters, which are attached to the walls to provide a record of development and material for other groups to inspect at intervals. The key technique is crystallising the thinking about factors, within different subgroups (and for them to communicate among themselves) in the form of lists. The background

information, participants' knowledge, and their conceptual frameworks are brought together in ways that challenge them to develop shared understandings.

The success scenario methodology provides an impetus for these processes. It does so by asking the workshop, and working groups within it dealing with specific subtopics, to consider what might be *realistically achieved* if the UK (in these studies) is to be *successful* in the technology and its application areas. This means, of course, asking just what success in each area might constitute. This is another topic where views may differ. There may be quite different views of relations between means and ends, causes and effects; and also very different emphases on such values as efficiency, equity, sustainability, etc.

The next task for each working group was to characterise the scenario that they have developed; succinctly describing it in terms of what success looks like, what the main drivers and shapers are, and how they might be called into play. Since the success scenarios need to be both credible and optimistic, this part of the exercise provides a chance for the groups to consider whether the different scenario elements are consistent. A number of prompts were provided to the groups, suggesting elements of the scenarios that it would be helpful to describe. These subjects form the basis of brief presentations to a plenary session. This provides an opportunity to contrast the different groups' scenarios, and see if they are consistent or divergent – and what this implies. Knowledge cycles are thus established again, within and between subgroups.

In this session the working groups further characterise the success scenario by specifying concrete ideas about how to recognise that the success scenario was becoming a reality. Again, some preliminary ideas of the sorts of indicator that might be developed are provided to kick off the work. The groups are challenged to suggest plausible quantitative estimates of such indicators - to clarify points of agreement and disagreement, to provide tools for monitoring progress, and to suggest alternatives to the narrow set of indicators that are typically used to drive policies. Box 3 reproduces the introduction to this task as provided in the nanotechnology workshop. Box 4 reproduces instructions drafted for the facilitators and chairs of the subgroups, to guide them in the tasks they were to undertake.

The final working group task now is to provide suggestions for steps that need to be taken to maximise the likelihood of the success scenarios. This work may be conducted within the original working groups. One approach here is to use a “carousel method”, where stations are set up with wall posters dealing with specific types of action – typically different policy areas. For example, a broad categorisation of areas used in the nanotechnology workshop was:

- Research
- People
- Facilities
- Finance and taxation
- Access to technology [and international collaboration]
- Regulatory issues
- Other issues

In the carousel method, each group proceeds round the posters in turn (but starting at a separate point). It is free to read and comment on other groups' suggestions when visiting a station that another group has previously visited. (An alternative approach is to form new working groups, dedicated to specific action areas. It is possible to envisage other ways in which this task may be organised.) As well as specifying actions, participants are asked to indicate **who** might be responsible for seeing them through. The outputs of this phase of work need to be synthesised and prioritised, and plenary sessions are typically used to achieve this.

### Box 3 Task of developing a Success Scenario

Text of three PowerPoint pages used in nanotechnology workshop.

#### **What would constitute 'Success'?**

##### Indicators

- key products and applications
- impact of products on end-user performance
- local and global end-user markets - size and UK share
- industry structure - large firms, SMEs, spin-outs
- business model (e.g. high value added)
- where are the UK companies in the supply chain?
- effect on GDP/employment? And impact on inward investment?
- our competitors, and how we compare
- where is the leading-edge research? where UK stands?
- other features

How much change by 2006?

#### **What Enables Change?**

- Quality of research
- Ownership of research
- Availability of skilled people
- Sources of finance
- Instrumentation, standards
- Infrastructure and manufacturing capabilities (e.g. fabrication facilities)
- Structure and organisation of industry and markets
- Regulatory Environment
- Policies for Health Services and other public sector markets
- Intellectual Property Regimes
- Other issues (please add your own)

#### **How do we know we are beating the competition?**

- Relative performance with other countries:
- UK research recognised by global firms as leading edge
- UK firms assembling high value added patent portfolios
- Venture capitalists and inward investors investing in UK start-ups
- International collaborations
- End users seeking/ recognising value of UK products (market share)
- Availability/size of facilities in the UK
- Number of graduates and post-graduates in relevant disciplines
- Other issues (please add your own)

#### Box 4 Guidance Material Used in a Success Scenario Workshop

##### Session 2A

##### Building a new scenario – the Success Scenario

The scenarios we have provided are intended to provide stimulus for you to consider what might be realistically achieved if the UK is to be successful in each area of nanotechnology applications. This means, of course, considering what success in each area might be. In order to move toward more concrete and credible analyses of this, we are asking the groups to work systematically through a range of factors that are liable first, to drive, and then, to shape the development of science and industry in the UK and beyond. In later sessions we will go on to consider relevant indicators and actions needed.

Here is a list of potential drivers:

- **Basic research – new knowledge, incremental and radical developments**
- **Demand from intermediate and end-users; users' appreciation of opportunities presented by new knowledge**
- **Sources of finance for development of applications (e.g. venture capital, stock markets, government)**
- **Instrumentation, standards**
- **Structure and organisation of industry and markets (e.g. relations between large and small firms, role of intermediaries)**
- **Entrepreneurial attitudes, visions, incentives (in research and business)**
- **Other issues (please add your own)**

##### QUESTION 1

We would like you to work through and comment on each of these drivers. Please use the flip chart to identify the issues that you consider most important for each, and how they impact on your application area – how far do they promote development of applications in your areas? Are there specific applications that are promoted especially? Please indicate, too, what each of these might look like by 2006 – e.g. will the scenario be driven by large firms or SMEs?

For each driver :

1. Identify the most important issues
2. Discuss how far the driver impacts on your application area – how important is it as a driver (*could you indicate this on a scale from 1 (not important) to 5 (extremely important)?*)
3. Identify specific applications promoted by this driver
4. What might this driver look like by 2006 - would it be growing or decreasing in importance or its particular type of impact?

##### QUESTION 2

When discussing these issues, please:

- consider if your application area has special features here (e.g. different application areas feature very different regulatory environments)
- consider whether the UK situation is shared by other countries, or if we have specific opportunities or problems.

**Continued**

**Box 4 Continued Session 2b****Further Building the Success Scenario**

To further move toward a more concrete vision of what success for the UK in each area might be, we are now asking you to work systematically through a range of factors that are liable first to **shape** the development of science and industry in the UK and beyond.

Here is a list of potential shapers:

- **Regulatory Environment – Health & Safety, Environmental & Food Regulations; Competition Policy**
- **Policies for Health Services and other possible public sector markets**
- **Intellectual Property Regimes, knowledge of and support for using them**
- **Public attitudes to Risk, to Expertise, to Technology**
- **Quality of Life issues (e.g. UK as an attractive market, base for production and research, place to live)**
- **Availability of technical, disciplinary, and multidisciplinary skills, and of management capabilities**
- **Other issues (please add your own)**

**QUESTION 1**

We would like you to work through and comment on each of these shapers. Please use the flip chart to identify the issues that you consider most important, and how they impact on your application area – do they impede developments, or push them in particular directions, for example? Please indicate, too, what each of these might look like by 2006 – e.g. will the scenario feature a large number of people trained in multidisciplinary team -working?

For each shaper :

1. What are the most important issues (*again, can you rate them on a 1 to 5 scale?*)?
2. How will those issues impact on your application area ?
3. What will this shaper look like by 2006 ?

**QUESTION 2**

When discussing these issues, please:

- consider if your application area has special features here (e.g. different application areas feature very different regulatory environments)
- consider whether the UK situation is shared by other countries, or has specific opportunities or problems.



**Box 4 Continued Session 2c**

**Summarising the scenario**

Here we would like you to characterise the scenario developed by your group. One way in which this can often be assisted is to come up with a “name” for the scenario. Beyond this, how can we succinctly describe it – what does success look like? What are the main drivers and shapers, and how are they being called into play? Remember that the success scenarios need to be both credible and optimistic: this part of the exercise is a chance to see if the different elements of your scenario are consistent.

What would this scenario look like in practice? What is the industrial landscape, the patterns of supply and use of the application? Where is the action taking place? What could we hope for in terms of a UK presence? Please try to characterise the scenario in terms of such features as:

- What level of UK activity is there likely to be in this application area? How much would it have grown in value and employment terms from current levels?
- What sort of presence is this in world markets – what is the UK’s market share?
- Inward Investment in the application area: how much growth would we expect? From where, what sort of firms? To what level?
- What sorts of UK firms are involved - are the main actors large firms? How many start-ups could we expect in this area? How many SMEs involved in the supply chain?
- How big are the end-user markets, what sorts of purchasers are there, what is the impact on their performance?
- What would industrial funding of research in Universities for relevant nanotechnology look like?

You will have more time this afternoon to address such questions further, but it will help to make a start on them now to characterise the scenario – and see how far members of the group are in agreement about optimistic prospects for such issues.

Please prepare a brief presentation on this, kicking off with the name of the scenario, and then describing it in ways that the other groups can rapidly grasp. This will provide us with an opportunity to contrast the different groups’ scenarios, and see if they are consistent or divergent – and what this implies.

**Continued**

**Box 4 Continued****Session 5 Indicators for success**

In session 2c we asked you to begin to characterise the success scenario. Could you return to the bulleted questions there, and amplify your answers if that seems necessary. Please also give us some further concrete ideas about how you would be able to recognise that the success scenario was becoming a reality. The ideas below are “off the wall”, but are intended to indicate the sorts of things you might want to suggest:

- Share of UK research in EU collaborations in nanotechnology fields.
- Number of patents taken out by British innovators in application areas based on nanotechnology.
- There is considerable public enthusiasm for nanotechnology, as evidenced by recruitment for courses, media attention, etc.
- The NHS (as a market), NICE and the FSA become champions of nanotechnology applications.
- Growth of high-quality dedicated nanotechnology firms supported by more venture capital, large firms and a strong science base.
- Harmonisation of the European patent system and a credible, transparent European-wide regulatory framework in nanotechnology-related areas.
- Contribution of nanotechnology applications to major users reflected in relevant processes or products constituting xxx% of their outputs/ new products.
- Growth in UK trade surplus, reflecting nanotechnology applications.

The big challenge, of course, is to suggest plausible quantitative estimates of such indicators. The closer you can come to suggesting not only indicators, but also ball-park figures, or ranges of figures, that might apply by 2006, the more valuable the exercise will be – not least to clarify where our points of agreement and disagreement are. Another benefit of this part of the exercise is that it can, hopefully, suggest alternatives to the narrow set of indicators that are currently used to drive policies for research.

**Session 6 Critical Success Factors and Actions**

The task now is to provide suggestions for steps which need to be taken to maximise the likelihood of your success scenarios. Please do so by discussing them in your groups, and writing points down on the wall posters. We invite each group to proceed round the posters in turn – feel free to read and comment on other groups’ suggestions. Please indicate on your suggestions if they are specific to certain application areas. If there is a suggestion which divides your group, it is probably best to write it up and indicate the lack of consensus! Please try to indicate **who** might be responsible for seeing particular actions through. You might also be able to indicate what sorts of systems, indicators, feedback, etc., they could be using to see if actions are having the desired effects.

### Case Study 3: Work in Progress

The final case study is still underway at the time of writing, in that the scenario workshop has been conducted, but the results have yet to be fully written up and returned to participants for correction and feedback. Thus we shall not present any results, but briefly discuss the methods used and results emerging

The topic area is that of Bioscience and Non Food Crops (NFCs). There has been an immense level of debate in the UK about the use of Genetically Modified Organisms (GMOs) in agriculture, with high levels of public opposition. But this debate has almost entirely concerned food crops, and public concerns about health have had a high prominence. (Surprisingly, perhaps, in that the most problematic aspect of GMOs in practice is liable to be connected with their implications for the natural environment. But food/health issues have been prominent in the UK for a decade or more, with “mad cow disease” and a number of other major scares.)

A background paper prepared for the day-long scenario workshop introduced five main areas of NFC application: Energy; Industrial processes; Health; Land use, amenity, and bioremediation; and Novel materials. These areas were discussed in the light of five major issues (an alternative to STEEPV developed for such technoeconomic appraisals): developments in: Science and technology; Institutional capabilities; Market formation and demand; Regulatory and policy environments; and Public acceptability. Finally, four scenarios were developed:

Underlying all the scenarios is the assumption that globally, challenges to scientific endeavour, and the potential social and economic benefits of understanding and controlling biological processes, will continue to drive bioscience. It will continue to develop rapidly, and the range of applications of the knowledge developed here will continue to widen dramatically. Among these applications of bioscience, we assume that there will continue to be, across all scenarios, more or less extensive use of non-GM agricultural biotechnology (e.g. enhanced crop breeding techniques using gene markers, etc.), and more or less extensive use of microbial and other “industrial” NFC applications of bioscience, whether GM or otherwise. What differentiates the scenarios, then, is not the pace of development of global bioscience. They vary in terms of the extent and style of development, in the UK, of agricultural NFC applications of bioscience.

In Scenario 1, NFCs are widely used in agriculture, with regulatory and other developments making it possible to exploit the new technologies on a wide scale in open fields and the like. In Scenario 3, this route is ruled out, but various ways of practicing agriculture in contained environments are employed to enable NFC use. Scenario 2 lies between these: it sees limited development of “open” GM-based agriculture, with some development of these contained methods too. Scenario 4 sees practically no commercial use of GM in agriculture, though bioscience still generates novel applications in non-GM uses and industrial settings. These skeletal scenarios were described in a little more detail as follows.

*Scenario 1 : “Dive In!”* NFC use of GMOs in UK open-field agriculture is fairly widespread, and no longer considered at all remarkable. Regulatory arrangements are in place that allow for more rapid and less costly approval; major overseas markets are

open to GM-derived products. Political opposition to GMOs is muted, as concern over environmental and health impacts of GMOs are diminished – probably by combination of convincing evidence as to the lack of severe problems (at least as compared to conventional agriculture) and wide recognition of significant benefits in terms, say of health products, or environmental remediation. In this scenario, a wide range of GMO developments in agriculture can be expected. There may be localized oppositions to particular categories of application – e.g. extensive growing of fuel crops may be unpopular for a variety of reasons. Some classes of gene transfer may be problematic, on account of high risks or likelihood of “escape” into wild populations, etc. Bioscience-informed regulations would support improved (better targeted and more rapid) regulations here. “Contained” applications would be likely to develop in niches where plants cannot be grown in open fields due to regulations or environmental circumstances.

*Scenario 2 : “Testing the Water”* NFC use of GMOs in UK open-field agriculture is emerging slowly, being limited by such factors as lengthy approval processes, slow development of markets, political opposition, uneven development of markets, large costs involved etc. Probably the crops that are being exploited in this scenario are those with the best combination of (a) high value (e.g. pharmaceuticals); (b) large markets (e.g. treatments for common diseases); and (c) least likely to give rise to environmental concerns (e.g. non-indigenous species?). (Note that using crops for pharmaceuticals can be seen as raising biosafety issues that may at least initially offset the high value of such crops.) Open-field agriculture will be accompanied by contained agriculture in this scenario.

*Scenario 3 : “Contain Yourself”* NFC use of GMOs in UK open-field agriculture is practically, if not entirely, non-existent in this scenario, but there has been extensive development of “contained” agriculture – with regulatory and technical developments allowing for use of GM crops in greenhouses and similar built environments. Presumably building and other costs further push the technology development toward high value, large market products (though market size would be restricted by the low yields that would be expected with contained growth– unless it is on a huge scale such as the Spanish tomato and salads industry.). (Some products might best be produced in atmosphere and climate-controlled circumstances, of course.) There may be some local political opposition, perhaps more aimed against the new buildings than the GMOs themselves.

*Scenario 4 : “Keep Out!”* In this scenario, commercial NFC use of GMOs in UK open-field agriculture is practically, if not entirely, non-existent. A combination of regulatory barriers, political opposition and market resistance has meant that the costs of engaging in such applications far outweigh the benefits. (Note that market resistance would be expected to apply to imported products as well as UK-produced ones.) This might provide greater incentives to undertake non-GM technological development in NFC agriculture, and the scenario challenges us to think of what breakthroughs and major developments might be expected here. A major question concerns the evolution of UK bioscience in such a scenario. Without application of GM technology in UK agriculture, would UK bioscience be consigned to a scientific niche in terms of global development? Could non-GM bioscience and “industrial” bioscience be the source of significant commercial opportunities and wealth creation? Or could the UK continue to develop bioscience and gain value from its applications, even when these applications are largely overseas?

Box 5 displays a vital tool used in the preparation for the workshop – a draft programme of how the activities are to be organized through the day. This version of the draft was circulated among those running the workshop, including the providers of technical support. It formed the basis of discussion, for example about the equipment needed (laptops for each break-out group, various prepared flipcharts, etc.) It also allowed us to assess whether activities could be fitted into the allotted time and what detailed instructions should be provided for facilitators. On this basis, task sheets were prepared (e.g. Box 6); the final version of the programme was used to guide events through the workshop.

In practice considerable revision of activities had to be built into the process. It took longer for groups to get going than expected, and then they required more time to talk through some issues than had been allotted. A major lesson of this experience is the need for *flexibility* in running such a workshop. If we had not been able to change the details of the programme through the day, we would have run the risk of alienating participants and getting far more rushed and superficial judgments. Flexibility required that there was one member of staff in charge of the whole process, able to take an overview while others were facilitating the work of break-out groups. We needed to liaise with the technical support, too, as to changing the timings, providing new support material and the like. Such non-intellectual details can be critical to the success of an exercise.

#### Box 5 Developing a Workshop Programme

<b>9am</b>	Arrival, Registration	**** to provide flipcharts, pens, post-its, at least one projector. Their office support room may allow for printing and photocopying. We should ensure 4 laptops minimum. There are 3 big rooms, one of which is big enough for two groups. Participants will be provided with background material, including interview results on the various application areas and key apps, and our starter scenarios.
<b>930</b>	(PLENARY) SESSION 1	Welcome ( <i>polycymaker, chair of****</i> ) Orientation, Splitting into Scenario Groups
<b>1000- 1100</b>	(BREAKOUT) SESSION 2a Developing the scenarios:  Drivers and Shapers	<b><i>Each scenario group is given a 1 page scenario to discuss and elaborate</i></b>  Scenario groups discuss and elaborate on drivers and shapers (we are doubtful about differentiating – but can ask groups about “type of influence” on scenario. . NOTE 3 or 4 groups <ul style="list-style-type: none"> <li>• Discussion of credibility of scenario, whether it needs to be nuanced, refined, restructured.</li> <li>• Using the categories provided, what developments/trends in each would be likely to make this scenario more likely, affect the characteristics of the scenario.</li> <li>• How could this scenario happen, what would it look like?</li> <li>• What would the position of UK bioscience look like in the world? (<i>we might ask them for their view of the RoW scenario here this is liable to be an influence.</i>)</li> </ul>
<b>1100 - 1115</b>	Coffee/tea	

<b>11.15 – 12.00</b>	(BREAKOUT) SESSION 2b  <b>Summarising and describing the scenario</b>	<i><b>Characterise the new scenario</b></i>  NOTE 3 or 4 groups Appoint rapporteur. Name scenario, construct a short account to explain and “market” it as a plausible future to the plenary. Preparation of list of top drivers and shapers under standard categories. ( <i>need to work on logistics – possibly use carousel technique</i> )) <i>Issue may be that some groups may derive more than one version of their scenario</i>
<b>1200 – 1230</b>	(PLENARY) SESSION 3a  <i>Sharing scenarios</i>	Each group presents its scenarios, the underpinning drivers and shapers. <i>We could ask for the top (three) influences in each of our categories to be put on flip charts – collating those from the different scenario groups for a later move.</i>
<b>1230 - 1245</b>	(PLENARY) SESSION 3b  Voting on Drivers and Shapers	All participants select their most important drivers and shapers (irrespective of scenario – the things that will be most crucial for UK NFC development in their view) by a voting process. We could then take the top ten (say) and ask for views (again voting) on how malleable these are, say, to policy influence, or how uncertain they are about what the development or direction of influence might be.  This is a move that needs to be reflected on. Rationale includes – getting snapshot overview of group views (not consensus); getting sense of drivers/shapers seen as most important’ material to feed into afternoon sessions and final report. However, there could be other things we might do. We could take the top drivers and get views on which scenarios they most favour, for example (though we could also retrospectively determine this over lunch by seeing which scenario groups they originated from. Another possibility – 5 stations based on the drivers and shapers – hence influences – and we make a summary account of the most important subset on each station. Then the groups process around carousel like, and say how far each set of influences favours, undermines each scenario (-5 very negative to +5 very positive).
<b>1245 – 1400</b>	Lunch	Work!! Print out brief descriptions of scenarios.
<b>1400 - 1415</b>	(PLENARY) SESSION 4  Moving on	Feedback and review of morning outputs. Introduction to afternoon sessions Presentation of results of voting.
<b>1415 - 1515</b>	(BREAKOUT) SESSION 5  Key applications	Application groups formed. Each is asked to identify key example applications within their areas, and then to address the ways in which these might be realised in R&D and commercial use. <ul style="list-style-type: none"> <li>Choose a set of applications within this broad area – they should give us a range of apps whose development (not market take-off, that is scenario dependent) could be anticipated at different points in time, reflecting quite different sorts of app, and which are ones where there could be a big UK role, market and/or social and environmental need.</li> <li>Put these on a timeline/roadmap in terms of development of the bioscience. (Allowed to make “fuzzy” placements with error bars, and to note if vary across scenarios.)</li> </ul> NOTE 4 or 5 groups
<b>1515 – 1530</b>	Coffee/tea	
<b>1530 - 1600</b>	(BREAKOUT) SESSION 6  <b>Key</b>	<i>Application group</i> Finish the roadmapping. <ul style="list-style-type: none"> <li>How far and which applications would develop in different scenarios?</li> <li>What would the UK role be in science, commercialisation, use?</li> </ul>

	<b>applications and roadmaps</b>	<ul style="list-style-type: none"> <li>What are scenario-specific and cross-scenario issues that confront specific applications and markets for NFC developments.</li> </ul> <p>NOTE 4 or 5 groups</p>
<b>1600-1630</b>	(PLENARY) SESSION 7a	<i>Groups to feedback on their top applications – the rationale for these. Timelines displayed alongside each other. Look for inconsistencies and synergies. This is quite demanding, and this and the next move don't have much time – maybe do away with session 6??)</i>
<b>1630 - 1700</b>	(PLENARY) SESSION 7b <b>Actions</b>	<p><b>We need a session that develops major messages, allows for specification of key opportunities, allows participants to add comments and the like. Again several different possibilities here. This is one we have discussed.</b></p> <p><i>IoIR team prepare a series of posters representing different topic areas for action e.g. regulation, training, research, finance etc. (or different actors eg DTI, DEFRA, HEIs, etc. but probably better to ask “whom?” under the topics, and can then urge collaboration and coordination) One station to be blank to allow for actions which don't fit any of the pre-set topics.</i></p> <p><b>At each topic</b></p> <ol style="list-style-type: none"> <li>1. Add actions to the application flips; specify who should undertake them, what would be achieved (and targets/indicators?).</li> <li>2. indicate if related to specific applications.</li> <li>3. add comments to actions already there</li> <li>4. Put ticks against areas of agreement</li> </ol> <p><b>Indicate other points /caveats on separate flip chart</b></p> <p>Carousel :</p> <p>6 stations – 5 topics + 1 general.</p> <p>At each station 6 flips headed with the 6 applications plus one blank for other comments</p> <p>each group spends about 10 minutes at each 'station'</p>
<b>1700 - 1730</b>	Closing comments, thanks	<i>Can we get senior policymakers – *** - to feed back on day and pledge to take results on board, see reports published?</i>

**Box 6 example of workshop instructions**

**SESSION 1a 50 minutes**

***Purpose of session***

- Amend / elaborate / clarify your scenario
- Identify influencers (drivers and shapers)

**QUESTION 1**

Is this scenario credible (i.e. **does it hang together** / make sense) ?  
If not, what would you need to change to make it more credible as a scenario ?

**QUESTION 2**

**How likely** is this scenario (as now revised) to happen ?  
Score it on a scale of 1 -5 of likelihood

**QUESTION 3**

What would make this scenario move UP the scale of likelihood (**more likely**) ?  
What are the trends / influencing factors which would make this happen?

**QUESTION 4**

What would make this scenario move DOWN the scale of likelihood (**less likely**) ?  
What are the trends / influencing factors which would make this happen?

**QUESTION 5**

In this scenario, what would the **position of UK bioscience** look like in a world context ?

**Session 1b 40 minutes**

***Purpose of session***

- Characterise the scenario for presentation to plenary session
- Prioritise the 'influencers'

**TASK 1**

**Characterise** your revised scenario -

1. Give it a name
2. Construct a short account of it to explain and 'market' it to the plenary
3. Put it onto a powerpoint slide

**TASK 2**

**Review the influencers** (drivers and shapers) you identified in the previous session and **choose the top 5** - the ones you think are most significant / will have greatest impact

**TASK 3**

- Choose someone to present your scenario to the plenary session
- Choose someone to present your top 5 influencers to the plenary session



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## THE OUTPUT OF SCENARIO WORKSHOPS

The results of such a process can take several forms. Typically a major activity will be the production of a published report, outlining the results of the scenario workshop (and often also presenting at least some of the background research, too). This “codified knowledge” – information really – may remain with the sponsor.

In Fully Fledged Foresight such material should be used more widely. They should enter into the public domain (with necessary caveats). They can be used in the processes of other organisations, feed into the components of an ongoing Foresight exercise, and may perhaps be used in successive workshops.

The workshop may define actions to be carried out, including some which participants themselves may be engaged in. This is central to the success scenario methodology. A major task will be to move other parties through the knowledge cycles, so that they can incorporate the thinking of the workshop in their own decision making.

The workshops described above have proved useful in decision processes. There are several elements to this:

- Helping to bring a wider span of knowledge into the process, which can be viewed technocratically as increasing efficiency, or democratically as enabling wider participation.
- Providing a methodology for arriving at lists of priorities that decision-makers can rely on as more than the opinion of a few self-serving individuals. Of course, such lists are not translated automatically into policy actions –the decision makers have their own judgement to exercise and choices to make, though there is now a reference point at which the decisions can be compared.
- These inputs may serve to provide sponsors with huge amounts of intelligence which they previously lacked. Or they may serve to confirm what the policy expert already believed, but legitimise this by validating the views by reference to a wider set of experts and stakeholders.

Formally, we know that the studies described above have been utilised in funding decisions. They have helped provided intelligence, too, that can be used in debates between different decision makers. (Thus the genomics exercise could be used within the sponsoring organisation to raise awareness of the relevance of the topic more widely than just among those centrally concerned with the decision. The other exercises provided those responsible for science expenditure with a case to take to the Treasury, and with suggestions as to how financial authorities might be able to assess whether the investment was worthwhile – staving off the threat that indicators of success might be imposed from outside.)

In the cases summarised above, client involvement proved vital, in the design and conduct of the scenario workshops. Without such involvement, the exercises would not have been adequately tailored to the decision-making needs of the sponsors. And participation in the activities helped ensure, as suggested above, that there were “champions” for the scenario work within the sponsoring organisation, who could take the messages of the study further. This could be seen as a matter of disseminating the products of the exercise further. Equally, it can be viewed as a matter of extending the

process of the exercise. Design to allow both of these dimensions to be maximised is needed to make sure that scenarios effectively contribute to decision making.

We can anticipate that there will continue to be emphasis on scenario methods in foresight exercises. It is likely that there will be further development of methods, computer-assisted and otherwise, for both "outward-bound" and "inward-directed" scenarios. There will also be exploration of means and methods for representing and disseminating scenario results, and for enabling users to build these into various Foresight processes. Hopefully, we will accumulate information as to good practice and quality issues in scenario work.

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# BRAINSTORMING, SWOT, and STEEP (V) ANALYSIS\*

*Metin GER*

## INTRODUCTION

Problem solving has always been, is and will ever be the major preoccupation of humankind. There is a relatively strong agreement on the meaning of a “problem”. In all definitions it is emphasized that one has a problem if he/she has a goal, but the series of actions to be performed to reach it is full of uncertainties. In other words, there arises a problem when one is confronted with a difficulty. It must be noted that, the difficulty encountered is not limited to a present situation only, but it also implies a discrepancy between an existing situation and a desired state of affairs in the future. The latter type of problems constitutes the realm of foresighting. Not to be trapped into the deception of conventional solutions, the novelty of the solutions is essential. Creativity is most intimately linked to problem solving that results in high-novelty. However, it is worth noting that the “creative thought product” must also be of some “use” and “value”.

“Brainstorming”, an invention of Alex Osborn, is a valuable instrument, a technique for problem solving through generation of creative ideas. However as he argues, a major block in creative thinking is the tendency to premature evaluation of ideas. Consequently, the basic idea of brainstorming is to separate idea generation from idea evaluation. Only then, the major requirement of creativity for a strategy of brainstorming in problem solving is satisfied.

Once the list of creative ideas is available, a decision has to be made to identify those ideas, which will be the building stones of the strategic plan that will lead to the goal. Strategic plan comprises the most important sets of actions to be taken to achieve our vision. Irrespective of the type of issue/subject at hand, a strategic plan is needed and analyzing the environment in which future shapes is the most important of many elements used in creating a strategic plan. Environmental analysis involves scrutiny of the social-cultural, technological, economic, ecological, and political events that are in effect or may occur in an effort to identify trends and conditions that could effect the issue/subject at hand. There are many tools available to perform environmental scanning, two of which will be discussed below.

The first and the most common is the **SWOT** Analysis. SWOT is actually an acronym for **S**trengths, **W**eaknesses, **O**pportunities, and **T**hreats. SWOT Analysis is a very effective way of identifying Strengths and Weaknesses, and of examining the Opportunities and Threats. Carrying out an analysis using the SWOT framework will help focusing activities into areas where there is strength and where the greatest opportunities lie.

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Of course, just looking at potential opportunities and threats may be rather broad while useful; it may not uncover the full potential of what is happening in the environment. It is often useful to employ an additional analysis tool, such as the

**STEEP** Analysis, which may facilitate a more extensive and in depth look at the environment. STEEP is actually an acronym for **S**ocial-cultural, **T**echnological, **E**conomic, **E**cological-environmental, and **P**olitical-legal aspects. Carrying out an analysis using the STEEP framework by looking at aforementioned aspects of external environment will help uncovering as many nuances, opportunities and threats possible.

## **BRAINSTORMING**

The idea and function behind brainstorming is to gather as many diverse ideas or solutions related to some goal or problem as can be in a limited time - the longer the list is, the better the result will be. Brainstorming can be used for almost anything: program ideas, themes, slogans, publicity, group goals and problem solving.

While most people are familiar with the term "brainstorming", there is only a few who know precisely what it is all about. For most, it is an informal unstructured technique, which facilitates discussion among participants aimed at coming up with a few bright ideas. The truth is brainstorming is a formal, structured technique for which some of the rituals normally performed in ordinary discussion and debate are not used at all.

The brainstorming technique is structured in such a way that the medium set enhances breaking down of the unconscious constraints or prejudices of the participants otherwise they normally place on their thinking. This helps the participants to be truly creative. Furthermore, there are some rules of conduct of this structured technique. It is these rules, which create a relaxed and enjoyable atmosphere. These help participants to express themselves without fear of being criticised and enhance the participants' ability to make associations that lead to longer list of creative ideas.

The advantages of the brainstorming process are:

- Encourages participation
- Fast-paced; can be an energizing activity
- Nonevaluative of content/ideas generated
- Stimulates ideas; one idea tends to build on another
- Easy to understand and use

The disadvantages of the brainstorming process are

- Does not include mechanisms for converging ideas (many ideas may be thrown out if not obviously relevant)
- Limited in its capacity to take advantage of participant expertise directly
- May introduce too much chaos; needs to be managed firmly

As in the case of any session or meeting, there are number of phases that need to be performed one after the other.

### **Preparation phase**

This phase includes, the identification of the topic, selection of the participants and the time and place of the meeting.

- Once the topic is identified, it must be restated in a form, which ensures that it is not an attempt to a solution. For example, if the topic is the “national innovation system”, topic statements “how do we improve the national innovation system to have a better quality of life” and “how do we improve the national innovation system to have a more competitive industry” will lead to a different set of ideas.
- The optimum number of participants is 12. The less may slow down the production rate of ideas while the more may make the facilitation more difficult. The participants must be selected not only among those who have a direct interest in the topic but those who may have an indirect interest or even no interest at all should also be invited to the brainstorming sessions. The presence of the latter group of participants may lead to some fresh ideas that may lead to novel creative ideas through associations by the more involved participants.
- The place and time of a brainstorming session seems to be a rather trivial issue at the first glance. However, a special effort must be made to provide a meeting environment that has all the requirements for a relaxed, uninterrupted conduct of the session. It is therefore recommended that the meeting be held at a place different than the working environment of the participants. In Figure 1 and Table 1, the room arrangement and the basic requirements for a healthy conduct of a brainstorming session is shown, below.

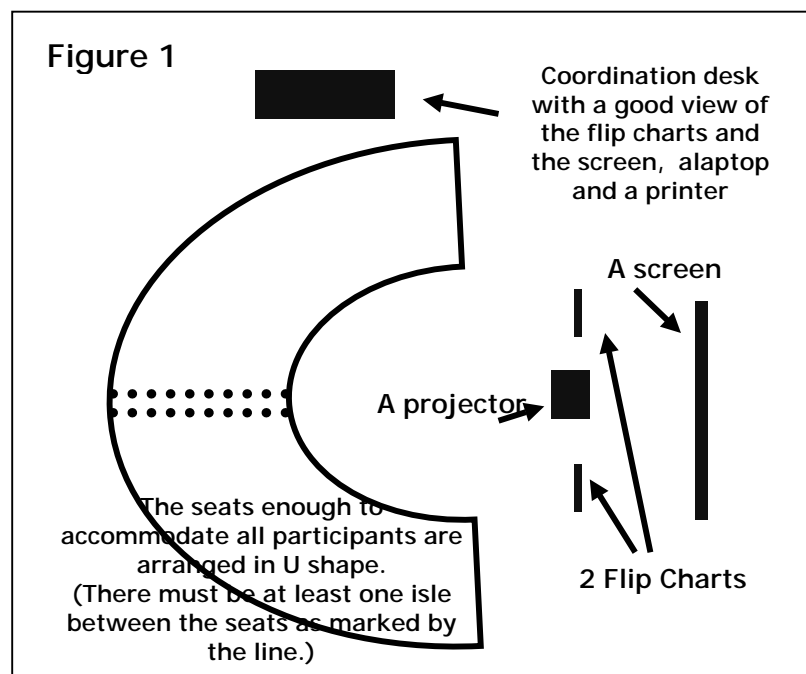


TABLE 1. Requirements	
Facilitator/assistants	1 Facilitator and 1 or 2 assistants
Didactic aids to prepare	<ul style="list-style-type: none"> <li>– flip chart with instructions (Annex 1)</li> <li>– guidelines for the facilitator (Annex 2)</li> </ul>
Materials for the facilitator (during the exercise)	<ul style="list-style-type: none"> <li>– 2 flip charts with large sheets of paper.</li> <li>– marker pens</li> <li>– masking tape</li> </ul>
Materials for the participants (during the exercise)	<ul style="list-style-type: none"> <li>– paper and pencil</li> </ul>
Important conditions of the room	<ul style="list-style-type: none"> <li>– A place where the participants will not be disturbed for at least one hour.</li> </ul>

### The Execution

The execution of the brainstorming session has several stages. In Table 2, these stages are shown together with appropriate time allocations.

TABLE 2. Stages of Execution		
Stage	Time	Most important contents
Explanation of Technique and the topic	5'	<ol style="list-style-type: none"> <li>1. Clarifying the technique</li> <li>2. Briefing the topic</li> </ol>
General Instructions	10'	<ol style="list-style-type: none"> <li>1. Explanation of Rules</li> <li>2. Warm-up process</li> </ol>
Brainstorm Process	25'	<ol style="list-style-type: none"> <li>1. Generation of ideas</li> </ol>

**Explanation of technique and topic:** Participants are briefed about both the brainstorming technique and the topic. It is recommended that the topic definition statement is posted.

**General instructions:** The brainstorming rules are explained. The rules are

- Do not criticize an idea. Every idea is acceptable, even if it sounds silly. Remember, we're trying to gain a large number of ideas. Criticism tends to shut some people up. As a leader, it is your responsibility to inform the group of the rule and to ENFORCE IT!!!
  - \* Every contribution is worthwhile.
    - + Even weird, way-out ideas
    - + Even confusing ideas
    - + Especially silly ideas
  - \* Suspend judgment.
    - + We won't evaluate each other's ideas
    - + We won't censor our own ideas
    - + We'll save these ideas for later discussion
  - \* Piggybacking is encouraged. Piggybacking is picking up on an idea and altering it a little, or taking something away, or even expressing the exact

opposite. You'll be surprised to find that the screwiest thing you ever heard can turn into a beautiful idea just by applying a little piggybacking.

- \* The faster the better --Things must be kept moving. As a leader, you should keep the brainstorming storming. The best way is to save your ideas for a dull moment.
- \* All ideas expressed must be kept recorded. The group leader lists each idea as quickly as possible. Hesitation in recording the idea sometimes gives the impression of disapproval.
- \* Evaluation comes only after as many ideas as possible are brainstormed. Then the group goes back over the list to determine which projects or ideas are valuable.
- \* No negative comments during brainstorming. They can be disruptive. Inform the team on how negative comments will be dealt with. E.g. each time someone makes a negative comment, the policy is to let the group member know that he or she will be asked to leave after three negative comments.

After the explanation of the rules it is optional to run a warm up exercise. If a warm up exercise in creative thinking is conducted it should not last longer than 5-minutes. The following are typical warm-up exercises: Brainstorm "as many ideas as you can think of" for "a name for the group", "a telephone book", "an old blanket", "a fountain pen", "a ball", "a lighter".

**Brainstorm Process:** Set a time limit (say 20 to 30 minutes) and ask the participants to start sharing ideas. Speed, quantity and spontaneity are the goals of the process. If the flow of ideas slow down, facilitator can encourage the process buy throwing out an outrageous idea that can serve as a stepping-stone. Some participants may be reluctant to speak out in a group but brainstorming is an open and sharing activity that encourages all in the group to participate. If things really slow down interrupt the session for a brief period of relaxation, then start again by using a force-fitting technique.

A list of guidelines for generating ideas, that is neither exclusive nor exhaustive, are given below.

- Absolutely no comments or reactions are allowed while ideas are being hatched.
- Brainstorming - means lot's of ideas, lot's of ideas, ... ..
- Group involvement is at high levels.
- Ideas can be wild and crazy.
- Remember that creative ideas can be triggered by some other idea.
- The focus is on creating an environment for thoughts and ideas.
- Atmosphere of complete freedom to suggest.

The facilitator should lead the exercise to restrain the attempts of evaluation as critical or sarcastic comments. It should be avoided to give details of the ideas or keep too much time giving minimum variations of a same idea. For instance: A person presents as idea the technologies. Others present as idea the transfer of automotive technology, microelectronics technology, nano-technologies, etc. The facilitator can interrupt it, saying: "Now, there are enough technologies" or "from now on, we do not want more ideas of technologies..."



The exercise finishes when there is a great amount of ideas and the group shows signs of fatigue or when the free flow of ideas is dried up. Once the flow of ideas has slowed down to a trickle and the previously announced time limit is coming up, give a 3-minute warning. Some of the best ideas can be generated during the extra time period at the end. Quantity is most important. A typical brainstorming session will yield 50 to 100 ideas.

There are several brainstorming techniques; Round Robin – members suggest in turn, Free wheeling – team shouts out their thoughts, Slip – each member writes down and turns in their ideas. The description and pros and cons of these techniques are summarized in Table 3, below.

In small teams, ideas can be called out as fast as they can be written down. In larger teams, people can take turns speaking. The participants should jot down any ideas they have so that they do not forget. Arrange a signal – such as a raised hand – to be used when someone has a modification or addition to an idea that has just been presented. Such “piggybacking” is encouraged and given priority. Do not allow long explanations; that will come when the ideas are evaluated. All ideas have to be recorded.

TABLE 3: Brainstorming Techniques			
TECHNIQUE	ROUND ROBIN	FREE WHEELING	SLIP (ANONYMOUS)
Methods:	<ol style="list-style-type: none"> <li>1. Members give ideas, around the room, in order</li> <li>2. All ideas listed on chart</li> <li>3. Members may pass after first round</li> <li>4. Structured</li> <li>5. No 'passing' on 1<sup>st</sup> round.</li> </ol>	<ol style="list-style-type: none"> <li>1. Members give ideas randomly</li> <li>2. All ideas listed on chart</li> <li>3. Unstructured</li> <li>4. Opens up the team, building level of trust.</li> </ol>	<ol style="list-style-type: none"> <li>1. Members list ideas on slip of paper</li> <li>2. Slips collected</li> <li>3. All ideas listed on chart</li> <li>4. Structured</li> </ol>
Advantages:	<ol style="list-style-type: none"> <li>1. Good starting technique</li> <li>2. No one dominates</li> <li>3. Focused</li> <li>4. Full participation</li> <li>5. Hitchhiking</li> </ol>	<ol style="list-style-type: none"> <li>1. Spontaneous</li> <li>2. Ideas more open and creative</li> <li>3. Takes the 'heat' off quiet/shy people</li> </ol>	<ol style="list-style-type: none"> <li>1. Good to “air out” issues</li> <li>2. Ideas are anonymous</li> <li>3. Reluctant member(s) can give ideas freely</li> </ol>
Disadvantages:	<ol style="list-style-type: none"> <li>1. Waiting for turn</li> <li>2. Forgetting ideas</li> <li>3. May put 'quiet' folks on the spot</li> <li>4. Individuals may keep to pass on; not on the first round</li> <li>5. Somebody said my idea already</li> </ol>	<ol style="list-style-type: none"> <li>1. Difficult to capture in print - use 2 scribes as required</li> <li>2. Some can dominate</li> <li>3. Quiet members may stay quiet</li> <li>4. Confusion when all talk at once</li> <li>5. May miss a few ideas</li> </ol>	<ol style="list-style-type: none"> <li>1. Creativity may be blocked</li> <li>2. No building possible</li> <li>3. Confusion over something written on slip</li> <li>4. No clarification can be used</li> </ol>

At the end of the execution phase, the facilitator thanks the team members for participating and collects all ideas that were written down.

## **Processing and Generalizing**

The brainstorming exercise has essentially the objective to generate ideas; processing is not required. Yet, a brief scrutiny of the experience may help the participants to appreciate the creativity process. The facilitator may ask the group about the feelings and difficulties (mental blocks) experienced in the exercise. The facilitator may also call the participants' attention to the differences between the nature of ideas generated in the beginning of the exercise and after a certain time, in order to verify the effect of the technique on the increase of the people's creative capacity.

Furthermore the long list of creative ideas may be reduced to a practical size to increase the utility of the outcome of the brainstorming exercise. List Reduction is a method used to narrow down the range of ideas, options, and solutions to a practical size. It is a contraction process of eliminating the low priorities and focusing on high priority ideas. List reduction begins after brainstorming. A structured is needed to achieve group goal of consensus by list reducing. The "Rules of Reduction" creates an environment of 'fair and equal' treatment, building group consensus. These are given below as the three steps of the reduction process;

1. Discuss Pros and Cons of each idea; characterize ideas
  - Group reactions are allowed
  - No list changes/crossouts/eliminations
2. Categorise and group similar things through consensus; combine like ideas
  - Ask, "Is #2 like #1?" and so on down the line or let the participants make suggestions for combination of ideas stating "#x" is like #y"
  - Avoid all ideas getting clumped under one number (The "Dumpster Effect")
  - If one individual disagrees with the proposed combination, it gets a different number - no questions asked
3. Once the list has been reduced use a multiple voting or any prioritization technique to obtain the priorities of the ideas in the list.

## **SWOT ANALYSIS**

SWOT Analysis is a very effective way of identifying the Strengths and Weaknesses, and of examining the Opportunities and Threats facing the issue/subject at hand. The aim of the SWOT analysis (Strengths, Weaknesses, Opportunities and Threats) is to capture a snapshot of the main strengths and weaknesses of the issue/subject at hand and the opportunities and threats which may affect the way in which it works in the future.

A SWOT Analysis is one of the most useful exercises one can undertake to increase knowledge about the issue/subject at hand. Often carrying out an analysis using the SWOT framework will be enough to reveal changes that can be usefully made. Carrying out an analysis using the SWOT framework will help focusing activities into areas where the issue/subject at hand are strong, and where the greatest opportunities lie.

Strengths and weaknesses, which constitute the first part of the analysis, are those factors that are internal to the issue/subject at hand, the aspects that can be controlled. A

SWOT analysis should not just look at output. It considers all aspects of the issue/subject. These may include physical facilities, infrastructure, human resources and location. The second part of the analysis - opportunities and threats - relates to those aspects outside the issue/subject at hand which have an effect on it. Obvious examples of the latter include government policies, regional and global factors, allocation of budgets and financial management, and competition from others.

### The Execution

The structure of the SWOT analysis is schematised in Table 4, below. The space of scrutiny of the issue/subject at hand is divided into four quadrants.

Table 4: SWOT analysis		
	Positive	Negative
Internal	Strengths: Strengths are internal, positive factors – developed from a realistic assessment of your abilities.	Weaknesses: Weaknesses are internal, negative factors – developed from a realistic assessment of your abilities.
External	Opportunities: Opportunities are external, positive factors – developed from a realistic assessment of the macro environment.	Threats: Threats are external, negative factors – developed from a realistic assessment of the macro environment.

The top two quadrants are internal aspects of the issue/subject at hand; Strengths (positive) and Weaknesses (negative). The bottom two quadrants are external aspects of the issue/subject at hand; Opportunities (positive) and Threats (negative).

SWOT Analysis is all about answering questions about the issue/subject at hand aiming at filling the four boxes shown in Table 4. A representative set of questions to start up any SWOT session is listed in Table 5.

Table 5: A sample set of start up questions for a SWOT analysis	
Strengths (Internal – Positive)	<ul style="list-style-type: none"> <li>• What are your advantages?</li> <li>• What do you do well?</li> <li>• What do others see as your strengths?</li> <li>• Other relevant questions....</li> </ul> <p>in terms of</p> <ul style="list-style-type: none"> <li>• Attitude and Vision</li> <li>• Knowledge Capital</li> <li>• General Skills</li> <li>• Technical Skills Experience</li> <li>• Human Capital</li> <li>• Network Credentials</li> <li>• ...</li> </ul>

<p><b>Weaknesses (Internal – Negative)</b></p>	<ul style="list-style-type: none"> <li>• What could you improve?</li> <li>• What do you do badly?</li> <li>• What should you avoid?</li> <li>• Other relevant questions...</li> </ul> <p>in terms of</p> <ul style="list-style-type: none"> <li>• Knowledge Deficits</li> <li>• Gaps in Education</li> <li>• Skill Deficits</li> <li>• Lack of Experience</li> <li>• Inadequacy in Network</li> <li>• Negative Aspects of Human Capital</li> <li>• ...</li> </ul>
<p><b>Opportunities (External – Positive)</b></p>	<ul style="list-style-type: none"> <li>• Where are the good opportunities facing?</li> <li>• What are the interesting trends?</li> <li>• Other relevant questions...</li> </ul> <p>in terms of</p> <ul style="list-style-type: none"> <li>• What is positive in the field</li> <li>• Changes in technology and markets on both a broad and narrow scale</li> <li>• Changes in government policy related to field</li> <li>• Changes in social patterns, population profiles, lifestyle changes, etc.</li> <li>• Local Events</li> <li>• How the field could change</li> <li>• Need in field for your vision, or attitude to change and reform</li> <li>• ...</li> </ul>
<p><b>Threats (Internal – Positive)</b></p>	<ul style="list-style-type: none"> <li>• What obstacles do you face?</li> <li>• What is your competition doing?</li> <li>• Are the required specifications for your job, products or services changing?</li> <li>• Is changing technology threatening your position?</li> <li>• Do you have bad debt or cash-flow problems?</li> <li>• Other relevant questions...</li> </ul> <p>in terms of</p> <ul style="list-style-type: none"> <li>• What is negative in the field</li> <li>• How the field is changing/declining</li> <li>• Competitive factors in field</li> <li>• Threat of “substitutes”</li> <li>• Other factors that may inhibit your access to opportunities</li> </ul>

It is important to look at Strengths and Weaknesses critically, as if from an outside perspective, e.g. from the point of view of someone outside the organisation. An attribute is only Strength if an external party would perceive it as such. This perspective is very important in the use of SWOT analysis: there is a critical distinction between

what the organisers think is important and what others consider important. Therefore, it is important to have participants be selected not only among those who have a direct interest in the topic but those who may have an indirect interest or even no interest at all but be affected by the changes in the issue/subject.

Often it is difficult to decide in which box (or boxes) an attribute should be placed. For example, a change may provide Opportunities for growth and development, while at the same time posing a Threat.

During the execution of SWOT analysis, it must be secured that everyone is involved, so that no aspects are overlooked. To do this, it is very common approach to exercise series of brainstorming sessions for each one of the four boxes. Sometimes, where there are sensitive issues, participants may wish to preserve anonymity. Then, individuals are asked to complete a SWOT analysis sheet (Annex 3).

### The follow up stage

There is a follow-up stage to carrying out a SWOT analysis - to ensure that action is taken on Weaknesses and Threats where appropriate taking the advantage of the Strengths and Opportunities.

Having obtained the list of Strengths, Weaknesses, Opportunities, and Threats either from brainstorming sessions or following pooling results, the results need to be analysed by discussion. In order to have a fruitful discussion; list reduction process described above may be used followed by any one of the prioritization techniques.

From the list of entries in each of the SWOT boxes, it is possible to develop a strategy, based on the relationships between Strengths and Opportunities and Weaknesses and Threats as shown in Figure 2, below, recalling the fact that

- Strengths: Capabilities that reinforce our ability to create sustainable competitive advantage
- Opportunities: Open up possibilities for creation of sustainable competitive advantage
- Weaknesses: Detract from ability to create sustainable competitive advantage
- Threats: Potential to weaken or destroy existing base for competitive advantage

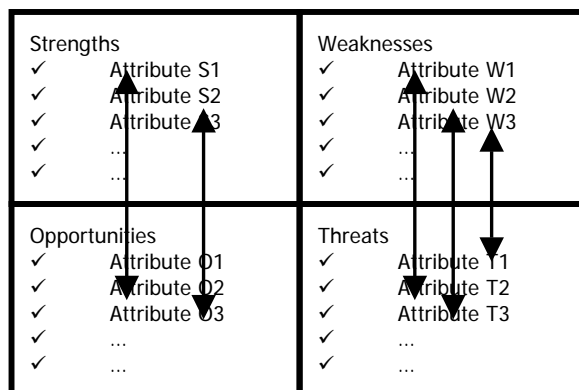


Figure 2: Relating S-O and W- T

Opportunities and Threats need to be assessed in terms of both the likelihood of them being relevant (relevance) and their significance to the organisation if they do happen (impact). Each item recorded as an Opportunity or Threat can be scored on a scale of 0-10 for both probability and impact as shown in Figure 3.

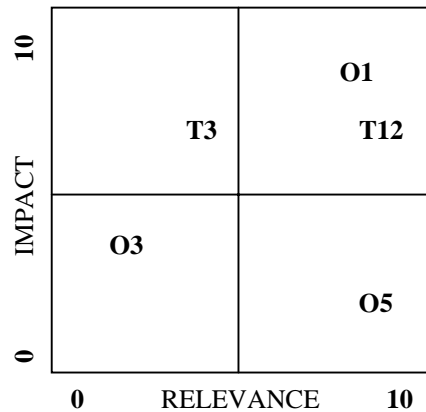


Figure 3: Impact-Relevance Plane

Taking the positioning of the items in the four boxes of the SWOT Analysis, strategies ready to deal with these factors are developed. In essence, these should be to effectively match Strengths to Opportunities to neutralise Weaknesses and Threats. It may not always be possible to correct weaknesses in the short term, especially if they relate to physical factors. However, identifying them at least ensures they are firmly on the agenda and not ignored. Carrying out this analysis is often illuminating - both in terms of pointing out what needs to be done, and in putting problems into perspective. SWOT analysis puts the issue/subject at hand into the context of the environment in which it works, so that no outside change (opportunity or threat) is totally unanticipated. This helps it to develop contingency plans. Interesting insights may emerge when SWOT analyses are applied to competitors too!

## STEEP ANALYSIS

**STEEP** stands for the **S**ocial/Cultural Factors; **T**echnological Changes; **E**conomic Conditions; **E**cological/Environmental Impact; and **P**olitical/Legal Issues (and Values) that affect the today and the future of the issue/subject at hand. A STEEP Analysis is therefore a critical assessment of the macro external environment in which the issue/subject at hand operates. A good STEEP Analysis is one that not only pinpoints the relevant effects, but also assesses the opportunities and threats that these effects present to the issue/subject at hand. The best time to use a STEEP Analysis is probably after issue/subject at hand is defined and a SWOT Analysis is performed.

STEEP Analysis is essentially scanning the macro external environment for forces and trends that may be opportunities or threats for the issue/subject at hand. It enhances understanding the external environment's context. External analysis addresses the following generic questions:

- What social, economic, ecological, technological, and political factors in the external environment influence the ability to accomplish the mission and vision?
- Which events or trends are having (or may have) an impact on the issue/subject at hand?
- How will these external factors develop? What will the developments mean for the issue/subject at hand?
- How will developments affect the position in the marketplace, stakeholders, the programs, the products and services, and the institutional capacities?

The advantages and disadvantages of the STEEP Analysis is summarised in Table 6, below.

Table 6: Advantages and Disadvantages of STEEP Analysis	
Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• It is straightforward, easy to grasp technique</li> <li>• It helps scrutiny of broad categories covering major external environmental factors</li> <li>• It can prioritise specifics for the issue/subject at hand</li> </ul>	<ul style="list-style-type: none"> <li>• The linear analysis of trends assumes future will be like the past</li> <li>• The reliance on data may exclude attitudes as predictors of the future</li> </ul>

### The Execution

The structure of the STEEP analysis is schematised in Table7, below. The space of scrutiny of the issue/subject at hand is divided into five boxes. STEEP Analysis is all about answering questions about the issue/subject at hand aiming at filling the five boxes shown in Table 7. A set of essential questions to start up any STEEP session is listed in the same figure.

Table 7: The structure of STEEP Analysis
<p><b>Social/Cultural</b></p> <p>"How will changes in the Social/Cultural structure and behaviour of our population affect the issue/subject at hand and the skills required running and operating it?"</p>
<p><b>Technological</b></p> <p>"How will technological advances deliver changes in the way the issue/subject at hand run and operate?"</p>
<p><b>Economical</b></p> <p>"How will changes in the market or economic environment require the issue/subject at hand to reassess how it operates?"</p>
<p><b>Ecological/Environmental</b></p> <p>"How will ecological (conservation, health and green) planning affect how the issue/subject at hand run and operate in years to come?"</p>
<p><b>Political/Legal</b></p> <p>"How will Government legislation and Government and/or local policies affect the way the strategies for the issue/subject at hand are managed?"</p>

During the execution of STEEP analysis, as is the case for an implementation of any participative technique, it must be secured that everyone is involved, so that no aspects are overlooked. To do this, it is very common approach to exercise series of brainstorming sessions for each one of the five boxes. For a small group of participants, a single brainstorming session is sufficient to have all five boxes filled simultaneously. Sometimes, where there are sensitive issues, participants may wish to preserve anonymity. Then, individuals are asked to complete a STEEP analysis sheet (Annex 4).

One probably needs about an hour for the STEEP Analysis process. The process has the following steps:

- Running a brainstorming session to gather information on macro external environmental (social/cultural factors, technological change, economic conditions, ecological/environmental impact, and political/legal issues) trends. A trend is a data series of past, current, and future developments that can be estimated or measured over time.
- Gathering information about potential developments or events. An event is a discrete, confirmable occurrence that makes the future different from the past.

A representative set of attributes to start up any STEEP session that would lead to gathering of trends and developments and events are listed in Table 8.

Table 8: A sample set of start up attributes for a STEEP analysis		
BOXES	TRENDS	DEVELOPMENTS / EVENTS
Social/Cultural	<ul style="list-style-type: none"> <li>• Demographics,</li> <li>• Values and lifestyles,</li> <li>• Attitudes,</li> <li>• Families,</li> <li>• Health,</li> <li>• Crime,</li> <li>• Education,</li> <li>• Others?</li> </ul>	<ul style="list-style-type: none"> <li>• Population growth and rates</li> <li>• Age distribution</li> <li>• Health awareness</li> <li>• Demographics</li> <li>• Distribution of income</li> <li>• Social mobility</li> <li>• Lifestyle changes</li> <li>• Consumerism</li> <li>• Lifestyle changes</li> <li>• Regional shifts</li> <li>• Others?</li> </ul>
Technological	<ul style="list-style-type: none"> <li>• Scientific</li> <li>• Technological</li> <li>• Industrial</li> <li>• Others?</li> </ul>	<ul style="list-style-type: none"> <li>• Automation technology incentives</li> <li>• New discoveries and innovations</li> <li>• Speed of technology transfer</li> <li>• Rates of obsolescence</li> <li>• Information technology</li> <li>• Government spending on R&amp;D</li> <li>• High cost of R&amp;D so use of joint ventures</li> <li>• Focus of technological effort</li> <li>• Patent protection</li> <li>• Satellite use</li> <li>• Internet and e-commerce</li> <li>• Others?</li> </ul>



Economical	<ul style="list-style-type: none"> <li>• International,</li> <li>• National/Regional/Local economies,</li> <li>• Labour force,</li> <li>• Income,</li> <li>• Infrastructure,</li> <li>• Others?</li> </ul>	<ul style="list-style-type: none"> <li>• Economic growth</li> <li>• Income growth</li> <li>• Interest rates</li> <li>• Exchange rates</li> <li>• Inflation</li> <li>• Energy availability and cost</li> <li>• Employment</li> <li>• Trade deficits</li> <li>• Public spending/borrowing</li> <li>• Wealth</li> <li>• Purchasing power</li> <li>• Savings</li> <li>• Investment</li> <li>• Others?</li> </ul>
Ecological/ Environmental	<ul style="list-style-type: none"> <li>• Reusing and recycling energy,</li> <li>• Protecting biological bases,</li> <li>• Food protection,</li> <li>• Air and water quality,</li> <li>• Others</li> </ul>	<ul style="list-style-type: none"> <li>• Public Awareness,</li> <li>• Education</li> <li>• Public policies</li> <li>• Environmental regulations</li> <li>• Environmental protection laws</li> <li>• Alternative and new energy use</li> <li>• Others</li> </ul>
Political/Legal (Values)	<ul style="list-style-type: none"> <li>• Government policies,</li> <li>• Tax policy,</li> <li>• Legislation,</li> <li>• Political participation,</li> <li>• Political influences,</li> <li>• Changes in government &amp; policy,</li> <li>• Others?</li> </ul>	<ul style="list-style-type: none"> <li>• Political stability,</li> <li>• Trade limits,</li> <li>• Employment laws,</li> <li>• Monopolies,</li> <li>• Market regulation/de-regulation,</li> <li>• Foreign trade regulations,</li> <li>• Others?</li> </ul>

Social factors are the building stones that build societies. They affect people's choice and consist of beliefs, values and attitudes of the society, so it's so important to understand changes in these areas. New and advanced Technologies have become an integral part of daily life; all aspects of society are affected by the changes in technology. Ecological issues are essential not just for a sustainable development but also have a vital role for the survival of all species. Economic factors include the purchasing power and the definite cost of capital. Usually the economy is linked with the political situation. Political factors are mainly about government regulations and it's also about legal issues. Inevitably there will often be some overlap across these categories.

During the process of execution of the STEEP analysis,

- Ask the participants in the process to scan the trends and identify events that "signal, the new, the unexpected, the major and/or the minor."
- At first gather a list of Trend Statements that could affect the future if they occurred within the next, say, ten years. It is important that a trend statement is unambiguous; otherwise, different people may understand the statement differently and there will be no clear target that allows us to derive implications and action steps.

- Then, exploring the possible and/or plausible futures based upon these trends for the issue/subject at hand, the participants should then identify and/or relate potential opportunities and threats for each entry of the list of trends.

### The follow up stage

There is a follow - up stage to carrying out a STEEP analysis - to ensure that action is taken on the five factors elaborated to have a better understanding of the external environment where appropriate taking the advantage of the Strengths and Opportunities.

Having obtained the list of Social/cultural, Technological, Economical, Ecological/environmental and Political/legal (Values) trends as shown in Table 9, either from brainstorming sessions or following pooling results, the results need to be analysed by discussion. In order to have a fruitful discussion, list reduction process described above may be used followed by any one of the prioritization techniques. the list of entries in each of the STEEP boxes must be reduced and those entries that are most significant for the issue/subject at hand must be identified. It is also essential that during this process of reduction the participants must distinguish trends that are converging, diverging, speeding up, slowing down, or interacting.

Table 9: The list of trends	
BOXES	TRENDS
Social/Cultural	SC01, SC02, SC03, ..., SC15, ...
Technological	TE01, TE02, TE03, ..., TE12, ...
Economical	EC01, EC02, EC03, ..., EC09, ...
Ecological/ Environmental	EN01, EN02, EN03, ..., EN07, ...
Political/Legal (Values)	PO01, PO02, PO03, ..., PO13, ...

The Cross-Impact Analysis is the next step to develop strategies using the list of trends entries in each of the STEEP boxes. The Cross-Impact Analysis is schematised in Table 10, below. The Cross-Impact Analysis Matrix helps the participants to identify the interactions between STEEP factors. Once these interactions, as depicted in Table 10, are established, it is possible to develop a strategy, based on these interactions.

Table 10: The Cross Impact Matrix				
	Technological	Economical	Ecological	Political
Social	So – Te • SO02-TE11 • SO07-TE01,TE08 •	So – Ec • SO04-EC10 • SO11,SO13-EC03 •	So – En • SO10-EN09 • SO07-EN14 • •	So – Po • SO08-PO01 • • •
Technolo		Te– Ec • TE02-EC11 • TE07-EC01,EC08 •	Te – En • TE12-EN11 • TE07-EN01,EN08 •	Te – Po • TE02,TE11-PO07 • TE01,TE08-PO04,PO13
Economic			Ec – En • EC02-EN11 • EC07,EC01-EN08 •	Ec – Po • EC11-PO11 • EC06-PO01,PO08 •
Ecologic				En – Po • EN12-PO11 • EN07-PO11,PO12 •

However, it is recommended that before the development of the strategies based on these interactions, the contents of the boxes of The Cross-Impact Analysis Matrix be prioritized. Prioritization may be carried out in two steps:

- Each box can be scored on a scale of 0-10 in terms of both the likelihood of their actually happening (probability) and their significance to the issue/subject at hand if they do happen (impact) as shown in Figure 4.

IMPACT	10		So – Po Ec – En
	0	So – Te	So – Ec
		0	PROBABILITY 10

Figure 4: The Impact-Probability

Based on the positioning of the boxes on the “impact – probability” plane, they are rated and the results may be tabulated as shown in Table 11.

Table 11: Rating of Cross Impact Boxes	
The Cross-Impact Analysis Matrix Box	Priority Level
So – Te	-
So – Ec	+
So – En	+
So – Po	++
Te– Ec	-
Te – En	-
Te – Po	+
Ec – En	++
Ec – Po	+
En – Po	-

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## **ANNEX 1: Guidelines for the participants**

In order to clarify the brainstorming process, the facilitator can write down on a soft board or a flip chart the following instructions:

- All members of the group must participate. Be creative. The more ideas, the better.
- No idea should be blocked. All ideas are allowed, even if they seem absurd or foolish for the author himself.
- The participants must give only one idea per turn.
- The group should make its thinking as funny or as silly as possible.
- All ideas will be respected and not evaluated. Do not criticise or judge. Do not even groan, frown or laugh. All ideas are equally valid at this point.
- Ideas already mentioned must be avoided.
- The ideas should not be detailed. Keep ideas brief, do not tell stories.

## **ANNEX 2: Guidelines for the facilitators**

The facilitator must follow these rules for more productive brainstorming sessions:

- Establish a warm and supporting environment. Keep a relaxed atmosphere (the process should be disciplined and structured, but informal).
- Focus on the issue to be brainstormed and set rules (see annex 1).
- Emphasise that a quantity of ideas is the goal.
- Write down every idea – clearly and where everyone can see them (visual feedback is critical). Try to keep each idea expressed in as few words as possible (without losing the meaning, of course).
- Discourage evaluative or critical comments: contributions are accepted without judgement. Explain that everyone's ideas are valuable and worthy of respect.
- Do not speak during the brainstorming.
- Encourage the participants to listen carefully and politely to the others contributions.
- Give everyone equal opportunity to contribute.

## **ANNEX 3:**

### **SWOT Analysis Sheet**

<u>Strengths</u>	<u>Weaknesses</u>	<u>Opportunities</u>	<u>Threats</u>
<ul style="list-style-type: none"> <li>• What are your advantages?</li> <li>• What do you do well?</li> <li>• What do others see as your strengths?</li> <li>• Other relevant questions...</li> </ul>	<ul style="list-style-type: none"> <li>• What could you improve?</li> <li>• What do you do badly?</li> <li>• What should you avoid?</li> <li>• Other relevant questions...</li> </ul>	<ul style="list-style-type: none"> <li>• Where are the good opportunities facing?</li> <li>• What are the interesting trends?</li> <li>• Other relevant questions...</li> </ul>	<ul style="list-style-type: none"> <li>• What obstacles do you face?</li> <li>• What is your competition doing?</li> <li>• Are the required specifications for your job, products or services changing?</li> <li>• Is changing technology threatening your position?</li> <li>• Do you have bad debt or cash-flow problems?</li> <li>• Other relevant questions...</li> </ul>

ANNEX 4:

**STEEP Analysis Sheet**

BOXES	TRENDS	DEVELOPMENTS / EVENTS
Social/Cultural Factors		
Technological Change		
Economical Conditions		
Ecological/ Environmental Impact		
Political/Legal (Values) Issues		

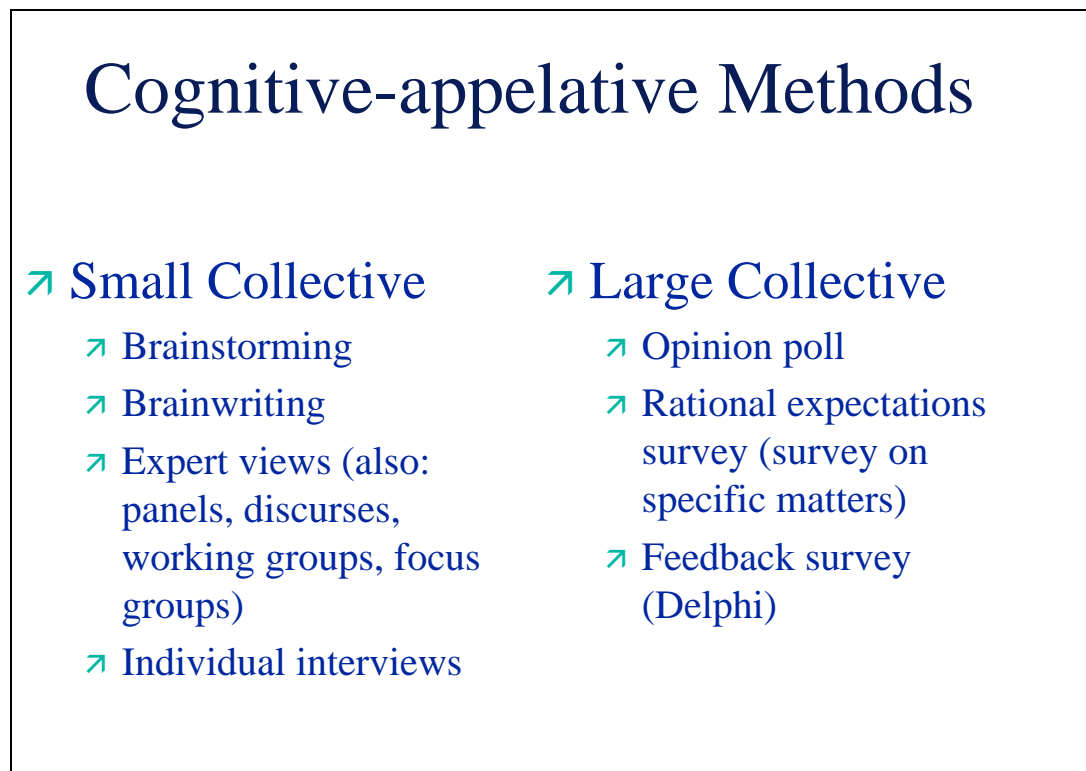
# Delphi and Survey Techniques

*Dr. Kerstin CUHLS*

## 1. Methods to collect views through surveys

Foresight is about the systematic view into the future in order to draw conclusions for today. To do this systematically, different kinds of surveys are a good means. There are different methods to collect views from persons for foresight purposes. But why collecting views? The future is unknown to us. We can extrapolate, simulate, design different models but all these methods are based on assumptions made by persons. When there are data extrapolations, it is unknown, where the trend breaks and no one can assume that trends remain stable forever. Therefore in foresight processes - contrary to forecasting – it is tried to look openly into the future by bringing in different opinions, different information and information sources and communicate about them (see e.g. Martin 1995). For this purpose, opinions and views are collected and assessed with surveys which make the tacit knowledge in the heads of persons a bit more explicit. According to the objectives of a foresight activity, there are different kinds of surveys (figure 1-1).

Figure 1-1: Different kinds of surveys used in foresight





There is nowadays also the question if the survey is

- collecting views or judging on them, e.g. for decision-making,
- representative or not, this is a similar question as is asked in section 4.4.,
- a postal survey, one by fax, an electronic survey or telephone interviews.
- If it is an electronic survey, there is the question of online (e.g. internet) or offline (e.g. e-mail), in some countries and by specific person groups online surveys are not always accepted.
- There is also the question of the intensity of questions asked, e.g. an online-voting, which is mainly used to assess something, is different from an open survey.

In all cases, the sample has to be clear and controllable. Without control on the sample, it is difficult to interpret the results. The sample has to be large enough to draw any conclusions.

The usual way in foresight is the combination of a formal survey (Delphi, see below, or simple survey) with working groups or panels because topics as well as questions have to be formulated elsewhere. There is also the possibility to do this as desk research, even with the help of bibliometrics or other analyses, but as foresight processes are communicative processes, often even aiming at bringing different stakeholders together instead of just asking them questions, the major way of doing it is a mix of methods.

The following sections concentrate on Delphi surveys, but what is said about Delphi is also relevant for the other types of surveys.

## **2. Definition, principles and types of Delphi surveys**

### **2.1 On the History of Delphi**

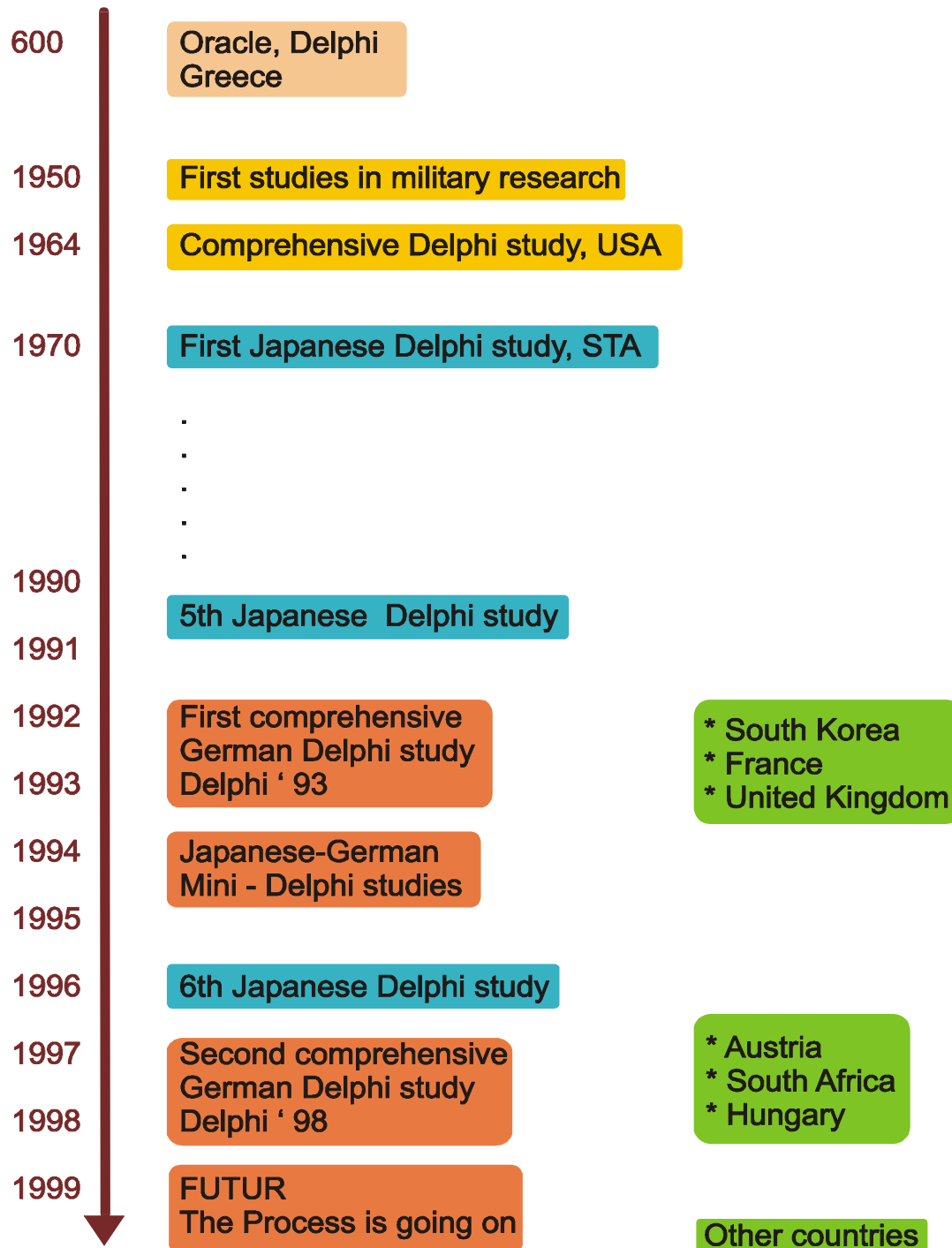
The Delphi method belongs to the subjective-intuitive methods of foresight. Delphi was developed in the 1950's by the Rand Corporation, Santa Monica, California, in operations research. The name can be traced back to the Delphic oracle, as Woudenberg (1991, p. 132) reports that the name 'Delphi' was intentionally coined by Kaplan, an associate professor of philosophy at the UCLA working for the RAND corporation in a research effort directed at improving the use of expert predictions in policy-making. Kaplan et al. (1950, p. 94) referred to the 'principle of the oracle' as a 'non-falsifiable prediction', a statement that does not have the property of being 'true' or 'false'. Thus 'Delphi' for the modern foresight method seems to be more than a simple brand name.

The foundation of the temple at Delphi and its oracle took place before recorded history. Thanks to archaeologists and historians we have extensive knowledge on the functions and benefits of the oracle (Parke/ Wormell 1956). For a thousand years of recorded history the Greeks and other peoples, sometimes as private individuals, sometimes as official ambassadors, came to Delphi to consult the prophetess, who was called Pythia. Her words were taken to reveal the rules of the Gods. These prophecies were not usually

intended simply to be a prediction of the future as such. Pythia's function was to tell the divine purpose in a normative way in order to shape coming events. This is similar to the current approach.

In figure 2-1, as an illumination of the 'genealogical tree' of the Delphi technique, the major steps achieved in a chronological manner are listed. The major national endeavours using the Delphi technique are taken into account, but not for example the many experimental or scientific applications where, say, 20 students are engaged in the frame of a master or doctoral thesis. Also not included are business applications on a more focussed and less sophisticated level. It has to be stressed here that the focus lies intentionally on large holistic surveys with a likely impact on society. For the other type of Delphi application, refer to business management textbooks or monographies on strategic planning where Delphi applications are mentioned among the other tools (compare Linstone/ Thuroff 1975; Martino 1993; Jantsch 1967; Cuhls 1998).

Figure 2-1:           Genealogical tree of Delphi



As already stated, the initial work was performed at RAND after 1948. In 1964, for the first time, a huge Delphi survey in the civil sector was published (Gordon/Helmer 1964). Shortly after this, the lead in further development and broader application of the Delphi technique was taken over by Japan. Japan started its development of S&T later than Western countries and was nevertheless immensely successful. There are many success factors for this story – and one of them was the adaptation of large foresight studies at the end of the 1960s. In Japan, the Delphi method was selected for foresight activities, and the Science and Technology Agency in 1969 started to conduct a large study on the future of science and technology. Before, in a systematic attempt, foresight

knowledge from the USA was invited. Although the first large Delphi study in Japan did not correctly describe the oil price shock and was conducted and published just before that happened, the Japanese Delphi process continued every five years. It is regarded as an update of data concerning the future. In 1997, the sixth study was finished, the seventh was published in 2001, the eighth is in preparation.

With the resurrection of foresight in general and the possibilities to filter all these 'options' of different actors, the Delphi technique was taken out of the toolbox and implemented in Europe in a different manner than in the early years. In the new wave of large-scale government foresight in Europe, Dutch and German government agencies and similar bodies were among the first, with France and the United Kingdom joining in quickly. The Germans organised a learning phase starting both from the 'mediating' publication of Irvine and Martin (1984) as well as from Japanese experiences and co-operated in their first Delphi with the Japanese fifth endeavour (Cuhls/ Kuwahara 1994). France in turn followed in just copying the German approach. In none of these countries was a sole resort to the Delphi technique considered useful. In the Netherlands, Delphi methods were not embarked upon at all, whereas in Germany parallel approaches are reported, some using the Delphi method, others not. The same is true for France where a Delphi survey and the critical technologies approach (see Grupp 1999) were pursued in parallel and organised by different, even competing ministries. Again in co-operation between Japanese and German institutions, joint methodological developments were achieved in the frame of a 'Mini-Delphi'.

## **2.2 Definition and Principles of Delphi**

The *Delphi method* is based on structural surveys and makes use of the intuitive available information of the participants, who are mainly experts. Therefore, it delivers qualitative as well as quantitative results and has beneath its explorative, predictive even normative elements. There is single Delphi methodology but the applications are diverse. There is agreement that Delphi is an expert survey in two or more 'rounds' in which in the second and later rounds of the survey the results of the previous round are given as feedback. Therefore, the experts answer from the second round on under the influence of their colleagues' opinions. Thus, the Delphi method is a 'relatively strongly structured group communication process, in which matters, on which naturally unsure and incomplete knowledge is available, are judged upon by experts', so Häder and Häder (1995, p. 12). Giving feedback and the anonymity of the Delphi survey are important characteristics.

Wechsler describes a 'Standard-Delphi-Method' in the following way: *'It is a survey which is steered by a monitor group, comprises several rounds of a group of experts, who are anonymous among each other and for whose subjective-intuitive prognoses a consensus is aimed at. After each survey round, a standard feedback about the statistical group judgement calculated from median and quartiles of single prognoses is given and if possible, the arguments and counterarguments of the extreme answers are fed back...'* (Wechsler 1978, pp. 23f.).

Characteristics of Delphi are therefore specified as (see e.g. Häder/ Häder 1995):

- Content of Delphi studies are always issues about which unsure respectively incomplete knowledge exists. Otherwise there are more efficient methods for decision-making.
- Delphi are judgement processes with unsure aspects. The persons involved in Delphi studies only give estimations.
- For the participation experts are to be involved who on the basis of their knowledge and experience are able to assess in a competent way. During the rounds, they have the opportunity to gather new information.
- Especially the psychological process in connection with communication and less in the sense of mathematical models have to be stressed (Pill 1971, p. 64, Dalkey 1968 and 1969, Dalkey/ Brown/ Cochran 1969, Dalkey/ Helmer 1963, Krüger 1975).
- Delphi tries to make use of self-fulfilling and self-destroying prophecies in the sense of shaping or even 'creating' the future.

### **3. When does the use of a Delphi as a foresight tool make sense?**

The Delphi method is mainly used when long-term issues have to be assessed. As it is a procedure to identify statements (topics) that are relevant for the future, it reduces the tacit and complex knowledge to a single statement and makes it possible to judge upon. Therefore, the use in combination with other methodologies like scenarios, technology list or others can be interesting. On the other hand, in more complex issues, when the themes cannot be reduced that much or when thinking and discussions in alternatives are the major target, the Delphi is not the method of choice. It is also suitable if there is the (political) attempt to involve many persons in processes (Eto 2003).

For the Japanese policy, it was especially interesting to answer the following question (and this question is also asked by other governments, too, now): How should we proceed with the long-term application-oriented basic research of the hyphenated type? This extension is no mistake, it is really meant *long-term application-oriented basic research*. This is the research where one does not know what will be found out in the laboratory in the next month or year, but it is research which does not only satisfy scientific curiosity and the enhancement of knowledge. It is research with a definite long-term economic or social perspective. Examples are climate research, health research, environmental research and so forth. In days of low budgets many business and policy-makers think it is impossible to support each piece of interesting research only for the sake of good quality. One has to discuss the long-term orientation in which we invested our precious money. The public is convinced that science and technology are partly responsible for modern bottlenecks and problems and hence has a right to learn about priorities in technology and also the opposite, the non-priorities, what is down at the end of the list of priorities.

Consider the situation in which a company or a ministry has to decide which of two research programmes to support, A or B. Programme A is proposed from faculty A and industry A and the peers from discipline A have given their reviews. Programme B in conjunction with industry B originates from faculty B and the peers of discipline B

made up their minds. Everybody did her or his best. But how to decide between them? Do the peers know each other? Our science and technology system of tomorrow needs, alongside with disciplinary peers, new instruments to mediate between A and B, and here is another function of foresight, across the board. A second argument here is that they all have their stakes in the matter. They come from the technology provider side. But do they really know what is needed in the future?

The Delphi technique as a foresight tool seems to possess certain degrees of invariance to survive in the changing challenges of the past 50 years. The method could serve different understandings of forecasting or foresight and was probably understood by the users as being relevant for covering technical perspectives, organisational perspectives, but also personal perspectives. The individual could express a distinctly different opinion as compared to the group perspective and this to a differing degree between the technical details under scrutiny. As multiple perspectives are recommended for decision-making, (Linstone/ Mitroff 1994; Linstone 1998) the Delphi technique seems to have appeal in quite diverse situations which touch the long-range scales. As it can be shown in controlled scientific experiments that the position of Delphi estimates is not better than those of other consensus-oriented methods (Woudenberg 1991) it must be the communicative force of Delphi approaches that facilitates the switching between different perspectives. What users especially like are the sets of data about the future that are gathered. Writing down future topics seems to have an immense psychological effect because it transfers implicit to tacit knowledge to the more visible, explicit, and therefore transferable knowledge.

Nevertheless, the danger that many persons regard this as 'the future' that 'will come true' cannot be neglected. When the media in Germany used Delphi '98 data for an outlook into the next century, they often made the mistake of arguing that the future will be like it is described in Delphi '98 disregarding that the decisions of today (or non-decisions) have a strong effect on the things to come and that Delphi can only provide 'potential answers' to problems that can already be identified today.

Therefore, one can conclude that Delphi and other surveys are tools to bring together the opinions or judgements of a large number of persons. These kinds of surveys are mainly useful in processes where the exchange of opinions and the communication effect is important but which are mainly result-oriented. Especially when data sets are needed for priority-setting (see the priority-setting paper), they deliver the essential basics.

#### **4. Design of a Delphi process**

There are of course different possibilities to organise a Delphi or other survey processes. Before starting, you should answer the following questions:

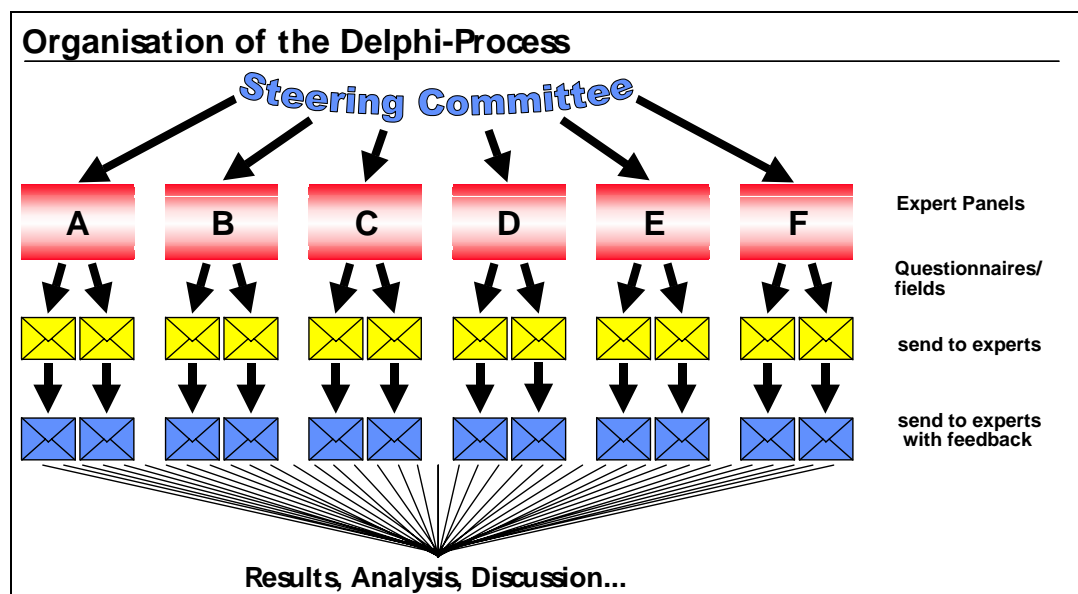
- What is my objective?

- What kind of resources (manpower, money...) and how much of them do I have?
- Is Delphi or a survey in general the right choice?
- If I decide on a Delphi: How can I formulate the statements for a Delphi?
- What are my questions?

#### 4.1 Organisation of a Delphi process

As mentioned before, the usual way is a combination of methods as especially the topics have to be formulated, a process that already needs methods like creativity procedures or can even be combined with scenarios or future workshops. In the following, a more "standard" procedure is described. It starts with the organisation of the process as such. In Figure 4-1, this is illustrated by the "real" example of the Delphi '98 in Germany (Cuhls/ Blind/ Grupp 1998 and 2002).

Figure 4-1: Organisation of a Delphi survey



The first step is to found a steering committee (if you need one) and a management team with sufficient capacities for the process. Then expert panels to prepare and formulate the statements are helpful unless it is decided to let that be done by the management team. The whole procedure has to be fixed in advance: Do you need panel meetings or do the teams work virtually? Is the questionnaire an electronic or a paper one? This means, that logistics (from Internet programming to typing the results from the paper versions) have to be organised. Will there be follow-up workshops, interviews, presentations? If yes, these also have to be organised and prepared. Printing of brochures, leaflets, questionnaire, reports have also to be considered.

#### 4.2 How to formulate topics

When the organisation is roughly defined, the fields of the Delphi or survey should be decided on. In some cases, one thematic field is enough, in many cases it is wished to

get an overview so that more fields are decided on and handled in a flexible way. There is always the possibility to add or disclose or re-name fields. To clarify what level of aggregation is meant, here are some examples from the Delphi '98 (Cuhls/ Blind/ Grupp 2002):

- Information & Communication
- Service & Consumption
- Management & Production
- Chemistry & Materials
- Health & Life Processes
- Agriculture & Nutrition
- Environment & Nature
- Energy & Resources
- Construction & Dwelling
- Mobility & Transport
- Space
- Big Science Experiments

Then, the topics have to be formulated. This is a time consuming process. It has to be clear, where the topics stem from. The easiest way is desk research and to take them from literature and surveys that are available. But the more creative way is to found working groups who have the task to structure the field and formulate topics. One can start from scratch, but it is very difficult to focus the themes, then. Therefore, the more efficient way is to feed in already existing material from research. Then a brainstorming, brainwriting or other creativity activities can add themes. Even a survey can be conducted at this step. When there is the critical mass of topics, then you need a filter system. What are the topics that are relevant for your specific Delphi or survey with your specific objectives? Here you can already make some formal or informal judgments (from discussion to giving points or school notes, even computer semi-anonymous topic selection is possible). It is recommended not to have more than 50 topics per questionnaire but it also depends on the questions you intend to ask.

It is helpful to start with structuring the field a bit before the creative phase starts and then flexibly adapt the structure of a field, figure 4-2 is one example from Services and Consumption in the Delphi '98.



Figure 4-2: Structuring Example from the German Delphi '98

**New services (based on new media)**

**Teleshopping**

- electronic supermarkets
- biometric technics for the authentication of trade transactions

**Finance services**

- digital money for electronic money transactions
- permanent monitoring as deterrence against money-laundering and fraud
- robot-leasing

**Leisure**

- pay-TV
- virtual reality for journeys, sports events, film shows etc.

Therefore, it is often necessary to filter twice or even three times because often, the experts in working groups add topics instead of reducing the number. The last step is the fine formulation. Often there are stereotypes of verbs (e.g. for science and technology foresights), that indicate innovation phases (is elucidated, is developed, is used, is in widespread use) or others so that the topics fit. The topics have to be formulated in a way that misunderstandings and different interpretations are impossible. It is also necessary not to have two different matters mixed in one topic. And the topics have to fit to your questions, so that the questions can be answered or the criteria you have can be judged upon.

The parallel step is to develop the criteria or "questions" as written columns in the questionnaire to be asked. The questions derive from the objectives of the foresight in general and have to be adapted to them. On the other hand, they have to be adapted to the way the statements are asked and vice versa. The statements have to be formulated in a way that the criteria or questions can be judged upon. Therefore it does not make sense to formulate them too early or too late but in parallel during the design phase of the questionnaire. For the different fields of the survey, they have to be adapted during the development phase accordingly, if comparisons are aimed at. If the different sections of the survey ask different questions, this is not necessary.

The careful development of questions is not only important for Delphi surveys but for (foresight) surveys in general. One of the major criteria or question is always the one about the estimated time of realisation. This is important to understand what time horizon you are talking about. It does not mean a prediction. Other criteria are necessary for the assessment of the validity of sample and answers like the self-estimation of the "expertise" of the participants. Some examples from national Delphi studies (e.g. the German Delphi '98 or the 5<sup>th</sup> Japanese Delphi, NISTEP 1997) are to ask if the topics are important for the enlargement of human knowledge, the economy, the development of

society, the solution of environmental problems, work and employment or to ask if they are unimportant.

Other questions and criteria can be:

- What is your expertise on the specific topic? Is it very high (you work on the field), is it high, medium or low?
- Which country is leading in the field?
- What measures should be taken? Here, also options can be given, e.g. better education, more financial support...

The time of realisation is normally asked in five year steps because single years would be so exact that nobody would be able to estimate that. The normal time horizon of Delphi studies is 30 years ahead (e.g. from now to 2033), but it is also helpful to ask for a later time (after 2033) or "never". The analysis is often done in percentiles (lower quartile, median, upper quartile) in order to show the breadth of the opinions. But simple graphics or percentages can also be used, especially if there is the hypotheses that "statistical camels" occur (there are two opposing groups of participants, one part judges an early time, added normally by high importance, and the other with late time horizons and low importance, representing different lobbies, or different schools of thought). The presentation of the data should be thought of in advance and depends on the "clients" or users.

When designing the questionnaire, it is important to consider from the beginning, how to give feedback to the participants during the second round. A usual way is to provide percentages or graphics from the accumulated data in a similar form as in the first round questionnaire. But that gives often the impression of a very 'full' picture and too much information has to be shown on one page. The new electronic media provide many more possibilities. Here is much room for creativity.

### **4.3 Dimension of a foresight study, resources needed**

As in all processes, the resources are the crucial point: Is there enough money, time and personal capacity available? Therefore, one has to calculate from the beginning, which resources are needed. Surveys in general and specifically Delphi surveys belong to the more resource-intensive foresight approaches, but also here, there are differences. A Delphi survey with statements from literature and an already existing database for addresses in one field sent by e-mail is relatively cheap (cheaper than e.g. workshop approaches). Huge processes with preparation workshops, a database that still has to be created and a larger range of fields is rather expensive. In many cases, printing costs make a huge part of the overall costs (e.g. if you print questionnaires, leaflets and reports).

Public relations activities and awareness campaigns can also be very costly. Here, no estimates can be given as especially costs for staff vary a lot between countries. Just to give a number: The German Delphi '98 cost about 700,000 Euro including the end report (re-financed via selling it, only for participants, it was free). Follow-up additional

expenses were paid for international comparisons, presentations, newsletters, conference etc. Thus, it is recommended to answer in advance the following questions which determine the costs:

- Do you intend many workshops? How many? They can be calculated easily.
- What do you intend to print? Do you need designers?
- How much programming is needed?
- How many participants do you have? This determines the number of questionnaires but also the number of persons to nominate and addresses you have to deal with in your database.
- Do you pay for participants?
- Do you need to type the results (e.g. from paper questionnaire)?
- What are the management costs? What are your salaries? And how many external persons contribute to the process so that they have to be paid, too?
- How much follow-up/ PR do you intend? How do you intend to present the end results? ...

Delphi processes with their two rounds are rather time consuming. Therefore, a Delphi needs some time especially when postal delivery is planned. But also for an Internet or electronic version, the participants need time to answer the questionnaire. Preparation time, analyses and implementation should also be calculated. Therefore, for a larger Delphi with different fields, at least one year should be calculated.

#### **4.4 Participants in a survey**

This question sounds trivial but it is not. Most sociologists of science assume that there is a positive relationship between involvement in a research area and assessments of it and that this relationship derives from the tendency of scientists to select problems in areas where there is high pay-off for successful solutions and career. The tendency to overrate fields in which a person works may be termed 'bias'. Not only a tendency toward positive bias for fields in which researchers have been active was found, but also that this bias is stronger in less innovative sub-fields. As market signals fail to be useful for business strategy in the long run and expert assessment is not always objective, Delphi surveys may play a part in science and innovation management.

There are three examples from the first German Delphi '93: first, in the field of volcanoes, there were so few specialist experts, as this is not a direct danger for Germany, that the topic could not be analysed as a single item. Secondly, specialist experts and thus future knowledge may not be available in some countries. The availability of experts in the case of biotechnology in Germany was mixed. Among the 73 respondents who were all experts in biotechnology, many did not answer in particular sub-areas (most expressed for tissue and organs). The largest number of specialist experts (i.e. those working in the sub-area) among all experts in Germany is found in molecular biology, but not in the sub-area of tissue and organs. An almost perfect correlation was found between the number of experts and their rating of German research performance.

In sub-areas where we know more, we are good. In sub-areas where we are not advanced, we know little of the opportunities.

A test for Delphi expert bias in the energy area from the German Delphi '93 tends to support this view. Top experts rate the importance of their own research speciality significantly higher than the other experts - both in Japan and in Germany. At the same time, the top experts downplay technical constraints in Germany (less so in Japan) in their own working area (see Cuhls/ Kuwahara 1994). An unwanted test also made clear that the 'higher level' experts also do not tend to change to the direction of the mainstream answers and remain with their opinions in the second round (see Cuhls/ Breiner/ Grupp 1995).

In the Delphi '98, this is not so obvious. There are topics for which the specialist knowledge experts see more problems (or ask for more measures to be taken), but for others all other persons ask for more measures. In some cases, the special experts rate the topic to become reality earlier than the 'medium' and 'lower level' experts, in other cases, they are much more reluctant with a prognosis on the time horizon. What can be observed is that in the first round, more experts claimed to work on the field (13.5 %) than in the second round (10.18 %). This can have several reasons. New foresight approaches tend to involve more and different stakeholders of the innovation systems to provide multiple perspectives (Cuhls 2000, Linstone 1999, the German Futur, see [www.futur.de](http://www.futur.de), is based on this assumption) on the issues. Therefore, more and more, the expert definition is broadened. Often persons are involved, who know about the subject, wherever they stem from. But they have to be selected carefully according to the themes asked for. It is recommended to invite a mixture of persons from industry/business, academia, research institutions, and others.

As in all surveys, the sample in the end needs to be large enough to draw conclusions, therefore the number of answers per topic has to be high enough. The sample as such also has to be selected and additionally to the already mentioned criteria, the sample mix should comprise e.g., persons from different age cohorts, sector groups, etc. Often, female participants are under-represented, which is always a problem that has to be dealt with. Lobbying should be avoided or dealt with (e.g. involve the same number of persons from the different lobby groups).

To identify addresses is less and less difficult: Internet, data bases, trade fair catalogues, members lists etc. can be obtained rather easily. To structure the database in order to facilitate mailing, storing data and at the same time meet data security standards is more difficult but has to be considered, too. In foresight processes, co-nomination is also often applied. This is a kind of snowball-sampling, in which one persons recommends others (for details see Nedeva et al. 1996). But as these recommendations often remain in "existing communities", this is more and more criticised and has to be added by more "neutral" search for participants, also to define a broad, interdisciplinary sample according to the own criteria. Especially for representative surveys, this approach has to be added to by other ways of selecting persons.

How many participants do you need? That depends on the number of topics, the fields, the expected response or participation rate and other issues. If a small Delphi in a computer groupware room is used, the sample will be very small. If a national foresight with a specific representativeness is asked for, many persons are needed and it is often attempted to achieve about 100 answers per topic. But this also depends on the country: In a small country, you cannot expect so many experts in the field. And in some future-oriented fields, there are only a few persons available, even in large countries. To involve the general public in such an endeavour is generally possible, but then, the questions have to be rather simple and easy to understand. In Internet surveys, it is very difficult to hold the control on the sample, this should also be taken into account.

## **5. Analysis, interpretation and presentation of (Delphi) survey results**

As in most (Delphi) surveys, you gather a lot of statistical data, which can be used in very different ways. But also comments are often asked and can help to interpret the statistics or be analysed in a qualitative way. Especially the combination of Delphi and scenarios makes many qualitative presentations possible. The following examples are just a few from the selection. Looking at the different international reports, there is a wider range of possibilities. What a survey manager should do is to think about the way to analyse in advance because this has implications on the criteria and the whole design of the questionnaire as described above.

### **5.1 Rankings**

Simple rankings of statistical data are the easiest way of presenting results. Of course, the data have to be aggregated first, sometimes an index has to be built. Often, the importance categories are used to figure out the most important topics. But also the measures or other assessments can be ranked. Especially, the older Japanese Delphi studies worked a lot with rankings (e.g. also NISTEP 1997). Figure 5-1 stems from the Delphi '98 but is of different character. Here, the megatrends asked for are ranked according to their agreement (persons could agree to a topic personally or not), which was important because the megatrends were used to figure out a personal opinion of the answering participant cohorts by a factor analysis (for details, see Blind/ Cuhls/ Grupp 2001).

Figure 5-1: Ranking of agreements on megatrends

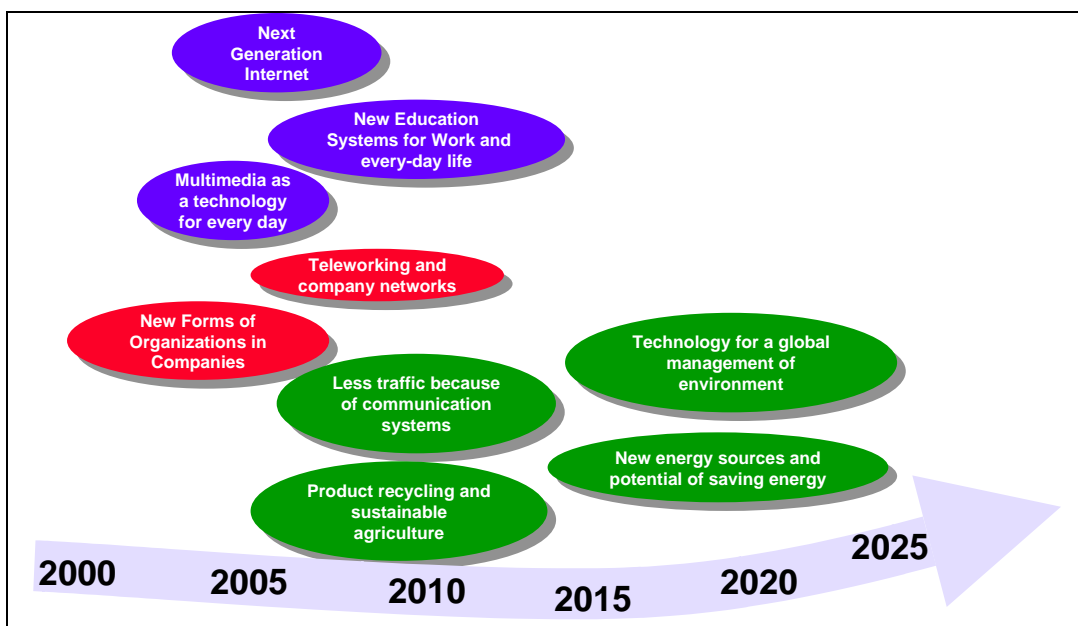
## Megatrends

Megatrend	Agree- ment	Time Frame	Disagree- ment
In industrialized countries over 1/3 of the population will be older than 60 years.	89	2008 - 2019	7
The unemployment rate will increase permanently in the developed countries.	74	1999 - 2006	22
World population will surpass the 10 billion border.	72	2010 - >2025	19
Germany will again become an internationally attractive location for investment.	61	2003 - 2009	27
Women will at least keep one-third of all executive positions in business.	57	2008 - 2020	32
Rationing of energy consumption for private households will be enforced.	54	2011 - >2025	41
Increasing environmental problems will negatively affect the health of most people.	53	2003 - 2015	42
A European government will be developed that will substitute national sovereignty.	52	2010 - 2024	42
Increasing individualization hamper the functioning of representative democracies.	49	2003 - 2012	33

## 5.2 Qualitative Clustering

Another possibility is a half quantitative and half qualitative way of analysis. In the Delphi '98, the most important topics from the different importance categories (for the economy, the society...) were ranked and those which were often highly scored were clustered qualitatively and described under a joint headline. This was done to provide a very compact picture on results. Figure 5-2 illustrates this. It can be argued that this is a bit arbitrary, but the fact that ICT technologies invade all other fields and other clusters could easily be backed up by statistical data. The arguments for clustering and the single topics clustered were described in detail in the results.

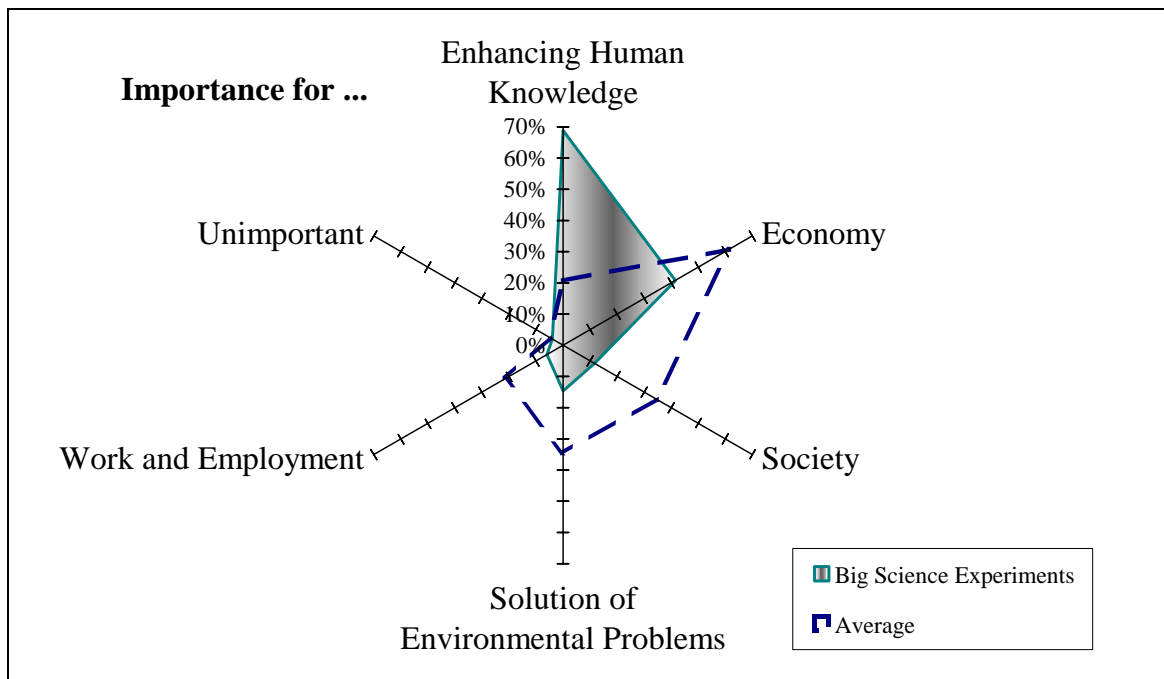
Figure 5-2: The most important topic cluster



### 5.3 Different graphics

Like in every report, graphics are welcome to illustrate and make understanding easier. Figure 5-3 shows an example for the different importance categories of the Delphi '98 (average of all data compared with average of the single innovation field Big Science Experiments). This also makes comparisons easier. It depends very much on the data set and the questions asked to the data which graphics to be used to answer the questions. The separate paper on priority-setting will demonstrate other examples, too.

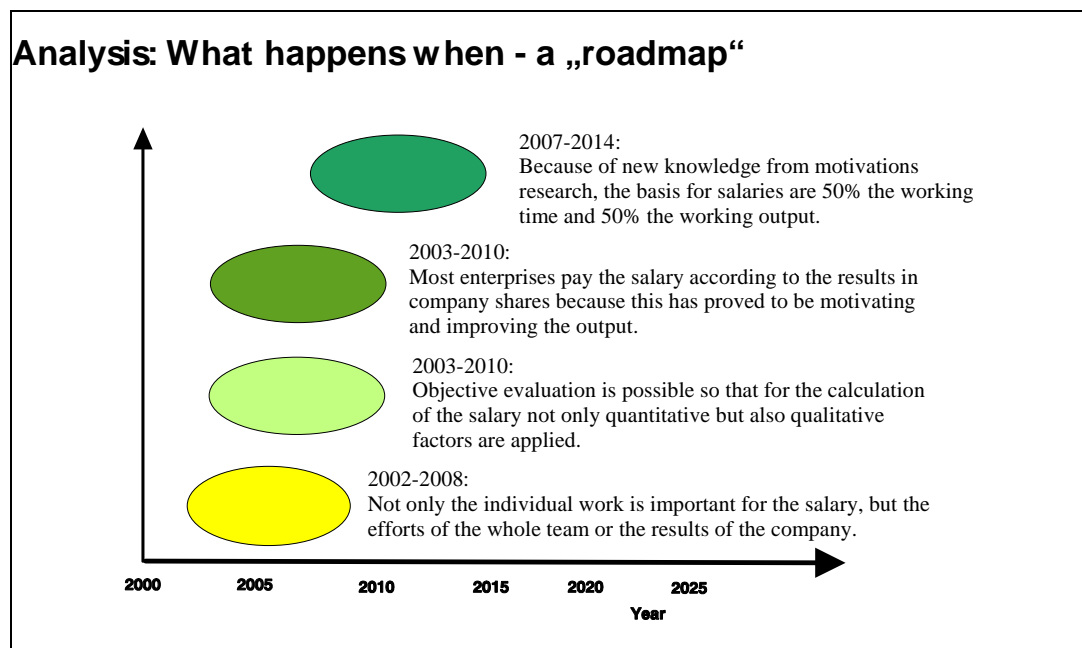
Figure 5-3: Importance categories, difference between "average of all topics" and the average of the specific innovation field "Big Science Experiments"



### 5.4 Scenarios or roadmaps

As in most Delphi surveys, it is asked for the time of realisation, and small roadmaps can be drawn from the field. If the categories and statements fit to each other, also small scenarios can be derived from it. Figure 5-4 shows a kind of roadmap concerning the development of paying salaries in Germany. This analysis can also help to identify breaks in the assessment of the statements. It can be checked, if it is plausible if one development is realised earlier than another, it could also be the case that a technology is not yet developed that would be necessary for the development of another one – but the experts judge the second one earlier, which would lead to the question of plausibility. In the German Delphi '98 we found breaks, especially in the field of Management and Production, but no implausibility.

Figure 5-4: Example of a 'roadmap' from the field Management &amp; Production



These were just a few example, there is still much room for creativity.

## 6. Implementation of Foresight with a (Delphi) survey

The second problematic point remains the interface to implementation. In some surveys, it is already enough to provide some results in form of graphics or statistical analyses as 'information about the future'. But how can the 'results' further be used? New foresight processes are more than just providing data and results. As the providers of foresight results and the users, which means the decision-makers, are in most cases not the same persons, there remain the difficulties

- (1) of bringing them together
- (2) of linking the needs of the users and the concepts of the methodologies very early
- (3) of making potential users aware of the possibilities (marketing) so that they have the choice
- (4) of establishing mechanisms of transfer
- (5) of delivering results that are useful
- (6) of involving persons who have the power to decide and implement.

Until now, the use of foresight results in Germany and other countries was based on ad hoc activities. There are different possibilities (see Cuhls/ Blind/ Grupp 2002): One of the most interesting was the use for an evaluation of the Fraunhofer Society by an international panel (SWOT analyses). The different ways of implementation were very useful and there were a lot of them, especially by companies, but a more strategic approach would certainly bring more results. The Delphi '98 was aimed at information for those who are interested in.



The question if one works closely together with the financiers has to be thought about very carefully. Sometimes, a more neutral look-out is asked for or suits the situation better. On the other hand, the interface between Delphi and the financier is more difficult, then. But this is true for nearly every foresight approach, especially surveys, that can be conducted externally. Setting priorities is often a major aim of foresight, the separate paper tackles this issue.

## **7. Some recommendations**

The major recommendation is to clarify the objectives of the foresight approach at first. The second point is to check if a survey (or a Delphi) is the right choice and if there are enough resources available. If you considered all pro's and con's, and you decide to conduct a Delphi, then consider as early as possible at least the following:

- What should be the breadth of the study?
- How many and which fields should I ask for?
- How will the organisation be? Who manages the process?
- Who will be invited to participate (active or non-active)?
- What results can be expected?
- What are the questions asked?
- How is the questionnaire designed?
- What kind of analysis is needed for the objectives of the survey and has to be facilitated by the data gathered?
- How do you intend to implement the results?
- Will there be follow-up activities (public relations, publications, workshops, presentations, conferences etc.)?

Delphi is a very interesting tool, especially for companies but also research organisations who for example in Germany were the major users of data and who also conducted own Delphi processes. Survey approaches and especially Delphi have their advantages and disadvantages that are described above and elsewhere but the major danger is – as in all Foresight processes – to regard the results as *facts* because they are presented in the form of data. They are working tools and although information about the future are provided and worked out, the future cannot be predicted and will always be different from what you expect.

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# Setting Priorities

*Dr. Kerstin CUHLS*

## **1. Objectives and potential outcomes of Foresight**

Or: Why setting priorities?

Foresight is often described as a "a systematic, participatory, future intelligence gathering and medium-to-long-term vision-building process aimed at present-day decisions and mobilising joint actions. The term "Foresight" therefore represents the processes focusing on the interaction between science, technology and society" (EU: Strengthening the dimension of foresight in the European Research Area, [www.cordis.lu/rtd2002/foresight/home.html](http://www.cordis.lu/rtd2002/foresight/home.html)). For decisions, it is necessary to know what to decide – and for mobilising joint actions, one needs to know in which direction to go and what the mobilisation is necessary for.

(New) Foresight processes therefore have different objectives (Cuhls, 1998)<sup>1</sup>; but since foresight cannot meet them all, specific targets have to be set. In the context of policy-making, the most important are:

- to enlarge the choice of opportunities, to set priorities and to assess impacts and chances,
- to prospect the impacts of current research and technology policy,
- to ascertain new needs, new demands and new possibilities as well as new ideas,
- to focus selectively on economic, technological, social and ecological areas as well as to start monitoring and detailed research in these fields,
- to define desirable and undesirable futures and
- to start and stimulate continuous discussion processes.

Of course, a single foresight activity or programme cannot meet all the objectives at once (although some make the mistake to try it). There must be a clear focus on the objective of the specific process, and in most regional and national foresight cases, the major target is to identify the most promising issues in science, technology and education. These issues are identified to assess the priorities which get additional support from the regional or national governments or companies in which they are identified and selected.

Setting priorities does not only mean selecting the winners but also identifying "losers", those issues which decrease in importance and therefore will be less supported than oth-

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<sup>1</sup> In some cases, they even have too many at once.

ers. When planning a foresight, one has to be aware of the resistance of those persons committed to the "loser" subjects.

There are on the one hand foresight activities that are more result-oriented, here we often find the priority-setting question. Others are more process-oriented, trying to make people aware of certain developments. These are on the other hand often less result-oriented, therefore, we find less priority setting in these cases.

According to the objectives of a particular foresight activity, the outcomes of the process differ. More result-oriented activities have often a focus on publishing the results, in the case of priority-setting activities, also the priorities chosen. The major form of publications are reports, e.g. with key technologies lists that represent the priorities or Delphi results which are analysed according to specific criteria (see below). But it can also be descriptions of different issues, subjects, technologies that are regarded as important in the one or another way (like the lead visions in the German Futur).

The process benefits insofar from these results as something can be shown by process managers and sponsors that legitimates the endeavour as foresight is often cost-intensive and has to be defended. Outcomes in the form of clear priorities can be used directly or indirectly, implemented in different ways and show clear directions. Therefore, often different stakeholders in the process can benefit from them. There are those (regional, national) governments or companies which initiated the activity, there are the participants who "see clearer", in which direction things are developing and where to invest money and their efforts, because the back-up by policy is made clearer and more explicit. There are also those who benefit directly because more investments are made in specific future fields.

One warning at the end of this introductory section: Setting priorities is not easy. In only few cases, pure statistics can be used. A mixture of clear methodology and policy-decisions are the reality. Thus, even if the outcome of a structured foresight is a clear list of priorities (see 1-1), that does not mean the proposals are adapted by the policy-makers. This can sometimes be confusing – even disappointing for the managers of such processes.

Figure 1-1: List of critical technologies at the beginning of the 21st century  
(Grupp 1993 and 1994)

Topics and areas	Code	Topics and areas	Code
<b>Advanced materials</b>	(-)	Telecommunications	TEL
High-performance ceramics	KER	Broad-band communications	KOM
High-performance polymers	POL	Photonc digital technology	PHD
High-performance metals	MET	Advanced broadcasting (HDTV, DAB)	HDT
Gradient materials	GRA	Optical computing	OPR
Materials for energy conversion	ENW	<b>Mikro-systems technology</b>	<b>MST</b>
Organic magnetic materials	OMM	Micro-actuator technology	MAK
Organic electric materials	OME	Signal processing in micro-systems	SVM
Surface & film technology	ODT	Micro-sensor technology	MSE
Surface materials	OBW	Mounting & connecting techniques	AVT
Diamond layers & films	DIA	<b>Software &amp; Simulation</b>	(-)
Molecular surfaces	MOO	Software	SOW
Non-classical chemistry	NCH	Modelling & Simulation	SIM
Meso-scale polymers	MES	Molecular Modelling	MMO
Organized supra-molecular systems	OSS	Bio-informatics	BIN
Clusters	CLU	Simulation of materials	WSI
Adaptronics	ADA	Non-linear dynamics	NDY
Multi-functional materials	MFW	Simulation in manufacturing	SIF
Lightweight construction	LBW	Cognitive systems (AI)	KIN
Composite materials	VBW	Fuzzy logics	ULO
Aerogels (solid foam)	AEG	Data network safety	DSI
Fullerenes	FUL	<b>Molecular electronics</b>	<b>MOE</b>
Material synthesis in standard shape	MSG	Bio-electronics	BEL
Implantation materials	IMP	Bio-sensor technology	BSE
Manufacturing of materials	FVW	Neuro-biology	NEB
<b>Nano-technology</b>	<b>NAT</b>	Neuro-informatics	NEI
Nano-electronics	NAE	<b>Cellular biotechnology</b>	<b>ZBT</b>
Single electron tunneling	SET	Molecular biotechnology	MBT
Nano-scale materials	NAW	Science-based medicine	MED
Manufacturing in micro- & nano-scale	FMN	Katalysis & bio-katalysis	KAT
<b>Micro-electronics</b>	<b>MEL</b>	Biological production systems	BPW
Information storage	INS	Bionics	BIK
Signal processing	SVA	Biomimetic materials	BMW
Micro-electronic materials	MIW	Biological hydrogen production	BWS
High-speed electronics	HGE	Renewable resources (biomass & agents)	NWW
Plasma technology	PLA	Environmental biotechnology	UMB
Superconductivity	SUL	Plant breeding	PFZ
High-temperature electronics	HTE	<b>Production &amp; management technology</b>	(-)
<b>Photonics</b>	<b>PHO</b>	Management techniques	MAN
Opto-electronics	OEL	Modelling in manufacturing	MPR
Photonic materials	PHW	Control station technology	LST
Laser technology	LAS	Production logistics	PRL
Flat display technology	DIS	Lean-resource production	URP
Luminous silicon	LSI	Behavioural biology	VBH
		Ethics in science & technology	ETH

## 2. How to set priorities

As described above, there are different structured and less structured methods of setting priorities. Some are shown in Figure 2-1.

Figure 2-1: Some methods for setting priorities

- rankings from (Delphi) surveys
- analyses from surveys, simulations, extrapolations and other futures' studies
- votings (postal, fax, electronic: online, offline,...)
- listings according to a set of criteria (group work, panels, expert consultations, interviews...)
- consultation of single experts (open interviews etc.)
- panel sessions with discussions
- workshops with different stakeholder groups
- structured interviews

Among the methods for priority-setting are two types: the first type is based on more or less structured data, the second on person workshops and discussions. Although the manager of a foresight process often assumes that with a clear input from a data set, a clear list can be derived and therefore clear priorities can be set, the reality is a mixture.

To make rankings from surveys is relatively simple, but they have to be adapted for implementation. If the different actors who are supposed to be active do not accept the list, these rankings are useless. Therefore, in most cases, the actors are already involved in the process as such. In other cases, some actors (see below) make their own decisions on priorities based on these lists: The list is the start of the decision-making process, but not all of the "priorities" of the list (the high ranks) are taken over.

In all cases, to provide a certain transparency of the process, a clear set of criteria has to be developed. In surveys, these are formulated as questions, in Delphi studies (see the Delphi survey paper), they are inherent in the questionnaire design. There are many possibilities of formulating the criteria. They all derive from the objectives of the foresight. Figure 2-2 and 2-3 explain some relatively different examples.



Figure 2-2: List of criteria applied in the "Technologies at the Beginning of the 21<sup>st</sup> Century" (Grupp 1993 and 1994)

- R&D infrastructure
- Scientific and technological constraints on implementation
- Human capital
- Innovation expenditures
- Interest of enterprises
- National competitive position (status quo ante)
- Public interest
- International division of labour

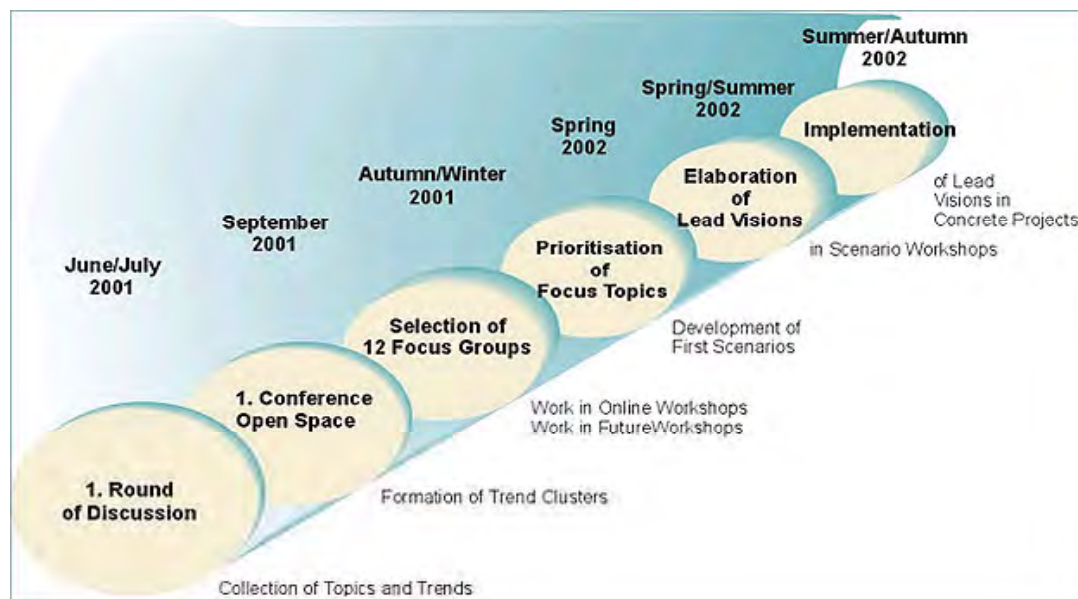
Figure 2-3: Criteria applied in the German "Futur", phase I

- societal demand
- focus potential
- interdisciplinarity
- relevance for research

The criteria can be applied in a voting procedure during a workshop (e.g. by giving points to the issues to be selected), by just discussing or in a more formal voting procedure like a survey or (online and offline) voting. The criteria can even be weighted, e.g., for a specific objective and purpose, one criteria is weighted higher than another one.

To illustrate this: In the German Futur, the criteria were even applied in different ways and at different steps of the process (see figure 2.4). One selection step took place in autumn 2001, when the focus groups were selected: 25 theme profiles were generated from the first Futur conference. Most of the groups and themes met the criteria mentioned above. As it was only possible to continue the discussion of 12 themes, a broad selection process was organised to select 12 profiles for a continuation of the discussion. For the selection, the following procedures were taken into account.

Figure 2-4: Steps of the German Futur, phase I



**Voting of the participants:** an online-voting was organised in the internal workspace asking for the opinion of the inner and outer circle members. 154 out of about 680 persons addressed, participated in the process. The participants were informed via e-mail and entered into the workspace with a personal password. Each participant was able to vote only once. For the voting, an online-form had been prepared. The participants were asked:

- to select themes, which they considered most important for future research
- to judge these themes by given criteria on a five-point scale
- to vote on all of the 25 theme profiles, these should be further integrated into the process.

**A workshop of BMBF divisions** was organised with division and division heads as well as the project managing agency representatives. They voted on the similar criteria as the participants by giving "points" according to the criteria (stickers were put on the wall at the name of the field). Then, the **Innovation Council** was informed and gave a short statement on the themes. In a session with the consortium, BMBF division Z 22, responsible for Futur, decided on twelve groups, taking into account the votes from the participants and divisions, as well as the opinion of their own representatives. On the basis of the different votings, the background information and the suggestions by Z 22, the final decision was taken by the minister Mrs. Bulmahn.

The second round of selection was necessary to reduce the number of the themes to be developed further from 12 to 5. As in the first selection round, the second selection was based on a variety of votes on the respective themes:

- An **online-voting** was realised in the workspace to ask the participants of Futur about their priorities and opinion. 332 people participated. The results were a Top-5-

Theme-Ranking, a judgement on the importance of the themes as lead visions and an evaluation of the individual themes according to the criteria of "research perspective" and "societal demand".

- The **project managing agencies** and specialist divisions of BMBF ranked the themes according to their opinion of relevance of research, the societal demand, the status of maturity of the themes and the possibility of political usability.
- The **Innovation Council** discussed the innovativeness and quality of the focus themes. As result, the council came up with the suggestion to structure the lead visions in a broad political context and frame them in "roofs" (resuming the strategic orientation of the research policy in a wider context, e.g. living better, healthier and longer) and "columns" (conceptualisable focal points which emphasise the societal demand and include a concrete objective and a new quality in the problem-solution process for which interdisciplinary actors are necessary due to the complexity).

BMBF, with support of the consortium, reviewed the different statements with regard to the Futur criteria. The final decision of the 5 favourite focus themes was again taken by the minister Mrs. Bulmahn. Some selection decisions of the themes were accompanied by requirements, stimulating the group to emphasise their further discussion on certain focal points. In addition to the five favourite themes, it was decided to recover the theme "understanding thought processes", which had been discarded during the open-space conference due to the lack of interested participants. But the topic was regarded to be "very interesting" by BMBF, the project managing agencies, the Innovation Council and the consortium, so that they established an additional expert group.<sup>2</sup>

The lead visions were debated by the Innovation Council. The council accepted four out of the presented five themes (Network World, Prevention, Understanding Thought Processes, Access to Learning) and recommended the theme "Intelligent Products" as cross-sectional theme to the respective BMBF divisions. The theme "Understanding Thought Processes", which had been taken up parallel to the selected themes, was also approved as lead vision.

### **3. Who sets priorities?**

There are different kinds of priorities. As we have already seen in the previous section, there are different actors involved in different steps of priority-setting. In some cases, expert panels discuss priorities (e.g. in key technologies approaches), in others, the priorities are indirectly set by different participants in a survey directly. In –most cases, a steering committee or the sponsor (company or policy-makers) have the last word.

The example of Futur (see above) is therefore very illustrating: Although there is participation in the development of the lead visions and the online-voting on the subjects, in the end, innovation council and the minister herself have the last say, because the ministry is the major target group of the process and has to implement the results. In

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<sup>2</sup> This is an example of priority-setting in a foresight process, where the priorities were set in a different way by different actors but still under the roof the process.

Futur, there was not much discrepancy between online-voting and the assessments of BMBF, therefore, this was no critical point. But when power structures are tackled, this can be very critical. Often, it results in methodological criticism – although the power parties just dislike the results. Therefore one should be careful to apply an explicable methodology.

In most current foresight activities, participants stem from different backgrounds ("participation" principle) to bring in new ideas and set different priorities. But it has to be clearly stated, where their power ends in order not to disappoint these people by evoking too many expectations. It has to be clearly stated and communicated who selects what, when, and with which criteria. Then, also laymen can accept that in the end a minister or a CEO of a company has the last word.

Even in processes with laymen and different participants, one has to be very careful of lobbying. In open discussion processes they are sometimes obvious, but not always. In policy-oriented processes, lobbies occur quickly on the spot. In less result- or less implementation-oriented processes, there are fewer lobbies. Delphi processes and other surveys try to avoid these lobbies by giving all participants the same weight when voting. This has other disadvantages, but makes people more equal. Dominant group leaders like in physical open groups can be avoided. On the other hand, especially votings with uncontrolled samples (internet polling, online-votings etc.) can be the best place for lobbies when they mobilise and vote as much as possible.

The conclusion here is that the actors who set the priorities can be very different and range from policy-makers to laymen. Even their number is unlimited. If a survey with many participants is conducted and in the end, their vote is taken over directly, this is as much priority-setting as the single decision of a man in power. It is very important that the procedure of selecting the priorities is clear and can be communicated. One could even imagine to leave setting priorities to a machine (as seen in some science fictions), but then, it is totally unknown what is assessed in which way, and fortunately, foresight processes are based on people.

#### **4. Various levels of priority-setting in foresight**

It is also important to think of the level, the priorities are set for and should be used. In a regional or communal context, people often know each other, and it is easier to decide openly because there are not too many persons who could be involved. On the other hand, there are as many power games going on as on the larger levels of decision-making. Cross-boarder regions define them more and more as one region, therefore, here the different administrative structures might play a role.

On a national level, this is more difficult: Here are many interest groups who have more power than ordinary people, therefore, it is more difficult to create "trust" in the decision and to get acceptance for it. What is also interesting are comparisons of the priorities set in different national contexts (see e.g. the German-Japanese comparisons, Cuhls/Kuwahara 1994). Although the first impression is that all high technology nations set the same priorities, in detail, that varies. Cultural aspects add to this differentiation.

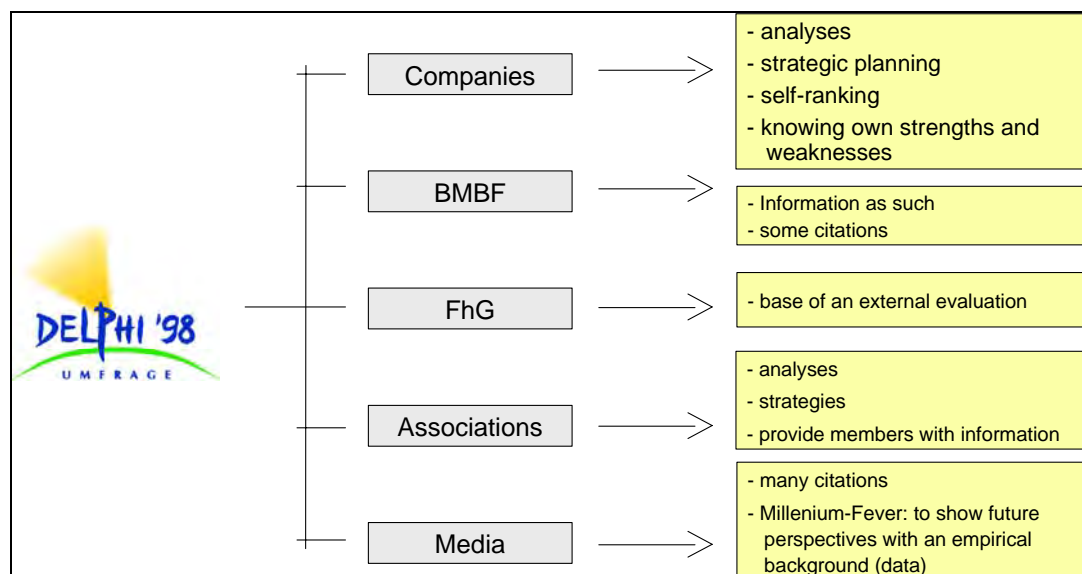
If there is a sector or thematically limited foresight, there are also different levels: already established communities, who know the different opinions among each other agree more or less easily on the priorities. There are themes, in which no agreement can be expected at all (e.g., the field "Energy" in Germany, see Grupp 1995), and there are others which are internationally agreed upon (e.g., ICT developments, see Cuhls/ Kuwahara 1994).

## 5. Making use of priorities in the broader strategic framework

There are different ways of making use of priorities, again according to the context they are set in. Priorities set in a context of a company are clearly used for their purposes, e.g., strategic planning. If a survey like the German Delphi '98 is provided just as information for all interested parties, these can apply their own priority-setting criteria and set their priorities according to their wishes. Figure 5-1 shows the users of the Delphi '98, which is an interesting example.

When the Delphi '98 survey was finished, no strategic plans for implementation existed, although this was regarded as necessary. Money for "marketing" was not available. From the political side, it was mentioned that this "practical application" should be planned. Unfortunately, the report was published in pre-election times for the German Bundestag (parliament). This meant that political exploitation of such studies was extremely dangerous as many of the current problems and their effects always become obvious when looking into the future (e.g. the lack of personnel in the IT area, demographic consequences, problems in the health sector, the consequences of the unpopularity of expensive big science projects especially in the nuclear power field, and many others).

Figure 5-1: Users of the Delphi '98 in Germany



The election passed, and the new government this time was really a new one – representing different parties, persons, and opinions. It took time until the new BMBF was

able to decide on follow-up activities in foresight. It was decided to start a new foresight process, Futur. Nevertheless, the work on Delphi '98 was not in vain. There were many different users of the data. Many are even unknown, as they work more or less anonymously. It is not known who made what use of the two volume edition (around 10,000 sold), the downloads from the Internet and the eight newsletters that dealt with special topics, themes or fields and were provided by BMBF to all interested persons, especially in schools.

The major users of the Delphi '98 were *companies*. Most of them selected those topics and fields in which they were active. They analysed these topics in detail and used the information for different strategic planning purposes, often with a more long-term perspective than usually applied. Some had working groups to analyse and discuss the data or even made further Mini-Delphi studies to gain more in-depth knowledge of the field. Others developed their own strategic high technology lists. For most of them, it was very interesting to know how others (companies or experts from the different kinds of institutions) rate their field. Do all agree? Or is there no consensus? Did the own company overlook certain problems? Where is the conflict potential?

It was especially interesting for companies to know about fields at the borders of their own activities. They know their own fields pretty well, but what if other products coming from different areas replace their technologies? What happens if interdisciplinary research is conducted? What about technology combinations or fusions, or even the combination of production and services? What other frame conditions will change for the companies? For companies, these are the most interesting questions to be answered.

*Research institutions and associations* used the data similarly: for priority-setting, orientation and strategic planning. They also developed high technology lists for themselves, which were added to the traditional world market indicators. The associations sometimes provided their members with the results of their activities.

A very interesting approach was followed for the *system evaluation of the Fraunhofer Society (FhG)* itself. In 1998, the whole society was evaluated on behalf of the German Federal Ministry for Education and Research (BMBF) by an international independent committee. The questions they followed in their terms of reference were the following:

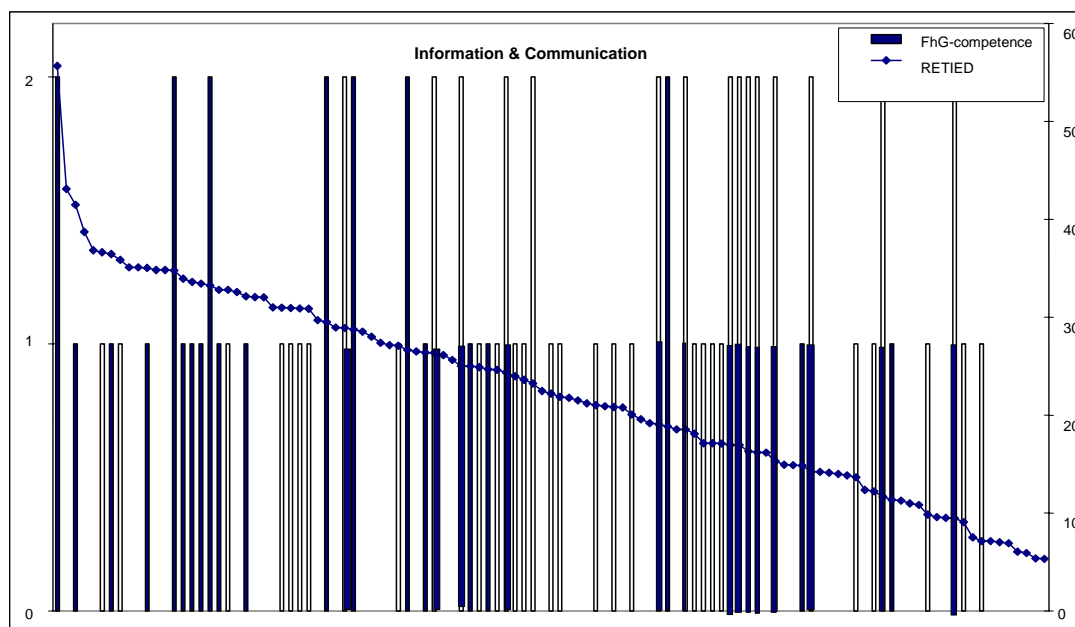
- Which technology-oriented markets have the greatest dynamics for the German economy?
- Which technology will the market dynamics be based on?
- Does the technological portfolio of the Fraunhofer Society match the developments that are expected, now?

Supported by a scientific secretary from ISI, the Delphi '98 data were used in a unique way to give partial answers to the questions. At first, a new index based on the Delphi criteria *necessity for the improvement of the R&D system, time of realisation, and importance of the solutions for the economy* was calculated. The index was applied to the Delphi data in all fields except "Space" and "Big Science". The reason for excluding

these fields was that the Fraunhofer Society works in applied sciences linked to markets. The basic research fields especially do not match the criteria of the general Fraunhofer targets. Therefore, only 1,019 of all Delphi topics were included. According to this, the relevancy was ranked for every thematic field.

The Fraunhofer research fields were defined by persons in the headquarter in Munich who have an overview of the thematic fields the 47 different Fraunhofer institutes are working in. Then, a relevancy estimation for Fraunhofer was made. Basis for this is at first the percentage of answers concerning the need for *R&D infrastructure* (between 0 and 100 %). The result was weighted by the time expectancy. The longer the time horizon, the lower the Fraunhofer relevancy, for details see Cuhls/ Grupp/ Blind 2002).

Figure 5-2: Fraunhofer Evaluation – Results in the Field of Information and Communication



In figure 5-2, it can be seen that the field of information technology is represented in the Fraunhofer institutes, but very selectively. The missing fields belong to the most promising markets of the future (e.g. new media). Therefore, the evaluation concluded that there are gaps in information technology in the Fraunhofer Society in general. This was used as *one* of the arguments for the planned fusion of the Fraunhofer Society with another large German research group (press release from 29/9/1999), the German National Research Centre for Information Technology (GMD). Of course, there were more reasons for this decision.

What is more difficult, is the application of foresight results in policy-oriented contexts. Foresight is often aimed at a harmonisation of government policies. On the regional level, with the commitment of the regional government, that may be possible, but on the national level, it is more difficult than managers of foresight normally expect. One example is the German Futur, which aims at bringing in new ideas but also harmonising

the ideas of different BMBF departments in lead visions and steer them to joint tenders in the selected fields. But implementation even here is difficult as the power game is also played in ministries and other policy-contexts. Lobbies argue against the priorities derived from foresight and structures that remained for a long time tend to be stable and difficult to be changed.

It is also important to reflect if the decision-makers themselves should be involved in the foresight process. Some decision-makers do not like to be involved in the processes themselves because they expect recommendations from "external" sources in a more "neutral" way. They regard it as a kind of "self recommendation" if they are part of the process. Others like to be directly involved, which makes the transfer of information and implementation easier.

The conclusion therefore is: Even if there are clear-cut priorities set, this does not necessarily mean that the implementation is easier than in those cases where the priorities are relatively vague but decided on in a consensus. If there is already a consensus, the chances that the stakeholders involved commit themselves and stick to their decisions are much greater than in the cases where the priorities are set elsewhere in the system.

Therefore one of the major tasks in foresight should be to convince people to participate in the process, to commit themselves, and to be multipliers for the priorities set. If you are successful here, the priority-setting procedure is much easier – whatever method is used.

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# **RATIONALE, SCOPE AND METHODOLOGY OF THE TECHNOLOGY FORESIGHT IN TURKEY**

## **VISION 2023 PROJECT**

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### ***Background: Evolutions in the Turkish S&T Policy***

Since its foundation, the Turkish Republic has been patiently constructing a sound scientific infrastructure. Until 1960's, however, science and technology was not a policy issue on its own, and scientific research was regarded as an academic activity of universities. The establishment of TÜBİTAK, The Scientific and Technical Research Council of Turkey, marks a turning point in national science and technology policy in Turkey.

TÜBİTAK was established in 1963 for the purpose of organizing, coordinating and promoting basic and applied research. For some ten years, its chief function was confined to supporting basic research in the universities through its grant scheme. Over the years, parallel to the above-mentioned developments in the economy, the mandate of TÜBİTAK has been gradually expanded from supporting basic research towards industrial technological activities and contract research. An important development in this direction was the establishment of Marmara Research Center (MRC) in Gebze, (at Marmara region near Istanbul, where the majority of Turkish industry is located) in 1972.

Thus, we can say that Turkey entered the S&T policy era in the early 1960's, with the establishment of TÜBİTAK. The debut coincided with the start of the five-year economic planning period. The naive period of the Turkish S&T policy lasted from early 60's to late 80's, following the main trends of the developed industrial economies from 20 years behind. Turkish economy entered its new stage before the S&T policy, by getting integrated with the world economy after sweeping economic reforms of the early 1980's, which liberalized the economy.

In the early phase the main targets of national S&T policy were easily formulated by TÜBİTAK without any official S&T policy document, through a tacit

consensus with the government. In this phase, the targets were to broaden R&D infrastructure by training researchers and establishing public R&D facilities, and to create a research tradition by encouraging, supporting and carrying out research activities almost exclusively in the academic sector to catch up with the critical values of the R&D indicators. In short, the Turkish S&T system was regulated by a supply-oriented S&T policy (science-push approach) for a relatively long span of time.

The first detailed S&T policy document was prepared in 1983 with the contribution of over 300 experts under the coordination of Ministry of State. This document, entitled “Turkish Science Policy: 1983-2003”, explicitly recognized the role of technology for development, and suggested priority areas of technology. Although these technology areas were broadly defined, this document could be regarded as the first attempt towards defining “critical technologies” in Turkey. This document led to the creation of a new institution in 1983, the Supreme Council for Science and Technology (SCST), as the highest S&T policymaking body chaired by the Prime Minister or his deputy. The Supreme Council enabled designing S&T policies with the participation of S&T related ministers, high level bureaucrats, technocrats and representatives of non governmental organizations who take part in the management of economic and social life.

The Supreme Council for Science and Technology that was established in 1983 had its first operational meeting only in 1989. In the mid-1990s, the Supreme Council started to play an active role in formulating the national S&T policy as the central component of the National Innovation System, reacting swiftly to the developments in the world.

In its second meeting in 1993, SCST approved the document entitled “Turkish Science and Technology Policy: 1993-2003”. This document paved the way for new policy initiatives, such as R&D support programs, in the 1990s. This was a turning point in the S&T policy era in Turkey, as there was a paradigm shift from “building a modern R&D infrastructure to “innovation oriented” national policies. The policy formulated in this document was further elaborated in 1995 with “The Project for Impetus in Science and Technology”, which formed the S&T chapter of the Seventh Five Year Economic Development Plan [1996-2000]. This policy document suggested seven priority areas of S&T, and together with the addition of earthquake

related research after the 1999 disasters, these constitute the priority areas currently in force (Box-1).

#### **Box 1- CURRENT PRIORITY AREAS OF R&D**

- Information and communication
- Flexible manufacturing and automation
- Transportation with particular interest in rail transport
- Aeronautics, space and defence
- Genetic engineering and biotechnology with particular emphasis on the agricultural applications in relation with the “South Anatolian Project”
- Environment friendly technologies and renewable energy systems
- Advanced materials
- Earthquake related problems and risk management

Considerable developments have been achieved since 1993, both in terms of S&T indicators (Box 2) and institutional framework (Box 3).

#### **Box 2- R&D INDICATORS IN THE LAST DECADE**

- GERD as percent of GDP:  
1990: **0.32%**    ↑    2000: **0.64%**
- R&D expenditures realized by business enterprise:  
1990: **20.4%**    ↑    2000: **33.4%**
- R&D expenditures financed by business enterprise (BERD):  
1990: **27.5%**    ↑    2000: **42.9%**
- R&D personnel intensity per 10.000 labour force:  
1990: **7.5**    ↑    2000: **13.1**
- World Ranking (and the number) by the number of SCI journal publications:  
1990: **41(1177)**    ↑    2000: **25(6074)**    ↑    2002: **22(9303)**

#### **Box 3- INSTITUTIONAL FRAMEWORK IN THE LAST DECADE**

- Small and Medium Industry Development Organization (KOSGEB), 1990
- Industrial R&D loans (TTGV), launched in 1992
- Industrial R&D grants (TÜBİTAK), launched in 1995
- National Research Network (TÜBİTAK), 1996
- University-Industry Joint Research Centres (TÜBİTAK), 1996
- National Metrology Institute (TÜBİTAK), 1992
- Reorganization of Turkish Patent Institute, 1994
- Industrial Intellectual / Property Legislation Reform, 1994-1995
- Accreditation Board, 1999
- Technology Development Regions Act, 2001

However, the current position of the country, in terms of its ability to generate knowledge and utilise it for socio-economic development, is not yet compatible with its demographic share in the world. In particular, there was little success in realising concerted actions of the rather fragmented S&T actors around the priority areas. The assessment of the S&T policy measures has shown that, it was not the policy measures themselves to blame, but the lack of a shared S&T vision of the government, the academia and the public and private sectors, and therefore their commitment to the policies adapted.

Motivated by these considerations, The Supreme Council for Science and Technology took the decision, in its sixth meeting on December 2000, that new national S&T policies should be formulated, and priority areas should be set for the next two decades, in order to create an innovative economy and society in 2023, which marks the 100th Anniversary of the foundation of the Turkish Republic. TÜBİTAK, as the general secretariat of the SCST, has accordingly detailed the project entitled “Vision 2023: Science and Technology Strategies”, which was approved by the Council a year later in its seventh meeting in December 2001.

The “Vision 2023” project involves the first-ever national foresight exercise of Turkey, together with three more sub-projects that aim at collecting and evaluating data on the current science, technology and innovation capacity of the country. The project has been initially planned for a 2-year period, and its implementation started in January 2002. The time plan has later been amended, and the new plan targeted completion of the sub-projects at the end of 2003, and preparation of their synthesis in the form of a policy document and its submission to the SCST in the first half of 2004.

### ***Vision 2023 Project***

“Vision 2023: Strategies for Science and Technology” is an ongoing project, which aims to build a S&T vision of Turkey, and to develop S&T policies for a time horizon of 20 years. It involves four sub-projects:

- • Technology Foresight
- • Technological Capacity
- • R&D Manpower
- • R&D Infrastructure

The technology foresight exercise, to be conducted for the first time in Turkey, constitutes the backbone of the “Vision 2023” project. The remaining three sub-projects aim at collecting data on the existing science, technology and innovation capacity of the country, in terms of R&D manpower, technology inventory, R&D infrastructure and institutional and legal framework.

“Vision 2023” project has been accordingly detailed in order;

- -to build a science and technology vision for Turkey,
- -to determine strategic technologies and priority areas of R&D, and,
- -to formulate science and technology policies of Turkey for the next 20-year period, while;
- -getting a wide spectrum of stakeholders involved in the process, thus gaining their support, and
- -creating public awareness on the importance of S&T for socio-economic development.

A Steering Committee, consisting of 65 representatives from 27 governmental institutions, 29 industrial organisations and NGOs, and 9 universities, has been formed as the top-level organisational body of the “Vision 2023” project. The Steering Committee guides the project by taking the strategic decisions and approving the reports and policy recommendations generated during its implementation. Operational and budgetary decisions are taken by the Executive Committee, which is chaired by the President of TÜBİTAK, and brings together three representatives of the Steering Committee with the related administrative officials of TÜBİTAK. The Project Office formed within the Science and Technology Policy Department of TÜBİTAK is responsible for the implementation of the project. Other organisational bodies include national and international advisors and panel chair groups.

The methodology adopted for the Turkish Technology Foresight Project involves panels, a two-round Delphi survey to be executed by the Project Office in co-ordination with the panels, and a prioritisation scheme similar to the one used in the UK and Czech exercises. Ten panels were formed on certain socio-economic fields and two others on cross cutting issues of education/human resources and environment/sustainable development. Possibly, a number of panels will be set up at a later stage on generic and emerging technological areas.

In its first meeting in April 2002, The Steering Committee decided the following 12 technology foresight panels to be formed:

1. Education and Human Resources
2. Environment and Sustainable Development
3. Information and Communication
4. Energy and Natural Resources
5. Health and Pharmaceuticals
6. Defence, Aeronautics and Space Industries
7. Agriculture and Food
8. Machinery and Materials
9. Transportation and Tourism
10. Textiles
11. Chemicals
12. Construction and Infrastructure

The panels were initially given the task of building their own visions of future, and list the underpinning technologies. At this stage, around 200 panel meetings and enlarged workshops took place between 3rd of July 2002 and 24th of January 2003. Deputy Prime Minister in charge of S&T issues announced the completion of preliminary panel reports at a press conference on the 28th of January 2003. The Minister also invited criticisms and contributions to the preliminary panel reports, which were available on the project web site (<http://vizyon2023.tubitak.gov.tr>: in Turkish). This wider consultation period also involved several activities planned by each panel for disseminating their initial works among the related actors in the field.

The preliminary reports of the 12 foresight panels are presented in a common format and address the following points with regard their areas of interest:

- Trends and issues, which are likely to affect the world and Turkey
- Assessment of Turkey's current standing (SWOT analysis)
- Turkey's vision for 2023.
- Socio-economic objectives to be achieved in order to realise their visions.
- S&T competencies and underpinning technologies needed to achieve the socio-economic objectives.

Delphi process aims at addressing the likelihood of achieving the envisaged technological developments as well as testing them against a set of criteria determined by the Steering Committee (Box-4).

#### **Box 4- CRITERIA FOR STRATEGIC TECHNOLOGIES**

In April 2003, Vision 2023 Steering Committee voted on: *Given the “welfare society” goal for 2023, what features of a specific technology make it preferable to others?* The conditions for the criteria were set as; “*technology relevant*”, “*policy relevant*”, and “*discriminating and objective*”. It was decided that the following criteria, with the weighting indicated, are to be applied in order to assess the comparative degree of contribution of technologies to Turkey:

- Competitive strength (in high revenue sectors) – 0,28
- Science, technology and innovation capability – 0,26
- Environment and energy efficiency – 0,16
- Creation of national value added by local resources – 0,15
- Quality of life – 0,15

All panels (with the only exception of the Education and Human Resources Panel) prepared more than 1200 statements that were likely to play an important role in realising their 2023 visions. The Project Office, in close co-operation with panels, carefully examined all statements for clarity of expression, technology and policy relevance, and double postings.

The final list included 413 unique statements (grouped in 11 questionnaires), 104 of which appeared in more than one questionnaire. The first round of the Delphi process commenced on the 12th of May 2003, and completed around mid June 2003. The forms were posted to more than 7000 related people, of different professional standings and expertise, who could reply by filling out either the printed versions of the questionnaires or the on-line electronic versions by using the username and the password provided by the Project Office. Those respondents who have fully expressed their opinion on at least five statements are offered a one-year subscription to one of the monthly popular journals of TÜBİTAK, “Bilim ve Teknik” (Science and Technique) and “Bilim Çocuk” (Science and the Child). All respondents had access to all of the 11 questionnaires through the on-line survey.

Because of the increasingly important role played by multidisciplinary research in R&D activities, it has become quite difficult to classify Delphi statements into different categories, as also observed in our case. Therefore, an “Individualised Delphi Survey” has been developed for the on-line version, where responders to the

questionnaire can prepare their own individual surveys by using a simple keyword-search interface. Thus, the “Individualised Delphi Survey” enables respondents to identify the statements that are closely related with their area of expertise without going through all the statements. The response rate of the first round of the Delphi process was 32%, with a total of around 45.000 responses received for the 415 statements.

The panels have been supplied the results of the two round Delphi survey for their review and evaluation. Panels have reviewed the results and responded to them in the first version of their final reports, which were submitted on the 24th of July 2003 to the project office. Panels, although generally taking into consideration the results of the Delphi survey, have been free to comment on, or even disregard them and to reflect their own interpretations in the final reports.

Each panel (with the exception of the Education and Human Resources Panel) has also submitted, in their final reports, technological roadmaps prepared on a format decided by the Project Office, for attaining the envisaged technological developments in each “Technological Activity Area”. They have drawn up a total of 95 roadmaps.

As of November 2003, the remaining tasks of the project include the following:

- Printing and dissemination of the final version of the panel reports.
- An evaluation of the Delphi process will be reported separately in its entirety.
- The project office will produce a synthesis report, on the findings and recommendations of all the panels, thus concluding the technology foresight exercise.
- The analysis of the data collected and surveys conducted in the “Technological Capacity”, “R&D Manpower” and “R&D Infrastructure” sub-projects will be reported.
- Finally, a 20-year S&T policy document to be based on the findings and recommendations of all four sub-projects will be submitted to the Supreme Council, and subsequently to the Government for consideration and adoption, in 2004.