UNIDO TECHNOLOGY FORESIGHT MANUAL

Technology Foresight in Action | *Volume 2*

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UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

UNIDO TECHNOLOGY FORESIGHT MANUAL

Volume 2

Technology Foresight in Action

UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
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WELCOME TO THE TECHNOLOGY FORESIGHT MANUAL

The UNIDO Technology Foresight Training Manual is part of the UNIDO Regional Initiative on Technology foresight for Central and Eastern Europe (CEE) and the Newly Independent States (NIS).

The manual is mainly based on papers presented at a series of events organized by UNIDO as part of this regional initiative. The manual consists of two volumes, divided into seven modules, each devoted to a particular aspect of technology foresight, as follows:

Volume 1 Organization and Methods

Module 1 Introduction to Technology Foresight
Module 2 Organizing a Technology Foresight Exercise
Module 3 Technology Foresight methods

Volume 2 Technology Foresight in Action *(published in a separate book)*

Module 4 Technology Foresight at the National Level
Module 5 Technology Foresight at the Supranational Level
Module 6 Technology Foresight at the Subnational Regional Level
Module 7 Technology Foresight at the Company Level

Making use of the manual

The modules may be studied individually, grouped to suit your own individual requirements, or as a complete course. For example:

- As a busy decision maker who requires only to understand what technology foresight is, the potential benefit that can be gained from setting up a technology foresight programme and how it may be able to assist you in making decisions about technology, but not to delve into the detail, you will probably find module 1 Introduction to Technology Foresight sufficient. Should you wish for more detail on particular aspects of technology foresight the other modules should provide it.
- If you are involved in setting up a technology foresight programme at a particular level, or may be considering whether to do so, you should study module 1 Introduction to Technology Foresight and the appropriate modules 4, 5, 6 or 7.
- If you have been charged with setting up a technology foresight programme you will find module 1 Introduction to Technology Foresight and module 2 Organizing a Technology Foresight Programme, plus the appropriate modules 4, 5, 6 or 7 most helpful.

- If you have responsibility for running a technology foresight programme you will find module 1 Introduction to Technology Foresight, module 2 Organizing a Technology Foresight Programme, module 3 Methods in Technology Foresight, plus the appropriate modules 4, 5, 6 or 7 useful.
- If you wish to obtain the fullest possible understanding of technology foresight you should study the complete manual (volume 1 and volume 2).
- If you wish to know about any of the methods used in technology foresight then module 3 Technology Foresight Methods is probably the place to start, but you may also find other blocks which deal with the application of methods in particular situations also helpful.

Each module is based around a number of papers and readings, most of which were prepared for events organized by UNIDO as part of the technology foresight initiative.

The manual may be supplemented by visiting the UNIDO website www.unido.org where you will find details, in English, of the technology foresight initiative and copies of the presentations made at the events held that include in most cases the slides and videos used to illustrate the presentation.

A recommendation: keeping a journal

At the start of module 1 Introduction to Technology Foresight it is suggested that you should write your own definition of foresight. You will then be able to compare your initial definition with those offered in the technology foresight manual.

It is recommended that you write your definition as the first entry in a learning journal and that as you work through the modules you note any thoughts and reactions that occur. Some things you may find particularly useful and wish to be able to refer back to them, noting where they are and why you considered them useful will both assist your learning and make finding them again easier. But at other points you may disagree with a particular point and find it useful to set down your reasons for doing so. Equally, working through the material is likely to encourage your own thoughts about technology foresight that will be useful to note before you move on and forget them.

Keeping a journal should not be seen as a chore that you have to undertake but a useful adjunct to your study that allows you to become active in your learning as opposed to simply passively reading the manual.

UNIDO Technology Foresight Initiative for Central and Eastern Europe (CEE) and the Newly Independent States (NIS)

Technology foresight (TF) is regarded as the most upstream element of the technology development process. It provides inputs for the formulation of technology policies and strategies that guide the development of the technological infrastructure. In addition, technology foresight provides support to innovation, and incentives and assistance to enterprises in the domain of technology management and technology transfer, leading to enhanced competitiveness and growth.

TF has increasingly been recognized worldwide as a powerful instrument for establishing common views on future development strategies among policy-making bodies, bridging the present with the future. Its unique feature stems from a wide participation of a large number of stakeholders and experts, namely, the government, science, industry and civil society.

The application of TF has become of crucial importance for strengthening the transition process in Central and Eastern European (CEE) countries and the Newly Independent States (NIS) in narrowing their competitive gap in the global economy.

In response to requests by member countries, UNIDO is implementing a global initiative on TF that draws on regional initiatives. The result will be the capability of using TF as a practical tool in designing policies and strategies that exploit emerging and critical technologies for the benefit of countries with economies in transition.

Although technology development planning was traditionally carried out by the State, the change of socio-economic systems in the CEE/NIS region necessitates the introduction of a new approach for consensus building and decision making encapsulated in TF processes. Applied at the national and regional levels, these processes would allow the countries in this region to benefit from the globalization process and integration of the region's economies in Europe and the global market. In the CEE/NIS region some countries such as the Chech Republic and Hungary made efforts to promote TF at the national level, and increasingly more governments recognize the need for a regional approach, which can contribute in shaping a regional long-term development vision in cross-country areas.

In this context, UNIDO was requested to formulate programmes at the regional level to both support national initiatives and create the basis for strengthened regional cooperation. Following this request, UNIDO launched the Technology Foresight Initiative for Central and Eastern Europe and the Newly Independent States in 2001. This initiative benefits from previous experience of UNIDO in promoting a TF Initiative for Latin America. Along this line, UNIDO is building up the bases for a global initiative for TF, as other developing countries and regions are showing growing interest to master and utilize TF methodologies and applications to better drive and focus their industrial development sectors, anticipate future opportunities, define strategies for sustainable economic growth and prepare their local enterprises to enter the global market.

UNIDO approach

The UNIDO TF approach focuses on industrial development issues. In so doing it assists developing countries to upgrade their industrial sectors from resource-based to technology-based in order to better integrate their production into the international economy. Such an approach shall be instrumental in identifying risks and opportunities thus enabling governments to respond successfully to the present and prepare for future challenges and opportunities.

Indeed, to deal successfully with the challenges of, and risks from, globalization developing countries must improve their market access capacity by adopting new strategies to counteract threats from the tremendous competition in international provision of products and services.

Only if a country is fit technologically and industrially can it compete to increase its share of international markets. However, due to continuous changes and innovation from advances in technology and applied research, international market preferences are continuously shifting in

trends over the long term. This implies that without continuous monitoring of societal needs and consumer expectations, stable market shares today can be in danger tomorrow.

The positive side of this development of accelerated competition is that there are many opportunities for developing countries and economies in transition. To be able to reap these opportunities and advantages, these countries have to make technology trends studies and assessments properly. They have to set in place institutional and structural arrangements as well as appropriate policies and strategies that enable entrepreneurs and productive sectors to play key roles in increasing core competencies and capabilities.

The level and capacity of each country to enter into international markets and improve their respective trade is closely linked to the domestic capacity to take advantage of new and innovative technologies. The adoption, absorption, mastering, adaptation and application of these technologies depend on the strength and efficiency of the national system of innovation in relation to indigenous R&D capabilities and related international networks.

In seeking an appropriate solution to the above issues that affect developing countries and economies in transition to different extents, UNIDO has further promoted the use and application of TF with a special focus on specific industrial sectors and production chains.

While it is important for developing countries and economies in transition to carry out TF exercises, making them an integral part in the process for their industrial development is another matter. UNIDO has combined the TF initiative with its core specialization in industrial development, industrial policy and technology change management. In supporting the post-foresight exercise UNIDO services should address the challenges that developing countries and economies in transition have to face to cope with the new international trade environment that globalization is bringing about, the complexity to carry out technology needs assessments, the intricacy and conflicting process to prioritize and target investment for R&D activities, the pressing demand for wide reaching training and education programmes, the mandatory requirement of institutional capacity to support and liaise between all the elements of the national innovation system.

In summary, the UNIDO TF approach is designed to capture complex variables, involve stakeholders from the highest level of decision making from Government, institutions and enterprises, and provide a durable basis for developing industrial policy. TF attempts to identify possible future development scenarios to: improve medium, long-term decision making; guide technology choices; generate alternative trajectories for development; improve preparedness for emergencies and contingencies; motivate change and innovation; and achieve broad consensus and strategic commitments. As such it is a decision support tool that facilitates anticipation and pro-active planning and policies. It provides strategic decisions and robust action plans combined with flexible tactics to enable restructuring and intervention in dynamic response to continuous changes at regional, national and enterprise level.

Development objectives

The UNIDO regional TF initiative provides assistance to countries with economies in transition, aiming at achieving more sustainable and innovative development, fostering economic, environmental and social benefits at national and regional levels. The regional initiative ultimately aims to develop policies and R&D programmes that deal with innovation, industrial growth and competitiveness which can be addressed through multi-country collaboration and joint exercises.

Immediate objectives

The immediate objectives of a regional initiative are: *(a)* to raise awareness of the critical importance of TF for improving the competitiveness of industry by exploiting emerging and future trends in science and technology; *(b)* to develop and adapt methodologies and tools for TF in the region; *(c)* to establish and strengthen national and regional knowledge as well as the capability of using TF for designing policies and strategies that focus on innovation; *(d)* to undertake demonstrations of regional studies for specific sectors or themes; *(e)* to assist national programmes to generate comparable data for possible aggregation at the regional level; and *(f)* to provide solutions to relevant problems in the region that can be addressed through the appropriate application of technology. Special attention will be given to those less economically advanced countries in the region.

Components

Awareness building and creation of foresight culture in the region

On the basis of a regional TF network, prepare and disseminate promotional and general information to demonstrate the utility of foresight approaches in countries in Central and Eastern Europe and the NIS context to policy makers, companies and R&D institutions, as well as the general public. This is done through conferences, forums, publications, electronic books, the Internet and the media. Special attention is given to motivating industry to participate in the initiative. In terms of the scope of the exercise, foresight work outside the region is to be examined, summarized, evaluated and adapted to regional perspectives; promotional materials and events should familiarize stakeholders with the concept, the practice and the results of regional foresight activities; hands-on experience shows how successful different approaches are, demonstrating the value of the results to stakeholders. The target here is to build the foresight culture into the thinking of future generations of decision and policy makers.

Development of national and regional capabilities

Create national and sub-regional centres of excellence on foresight process, which could be mobilized for the preparation of foresight studies. Develop a roster of regional and international experts on foresight and relevant areas of knowledge. Enhance skills of foresight practitioners through courses, workshops, seminars, fellowships and study tours. Develop exchange programmes with regional centres and institutions in other regions. Conduct selected foresight studies as sample cases to demonstrate the applicability of foresight approaches and their added value for the development of national and regional policies related to common issues or themes. A regional virtual "centre" (or network) will be established to function as a repository of foresight knowledge and experience to ensure long-term sustainability.

Coordination and implementation

Dedicated fund-raising to create appropriate financing mechanisms, such as a multi-partner trust fund. A regional steering party and national focal points are being established to coordinate and implement regionally conceived foresight projects. Such coordinating bodies shall harmonize regional foresight activities with a view to motivating national actors to adopt common foresight objectives, methodologies, infrastructure and management teams, and using foresight in the design of innovative technology policy. Ideally, the national focal points will be equipped with

the necessary human resources, organizational capacity, knowledge in the field, mandate to represent the country and direct access to decision-making bodies. The regional initiative makes strong use of information and communication technology. UNIDO is available to play a role of overall coordination and the coordinating mechanism shall promote contributions that are both creative and innovative from members of the regional network of institutions and experts.

Implementation strategy and activities

The following steps and activities have been defined for the implementation of the regional foresight initiative:

- *Awareness building exercise*

  To mobilize interest and support to the regional initiative, a concentrated effort to disseminate the different events and their results, using electronic media and target communication.

- *Conferences and expert meetings*

  Following the recommendations of the regional conference (in April 2001) and the expert group meeting (in June 2001), the initiative supports different types of events. As a major event of the initiative, UNIDO organizes an annual summit to enable a regional exchange of experience and best practices of TF efforts and programmes. Expert group and focal points meetings have been organized to determine and monitor the scope, methodology, costs, time frame and related details of studies and other activities of the initiative.

- *Establishment of an electronic information exchange facility and tools*

  Taking the UNIDO Exchange Facility and the Information Centre on Technology Foresight of the International Centre for Science and High Technology (ICS) as platforms, a special web site has been developed for the initiative, with a view to creating a live knowledge-sharing process.

- *Elaboration of studies and capacity building*

  To provide an immediate contribution to strategic decision-making in the region, special foresight studies shall be promoted, focusing on areas of critical interest for the industry in the region. To facilitate the preparation of the studies, capacity building exercises shall be carried out both at the national and regional levels.

- *Mobilization of financing mechanisms*

  Different strategies for funding the initiative have been developed, using UNIDO funds, national and individual donor contributions, and financial support from industry. Countries in the region are expected to be committed in order to create the necessary strong support for the initiative as a built-in capacity for themselves as well as for the region.

- *Definition of counterparts and creation of the coordination mechanism*

  Following the initial commitment of a group of participating countries, UNIDO shall support the constitution of a virtual regional centre (or network) for facilitating the coordination and implementation of the regional initiative. In order to create ownership at the regional level, a strategic steering party shall be set up, involving governments, research communities and industry.

GLOSSARY

Analytical hierarchy process: a technique that uses so-called hierarchical networks to construct a model of the probability or the occurrence of each possible scenario.

The Bayesian model: a method used to examine the probability of occurrence of a number of scenarios

Brainstorming: a method used in groups in order to support creative problem-solving, the generation of new ideas and greater acceptance of proposed solutions.

Critical or key technologies: technologies which have a strong potential to influence national competitiveness and quality of life.

Cross-impact analysis: a method that forces attention to chains of causality: *x* affects *y*; *y* affects *z* to create a matrix of conditional probabilities.

Delphi: a method of obtaining a consensus of opinions of a group of experts by a series of questionnaires interspersed with controlled opinion feedback.

Environmental Scanning: a formal or informal process for monitoring change.

Expert panels: normally consists of 12 to 15 individuals who are mandated to use their collective expertise in addressing a particular problem or set of issues.

Extrapolative methods: begin with the present as the starting point, and move forward to the future.

Genius forecasting: the generation of a vision (or several visions) of the future through the insights of a gifted and respected individual or individuals.

Normative methods: 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 futures might or might not grow out of the present.

Qualitative methods: emphasize opinion and other issues that are hard to quantify.

Quantitative methods: place heavy reliance on numerical representation of developments.

Simulation modelling: Computer-based models allowing a system to be represented in terms of its key components and relationships.

Scenarios: consist of visions of future states and courses of development, organized in a systematic way as texts, charts, etc.

Scoping: a process of research and deliberation that contributes to the shape and timing of a given TF activity.

SWOT analysis: a technique based on identifying the strengths, weaknesses, opportunities, and threats in any situation.

Technology Foresight: "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."

Technology roadmapping: a goal oriented technique for supporting technology management and planning

Trend extrapolation: historical data, such as that concerning population growth, economic development, social attitudes projected forward to form a forecast.

USEFUL SOURCES

Eurofore—Competence Mapping Project
http://les.man.ac.uk/eurofore/search

A searchable site offering links to European foresight projects, organizations and individuals.

European Union—Science and Technology foresight
http://www.cordis.lu/foresight

Information about European Union foresight activities and links to national and other projects.

Fistera—foresight on Information Society Technologies in the European Research Area
http://www.itas.fzk.de/eng/projects/fistera/overview.htm

Links to European foresight projects.

Institute for Prospective Technological Studies—IPTS
http://www.jrc.es/home/index2.cfm

Details of IPTS projects and links.

FUTUR—German Research Dialogue
http://www.futur.de

Details of the FUTUR project and links to other foresight projects.

OECD International Futures programme
http://www.oecd.org/department/0,2688,en_2649_33707_1_1_1_1_1,00.html

Details of the OECD programme and links to related websites, journals and think tanks.

Asia-Pacific Economic Cooperation Center for Technology foresight
http://www.apectf.nstda.or.th

National Institute of Science and Technology Policy, Japan
http://www.nistep.go.jp/

World Future Society
http://wfs.org

Shaping Tomorrow
http://www.shapingtomorrow.com

Commercial site offering links to a wide range of future related sources

Volume 2

Technology Foresight in Action

Module 4

TECHNOLOGY FORESIGHT AT THE NATIONAL LEVEL

The fourth module of the UNIDO technology foresight manual reviews the experience of technology foresight programmes at the national level. At the end of the module you should have gained:

- An understanding of the global scale of TF activity
- The range of countries that have adopted TF as an aid to policymaking.
- The range of approaches and methods used in selected case studies.
- The value of international experience to countries embarking on TF programmes.
- The need to adapt such programmes to the circumstances of the country concerned.

Contents

Figures

1. INTRODUCTION

Technology Foresight (TF) in its current form began in Japan in 1970 but until the 1990s was adopted by only a few other countries. Since then many more countries have undertaken technology foresight exercises. This module draws on the experience of several countries of varying size and location, including large and small countries in Western Europe, and two transition countries in Central and Eastern Europe.

The 1990s was the decade in that national foresight programmes became the norm. Until then as figure I shows, only a few countries had embarked on such programmes. The one notable exception is Japan where foresight programmes have been conducted since 1970. Three other countries the United States, Australia and Germany, started programmes in the 1980s while the majority joined in during the 1990s

Figure I. Introduction of national technology foresight programmes, 1970-2001

Year	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z	+	*	#
01	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
00	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
99	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X							
98	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X							
97	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X										
96	X	X	X	X	X	X	X	X	X	X	X	X	X	X															
95	X	X	X	X	X	X	X	X	X	X	X	X																	
94	X	X	X	X	X	X	X	X	X	X	X																		
93	X	X	X	X	X	X	X	X																					
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72	X																												
71	X																												
70	X																												

Country

a—Japan	k—United Kingdom	u—Ireland
b—United States	l—India	v—Spain
c—Germany	m—Indonesia	w—Sweden
d—Australia	n—Canada	x—Argentina
e—Republic of Korea	o—Thailand	y—Bolivia
f—Philippines	p—Finland	z—Brazil
g—Netherlands	q—Hungary	+—Mexico
h—New Zealand	r—South Africa	*—Venezuela
i—Italy	s—Nigeria	#—Czech Republic
j—France	t—Austria	

Source: Kozlowski, (2001).

Figure II. Technology foresight studies in the world—A summarized comparison of their objectives, time horizons and methodologies

Country	Responsible	Objectives		Time Horizons	Methodologies
Australia	Australia Science and Technology Council (ASTEC)	Establish framework for C&T policy Consensus building	Communication/ Education	15 years	Scenario analysis/ Delphi/ Relevance tree/ morphological analysis
Austria	Ministry of Science and Transport Innovation and Technology Funds (ITF)	Identify niches of competitive position Identify strengths and weaknesses of technological sectors	Technology policy recommendations	15 years	Technological Delphi and social Delphi
France	Ministry of Industry Ministry of Superior Education (MES)	Determine priorities of industry and society Anticipatory intelligence	Policy recommendations Consensus building	5 to 10 years 30 years	Lists of critical technologies (1993) Delphi (1993)
Germany	Federal Ministry of Education, Science, Investigation and Technology Fraunhofer Institute for Innovation Research	Policies recommendations in C&T Anticipatory intelligence	Consensus building Determine priorities (2nd Delphi)	10 years 30 years 30 years	Lists of critical technologies/Relevance trees (1991) 1st Delphi (1992) Minidelphi (1994) 2nd Delphi (1996)
Netherlands	Ministry of Education, Culture and Sciences	Determine research priorities Anticipatory intelligence	Consensus building Communication/ Education	10 to 15 years 25 years	List of emerging/critical technologies (1989-94) Scenario analysis (1990)
Hungary	Ministry of Science and Technology, National Commission for Technological Development (OMFB)	Identify strengths and weaknesses from S&T system Explore potential opportunities in the EU	National innovation strategy Increase private sector productivity	15 years	Delphi scenarios
Ireland	Irish Council for Science and Technology	Identify future opportunities for the country		Not indicated	Scenarios with expert panels/consults

Figure II. *(continued)*

Country	Responsible	Objectives		Time Horizons	Methodologies
Italy	Fondazione Rosselli	Support decision-making processes and strategies development in the long run		Not indicated	Emerging/critical technologies
Japan	Japanese Science and Technology Agency (STA)	Long run technological development S&T policy recommendations	Future society vision	30 to 20 years/ 10 to 15 years	6 Delphis/expert panels/ scenarios/ technologies mapping
Korea	Ministry of Science and Technology	Increase competitiveness of local industries Determine priorities	Long run planning of R&D in critical technologies.	10 years 5 years 20 years	Emerging/critical technologies Expert panels (1992) Delphi (1992)
New Zealand	Ministry of Research, Science and Technology (MoRST)	Determine national priorities	Identify challenges in becoming a knowledge society	15 years	Expert panels Quantitative analysis
Spain	Ministry of Industry	Technology policy recommendations Industrial competitiveness Development of new industrial capacities and technologies	Knowledge information base of impact on new technologies in Industry, Employment and Competitiveness	15 years	Delphi
Sweden	Royal Swedish Academy of Engineering Sciences (IVA) Swedish National Board for Industrial and Technical Development (NUTEK)	Promote long-term interplay between technical, economic and social processes Strengthen future-oriented approach in companies and organizations	Compile information and design processes for identifying high-priority areas in technological fields Identity areas of expertise with potential of growth	10 to 20 years	Expert panels

Figure II. *(continued)*

Country	Responsible	Objectives		Time Horizons	Methodologies
	Swedish Foundation for Strategic Research Federation of Swedish industries				
UK	Office of Science and Technology (OST) Policy research in Engineering, Science & Technology (PREST)	Determine priorities in C&T Anticipatory intelligence Future visions: possibilities and necessities	Communication/ Education Link science and industry	10 to 20 years	Consults/Delphi /panels of Experts Task forces/ "Knowledge Pool"
USA	Office of Science and Technology Policy (OSTP)	Determine research priorities for national security and economic prosperity	Policies recommendations Anticipatory intelligence	10 to 15 years	Emerging/critical technologies panels

An overview of national foresight programmes

It is widely accepted that science, technology and innovation have become more important than ever for today's economies and societies. This clearly implies a key role for technology and innovation policy. But the question of how these policies should look for an individual country to achieve economic and social progress is not at all an easy one. Several factors make the design of appropriate policies a highly demanding task that requires strategic intelligence. They include the following:

- Increasingly, liberalized global markets and global enterprises intensify the competitive pressure for all economies and call for strategies tuned to the situation of the specific country and region.
- The traditional rationale for technology policy has been changing. Advances in economic theory have extended the view from mere "market failure" to "systemic failure", i.e. the lack of coherence among institutions and incentives in complex innovation systems.
- Improved understanding of innovation and technology diffusion processes calls for policies that are capable of responding to a variety of challenges (Kuhlmann et al., 1999). These include:

— The changed nature of technological innovation processes necessitating inter- and trans-disciplinary research.

— The growing importance of the non-technical, "soft side of innovation" (design, human resource management, consumer behaviour).

— The transition from "mode-1 science" to "mode-2 science", a far more demand-driven mode of knowledge production (Gibbons et al., 1994).

Hence there is increasing pressure to produce results in terms of concrete contributions to the solution of societal problems and to increased competitiveness of national economies.

More recent efforts to improve inputs into the design of effective technology policies have concentrated on instruments such as policy evaluation. TF is increasingly recognized as a useful policy instrument and source of strategic intelligence. It has been defined as "... the systematic attempt 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 of generic technologies likely to yield the greatest economic and social benefits" (Martin, 1995).

Some overriding trends have become visible along with the remarkable upswing of TF during the last decade when it was establishing itself as a key policy instrument (Gavigan and Cahill, 1997; Grupp and Linstone, 1999). These include:

- In contrast to earlier periods one can observe a proliferation of foresight activities among practically all sorts of economies, not just among the leading industrial countries. Foresight activities take place in smaller countries as well as developing countries and transition economies.
- Foresight is no longer undertaken with the claim of forecasting or predicting a certain future situation but recognizes the possibility of alternative futures and also tries to shape or create certain paths of development.
- The foresight process, with its stimulation of communication and future orientation among the actors of the innovation system, is regarded at least as important as the outcomes in terms of identified areas of strategic research and emerging generic technologies.
- The function of mobilizing and "wiring up" national innovation systems adds to the function of informing science and technology policy-making, for purposes of priority setting, for example (Martin and Johnston, 1999).
- Increasing attention is being paid to socio-economic embedding and demand aspects of emerging technologies.
- Finally, with the growing diffusion of national TF studies in Europe and indeed on a worldwide scale, a differentiation and blending of approaches, tailored to different sets of objectives, is occurring (see figures I and II).

2. THE RELEVANCE OF TF FOR DIFFERENT ECONOMIES

The question to what extent TF and in particular the goals and approaches established by large and highly industrialized countries are relevant for other economies is certainly important. In the past, foresight studies had been the domain of a few big players among industrialized countries, notably Japan with great regularity, with the United States as the pioneer. In the 1990s small countries began to move to the front stage of TF and indeed make up a substantial part of the recent proliferation. But newly industrialized and developing countries as well as transition economies also have become increasingly interested in technology foresight.

The specific situation of small countries has a long research tradition (Soete, 1988). According to Katzenstein (1985) one has to acknowledge small States as a category of their own ("small" is defined here by a population size below 20 million). From an economic point of view, openness of the national economy, production for small segments of the world market, adaptation pressure exercised by economic "giants" and selective government interventionism are characteristic elements. Further characteristics such as stronger dependence on foreign trade, more limited resources for R&D and a disproportionate spending on basic science rather than on applied R&D may be added. Furthermore, economic openness and vulnerability of the small European States has favoured neo-corporatist political systems (that are less common in larger countries) and that both sets of characteristics together shape the politics and policy of industrial adjustment. While further research has led to some refinements and concentration on socio-institutional differences among small countries, the fact that they are under stronger pressure to specialize and that their adjustment policies will have to include an explicit "technology" dimension is most relevant here.

This situation suggests that for small countries TF can indeed be an instrument to cope with these demands but that the approach would seem to require an appropriate tailoring to more specific goals. Rather than identifying emerging technologies of strategic relevance across a broad spectrum (as appropriate for big countries), developing or redirecting technological specialization strategies and matching national potentials with economic opportunities and societal demand are crucial for small countries.

For developing countries the situation and problems are of a different nature, although some of the distinctive features of small countries may be given in more extreme forms. Even if they might see themselves less in a position to compete in technology development, there are reasons for them to be interested in using advanced technologies, in identifying and realizing their national potentials to apply these within the economy in a future-oriented perspective, in stimulating key actors and institutions to contribute to this, and in informing their future policies in this connection on the national level. A growing interest in TF is evident among developing countries: Brazil, Indonesia, Malaysia, Mexico, the Republic of Korea, South Africa and Thailand are examples with activities in this field. The manner in that foresight is being applied by small countries and their experiences should in some respects also be a useful source for developing countries.

Transition economies in Central and Eastern Europe (CEE) are another type of economic system with different sorts of issues and problems. One common set of aspects is the shrinking of R&D systems and the organizational, functional and funding restructuring these systems undergo. The rationale for foresight as an instrument for science, technology and innovation policy in CEE countries could be to provide a mechanism to address structural problems and opportunities, helping policy to identify and respond to crucial linkages within the national innovation system. It also offers a mechanism to address trade-offs between different objectives (growth, competitiveness, sustainable development and equality) and a mechanism to depoliticize the process of S&T policy-making. A specific feature suggested by economists emphasizes absorption and transfer rather than generation of technology at the present stage (Radosevic, 1999; 1997).

Many of the CEE countries are small and the approaches of countries with similar size are of interest. Out of the group of small countries in Europe, the Netherlands was one of the first to carry out a major TF experiment with a study commissioned to the Science Policy Research Unit (SPRU) at the University of Sussex (United Kingdom) in 1988. It served as preparation for area-specific foresight exercises that were started by the Ministry of Economic Affairs of the Netherlands with mechatronics in 1989 and followed by six similar studies on adhesion, chipcards, matrix composites, signal processing, separation technology and production technology (OECD, 1996). An evaluation of impacts led to the design of a knowledge transfer programme oriented at SMEs and to another major TF exercise entitled "Technology Radar" in 1997/98. It identified technologies of strategic importance for the Netherlands and focused on the needs of business and industry (Netherlands Ministry of Economic Affairs, 1998).

Ireland has published the results of its first TF exercise after a process of 12 months (Irish Council for Science, Technology and Innovation, 1999) and in Austria the first national foresight programme was completed in 1998. In the early 1980s, Norway, Portugal and Sweden made their first steps in the area of foresight (Gavigan and Cahill, 1997). Towards the end of 1998, Sweden launched a new TF project on eight quite broadly defined areas. Finland, that started the foresight process with the Technology Vision project in 1996, is preparing a further sector study in the chemical industry, following a foresight exercise in the food and drink industry. As the first out of CEE transition economies, Hungary has undertaken a major TF project that started in 1997. Combining a panel and Delphi approach the Hungarian TF programme "aims at creating sustainable competitive advantage and enhance the quality of life by bringing together business, the science base and government to identify and respond to emerging opportunities in markets and technologies" and "should result in a national innovation strategy" (Havas, 1998). Other small countries have also carried out foresight exercises or are planning to do so, such as the Czech Republic, Denmark and Estonia.

Further examples could be added from other continents, e.g. Singapore in Asia. In the late 1980s, Australia had embarked on prospective studies and applied priority-setting mechanisms. A first comprehensive foresight exercise at the national level "examined possible national and global changes to 2010 and Australia's key future needs and opportunities that rely on, or could be significantly affected by, scientific developments and the application of technology with an emphasis on demand-pull" (ASTEC, 1994; OST, 1998, p. 87). New Zealand has some experience in applying foresight for

identifying international leadership opportunities in areas of national strength and priority setting after two exercises carried out in 1992 and 1995. New Zealand is planning for a further foresight project started in 1997, this time with greater emphasis on consultation of end-users of science and technology (Martin and Johnston, 1999).

Identifying common trends in the foresight exercises conducted in all these small countries can best be attempted using a set of criteria developed by Martin and Irvine (Martin, 1995). It means to look at characteristics such as those of the performing organization, specificity, functions, orientation of research, "intrinsic tensions", time horizon and methodological approach. In short, evidence from a number of well-documented foresight exercises indicates that even among small countries the approaches are quite varied. However, some common traits may be pointed out:

- The goals and scopes of foresight exercises are more frequently oriented at specific national conditions and the identification of niche potentials.
- Time horizons are less long term but more often around 15 years.
- More and more emphasis is laid on the value of the foresight process itself as a means to stimulate communication, mutual learning, innovation-oriented consensus and coordination among the actors within national innovation systems.
- Mobilizing innovation awareness rather than limiting the function of foresight to priority setting is prevailing.
- Decentralized and bottom-up approaches tend to be favoured and combined with central steering agencies, usually at a national S&T policy level.
- To some extent a broadening of the expert base along with an integration of socio-economic demand and impact factors into foresight designs is observable.
- A stronger orientation towards the implementation, the applicability of results and transfer to SMEs is also more typical for small countries.
- Finally, a variety of methods are applied including the use of expert panels, widespread consultation, lists of strategic technologies, scenarios and also quantitative models, but some preference for the Delphi method is also visible.

3. CASE STUDIES OF NATIONAL FORESIGHT PROGRAMMES

Case studies from the following countries will be presented:

- France
- Germany
- Austria
- Sweden

- Hungary
- The Czech Republic
- The United Kingdom

Technology Foresight (TF) in France

French vision of TF

The French TF study was conducted in a specific context. The Minister of Economy, Finance and Industry requested the study with a view to the development of a new policy to support business efforts to adapt to major technological challenges, focusing on optimal allocation of the limited resources available for R&D programmes. The study was therefore based on an industrial perspective, its objective was to identify key technologies, it had a short-term horizon of 5 to 10 years; and it followed a market-driven approach. A science-driven perspective was incorporated by inviting scientific experts from leading public research centres, as well as industrial experts to participate in the working groups.

French TF study

The objectives of the study were twofold. The first objective was to identify what the key technologies for French industry would be in 2005, so that the government could define and implement appropriate policies to foster the development of cutting-edge technology. The second was to inform all companies, especially small and medium-scale enterprises, about the technological changes that would be required to remain competitive and at the forefront of innovation in 2005. A further aim was to evaluate the extent to that French industry, compared to that of other countries, was prepared to face the scientific and technological challenges of 2005.

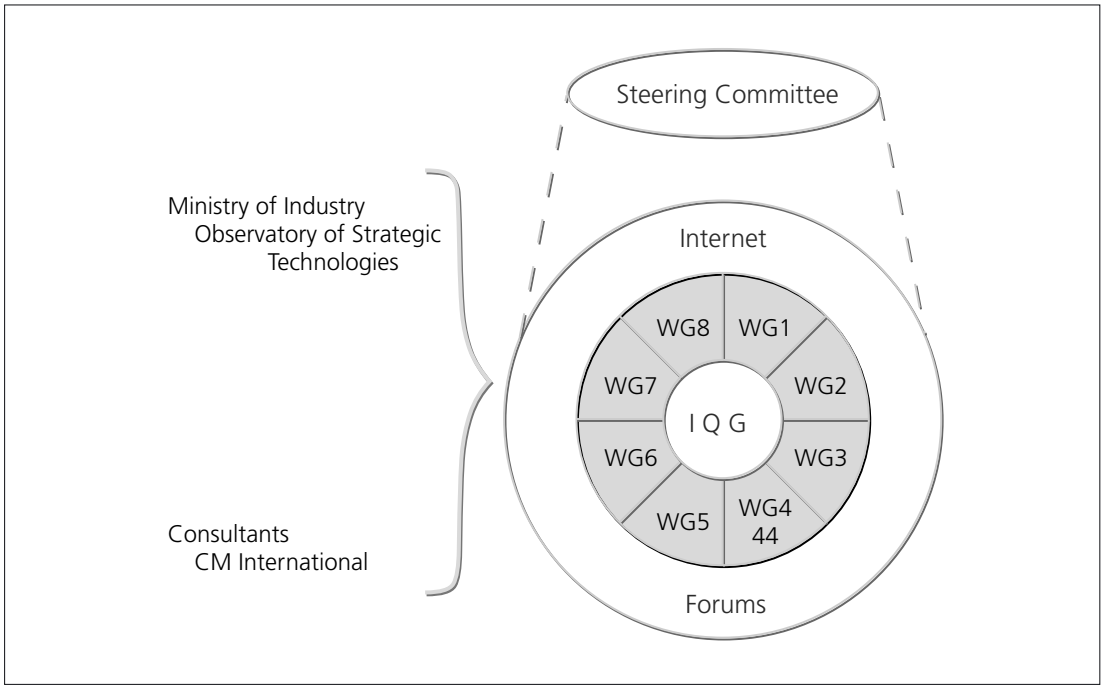
The study was conducted between June 1999 and October 2000. Groups of experts were asked to identify key technologies that French industry would need to develop to be at the forefront of progress in 2005. A technology was defined as a key technology if it met the following conditions:

- First, it had to be attributed a high score by the working groups, according to the five criteria of “attractiveness”.
- Secondly, it had to be a technology for that France had the required assets.
- Thirdly, the key conditions for the successful development of the technology had to be present.

Organization of the study

The organizational framework of the study is reflected in figure III.

Figure III. Organization of the study



Note: Working group (WG); interactivity and quality group (IQP).
Source: Bourgeois, (2001).

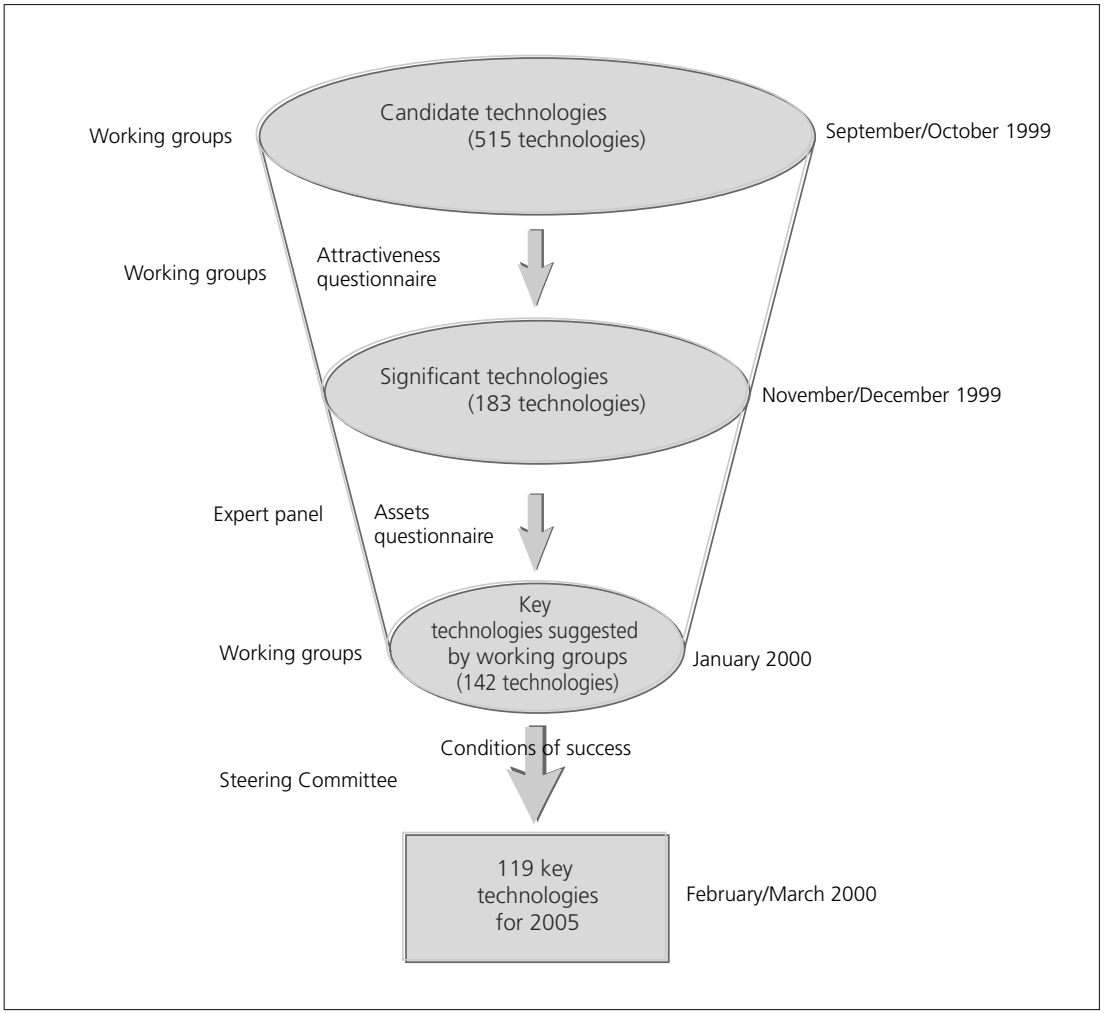
The following aspects of the conduct of the study should be noted:

- The Observatory of Strategic Technologies at the Ministry of Industry, in cooperation with the consulting group CM International, was responsible for establishing the conceptual and operational framework of the study.
- The Steering Committee supervised the whole study. The two essential missions of the committee were the final selection of key technologies and deciding on the recommendations that would be forwarded to the Minister of Industry.
- Eight working groups, composed of representatives from the public and private sectors, had to identify the key technologies for the industrial sector assigned to each group.
- The interactivity and quality group had the following two essential missions:
    - First, to ensure the quality and coherence of the study.
    - Secondly, to advise and brief the project team.

To ensure the legitimacy of the results of the study, the participation of a large number of experts was needed. To widen the scope of the input, an Internet forum was set up to enable all those interested in the study to make known their views.

As shown in figure IV, the process of selection of key technologies is in the shape of a funnel.

Figure IV. Selection of key technologies



Source: Bourgeois, (2001).

At each stage of the selection process, the number of technologies retained for the following phase decreased. The first selection was made according to the criteria of attractiveness; the second was based on the availability of the required assets; and the final selection was made by the Steering Committee, that took into account the assets and the conditions for the successful development of the technology.

The progressive process of selection was designed so that the experts would not be required to evaluate the three types of criteria (attractiveness, assets and conditions of success) for all the candidate technologies. Only attractiveness was evaluated for all the candidate technologies, whereas the assets and conditions of success were used only for significant technologies, thus greatly reducing the evaluation workload of the experts.

The results of the study have been published. The following essential points should be noted:

(a) A total of 119 technologies with a definition and a grid for analysing each were identified.
(b) Eight expert reports presenting the main trends in technological development for the eight themes covered by the working groups were submitted.
(c) The recommendations of the Steering Committee were delivered to the Minister of Industry.

The findings should serve as the knowledge base for political and economic decision-makers to select and support the most appropriate technology for future development.

The Ministry of Industry should use the results of the study in a very different way from the results of a previous study carried out in 1995. In 1995, the results were used to reorganize public funding and support 50 key technologies. The results of the 2000 study should be used to orient regional economic development in France. The scientific and technological potential of each region in France should be evaluated in terms of the key technologies identified in the study.

The change in focus clearly illustrates how TF studies can be adapted to changing contexts. The current regional focus reflects the important role of regional development in overall economic growth in France.

Strengths and limitations of TF studies in France

The four strong points of the methodology used in the French study are as follows:

(a) Having a clearly expressed objective is an essential element in implementing a TF study. The objective indicates the destination of the study, and the methodology is the path followed to get there.
(b) Using the Internet to diversify the range of expertise is another strong point of the study. It seems important to include the largest possible number of experts because a diversity of points of view enhances the quality of the results.
(c) The interactivity and quality group played an important role by providing an outsider's view of the perspective taken by the working group. The questions posed and remarks, made by the members of that group, encouraged discussion and improved the organization of the study.
(d) A list of 119 technologies emerged from the study of key technologies for 2005. In addition to that list, the working groups produced reports presenting the main trends in technological development in each of the industrial sectors analysed. Those reports enhance the value of the study because they go beyond a simple list of technologies to provide a context for the technological challenges to be faced.

However, as there is no such thing as the perfect study, and given the benefit of hindsight in designing TF studies, several areas in that improvements could be made have been identified and are described below.

Almost all of the experts were from French enterprises or research centres. Even though they are aware of what is happening abroad, they have a French view of technologi-

cal development. Although every effort was made to introduce the viewpoint of foreign experts in the Internet forums by asking each French expert to register at least one foreign expert, the fact is that no foreign experts participated. That is regrettable, because input from other countries would have enriched the results of the study. A further aspect worth mentioning about that mode of communication is the need to have a well-managed site. Although more than 600 French people registered, very few participated in the forum. As most only came to "look and see", ways need to be found to encourage visitors to contribute. Improved site management may even be a solution to counteract the next point, that concerns what might be called the lobbying effect. During the earlier study, lobbying was minimal, since none of the experts tried to promote their own technologies. A few officials at the Ministry of Industry were upset because the technologies that they had supported did not appear in the final list. Through the intervention of the President of the Steering Committee, the situation was resolved. In the latest study, however, the experts clearly had in mind that the results of their work could be used to develop key technologies, as had been the case after the 1995 study. Even though the experts were selected for their expertise, and not because they came from a specific institution, it is an open question whether their viewpoints always remained neutral. As indicated above, the involvement of foreign experts would certainly enhance confidence in the results achieved.

Another difficulty was encountered in regrouping all industrial sectors around eight themes. For example, in the first study, environment and health experts had great difficulty understanding each other. For the second study, the environment and energy were put together, and the experts showed greater mutual understanding. It is therefore important to group industrial sectors around common problems.

The list of criteria used to select technologies was intended to achieve a little objectivity in the very subjective question "Is this technology important?" Other methods of selection are possible. But what seems significant is to be able to justify why one technology rather than another was selected. Examination of the selection criteria should provide an answer to that question. Such a process suggests that the criteria used in the latest study tried to cover far too much ground with too many stakes. The experts often had difficulty assessing the criteria. It would be more useful to limit the evaluations to only a small number of strategic stakes, that it would then be necessary to justify. The criteria adopted need to be re-examined, in particular those relating to assets. A conclusion of the study is precisely that the assets of a country do not play the same role today as they did five years ago.

Conclusion

In a continually changing world, it is important that public authorities and the business community have an insight into the technological future. TF studies are necessary and even essential tools for assisting decision-makers in designing their strategies and implementing the most appropriate policy. In approaching such studies, the following points should be borne in mind:

(a) It is doubtful that any one methodology is better than another, or indeed that there is a "best" methodology. Each methodology has its inherent strengths

and weaknesses. What is important is to recognize and acknowledge them, so that appropriate measures can be taken to reinforce the strong points, and instigate the weaknesses;

(b) TF is very complex because the field of investigation is very wide, the concept of technology is not always precise, the selection criteria are arbitrary, and there is an inherent risk of overlooking a significant technology. There are numerous traps along the way, but the benefits of TF studies are worth the perilous journey.

Technology Foresight in Germany

Research structure in Germany

The German science system is rather complex. Although the *Länder* (states) are in charge of science policy (for example, the basic financing of universities), most application-oriented research is funded by the BMBF (the Federal Ministry of Education and Research). In Germany, research is carried out primarily by the following institutions:

- Max Planck Society: 72 institutes, €1.0 billion per year, mostly fundamental research.
- Fraunhofer Society: 49 institutes, €0.7 billion per year, mostly application-oriented research, cooperation projects with industry.
- Leibnitz Science Association: 84 institutes, €0.9 billion per year, fundamental science and application-oriented science.
- Helmholtz Association of National Research Centres: 16 national research centres, €2.3 billion per year.
- Higher education: 161 universities, 183 *Fachhochschulen* institutions (universities of applied science).

The first four institutions are partly funded by the BMBF (68 per cent on an average) and by the *Länder* (32 per cent). Besides basic support for the institutions the following organizations provide funding of R&D projects: the German Research Association (DFG); the Confederation of Industrial Research Associations (AiF); various private foundations such as Volkswagen Stiftung, etc.; and the BMBF and the Federal Ministry of Economics and Technology (BMWi), together with their project-management agencies (*Projektträger*). The largest part of R&D expenditure in Germany comes from industry.

In the following, the focus is on project funding by the BMBF amounting to a total of €2.3 billion in 2001, of that €1.5 billion are spent on technology-oriented R&D projects. The funding by the BMBF is organized in specific programmes. Most of them concentrate on a special technology, for example, research programmes on laser technologies, microelectronics or superconductivity. Some programmes are focused on a special application such as health or mobility and transport.

A comprehensive discussion between the various programmes (to identify synergies for example) is not systematically implemented in the BMBF. This was the aim of the FUTUR initiative in 2001 that is addressed in this section.

Research policy of BMBF

In order to explain the principles of the intended foresight process in Germany, it is necessary to outline the main issues of German research policy. The focus of German research policy is the human being and not technology as such. Research should contribute, for example, to health, responsible treatment of the environment and the quality of life or employment. A second aim is to strengthen the basis of German industry. Economic potential is always an important criterion for the evaluation of a new technology and is usually correlated with employment.

One of the central objectives of German research policy is to contribute to worldwide sustainable growth. Thus, before starting a funding programme, the contribution of the respective technology to sustainability was evaluated (for example, reduction of emissions, substitution of an environmentally hazardous production process, etc.).

Ethical questions need to be assessed before making a decision on funding a new programme (for example, the intensively discussed research on human embryos). Not every field of research that is feasible is desirable. The discussion shows that research must be done within established ethical boundaries.

Before starting to fund research in a future technology, risks must be evaluated. A new funding focus has begun on technology assessment. Technology assessment has to be closely correlated with foresight. To give an example, the American computer expert, Bill Joy, started a discussion on the combination of genetics, nanotechnology and robotics. His scenario envisions intelligent machines that are superior to humans and make humans superfluous within 20 or 30 years. Although most experts do not believe in the future he describes, possible risks must be analysed, and scenarios such as the one described should be discussed and evaluated simultaneously with the intensification of our activities in nanotechnology. Innovation is always accompanied by risks. Foresight together with technology assessment should result in a decision concerning that risks we want to take and that risks we are not willing to accept.

Government funding does not intervene in existing markets. Product-oriented R&D is the responsibility of enterprises. The BMBF funds projects involving larger technological and economic risks, especially in areas where a concrete market potential is not yet known. By providing such financial support, the BMBF encourages industry to invest in high-risk fields offering potential medium- and long-term applications.

Developments in recent years show that the most interesting research fields are found at the boundaries between the classical disciplines of physics, chemistry, biology or engineering science. One of the principles of the BMBF is to identify and promote interdisciplinary fields of research. To give some examples:

- The advances in the technology of medical operations are based on a combination of laser technologies, microsystem technologies and new measuring techniques from physics, computer science and medicine.

- Research on artificial intelligence brings together computer scientists, neuroscientists, microsystem technicians, biochemists and others.
- In nanotechnology, molecules are investigated as construction elements in molecular machines, drug-delivery systems or techniques to manipulate individual atoms, among other technologies. The boundaries between physics, chemistry and biology vanish in nanotechnology.

Identification of future technologies in the BMBF

Various methods of TF are used in the BMBF, including Delphi studies, early warning system for new technologies, and the FUTUR process.

German Delphi reports[1]

In the 1990s, four Delphi studies were carried out in Germany. The first German Delphi study was published in 1993, followed in 1995 by a mini-Delphi, that concentrated on selected topics and was carried out simultaneously in Japan. In 1998, the second German Delphi survey took place. These three Delphi studies were managed by the Fraunhofer Institute for Systems and Innovation Research (ISI). During all phases of Delphi in Germany there was close cooperation between German and Japanese experts so that comparable results could be achieved. (The Delphi survey can be downloaded from the ISI website: www.isi.fhg.de)

In addition to the technology-oriented surveys, a Delphi study focusing on education issues was launched.

More than 2,000 experts took part in the 1998 Delphi survey in Germany concentrating on the following 12 fields:

- Information and communication.
- Services and consumer goods.
- Management and production.
- Chemistry and materials.
- Health and life sciences.
- Agriculture and nourishment.
- Environment and nature.
- Energy and resources.
- Construction and housing.
- Mobility and transport.
- Space technology.
- Large-scale experiments.

[1] German approach to Delphi is included in volume 1—module 3, Methods in technology foresight.

The experts were provided with dozens (sometimes hundreds) of visionary statements in their respective fields of knowledge and asked for their opinions. The study contains a total of 1,070 visionary statements in the above-mentioned 12 fields. Some examples of those visionary statements are:

- New materials can be produced by self-organization.
- The pathogenesis of cancer is understood by identification of most of the genes participating in the formation of cancer and by understanding the environmental influences promoting cancer.
- Memories based on biomaterials with a storage density 1,000 times larger than the actual semiconductor memories will be realized.
- Vehicles and machines using alcohol or hydrogen instead of fuel are commonly used.

The experts examined such questions as:

- Time-frame until realization of technology.
- Importance for economic, social and ecological development, for increase of knowledge and for employment.
- Status of research, especially comparing the EU, Germany, Japan and United States.
- Important measures to realize the visionary statements.
- Possible problems arising for environment, security, society, etc.

In a second round the experts had the chance to change their opinions in the light of an evaluation of all the statements of their colleagues, providing a consolidated opinion of experts.

The strength of the Delphi survey's coverage of all the fields of technology is also its weakness. In the wide field of 1,070 visionary statements, no priorities among a set of recommended measures can be seen. This may be the reason why Delphi had nearly no influence on strategic decisions in research policy or on the shaping of research programmes of the BMBF. Delphi did not produce an interdisciplinary discussion about priorities. On the other hand, the majority of the visionary statements were already taken into account in the various research programmes existing in the BMBF.

Early warning system of the BMBF

The BMBF covers a vast spectrum of application-oriented research fields and research funding and is subdivided into a number of specific programmes (*Fachprogramme*). They are not static: as so-called "learning programmes", their development is permanent and there is continuous search for new aspects and fields within the respective programme. Out of this process, new programmes may develop or those dealing with technologies that have reached a certain level of maturity will be stopped.

In 1993 the BMBF (formerly known as BMFT) published a study on "Technologies of the 21st Century", managed by ISI. In this study the knowledge of the *Projektträger*, the project management agencies of the BMBF, was used to identify new trends in critical technologies. Eighty-six emerging technologies with a time-frame for application of about 10 years were identified in the fields of new materials, nanotechnology, microelectronics, photonics, microsystems technologies, software and simulation, molecular electronics and biotechnology. One important finding of the study was that new technologies will be more and more interdisciplinary, that should have consequences for structuring funding programmes. The study indicated that research efforts should be bundled in larger so-called *Leitprojekte* (lead projects), that follow a longer-term vision and should not concentrate on a distinct technology, but on social and economic problems to be solved. Some years following the ISI study *Leitprojekte* were implemented in the BMBF.

Nanotechnology provides an example of how the early warning system for new technologies in the BMBF generally works. Nanotechnology is considered to be a key technology of the 21st century. It is a field of research that is in an early stage and basic research is still necessary. New fields—like nanotechnology—are implemented as a funding priority in a three-phase process—the identification, evaluation and implementation phases—described below.

Identification phase

The first permanent active phase of the early warning system is a broad "technology screening", conducted in the framework of the different specific programmes of the BMBF. New technology-oriented subjects are identified by interviews with experts and workshops, by evaluation of scientific conferences, patent or publication analysis, or by observation of international activities.

Since the late 1980s we have known that single atoms or molecules cannot only be made visible but can be manipulated in a specific way. In principle it became possible to construct atom-by-atom, or molecule by molecule. Eric Drexler visualized that medical "nano-submarines" could be incorporated in the body and repair defects in the blood-stream. The potential of nano-machines constructing atom-by-atom, new products out of waste was recognized by the public, but criticized by experts. It became evident that nanotechnology is a field of increasing importance in research, but a clear definition and realistic opportunities for its application are still missing.

The BMBF organized several expert workshops and developed the definition of nanotechnogy as "production, analysis and application of systems with critical dimensions below 100 nanometres showing new applicable effects due to the small structures".

Evaluation phase (pilot projects and pilot studies)

The fields identified in the first phase have been evaluated, mostly in the form of a "technology study". This technology study aims to answer the following questions:

- What is the quantified economic potential of this technology? that concrete products and that fields of application are realistic? In the case of nanotechnology a world market of about €55 billion could be predicted. Considerable applications

have already been realized especially in the area of high precision engineering (e.g. high precision optics for semiconductor equipment).

- Is the identified future technology of interest from a scientific point of view? What is the level of innovation associated with the underlying scientific field? In the case of nanotechnology there are several completely new basic effects found by scientists that may lead to new products. Further basic research is needed, for example, in the field of nanobiotechnology or nanoelectronics. Nanotechnology is an interdisciplinary field covering physics, chemistry, biology and engineering science. Interdisciplinarity is a challenge to research policy, for example, in regard to questions of adequate training and education.
- What is the influence of the new technology on society? What contribution does it make to sustainability or to ethical questions? Several questions are raised in the case of nanotechnology. Nanotechnology will contribute to the reduction of resource consumption. It promises new drug delivery systems or medical methods like hyperthermia by using ultra-fine magnetic particles. On the other hand there are risks associated with nanotechnology. As mentioned previously, one risk was formulated by Bill Joy, co-founder and chief scientist of Sun Microsystems: "Our most powerful 21st-century technologies—robotics, genetic engineering, and nanotechnology—are threatening to make humans an endangered species." He envisioned machines being more intelligent than humans and thus making man superfluous. Identifying a new technology for funding should be accompanied by technology assessment from the very outset.
- What is the state of the art of the respective technology compared to the international situation? that funding activities exist in other countries? To return to the nanotechnology example, it is being paid great attention worldwide. For example, about one year ago, the United States administration started an initiative on nanotechnology amounting to $US 500 million per year.
- What is the research capacity in Germany for working on a specific technology?

The results of the technology study led to recommendations on funding activities. In the case of nanotechnology, an interdisciplinary programme was implemented at the beginning of 1999, including aspects of physics, chemistry, materials science, biotechnology, health research and microelectronics. At the moment the BMBF funds nanotechnology with about €41 million per year.

Typically, it takes months or up to one year to elaborate a technology study. To avoid losing time, pilot projects are usually started at the same time as the technology study. The objective of pilot projects is to learn about the potential for application and to give scientists and technologists a chance to define relevant questions. In the case of nanotechnology pilot projects in the most promising fields started (nanoanalytics, nanoparticles, nanoelectronics and lateral structuring, and ultra-precision engineering).

Implementation phase: funding: funding new programmes

Sometimes the funding of pilot projects is called the "greenhouse" of the BMBF. New technologies were grown like small plants and after a while, only the most interest-

ing and mature plants survive. Not all examples of pilot funding were as successful as nanotechnology. Some technologies had very promising beginnings but had to be stopped after a year or two. But others will continue to grow and will finally be implemented as new funding programmes.

These activities are closely coordinated between science and industry. The BMBF expects companies to participate and to finance projects at a certain percentage, at least after the pilot project phase. The ultimate objective is innovation, and this can only be achieved if enterprises are involved. At the same time, the financial engagement of companies is a good test of the economic significance of a technology.

Nanotechnology was implemented as a strategic interdisciplinary initiative of the BMBF. Besides research projects, the BMBF supports six centres of competence. Their aim is to make Germany an excellent location for nanotechnology. These centres should become starting points for the application of nanotechnology in industry. Although nanotechnology is rather young and the centres of competence have existed for only few years, more than a dozen new enterprises were established demonstrating that this technology offers promising market opportunities.

FUTUR initiative

FUTUR, the new German research dialogue, initiated by the Federal Minister for Education and Research, Edelgard Bulmahn, in summer 2001, represents a national foresight process focusing on the following key questions:

- Does the BMBF support future-oriented research topics?
- How can supportive measures for research programmes add to national and global problem-solving processes?
- Which research programmes need support by the BMBF to improve Germany's strive for innovation?

FUTUR aims at the elaboration of guiding visions, that focus on particular aspects of reality in order to have the right answers at hand when we need them. The idea of FUTUR is to focus on societal needs: technological development in reference to the future society. Consequently, FUTUR is confronted with two major tasks. Firstly, to create images of the future society, related opportunities and challenges. Secondly, based on these images to derive research questions, identify research issues and bundle them as guiding visions. The complexity of societal needs is obvious and calls for an interdisciplinary approach. On the one hand, the Ministry aims at interdisciplinary visions that go beyond existing programmes. On the other hand, it understands itself as initiator and presenter of a discourse that covers the complex links between science, economy and society at large. Thus the outcomes of FUTUR go beyond and across traditional departments within the BMBF.

FUTUR as a participatory dialogue facilitates a community of experts from a wide range of fields, such as industry, associations, non-governmental organizations and the church to formulate guiding visions. Through the interaction of diverse participants,

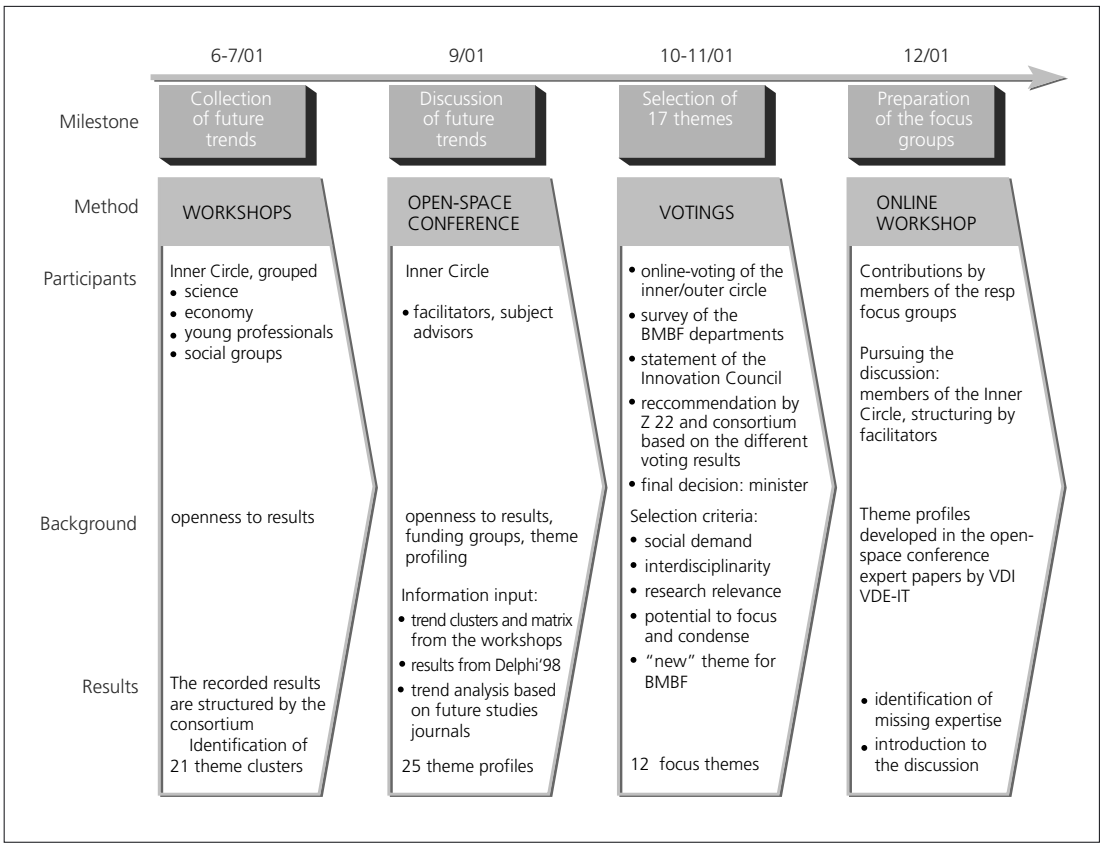
transparent discussions and a say for the public the German research dialogue establishes receptiveness for the future.

FUTUR as a process

In autumn 2003, there were 1,200 experts from all relevant areas of society fields (science, technology, economy, art and media) involved in the process. On the basis of future societal needs guiding visions were developed accordingly. FUTUR consists of several steps. At the beginning, the process was rather broad, but in the course of the discussions, concrete interim findings and an increasing differentiation have been identified. Thus, in the course of a filtering process a few topics were prioritized.

The first stage was characterized by comprehensive stocktaking. At the same time, individual experts from the natural sciences and humanities, as well as from societal and special interest groups were approached and encouraged to join the research dialogue. By late 2001 it was possible to identify important trends from a broad variety of sources. In 9 workshops approximately 400 experts were involved.

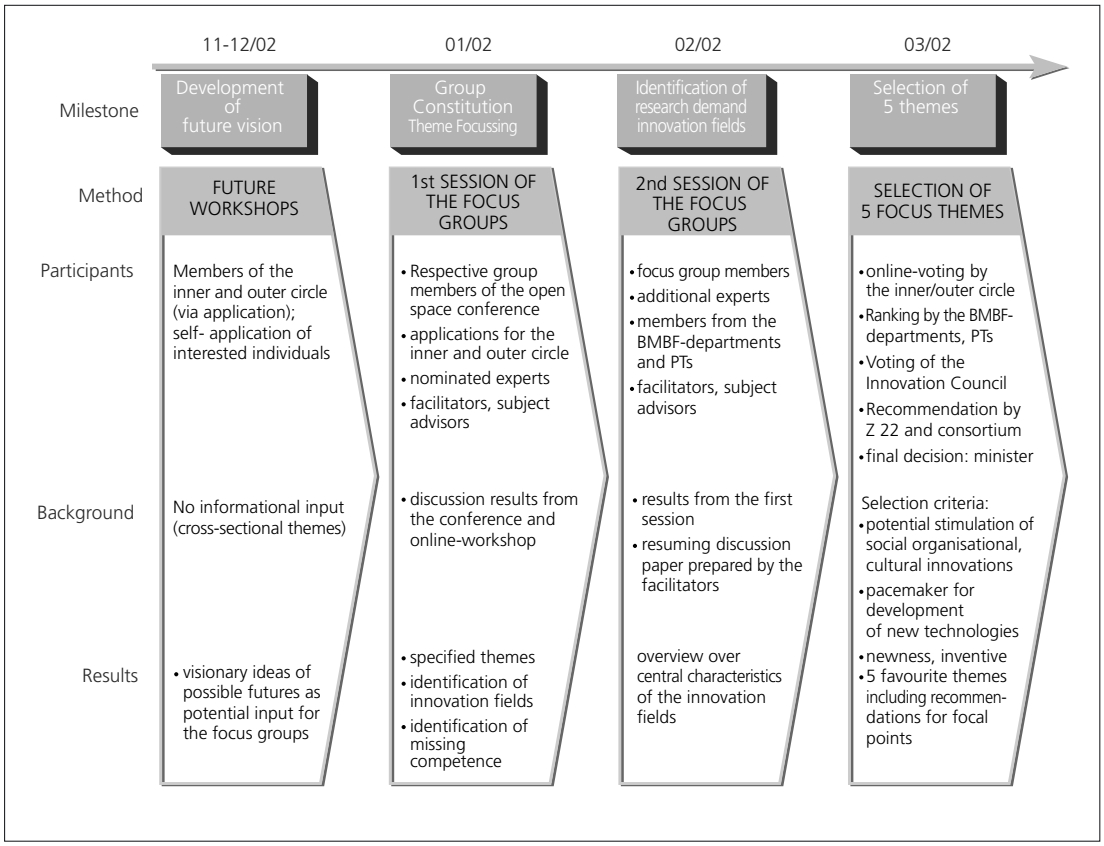
Figure V. FUTUR stage 1



Source: Banthien, (2003).

The second stage focused on 12 of the specified trends, that were further qualified in workshops, focus group meetings and an Internet workspace. During these sessions the topics were elaborated, especially regarding their scientific quality.

Figure VI. FUTUR stage 2



Source: Banthien, (2003).

During the third stage, via scenario-workshops—now only working on four topics of high priority—and expert reports, scenarios were written in order to strengthen the visionary quality and also the comprehensibility of the guiding vision.

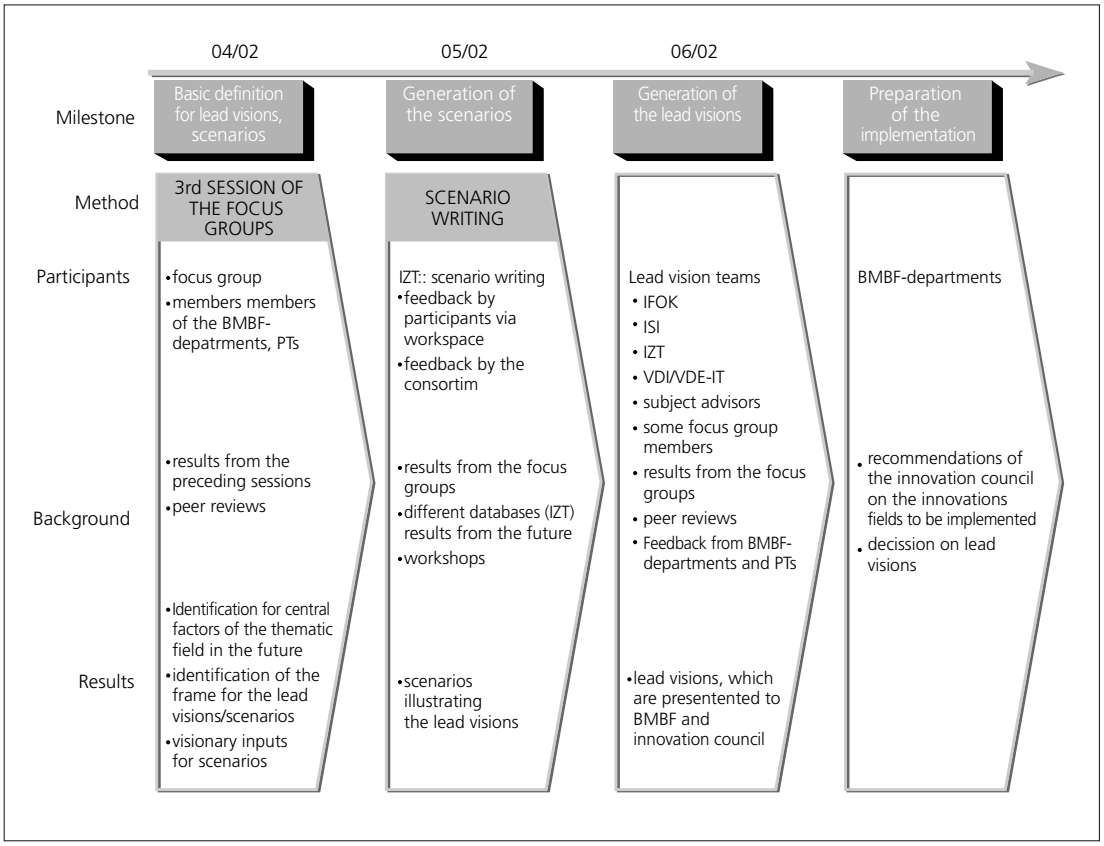
Finally, in July 2002, four guiding visions were developed. Their titles are:

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

Their implementation in research programmes is successfully under way. There are concrete funding programmes published.

During winter 2002 FUTUR was evaluated. The result was very positive:

Figure VII. FUTUR stage 3



Source: Banthien, (2003).

> International Evaluation-panel, 2003: "FUTUR is meeting its objectives and there is a clear case for continuation of this path-breaking experiment. This is the first attempt in any country to engage socially-oriented foresight with national research policy-making. This input has the potential to improve the eventual success rate of innovations by improving the appreciation and embodiment of social factors in technological development." (Georghiou, 2003)
>
> Research-Commission ("Wissenschaftsrat"), 2003: "The Research-Commission welcomes the attempt of the BMBF to develop long-term guiding visions via FUTUR that have a special focus on societal demand. The involvement of experts from a broad range of professional fields as well as outside research promotes the chance to break up disciplinary and sector-specific traditions." (Wissenschaftsrat, 2003)

Learning from the results of the evaluation, FUTUR was slightly re-designed and streamlined. More emphasis is made on the participation of the broader public. "Future-Dialogues" are going to foster the reflection about the future in various groups of civil society. Since summer 2003 a new round of topical work has started. The new issues—taken from the broad pool of ideas from the first round of FUTUR—are user-oriented production, silent city, security, sustainability, governance, infrastructure, nutrition and others.

Judging from these experiences, FUTUR is successful regarding a high level of participation and commitment; the fact that actors are inspired by lively and interdisciplinary discussions due to novel mixtures of participants, and due to the development of new ideas and the formulation of solutions to future societal problems. On the other hand, problems and challenges are becoming clear: participants are not used to interdisciplinary discourses and therefore need the support of a clear but flexible organizational structure.

FUTUR as part of a new understanding of politics

As a matter of fact, skills such as transparency, dialogue and wide participation symbolize a new way of policy-making that is not only applied in the field of research policy, but, seem attractive for various societal fields and is becoming increasingly important on both the national and international level. Perceptions of social conflicts and their solutions have changed. Traditional political management approaches are not sufficient to solve today's problems that are determined by globalization, high-level interdependence, individualism and value pluralism (Gerecke, 1998; Messner 1995).

Why do public participation processes become more and more important within decision-making procedures? Two main reasons must be differentiated: firstly, a knowledge problem, and second, an implementation problem. Today's society and politics are confronted with extremely complex problems. Hence, rather than collecting knowledge and deciding upon the implementation of projects following the "black-box-method" (this aspect is discussed by Friedrich August von Hayek (1945): The use of knowledge in society. *The American Economic Review*, no. 35, pp. 519-530), the process of bundling knowledge and identifying central issues needs to be achieved by many different experts. Furthermore, many questions cannot be answered with unequivocal and objectively correct responses. Also while there exists a shared knowledge on general aspects of lasting development, social integration and decreasing unemployment policies, there is no agreement on how to implement visions and projects realistically. The problem is especially present in the field of research policies. Here, experts can hardly ever agree upon research approaches in order to manage society's future. Consequently, decision-making procedures on central issues are often controversial and therefore less efficient.

The political system is unable to manage these complex problems and must consider various solutions. Here, the establishment of advisory councils and special committees stands for "dead-end streets" rather than innovative problem solving. Councils need to be directly included in the decision-making process in order to strengthen societal acceptance and thereby promote political procedures.

The participatory dialogue approach provides promising solutions to knowledge and implementation problems. The approach includes societal learning, searching and interacting processes and as such allows us to identify widely accepted problem solutions. Of course, there is not a common answer to every societal problem and there never will be. Ways and strategies need to be pointed out, rather than ultimate answers. It is crucial, however, to consider the solution as a process in that all those involved are directly linked to the subject. The greatest advantage of the participatory dialogue

approach is the opportunity to develop new visions through the interaction of experts from very diverse areas.

Conclusion

In Germany there are various established methods used to identify future trends in science and technology: Delphi surveys, a technology-oriented "early warning system", and the FUTUR initiative of the BMBF.

The following conclusions can be drawn from experience with TF in Germany:

- Delphi is unsuited for finding priorities among a large variety of topics. Thus Delphi had little or no impact on the formulation of research programmes in Germany.

- Both technology-oriented and demand-oriented approaches should be used. Technology-oriented approaches ("early warning system") result in explorative research at an early stage of innovation. Pilot projects could be used to evaluate the possible applications of a future technology under investigation. On the other hand, demand-oriented approaches, as specified by the FUTUR initiative, can focus research on central problems of our society.

- The early warning system has one important shortcoming: it is unsuited for detecting interdisciplinary fields of activity. It reproduces the structures of the BMBF. Fields that do not fit into existing specific programmes are in danger of not being identified.

- New technologies in Germany, especially if they focus on social demands, cannot be implemented without public participation. The new FUTUR initiative includes consensus-building conferences, scenario workshops with interested citizens, Internet participation of the public, etc.

Delphi Austria: an example of tailoring foresight to the needs of a small country

Goals and approach of the Austrian foresight programme

Austria's decision to undertake a foresight exercise arose from the following situation (Tichy, forthcoming). The country had undergone a successful catch-up process from a largely destroyed economy by the end of the Second World War to a position among the leading industrial countries. The closure of the income and technology gap had relied on importing foreign technology. With the position achieved in the 1980s, a policy change to master the difficult transition from a technology importer to a technology developer in promising future markets was perceived as highly necessary. As

Austria is still specialized in a broad range of traditional medium-technology goods—though of the highest quality—a focus on three aspects seemed reasonable: to create and support conditions for successful independent fundamental innovations, to upgrade existing technology in general by marginal innovations, and to concentrate on a limited number of innovative high-tech-market segments (niches), in that fundamental Austrian innovations and consequently Austrian market leadership appear likely.

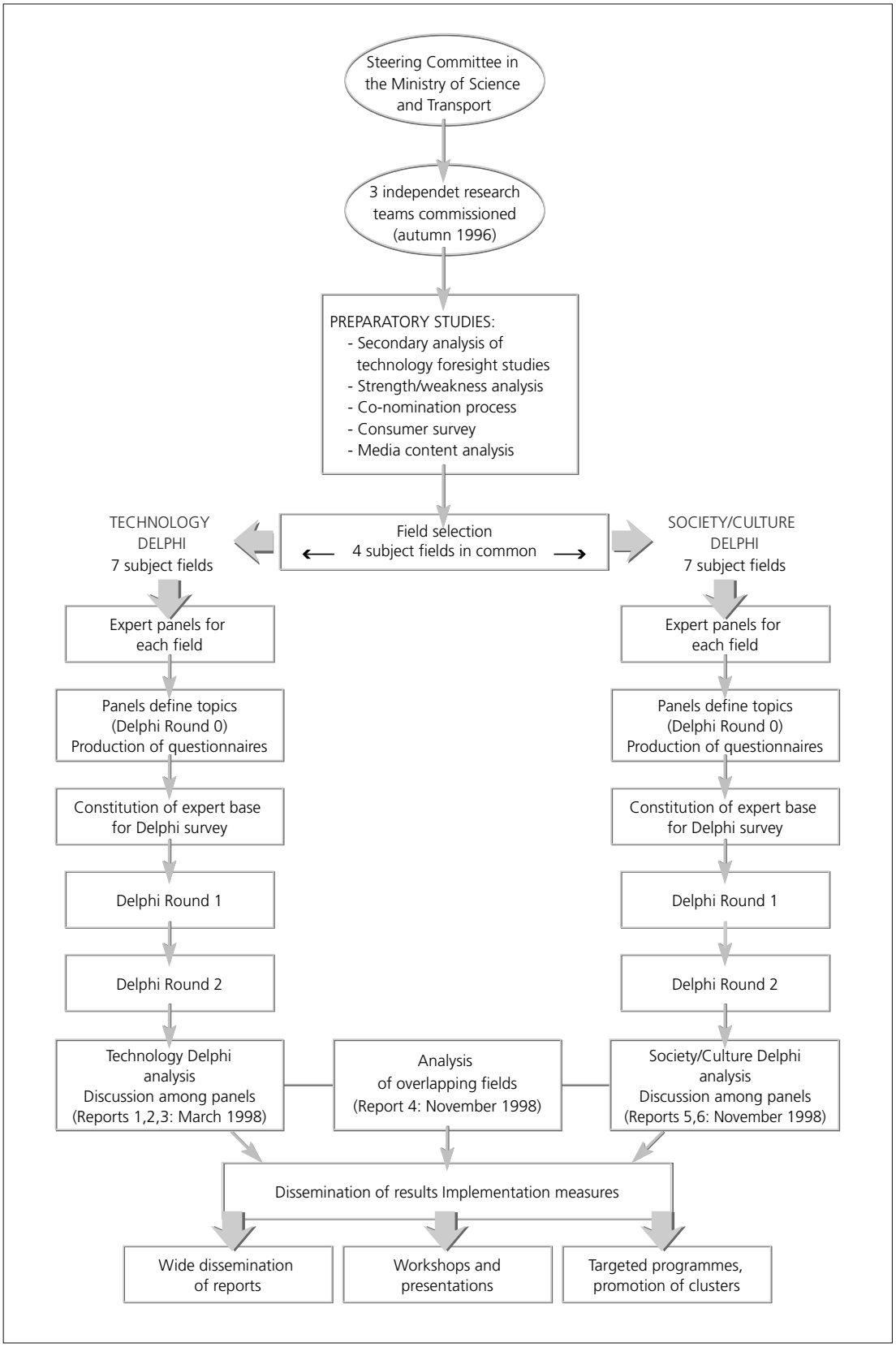
After several steps in this direction (e.g. the design of a comprehensive strategy for technology policy and a number of priority programmes in several high-technology fields) national technology policy was looking for new ways to stimulate the national innovation system effectively. The selection of priority areas was also seen as a problem and a concentration on a top-down approach proved less and less promising. Interested by foreign examples, the Ministry of Science and Transport decided to plan and commission a foresight exercise that would be tailored to the specific needs of Austria.

The task of the Austrian foresight exercise differed markedly from that of most of its foreign predecessors. Technologically leading countries such as Germany, Japan or the United States used foresight to search for emerging technologies, to concentrate their innovative efforts on emerging markets and to profit from first mover advantages. For Austria, however, a search for these emerging technological trends did not seem advisable—Austria can utilize the results of foreign technology Delphi studies. What has to be sought for are the market segments and niches within these worldwide emerging markets in that specific Austrian advantages in R&D, skills and production facilities provide good starting positions for successful innovations, i.e. innovations promising a good chance for future Austrian leadership in these very niches.

This situation shaped the overall goals and the approach of the Austrian foresight exercise. It had to be above all problem- and demand-oriented, responding to actual societal needs, whilst at the same time heading for the identification of the most promising areas of innovation in that Austria could hope to achieve a leading position both in R&D and in terms of economic success. Further objectives established from the outset were to build on a bottom-up flow of expertise. It was also clear that the foresight exercise should not deal with technology only; the TF exercise should also include organizational innovations and was to be combined with a society and culture foresight exercise as a consequence of the declared demand- and problem-orientation. Finally, the Austrian approach aimed at producing information to be implemented through technology policy-making and at concentrating the foresight efforts on a selection of areas with particularly high priority.

In autumn 1996 the first initiative for a systematic foresight process on a national level in Austria was launched. The approach, that was developed for this foresight task entailed a number of innovative elements whereby two Delphi processes represented a core instrument. They will be outlined below together with a brief overview on execution, major outcomes and impacts to date. To give an impression of the main building blocks of the Austrian foresight programme, its organization as a whole is summarized in figure VIII.

Figure VIII. Organization of the "Delphi Austria" foresight programme



Source: Aichholzer, (2004).

Execution of the TF programme

The Ministry of Science and Transport (now the Ministry of Transport, Innovation and Technology) commissioned different parts of the foresight programme Delphi Austria to three external research teams and established a small Steering committee at the ministerial level (comprising chief executives from different departments of the science ministry, a representative of the Austrian Academy of Sciences and a science journalist with experience as a former minister).

Essentially, the foresight programme Delphi Austria consisted of a series of preparatory studies, a number of expert panels, a technology Delphi and, as a quite unique feature, a combination with a society and culture Delphi. The selection of areas on that the foresight exercise should concentrate and the topics within the field are of utmost importance. To solve this task, the main stage of the Austrian foresight exercise was preceded by several other foresight-oriented preparatory studies. The work of defining suitable subject fields was, however, less focused on technological development to avoid the frequent trap of new technologies urgently searching for application; rather it was problem-oriented, assuming that innovations with a potential to solve existing problems will also more easily find a market in the future:

> "The set of Austrian foresight studies started with an analysis of the already existing foreign (classical) Delphis, to evaluate the predicted worldwide technology trends. Only those trends were considered as relevant for Austria that showed up in already existing Austrian strengths. To find these already existing strengths of the Austrian technology sector, the economic literature was surveyed and 350 experts (response rate 39 per cent, of whom 17 per cent were entrepreneurs, 23 per cent were physical scientists, 16 per cent were technicians, 13 per cent were social scientists and 19 per cent were administrators.) were interviewed. Sectors leading in R&D were found to be medical science, environmental techniques and materials, sectors leading economically proved to be environmental techniques, physical mobility and materials. In all these fields the experts indicated good cooperation between academia and firms in addition to high competitive performance. The same survey and the same sample of experts was used for a co-nomination study, searching for the networks of appropriate experts, as a basis for selecting the experts for the working panels responsible for elaborating the questionnaires as well as for the respondents of the later Delphi survey. All these preliminary studies did, however, not suffice as they concentrated on supply while the Austrian Delphi study ought to give an at least equal weight to demand. Methods to forecast long-term demand for high-tech goods, however, are still lacking. Two proxies, therefore, were utilized: a consumer survey and a media analysis. The consumer survey indicated a high acceptance of research in the fields of medicine, environment, energy and materials on the one side, and a heavy resistance against research in gene- and communications-technology. More than half of the respondents would not consume genetically modified food, even if it is better, and almost two fifths favour the production of bio-food, even if it is more expensive. The analysis of opinion-forming media yielded medicine, computer and telecommunications as the subjects most frequently dealt with, followed by bio/gentechology and space-research. As an important non-technical cross-sectional area pragmatics of every-day life (*Alltagspragmatik*) showed up." (Tichy 1999)

On the basis of these six studies the Austrian foresight exercise arrived at the selection of subject fields for the technology Delphi. The following criteria were applied in the selection process in cooperation between the research teams and the Steering committee:

- Positive world-wide trend.
- Capacity to solve problems.
- Presumed high future demand.
- Early stage of the product cycle.
- Already existing strengths of Austria.
- Complexity of the product or the process.
- Acceptance by the population.
- Sufficient differentiation of fields (portfolio aspect).
- Sufficient size of the field.

A broad definition of technology was applied, including organizational innovations.

The resulting fields, that were given highest priority and hence deemed subject areas of the Technology Delphi foresight exercise, are the following:

(a) New forms of housing and environment-oriented construction.
(b) Lifelong learning.
(c) Medical technology and support for elderly people.
(d) Clean and sustainable production.
(e) Organic food.
(f) Physical mobility.
(g) Tailor-made materials.

The combination with the subject fields of the Society and Culture Delphi will be described in the next section. In total, the Austrian foresight exercise comprises seven fields studied in each of the two combined Delphi processes, i.e. the technology Delphi and the society and culture Delphi.

For each of these fields, expert panels were established with up to two dozen members consisting of professionally qualified persons with high levels of competence, largely belonging to the decision-making hierarchy in science and research, business, public administration as well as intermediate interest organizations (including NGOs, consumer organizations and user representatives). These panels were key to the intended bottom-up creation of the contents of foresight, i.e. visions of innovations promising Austrian lead positions and of corresponding support measures. The next steps were the nomination of a large number of experts in each field (and the generation of an associated address database) who would later assess the hypothesized innovations as respondents in the large Delphi surveys. The results of these two Delphi rounds were statistically analysed by the responsible research teams and the outcome was summarized in a series of reports as the main products of the foresight exercise.

(The results of the TF comprise volumes 1, 2 and 3 of the series Delphi Report Austria. Volumes 4, 5 and 6 of this series contain the results of the society and culture foresight exercise and the cross-cutting analysis. All volumes are in German and available at the following Internet address:
http://www.bmwf.gv.at/4fte/materialien/delphi.index.htm#Downl. A summary report in English is available at *http://www.oeaw.ac.at/ita/*.)

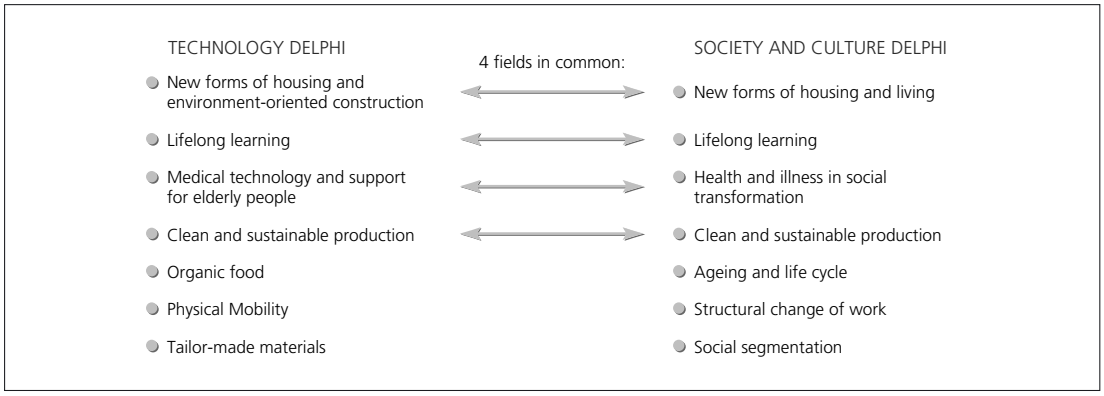
The combination of technology Delphi with society and culture Delphi

A consideration of the broader societal context of technical change has turned out to be a gap in earlier TF studies. For instance, the first German Delphi study had concluded that "technological developments should not be investigated and assessed in isolation from social and cultural circumstances" and that "the question of social desirability has to match the question of technical feasibility" (Germany, BMFT, 1993). Among others, a social TF exercise had also been explicitly suggested in relation to decreasing acceptance of products and technology development programmes in society (Todt and Luján, 1998).

In the Austrian foresight exercise, the inclusion of societal aspects was one of the principles guiding the whole approach (ITA, 1998a). This is reflected by the design and questionnaire contents of the technology Delphi itself as well as the idea of matching the technology Delphi with a society and culture Delphi. This combination was motivated by the objective to shed light on the social embedding of the various technical and organizational innovations and to examine different scenarios of social and cultural developments expected by experts in the short, middle and long term.

The two strands of Delphi studies in the foresight programme overlap in terms of subject areas: out of the seven fields of the technology Delphi and the seven areas of the society and culture Delphi, four focus on the same subject area. This combination was regarded as a reasonable mix of technology-specific and general scope of societal developments. These overlapping fields include new forms of housing and living; lifelong learning; medical technology and health and clean and sustainable production (figure IX).

Figure IX. The subject fields of the Austrian foresight programme



Source: Aichholzer, (2001).

The particular objectives pursued by the society and culture Delphi were the following (ITK, 1998): to map social, cultural, economic and political trends within Austrian society; to assess the societal and political significance of each of the trends; to assess impacts of societal trends on research and development, as well as in terms of priorities for politics; to identify conflict potentials of societal trends; and finally, to assess the desirability of trends as perceived by Delphi experts.

It is useful to consider a few examples of the results obtained in the subject field "health and illness in social transformation". Most important trends are:

- An increasing awareness of and interest in prevention.
- The growing importance of research on diagnostic and therapeutic strategies in the area of chronic disease.
- A split into high-tech medicine in central hospitals and treatment of patients with chronic disease in hospitals with less sophisticated equipment or in day-care centres and at home.
- A wide diffusion of voluntary service throughout the health-care system.

Highest priority for research and development was attributed to:

- Electronically networked health centres that coordinate Research via data networks, enable teleconsultations and exchange results, patient-related data and expertise of consultants on-line.
- Diagnostic and therapeutic strategies in the area of chronic disease with a corresponding upgrading of the image of chronic patients.
- Intensified health education in families, schools and companies, leading to increased interest in prevention.

The following trends deserving highest political priority were identified:

- A potential breakdown of the solidarity principle in health insurance (which is also seen as one of the highest conflict potentials).
- The increasing interest in prevention.
- Psycho-social support services for long-term unemployed people; a predominance of cost-benefit analyses in the medical system.
- The split between central high-tech hospitals and marginalized chronic patients.

Finally, further trends that are attributed major conflict potentials are:

- Growing difficulties for planning in the health-care system.
- Increasing codification in law of the doctor-patient relationship as a source of increases in price.

- The dominance of cost-benefit analyses in the medical system.
- Discussions on the issue of euthanasia.

The emerging split between an area of acute treatment with high-tech equipment in a few centres on the one hand and external treatment of chronic patients on the other is one of the central themes in this subject field. Increasing polarization turned out to be a trend also in other subject fields of the society and culture Delphi (work, housing, information and new media, gender). Further trends that are suggested by the experts' assessments as dominant across several fields are:

- A change of the demographic structure towards the elderly with impacts on the generation contract, health care, housing and living.
- Increased outsourcing in all service sectors and a role for decentralized networks.
- A preservation of the State's governance function, e.g. in environment policy and education policy.
- At the same time increased importance of the civil society through new forms of community action.
- A continued role for national level policies complemented by European Union and regional policies.

With respect to time horizons, the assessments of trends for the next 5 to 15 years are characterized by a surprising continuity of the societal status quo. However, within a horizon of 15 to 30 years quite a profound structural change of Austrian society is expected to occur. The authors of the report (ITK, 1998) interpret this contrast as an alarming time lag between unsolved social problems and successfully coping with them.

The matching of the questionnaire contents of the two Austrian Delphi exercises executed in parallel also allowed for a synthesis of the results of the four overlapping subject areas. This analysis concentrated on a number of cross-cutting themes that were seen as major elements generating change:

- Service economy.
- Science industry; information and communications technologies (ICT).
- Market opportunities (Rust, 1998).

The overall picture emerging from this synthesizing view is a somewhat muted modernization profile for the next 15 years: A number of technical and organizational innovations will impact on everyday lives and business but the basic institutions of the existing social market economy and public services will remain unchanged. Traditional values such as regional identity and public financing of health, education and other public services will be preserved. In none of the areas under investigation does technical change take on revolutionary forms. The health and medical system is one of the areas with particular innovation potentials with impacts both for aspects of service economy, science industry, ICT and market opportunities.

The design of the decision Delphi

According to Rauch (1979) it is useful to distinguish three types of use of the Delphi method: classical, policy and decision Delphi. He called the traditional Delphi approach a classical Delphi: it seeks to obtain a group opinion through an anonymous, multi-level group interaction in the form of a conditional scientific prognosis. A precondition for the reasonable application of a classical Delphi are developments following explicit laws or at least certain regularities. Such an environment is often lacking in social systems, as well as in technological development.

By contrast, a decision Delphi is an instrument to prepare decisions and to influence social developments: "reality is not predicted or described; it is made" (Rauch, 1979). A decision Delphi is also described as more appropriate in fields that are shaped by a mix of individual decisions rather than by general rules or regularities. If developments are dominated by a multitude of independent and uncoordinated decision-makers, a decision Delphi is recommended to structure and coordinate them on a path leading to a desired future situation. The participants of a decision Delphi are recruited primarily with regard to their actual position in the decision-making hierarchy and in the second instance to their expertise.

It has been pointed out that the goal of the Austrian foresight exercise was not to detect the general outlines of emerging technologies but to map out those fields and niches in that Austria could reach a leading position within the next 15 years, either in R&D, in economic exploitation or in social and organizational implementation. For this task of field identification a decision Delphi was regarded the appropriate tool.

As Tichy (1999) argues, these fields:

> "… are not so much determined by technological development and economic laws, but by the decisions and the efforts of numerous scientists, entrepreneurs and managers, by their expectations, uncertainties and actions or non-actions. The participation of these persons in a decision Delphi is part of a foresight exercise as well as part of 'making of the future': Answering the questionnaire in the first round forces the decision-makers to deal explicitly with probable future developments, a subject normally deferred to the Greek calends, to the never-never time of less urgent business. Answering the questionnaire in the second round confronts the decision-makers with the evaluations of their colleagues and competitors, and allows them to adapt their own assessment anonymously, thereby probably creating some form of consensus and implicitly formulating a national path of development and specialization. The results may or may not be acceptable for the governments' technology concept; they can, however, provide a basis for policy action in any case".

According to the bottom-up approach inherent in a decision Delphi and the necessity to involve decision-makers as much as possible, consideration was given to the expert panels in this design. They prepared the topics and questions used in searching for promising innovations. This input formed the basis for questionnaires that were then responded to by a much wider group of experts in a two-stage Delphi survey. In particular, the task of the expert panels was to formulate some 40 hypothe-

ses on promising innovations in a 15-year time horizon in each field (e.g. "Simulation-software for virtual optimization of vehicles and their components with respect to weight, safety, and emissions will be developed").

Special emphasis was given to orienting the visions of innovations towards a successful realization in Austria and on specific support measures to achieve this goal. This latter aspect has to be seen as a deliberate attempt to arrive at a "higher degree of finalization" of policy measures than other foresight exercises had done. For this purpose the expert panels had to compile lists of concrete policy instruments for appropriate groups of innovations likely to improve the chances of Austrian leadership.

The questionnaires for the Delphi surveys were designed in detail by the Institute of Technology Assessment (ITA): for any one of the around 40 hypothesized innovations within each of the seven fields, the respondents indicated *(a)* their specific knowledge, and *(b)* gave assessments on the following dimensions:

- The degree of innovation implied in the respective vision.
- Its importance (for society, economy and environment).
- The chances of realization in Austria in general.
- The chances of Austrian leadership with respect to R&D, organizational and social implementation, as well as economic exploitation.
- The desirability of the development in question.

In addition, the respondents indicated that policy measures out of a given list they considered as appropriate to enforce the envisaged development. Moreover, space for open comments was provided (see figure XI and figure XII). Seventeen so-called megatrend questions with regard to more general societal and global developments as a background to the innovation processes in question were posed to all respondents.

The respondents to the technology Delphi were selected according to their expertise and an intended equal composition of the sample constituted by three broad categories: academia, business and a category comprising equal numbers of administrators and groups of lobbyists. The co-nomination study served as the main pool of experts and was complemented by persons nominated by the basic expert panels. In addition, a number of other sources were used to fill the remaining gaps to reach a sample with nearly equal proportions of the three categories outlined (figure XIII).

The Austrian technology Delphi consisted of two rounds, like most other foresight exercises of this kind: 3,748 questionnaires were mailed in the first and 1,597 in the second round; 46 per cent and 71 per cent, respectively, were returned. Out of the respondents in the second round about one third were employed in firms and one quarter in academia; in terms of function, one third worked in R&D and management, respectively; one eighth indicated a combination of several functions. Women were heavily underrepresented while the age structure was rather well-balanced.

The decision Delphi approach and the combination with a society and culture Delphi were not the only innovations of the design of Delphi Austria. The broader con-

ception of the expert base deserves to be pointed out as an integral component: The composition of the expert base for the Delphi surveys aimed at including not only research and technology experts but also an adequate share of what can be described as practical user, public management and market-related expertise. However, an absolute requirement for an assessment to be taken as valid has been at least a medium level of expertise in the innovation in question.

Assessment of mega-trends and profile of the expert base

In the latest German Delphi study (Cuhls et al., 1998) an assessment of some general societal trends on the national as well as global level—a so-called mega-trends section—was added to each field-specific questionnaire of a TF exercise for the first time. This novel element served to control for more general visions of the future and world views among the respondents. Participants in the Delphi exercise in each field were invited to respond to the same set of 19 statements on general (economic, social, political, cultural and environmental) trends worldwide and in relation to the national context.

In the Austrian study, this tool was used in a slightly modified way. It should serve three functions:

- First, the world views of the respondents to the technology Delphi as well as the society and culture Delphi should be examined and compared.
- Second, the general attitudinal profile of the Austrian experts should be assessed by way of comparison with that of the experts of the German Delphi.
- Third, it should enable a control for two potential subjective biases of the experts' assessments:
    - — a bias due to particular world views; and
    - — a bias due to vested interests in a particular area.

For these purposes the list of items used in the German study was partially adapted. The same items as in Germany were presented to the participants in the Austrian society and culture Delphi, whereas for the respondents to the technology Delphi, seven more global statements from the German list were replaced by newly created items; each of these described a key trend in one of the seven subject areas. The idea was to have the possibility of comparing, with respect to key trends, the views of field experts with assessments by experts from all other fields as an—admittedly rough—check for a potential interest-based bias.

In brief, six different types of world-views were identified among the respondents of the technology Delphi. They largely reflected optimism or pessimism vis-à-vis economic and ecological trends, national sovereignty and societal progress. A comparison with results from the German study showed considerable similarity in assessments of general trends and confirmed the balanced mix of Delphi experts. Some field specific subjective bias could not be excluded in all subject areas but was not found to have a significant impact on the assessments of particular innovations (Aichholzer, 2001).

Main results and impacts

The analytical findings and implications derived from the results of the Austrian TF exercise for technology policy are summarized below.

In certain areas Austrian research institutions or firms already have achieved leadership or have the potential to do so in a middle range perspective, especially through the application of high—if not highest—technology in otherwise medium technology fields and, on the other hand, in markets in that Austria has lead market character (e.g. in clean technologies and organic food) because of a special demand situation (shaped, for instance, by legal regulation, characteristics of the social system, consumers' preferences, etc.). In general, however, Austria has not yet accomplished the leap from a technology adopter to a technology developer.

Special opportunities to achieve leadership exist in the following areas:

- Simulation models in construction processes.
- High-tech steel and low-weight materials.
- Recycling of composite materials and mixed materials.
- Low noise equipment for railways.
- Cleaner production technologies (especially in metal and paper production).
- Wood as material in constructive applications.
- Ecologically sound construction.
- Organic food (seeds and breeding, conservation and analysis techniques).
- Technologies supporting lifelong learning (tailor-made packages for further training, intelligent information agents, electronic learning media).
- Technologies supporting independent living of the elderly without losing personal contacts.
- Substitutes for organs and functions (in conjunction with bio-compatible materials, hybrid technologies).
- Information and communication technologies that are part and parcel in almost all cases of successful or potential leadership while as independent technologies they only play a role in certain niches.

The foresight studies also identified major problem areas. A specific problem is that the time horizon anticipated and taken into account in innovation activities by firms and applied research is too short. It also became clear that isolated technological efforts are not very likely to pay off. Success in achieving leadership requires a wider approach, networking, cooperation between firms and research institutions, a linking of technical and organizational innovations and a critical mass of firms and research institutions. Attitudes towards organizational innovations turned out to be more ambivalent, indicating a higher level of mistrust in their realization.

As concerns policy options, the most important measure suggested by the TF exercise is the strengthening of cooperation between research institutions and firms as well as among firms and research institutions themselves. Recommended measures include: actions promoting the development of clusters in future-oriented core areas; the creation of new institutions for the coordination of interdisciplinary research focuses; a differentiation in research promotion between more routine and high-risk, long-term projects; the prescription of targets and continuous evaluation in project promotion; and the setting up of pilot projects, especially regarding organizational innovations. (For each of the seven sectors more specific policy recommendations can be found in the volume devoted to sector-specific results of this TF exercise (ITA, 1998b)).

A few years after completion Delphi Austria achieved some real and measurable impacts. Direct impacts (i.e. policy measures) can be observed in the form of implementation of policy measures, initiated by the Science Ministry. Figures X to XIV show that several of Delphi Austria's subject fields are matched by such implementation measures.

Figure X. Impacts of the Austrian foresight programme

Technology Delphi Thematic field		**Impact 1: Targeted Impulse Programmes**
Environmentally Sound Construction and New Forms of Housing	→	"Building of the Future" Programme
Cleaner Production and Sustainable Development	→	"Factory of the Future" and "Renewable Raw Materials" Programmes
Production and Processing of Organic Food	→	"Food Initiative Austria", cluster initiative for organic food
Mobility and Transport	→	"M.O.V.E" Programme
Tailor-Made New Materials (focus on metals)	→	"K-plus Programme" (competence centres; 12 centres established)
In total. 1,530 million Austrian schillings (110 million) have been invested by public funds into R&D initiatives which were directly recommended or confirmed by the results of the foresight programme Delphi Austria since its completion in 1998.		Impact 2: Input to "Green Paper on Austrian Research Policy 1999". Use of Delphi Austria to enforce interdisciplinary, problem-oriented research as well as for the elaboration of an appendix catalogue of concrete measures. Impact 3: Orientation support for Research Strategy 2000. Function as guiding document for the creation of a framework for research promotion aimed at the solution of societal problems (Research Report of the Minister of Science and Transport, 1999) Impact 4: Stimulation of cluster building. Cluster development project "Organic Food Cluster Austria" started. Several clusters at regional level established (automotive, wood, plastics, eco-energy) Impact 5: Stimulation of sectoral foresight projects. Examples: Stationary treatment of elderly in selected medical fields and effects on hospital costs; biomedical technology; vocational training.

Source: Aichholzer, (2001).

Three targeted programmes are subprogrammes of "Sustainable Development" ("Building of the Future", "Factory of the Future" and "Renewable Raw Materials") are in operation. The "K-plus" programme has established 12 competence centres (centres of excellence) since 1999 that promote cooperation between firms and research institutions on major innovative projects in a pre-competitive stage. They also support the development of clusters in promising areas. The majority of centres within this programme work in areas suggested by TF results (e.g. new materials, wood technologies, information technologies). Also at least one new research facility of the Christian Doppler Laboratories was established in a field suggested by Delphi Austria (wood research).

It has to be said that a causal relationship cannot be postulated in all cases, but at least such measures are confirmed by results of Delphi Austria. On the other hand, some initiatives have been stimulated by way of self-organization. A case in point is the creation of the programmes "Building of the Future" and "Factory of the Future", that a participant in the technology Delphi survey organized.

Another important impact concerns the new research strategy programme (*Österreichische Forschungsstrategie 1999*) adopted after the discussion of a "green" paper based on Delphi Austria. It has strongly influenced strategic programmes at the regional level, such as in the Province of Upper Austria where several clusters have been set up.

Finally, more or less directly related with panel activities, independent foresight projects have been triggered in the fields of vocational training and retraining, mobile communications, medical technologies, and transport. For instance, a study on the future of vocational training and retraining has been undertaken by the Institut für Berufs- und Erwachsenenbildung at the University of Linz (IBE) within the framework of an international study commissioned by the European Foundation for the Promotion of Vocational Training (CEDEFOP), Berlin.

Although a systematic evaluation in a formal sense has not been undertaken, an internal assessment of impacts of Delphi Austria by the Ministry of Science is provided. It lists the measures stimulated by Delphi Austria and uses results by different agencies. It includes a quantification of the leverage effect in terms of the volume of promotion measures that amounted to 1,530 million Austrian schillings (€110 million) by late 1999 (approximately one year after the completion of the last of a series of Delphi reports).

On the other hand, one can see the following indirect impacts of Delphi Austria. The results of the Austrian foresight programme are built on a sufficiently broad basis of expertise to be used as an important information source for technology policy-making as well as actors of the innovation system, especially in companies and research institutions. The process of involving a great number of these actors, either as members of one of the panels developing the contents of the Delphi questionnaires or as participants in the Delphi rounds themselves, has been a deliberately promoted and valuable result of the whole foresight programme. Further steps in that direction have been undertaken with the wide diffusion of the results of Delphi Austria on the national level. Several thousands of copies of the reports were distributed among business, academia, public administration and other organizations in the spring and towards the end of

1998. All reports are accessible via the homepage of the Austrian Ministry of Science and Transport on the Internet and can be downloaded, including the tables containing the quantitative results. A number of major presentations and workshops have complemented this diffusion process as well as wide circulation of a number of contributions both in print media (several newspapers and magazines) and on radio and TV.

This means that with the foresight process itself and the dissemination of its results the stimulation of cooperation and networking has started. It can be expected to continue with ongoing and future sectoral activities and to contribute to "wiring up" the national innovation system.

Summary and conclusions

TF programmes have flourished, especially among the small countries, in the 1990s. Such exercises have also been taken up by transition countries and seem to be a useful instrument for them when tailored to the specific needs of the country. Goals and approaches are generally different and need to be adapted to the particular position of a country in the global economy as well as respond to national problems. Experience to date indicates that even among small countries the approaches are quite varied. However, the scopes of foresight exercises are most frequently oriented at specific national conditions and the identification of niche potentials, time horizons are less long-term, more emphasis is laid on the foresight process itself and bottom-up approaches tend to be favoured.

The Austrian foresight programme Delphi Austria is a typical example of a small country approach. It was tailored to the present stage of economic and societal development and should serve as a strategic intelligence input to a mid- to long-term oriented technology policy. Therefore the approach put emphasis on a problem- and demand-driven orientation, applicability of results and on strengthening the links in the national innovation system.

The TF process used a bottom-up approach including expert panels and Delphi exercises as key elements that had mainly two tasks:

(a) To identify and assess those areas of innovation with high importance in the next 15 years in that Austria could achieve a leading role.
(b) To consider and assess a variety of measures for each group of innovations to support this goal.

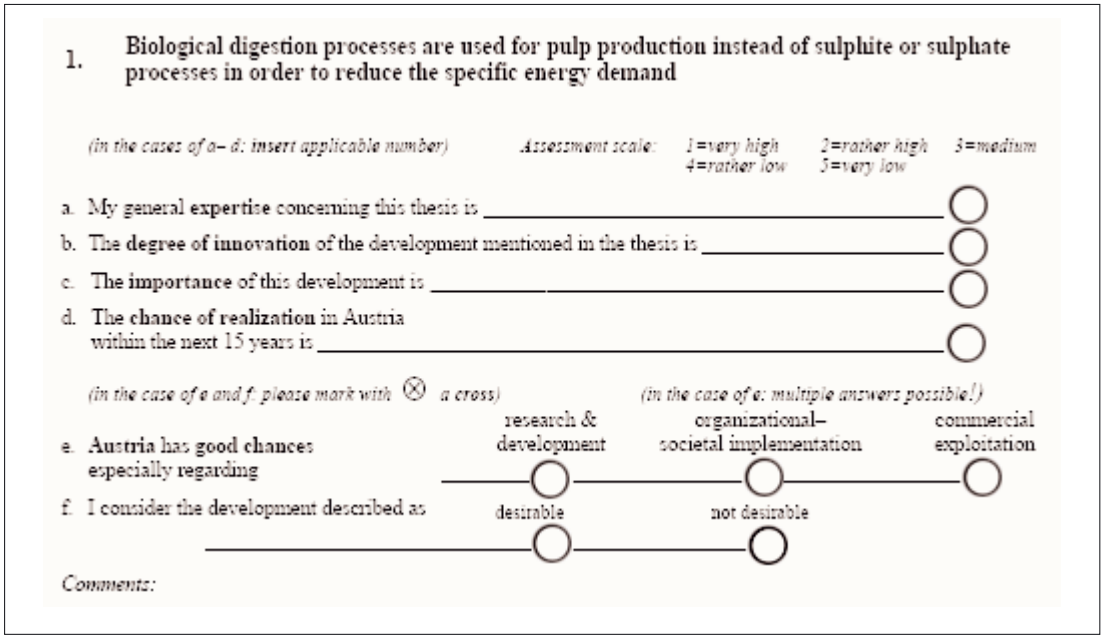
The TF exercise led to the identification of a number of promising innovation areas and policy measures. Around a dozen such areas have been pointed out as most likely to allow Austria to achieve a lead position in R&D and market segments. Matching the technology Delphi with a society and culture Delphi shed some light on the social embedding of the various technical and organizational innovations. A perspective emerging from this synthesizing view is a somewhat muted modernization profile in Austria. The assessment of some general societal trends that were first introduced in

a German Delphi study was used as a novel element and allowed the examination of the homogeneity of the expert base.

The Austrian foresight results are built on a broad basis of expertise and accessibility for technology policy-making as well as for actors of the innovation system, especially in companies and research institutions. A great number of these actors have been involved in the foresight process, either as panel members or as respondents to the Delphi questionnaires in two survey rounds. This has been deliberately promoted and proved to be a valuable result of the entire foresight programme.

The results of Delphi Austria have had considerable direct impact in shaping central technology policy measures so far. They have stimulated the start of new targeted programmes in the field of sustainable production, influenced the selection of subject areas of "centres of excellence" for promotion as well as of cluster building at national and regional levels.

Figure XI. Innovation statement (questionnaire sample page)



1. **Biological digestion processes are used for pulp production instead of sulphite or sulphate processes in order to reduce the specific energy demand**

(in the cases of a– d: insert applicable number) *Assessment scale:* *1=very high 2=rather high 3=medium 4=rather low 5=very low*

a. My general **expertise** concerning this thesis is _____

b. The **degree of innovation** of the development mentioned in the thesis is _____

c. **The importance** of this development is _____

d. **The chance of realization** in Austria within the next 15 years is _____

(in the case of e and f: please mark with ⊗ a cross) *(in the case of e: multiple answers possible!)*

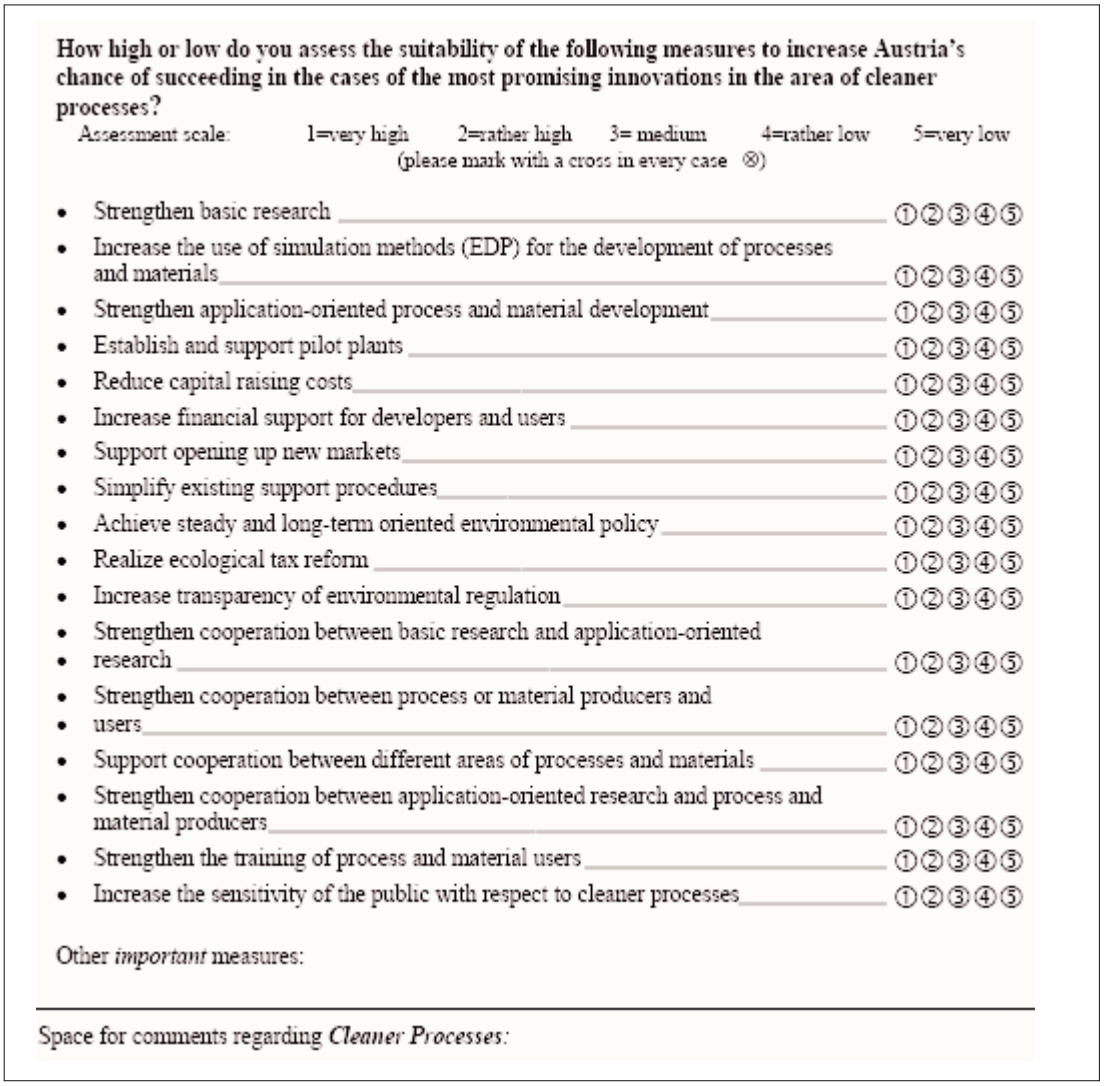
e. **Austria** has **good chances** especially regarding — research & development / organizational–societal implementation / commercial exploitation

f. I consider the development described as — desirable / not desirable

Comments:

Source: Aichholzer, (2001).

Figure XII. Policy measures (questionnaire sample page)



How high or low do you assess the suitability of the following measures to increase Austria's chance of succeeding in the cases of the most promising innovations in the area of cleaner processes?

Assessment scale: 1=very high 2=rather high 3= medium 4=rather low 5=very low
(please mark with a cross in every case ⊗)

- Strengthen basic research ①②③④⑤
- Increase the use of simulation methods (EDP) for the development of processes and materials ①②③④⑤
- Strengthen application-oriented process and material development ①②③④⑤
- Establish and support pilot plants ①②③④⑤
- Reduce capital raising costs ①②③④⑤
- Increase financial support for developers and users ①②③④⑤
- Support opening up new markets ①②③④⑤
- Simplify existing support procedures ①②③④⑤
- Achieve steady and long-term oriented environmental policy ①②③④⑤
- Realize ecological tax reform ①②③④⑤
- Increase transparency of environmental regulation ①②③④⑤
- Strengthen cooperation between basic research and application-oriented research ①②③④⑤
- Strengthen cooperation between process or material producers and users ①②③④⑤
- Support cooperation between different areas of processes and materials ①②③④⑤
- Strengthen cooperation between application-oriented research and process and material producers ①②③④⑤
- Strengthen the training of process and material users ①②③④⑤
- Increase the sensitivity of the public with respect to cleaner processes ①②③④⑤

Other *important* measures:

Space for comments regarding *Cleaner Processes:*

Source: Aichholzer, (2001).

Figure XIII. Composition of expert panels and number of participating experts in technology Delphi

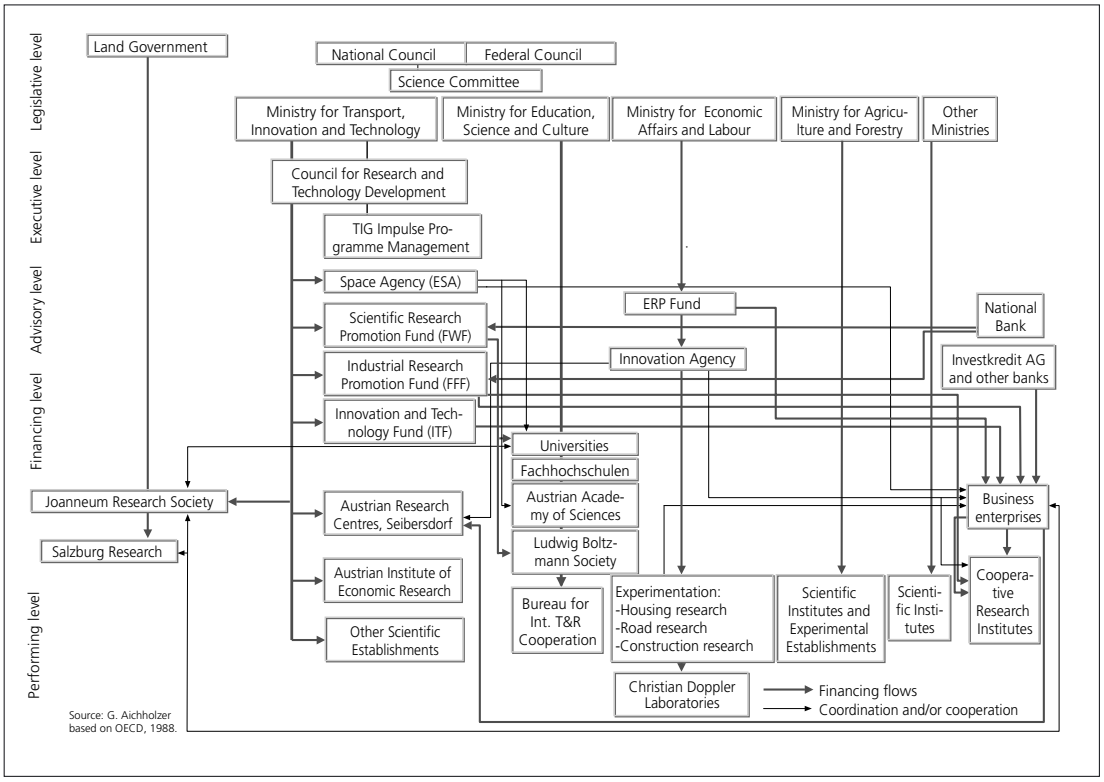
	Panel members		Delphi respondents	
	No.	%	No.	%
Science	42	34	321	25
Business	53	41	451	35
Administration	21	16	214	17
Interest organizations	12	9	90	7
Other	-	-	209	16
Total	**128**	**100**	**1,285**	**100**

Table 2. Numbers of participating experts in Technology Delphi (round 2)

Area	Questionnaires delivered (No.)	Questionnaires for analysis (No.)	Response rate (%)
Lifelong learning	301	219	73
Environmentally sound construction and new forms of housing	216	142	67
Medical technologies and supportive technologies for the elderly	191	139	74
Cleaner production and sustainable development	302	211	71
Tailor-made new materials	121	90	75
Mobility and transport	290	200	70
Production and processing of organic food	176	126	72
Total	**1,597**	**1,127**	**71**

Source: Aichholzer, (2001).

Figure XIV. Science and technology policy institutions in Austria



Source: Aichholzer, (2001).

Sweden

The idea of carrying out a TF project in Sweden emerged in the mid-1990s under the pressure of rapid technological and political change. Technologically oriented future studies had been conducted in Sweden during the 1970s and even earlier, but during the 1980s such studies, if at all, were only pursued inside private organizations. Perhaps the difficulties that had recently affected the Swedish national economy contributed to the increased interest during the 1990s.

There were several conceivable foreign models for Sweden's technology foresight project. The UK version of TF was an important source of inspiration. The Federation of Swedish Industries analysed the effect of relevant European studies and decided to initiate a Swedish study. IVA and NUTEK carried out a joint preliminary study on international experiences and on the preconditions and interest in Sweden for carrying out a corresponding project. This initiative evoked interest in many quarters.

After further preparation in 1997, the four organizations behind the study—IVA, NUTEK, the Federation of Industries and the Foundation for Strategic Research—formed a committee to evaluate the possibility of carrying out a TF project. Unlike most stud-

ies in other countries, the Swedish TF project was not carried out on behalf of the government, although it has enjoyed strong government interest and support.

To direct the Swedish TF project, in 1998 the four organizations behind the study formed a Steering Committee with the following members:

- Arne Wittlöv, executive Vice President, AB Volvo (Chairman).
- Gunnel Färm, Director-General, Swedish Council for Work Life Research.
- Christer Heinegård, Director, Technical R&D, NUTEK.
- Professor Ingvar Lindgren, Swedish Foundation for Strategic Research.
- Camilla Modéer, Research, Education and Development programme, Federation of Swedish Industries.
- Professor Kurt Östlund, President, IVA.
- Enrico Deiaco, Secretary to the Academy, IVA, who was appointed Secretary of the Steering Committee.

A project office was attached to the Steering Committee to administer the project. Lennart Lübeck, chairman of the Swedish Space Corporation, was appointed Programme Manager. Others working in the project office were Enrico Deiaco (IVA), Lennart Elg (NUTEK), Bengt Mölleryd (IVA) and Lennart Björn, Project Controller.

The four organizations behind the study also established an Advisory Committee in order to broaden the range of organizations involved in the TF process. Some 30 interest organizations have been represented in this committee. The task of the Advisory Committee has been to ensure that important interested parties in Sweden have been integrated into the process, as well as to suggest names of possible panel participants. Another task of the committee has been to create involvement and generate support for the project in their respective organizations, disseminate its findings and advise the expert panels on their work. In addition, an Evaluation Committee was established and entrusted with continuously following up and evaluating the implementation of the project.

The work of the project was mainly carried out within the eight expert panels. In each panel, a chairperson and about 15 other participants were appointed. Each panel engaged its own project manager, who worked in this capacity at least half-time. The panels were created and staffed by the Steering Committee after thorough deliberations on the delimitation of their subject areas and their composition. Among other things, the Steering Committee examined how comparable foreign studies had been implemented and what lessons had been learned.

The Steering Committee chose to create a limited number of panels, each with a broad-based composition and a broadly defined field, well aware that because of this, complete coverage of the technology would not be possible. The division into panel subject areas was made on the basis of need and user perspectives, not fields of technology.

No.	Panel	Chairperson	Project Manager
1	Health, medicine and care	Leni Björklund	Cecilia Warrol
2	Biological natural resources	Per Ove Werling	Monika Carlsson Ulin
3	Society's infrastructure	Ulrika Francke	Jan Parmeby
4	Production systems	Bengt Palmér	Arne Otteblad
5	Information and communications systems	Ulf J. Johansson	Cecilia Sjöberg
6	Materials and material flows in the community	Gunilla Jönson	Kerstin Lekander
7	Service industries	Rolf Skoglund	Charlotta Eiborn
8	Education and learning	Clas Wahlbin	Börje Svensson

A total of 130 people sat on the eight panels. By means of seminars, conferences etc., a few hundred additional people participated. The work of the panels began with a kick-off conference in January 1999 and ended one year later. A joint conference for coordination of their work took place in August 1999.

It was recommended to the panels that, within a firmly fixed timetable, they should follow a given methodology whose point of departure was a project plan based on the lessons of TF exercises in other countries. The Steering Committee also asked the panels to take into account certain lateral, multidisciplinary themes, for example, environmental and energy aspects, economy and market, and attitudes and values. Within their project plans, the panels were then given greater freedom to define and prioritize their tasks.

By and large, the panels followed the project plan. First they carried out an inventory of a large number of subject areas that they believed would prove to be of decisive importance to society in their respective spheres of responsibility. After thorough discussions, they grouped these under various themes. They selected a limited number of key areas for more detailed analysis. The structure of the final phase of their work varied between panels.

The panels had the option of forming subgroups and, as needed, outsourcing assignments in order to compile documentation for their work.

As a form of back-up for their work, during spring 1999 the project, together with consultants from Sweden's Defence Research Establishment (FOA), worked out four future scenarios. These were based on different assumptions about the role of geographic proximity in development, and about whether development would be characterized by relatively few or relatively many players. The panels used these scenarios to varying degrees in their work.

The eight panel reports were completed in draft form late in November 1999, and in final form in January 2000. A number of highly qualified referees—Bo Berggren, Lars Bergman, Kerstin Fredga, Kristoffer Hallén, Lars Ilshammar, Arne Kaijser, Anders Lindström, Peter Nygårds, Maria Stenström, Björn Sällström and Karl Johan Åström—were asked to read the panel reports and provide overall opinions as background material for the synthesis report.

The Swedish TF project was implemented in a very open way. The drafts of the panel reports were successively posted on a TF website (www.tekniskframsyn.nu) and all interested individuals were invited to comment on the drafts.

The results of the Swedish TF project were presented at a final conference in March 2000. During spring and autumn of 2000, the project was also presented at a number of meetings, including a series of regional conferences around Sweden.

The synthesis report was written on behalf of the Steering committee, and under its supervision, by Leif Magnusson (EnerGia), Stefan Zenker (Swedish Space Corporation), Olle Rossander (independent consultant) and Benny Kullinger (Ord & Vetande).

The project was run within a cost ceiling of 34 million Kronor. The financiers were the Swedish Foundation for Strategic Research (SKr 17 million), NUTEK (SKr 10 million) and the Swedish government (SKr 7 million).

The process moves ahead

The Swedish TF project is an ongoing process, in that the presentation of the reports on 28 March 2000 only marks the end point of an introductory phase. The objective of TF has thus been to use technological development as a point of departure for stimulating a discussion of the future development of Swedish society and business. Among other things, the project has identified fields of expertise with potential for growth and renewal in Sweden, for the purpose of strengthening the futures oriented work of companies and organizations. This is not something that can be done on a single occasion and then be regarded as finished. The Swedish TF project must be carried forward in various ways, and in various forms.

Dissemination of findings

During spring and autumn 2000, the TF project has organized regional conferences at many locations in Sweden. Participants in the various panels presented the results of their work. In the best case, this may lead to the beginning of local "foresight activities," perhaps with the TF project as a model. A number of organizations and companies have also invited project participants to present the project's findings at various events and gatherings during the year.

The findings of the project are also being disseminated via the four organizations behind the project, through their human resources networks. All the project reports are available from the Internet on the TF project's website, www.tekniskframsyn.nu—mainly in Swedish—and are also available in printed form.

The most important method for disseminating the thoughts and findings of the Swedish TF project, however, is the informal conversations and discussions conducted by the people who participated in its work, or by others who have come into contact with TF in some other way.

Broadening and intensifying the process

The Swedish TF project chose to work with relatively few panels and thus with broad subject areas. All panels were given the specific assignment of weighing in and taking into special account a number of interdisciplinary themes, among them environmental and energy issues. Within these limits, the panels made their own prioritizations. A prioritization means that certain subjects were highlighted while others, that were not thereby considered unimportant, were treated in a more summary way. Nor has the project conducted in-depth studies in its various fields. After all, its purpose was not to carry out research planning. The panel reports should provide a starting point for a continued process, that should include more in-depth analyses of Sweden's areas of expertise, improvement needs, consequences for various fields of technology and science, strengths and weaknesses, threats and opportunities, both nationally and regionally.

The shape of these in-depth and follow-up studies will be up to the players in the Swedish business and public sectors to decide.

Recurring TF projects

In Sweden a comprehensive national TF exercise should be carried fairly regularly, as is in a number of other countries. In general, such a process should have the same purpose as this one, but should naturally be open to changes in working methods. Among other things, all the lessons—positive and negative—from this TF project should obviously be taken into account, along with the lessons continuously being learned from similar processes in other countries. This may apply, for example, to such fundamental issues as how much time to allocate to the project and how best to utilize this time, especially considering that the most insightful people tend to have little time to spare.

The interval between recurring TF exercises at the national level should probably not be much shorter than five years, but perhaps not so much longer.

Evaluation

The lessons from the implementation of the Swedish TF project have been followed up on a continuous basis by an Evaluation Committee, that reported its observations and conclusions to the four organizations that ran the project. This evaluation focused on the actual process, not the findings of the project's work

Hungary

Aims, methods and the first phase of TEP

Background: systemic changes

Hungary launched TEP, its first foresight programme in 1997. As the country was undergoing fundamental economic and social changes—the transition towards a market economy—major institutions were being shaped. The first phase of the transition process is now over. Most firms and banks have been privatized, the most important new political and economic institutions have been re-established, e.g. a parliamentary democracy based on a multi-party system and the stock exchange. The so-called transition decline has turned into economic growth in the last few years; therefore, it was high time to think about medium- and long-term issues. It was possible to devise strategies aimed at improving the quality of life and long-term international competitiveness—the major goals of TEP.

Objectives

Foresight appears to be an adequate tool to bring together business, the science base and government in order to identify and respond to emerging opportunities in markets and technologies. In short, TEP should contribute to a national innovation strategy based on a comprehensive analysis of:

- World market opportunities (new markets and market niches).
- Trends in technological development.
- Strengths and weaknesses of the Hungarian economy and R&D system.

These demanding TEP objectives can only be achieved if researchers, business people and government officials join intellectual forces to assess Hungary's current competitive position and the impacts of likely global market and technological trends. Hence their realigned and reinvigorated relationships can be regarded as a means of the principal goal. However, the process in that these experts with different backgrounds communicate and share ideas about longer term issues, generate consensus, and cooperate with increased commitment in devising and realizing a national strategy, seems to be so crucial that it becomes an end in itself. The programme is also aimed at strengthening the formal and informal relationships among scientists and engineers, managers and civil servants alike, spreading cooperative and strategic thinking.

Hungary has joined the European Union. Accession to the EU is a major challenge, since it is likely to shape Hungary's future to a significant extent. It requires a clear and sound vision about Hungary's role and opportunities in the enlarged European socio-economic system. TEP activities and results could contribute to the success of the integration process.

Written TEP results are comprehensive analyses of strengths and weaknesses, visions based on these inquiries and likely global trends, as well as recommendations for pub-

lic policies regarding for realizing the most desirable vision (future). These analyses and information should also assist Hungarian firms in devising and implementing their strategies to improve their competitiveness.

Methods and the first phase

TEP is a holistic foresight programme, based on both panel activities (formulating visions, conducting SWOT analysis, devising recommendations, policy proposals, etc.) and a large-scale Delphi survey. It was conducted in three stages, namely, pre-foresight (October 1997 to March 1998), main foresight (April 1998 to May 2000) and dissemination and implementation (June 2000 onwards).

Awareness seminars were held across the country in the pre-foresight stage to promote this new concept among experts and professionals. Participants and organizers of these seminars (chambers of commerce and scientific associations) were also invited to nominate panel members.

A Steering Group of 20 leading industrialists, academics and government officials—deliberately comprising a majority of industrialists and academics with close contacts with businesses—was set up in October 1997 to oversee the programme. Following a thorough discussion the Steering Group has defined the following topics for panel discussions:

- Human resources (education and employment).
- Health.
- Information technologies, telecommunications, media.
- Natural and built environment.
- Manufacturing and business processes (new materials and production techniques, supplier networks, globalization, etc.).
- Agribusiness and food.
- Transport.

The above panels were formed and trained in April 1998; they began by identifying major developments in their respective fields and devising alternative visions (possible futures) for the long run. They have relied on the expertise of their members—who represent different schools of thought in a given field—as well as commissioned reports by other experts not belonging to foresight panels. They have also formulated statements for the two-round Delphi survey. Their tentative results have been continuously discussed with the wider expert community in their fields at workshops held across the country and organized jointly with the regional chambers of commerce and professional societies. All the background reports, the alternative visions and the Delphi statements have been made available on the Internet.

Characteristics of TEP: methodological issues

Emphasis on scenarios, institutions and regulation

Given the transition process major institutions are still being shaped in Hungary, as opposed to, for instance, the United Kingdom, where "the lawn has been mown and watered for centuries". The fundamental institutions have crystallized in the advanced countries for quite some time, whereas Hungary is still at a crossroads. Moreover, coming back from the Soviet political, military and economic bloc and joining the EU, that is also in the middle of a major transition process, the wider, international institutional context (economic environment) where Hungary is attempting to find its place, is changing. It is of the utmost importance to analyse this turbulent environment, hence the emphasis on formulating alternative visions, both at the macro-level (socio-economic framework conditions) and at the micro-level of panels. Macro-scenarios had not been developed in any other country engaged in foresight activities when TEP was designed.

Regional scenarios have also been devised, as background documents, aiming at identifying the possible futures of that part of the Central and Eastern European region that might have significant influence on Hungarian developments.

For the above reasons, TEP panels have also devoted a significant part of their interest to institutional development and regulatory issues. This is also reflected in the Hungarian Delphi statements: quite a few of them deal with these, rather than technological issues. Moreover, respondents who returned the questionnaire put a significant emphasis on these non-technological issues as shown by the number of these types of statements among the so-called top 10 issues. (An index was designed to reflect the combined social and economic effects of a given event/development (contained in a Delphi statement) based on the assessment of the respondents. The issues (statements) were ranked, and the first 10—with the highest score of the combined index—are called the "top 10".)

Education and learning as input of competitiveness

There was a "Leisure and Learning" panel in the first UK foresight exercise, where learning was mainly understood as a market opportunity, not as a major factor of competitiveness. TEP has opted for the latter approach, for obvious reasons. Furthermore, human resources have also been given a significant emphasis in the work, and, concomitantly, in the recommendations of the Steering Group. More recently other programmes have followed a similar approach, e.g. the Swedish programme.

Employment as a unique issue

TEP has put education, learning and employment together in one panel under the heading of human resources. The decision is self-explanatory in a country in transition, where unemployment was an unknown phenomenon for decades, before suddenly jumping to 12 per cent in the early 1990s (now it is down to around 7 per cent).

Broad issues as panel topics

In general, TEP has brought together various issues that were treated separately in most other foresight exercises. For example, the health panel covers life sciences, related fields of biotechnology, health care, pharmaceuticals and medical instruments. Some of these issues are not analysed at all in other foresight exercises (e.g. the health-care system) and others are treated in separate panels (e.g. life sciences has a separate panel and pharmaceuticals are included with chemicals in other exercises). Also, agriculture and food processing belong to a single panel in the Hungarian case (as opposed to the first UK exercise).

Although TEP has tried to set up panels around broad issues, some real-life cases are even more complex and require expertise from many disciplines and economic sectors. For example, our health is influenced by a number of factors, among others by one's lifestyle, social status and diet, as well as the medical care system and the environment. All these issues belong to different panels, and a close and well-reasoned collaboration is required to carry out a reliable, thorough analysis and formulate sensible policy proposals. Having recognized that need, some panels have joined forces (i.e. their budgets) in the early phase of the programme, and together have commissioned a group of experts to analyse issues from different points of view. For example, the healthy diet issue is considered by both the health and agribusiness and food industry panels; issues relating to causes of allergy are analysed by the same two panels.

Given the legacy of the planned economy—that is, strong "departmentalism"—and the inherent isolation of various disciplines, this can be regarded as an achievement in itself.

Cross-cutting issues

In spite of defining broad fields as panel topics to be analysed, strong emphasis is also given to the so-called cross-cutting (cross-panel) issues. The panels are encouraged to identify and adequately deal with these issues while analysing major trends and developing alternative visions (futures) for this fields, and a list of them was developed at the very beginning of the TEP process. This list includes, among others:

- Education, training and re-training.
- Information technology.
- Environment.
- Accession to the EU (threats and opportunities, impacts).
- Competitiveness.
- Social cohesion.
- The role of large (multinational) and small and medium-sized (indigenous) firms.
- Control and self-control of different systems and subsystems.

- Research and development, manufacturing (services), marketing.
- New materials.

Special workshops were organized to analyse these issues, and two of them were incorporated into the Delphi questionnaire as variables, namely impacts of a given event/development on the environment and lack of skills as a potential constraint. The latter variable (availability of skills) has been used in a number of Delphi questionnaires (in Germany, Japan, the United Kingdom, etc.), but the former one is only applied in the Hungarian survey.

There are a number of "cross-cutting" Delphi statements, too, for example, those concerning environmental issues but formulated by other panels (health, information technology, manufacturing and business processes, etc.). Those statements have been collected, and the respective panels—i.e. both those panels that formulated these "cross-cutting" Delphi statements and those that are affected by these statements—have been urged to analyse them.

The discussions of the panel and Steering Group reports show that even more systematic efforts—and more sophisticated methods—are required to deal with these cross-cutting issues. There is also an obvious need to find appropriate, efficient and convincing ways and means to convey these complex "messages" to decision-makers and opinion leaders.

Organization

The former socio-economic system has been influential concerning the organization and management of TEP. It has been a well-considered, conscious decision from the very beginning not to involve anybody from the former OMFB. (OFMB was a government agency responsible for S&T policy, supervized by the Ministry for Economic Affairs (previously the Ministry of Industry and Trade). As of January 2000 it is the R&D division of the Ministry of Education). In the running of the programme from a professional point of view (i.e. decision on panel topics, issues to be analysed, priority-setting, etc.). The role of OMFB has been restricted to providing financial and methodological support. No OMFB official sits either on the Steering Group or is a member of any panel. Moreover, members of the Steering Group and panels have been appointed as a result of a wide consultation process. All the major decisions are taken by the Steering Group—at joint meetings of the Steering Group and panel chairs and secretaries—or the panels themselves.

Ambiguous ("double") legacy of planning

Centrally set, mandatory plan targets were abolished in Hungary in 1968, the first time among the centrally planned economies. (Central planning was not abolished until 1989.) Yet, its legacy is still rather strong among some experts, and it has had some important impacts on the foresight process, especially in the beginning. Two rather different consequences have become visible:

(a) Some engineers and scientists have understood foresight as just another form or tool of central planning, and hence wanted to devise just one future (vision, scenario), i.e. not alternative, qualitatively different ones, and seek funding for that target (as a sort of "central development programme or plan").
(b) Some other professionals have also understood foresight—at least at the first glance—as just another form or tool of central planning, and hence rejected it immediately.

The perception of foresight has considerably changed as TEP has progressed. Yet not everyone shares the same understanding of the role and aims of foresight.

Results and constraints

This section briefly reviews first the products, that is, the written results of TEP, namely the Delphi survey and the various reports, and then highlights some of the process results as well as some .5 the major difficulties and constraints.

Delphi survey

The first round of the Delphi survey was completed in May 1999. Some 1,400 questionnaires have been returned, an average of 200 per panel. Each questionnaire consisted of 60 to 80 statements describing an event, development or phenomenon occurring in one of the fields analysed by the given panel and the following set of questions:

(a) Respondent's degree of expertise.
(b) Respondent's assessment of economic and social impact, and impact on natural environment.
(c) Period within that the event/development will have first occurred (including "never").
(d) Hungary's current position vis-à-vis advanced European countries in the following four respects: S&T capabilities, exploitation of R&D results, quality of production or service and efficacy of regulation.
(e) Constraints (social/ethical, technical, commercial, economic, lack of funding, regulatory standards and education/skill base).
(f) Promotion of development and application (domestic R&D, purchase of licence, know-how or ready-made products).

The second round was completed at the end of 1999, after that the data were processed and analysed.

Panel and steering group reports

panels formulated the first versions of their alternative futures by September-October 1998, and have discussed, revised and extended them in several rounds, relying on the expertise of the wider professional community (see examples of these alternative futures in figure XV). They have also analysed the underlying structures, human resources, economic factors and results, as well as institutions and regulations in their respective fields. Their final reports have been based on background reports (some 15

to 25 background reports have been commissioned by each panel), panel discussions, Delphi results and conclusions of the series of regional workshops. The main chapters of these reports are as follows: a critical description and assessment of the current situation (a sort of SWOT analysis), alternative futures (visions) and recommendations (policy proposals) to "prescribe" the way leading to the most desirable—and feasible—future.

The panel reports were launched and discussed at a conference in June 2000, and then finalized by taking into account the feedback and conclusions of the conference.

Figure XV. Example for alternative futures/visions developed by TEP panels

	HEALTH		
	Health-oriented, multisectoral	**Restrictive, efficiency-oriented**	**Profit-oriented, driven by suppliers' interest**
Conditions	Conscious governmental policy, long-term professional programme	State supply: uniform, cheap, equally available	Minimal role of the State (regulation aid public health)
	Public expenses: 5.5-6.0 per cent of GDP; private spending 3.0-3.2 per cent	Reduced public expenditures resulting in limited health care	Health expenditures: 10 per cent of GDP; deepening gap between the poor and rich
Results	Public finance dominates	Rate of public finance: 60-65 per cent	Increasing role of private finance
	Priority: prevention	Meet non-financial requirements: ambulance, epidemic control, international regulation	Preservation of health is not a priority
	Basic health services for all	Limited services by the State, need for private finance	Fixed-price services pre-dominate

	INFORMATION TECHNOLOGY, TELECOMMUNICATIONS, MEDIA		
	"Tiger"	**"Sparrow-hawk"**	**"Dinosaur"**
Technological trends in Hungary	Continuous, well-balanced development	Continuous, well-balanced development	Slow technological development, lack of convergence
Global environment	Favourable conditions	Strong influence of global players in Hungary	Favourable, but hardly any impact in Hungary
Role of the State	Active, promotes development	Passive, weak	Passive, weak
Impacts	EU-conforming regulation	National cultural heritage threatened	Economic and technological isolation
	Integrated ICT networks	Growing economic differences between regions	Size advantages are not ceased
Overall features	Shift to vegetables, fruit, biocultivation	Grain-meat chain predominates	Socially and ecologically sustainable system
Integration	Local and global actors, mutually beneficial cooperation	By the pressure of the world market	High-level international collaboration

Figure XV. *(continued)*

AGRIBUSINESS AND FOOD			
	"Garden" Hungary	**Drifting**	**"Green" alternative**
Knowledge intensity	High and wide-ranging	High, but only in a small circle	High and wide-ranging
Activity	State and farmers' coordinated responsibility	Low, foreign actors dominate	High: State and civilian self-organization
Results	Increasing employment	Fewer market players	Priority: employment and environmental farming
	Most dynamic development	Increasing efficiency in a shrinking agribusiness	Efficiency is subordinate to environmental and social aspects

Source: Havas, (2001).

Macro visions

The first draft of the so-called macro visions—analysing the broad social and economic trends at a macro level—has been developed and discussed by the Steering Group and other experts on several occasions. (A group of experts coordinated by Anna Vári and László Radácsi drafted these scenarios in September-October 1998; they were discussed in November 1998 through February 1999, and revised extensively.) Scenarios describing the potential developments of the neighbouring countries, broadly defined, were also developed and discussed in several rounds by autumn 1999.

Having discussed a number of possibilities, three macro visions—alternative futures at the macro level—were elaborated. With hindsight, they can be depicted as cells of a 2×2 matrix, where the columns represent whether Hungary actively pursues a firm, well-designed strategy, and the rows describe if there are fundamental structural changes in the global settings (figure XVI).

Figure XVI. Three macro visions

	Drifting (no strategy)	**Active strategy**
Fundamental, structural changes occur in the global settings		*Macro Vision III:* Hungary is integrated into a new, "green" world by active strategy along a knowledge-intensive path.
No major changes in the global settings	*Macro Vision II:* Hungary is forced into the current system of the international division of labour by multinationals along a low- skills, low-wages path.	*Macro Vision I:* Hungary implements an active strategy characterized by strong integration and high level of knowledge-intensity.

Source: Havas, (2001).

These three macro visions share one common feature: in all cases Hungary is integrated into the international division of labour in the future, as it is already part of the global and European economic and political systems. In other words, the case of isolation was excluded.

"Activity" or "strategy" is understood as an interplay of yet another "magic trio", namely the civil society, businesses and the government. The actual value of this variable is determined by the intensity and quality of the activities of these players.

One major characteristic, that is, knowledge-intensity, is not represented by a separate axis in figure XVI as it can be regarded as a dependent variable of "strategy". In other words, active strategies pursuing a path of low knowledge-intensity—and thus low value-added, low wages and weak local markets—as well as drifting along a highly knowledge-intensive path can be excluded from scenario-building.

All these macro visions take into account demographic, societal, environmental, economic and political factors as well as the physical infrastructure when describing potential futures. Policy recommendations of the Steering Group aim at facilitating macro vision I, emphasizing the importance of an educated, flexible and healthy population and an appropriate, strong national system of innovation. Of course, panel and Steering Group recommendations should be understood as equally important elements of an integrated policy "package".

"Process" results: workshops, networks, new ways of thinking

Taking into account the membership of the Steering Group and panels (some 200 leading experts), the respondents of the Delphi survey and the participants of the various workshops organized across the country, a few thousand industrialists, academics and government officials have contributed to the above written results. In other words, the products (that is, the reports) and the process are hardly separable. On the one hand, without a lively and constructive, creative process a high-quality final product cannot be produced. On the other hand, without inspiring "semi-finished" products (background papers, draft visions and reports) the process cannot be triggered at all. Experts would not attend meetings and workshops, or at least not at a satisfactory level, and people would not feel that they were being intellectually rewarded for their time and efforts.

However, the process in itself is a very important result, and it is worth mentioning that more than 100 regional workshops have been organized to discuss the Delphi results, background papers, draft visions and policy proposals. These workshops and meetings are likely to have contributed to the strengthening and redirection or refocus of existing cooperation and communication among different communities, as well as having facilitated new contacts and initiated new channels and actions. The extent to that these new forums have been useful, however, is very difficult to measure in an exact way.

There have been clear signs of emerging, strengthening and diffusing new ways of thinking. One important example is the fact that policy recommendations have taken into account the complex, multisectoral nature of crucial issues, e.g. health, environ-

ment and the information society. Moreover, non-panel-member experts have also understood the significance of these new types of policies, and have been willing to subscribe to them. In most cases consensus has been reached among the experts, although obviously not all of them would share these policy conclusions. Moreover, the real challenge, and in a way the ultimate test, is to convince policy-makers who are constrained, inter alia, by various political and/or ideological factors to implement these policies based on a new type of analysis. Obviously it is going to be an even more difficult task than to reach consensus in a professional community.

Another promising sign has been that a better understanding has evolved from the close relationship between technological and non-technological factors influencing the quality of life and competitiveness. It is also reflected in the various reports and has been sensed at some workshops.

In sum, however, a systematic evaluation conducted by independent experts seems to be an inevitable step in establishing that process-type results and benefits have been achieved, and what needs to be done to improve the efficiency of the foresight process in the next phase of TEP.

Constraints

Two kinds of constraints are worth mentioning here: a psychological and an institutional one. The first is mainly visible during the so-called main foresight phase, while the second one becomes apparent in the implementation phase. In spite of this somewhat abstract distinction, both constraints might be present in both phases. In practice, usually there is no clear-cut separation between these factors; moreover, they might even reinforce each other.

The first constraint is the mind-set of a number of experts: in their view there is only one "scientific" way of analysing a field, and as a result it is possible to define an "ideal" development path. More precisely, there is only one scientifically acceptable, sound and feasible strategy, that is this "ideal" trajectory. They do not understand the importance of developing and analysing qualitatively different futures or visions. Some would even deny the very existence of these different possibilities. Only a few can be convinced or converted in the course of the foresight process, as this way of thinking has been deeply ingrained during their studies and subsequent decades of work. This points to the need for some foresight methods to be developed at universities.

The second type of constraints is the institutional (organizational) hurdles. Clearly there is tension between compartmentalized government bodies on the one hand, and the complex, multisectoral issues (e.g. health, quality of life, innovation systems, environment and information society) on the other. While the governments are organized vertically, making communication and cooperation among various agencies very difficult, if not impossible, the fundamental issues are horizontal in nature. In the same way that generals fight the previous war when preparing for the next, governments are preoccupied with the nineteenth century's problems, and hence their approach, attitude, decision-making methods and organizational structures are geared towards the past, not the present. In the meantime, the future is already here. It is obvious

that we are living in a rapidly and fundamentally changing period, when we have to be prepared for future challenges.

The role of specific actors in the foresight process

A number of groups can, and should, play crucial yet different roles in the national TF exercise. Their connection to the policy- and decision-making process and practices are briefly highlighted below.

Foresight participants already constitute a somewhat diverse group. Some of them are directly and intensively involved in drafting, discussing and revising various documents, visions, policy recommendations and the final reports. They are members of, and experts working for, the Steering Group and the panels. Because of their close involvement they are the most committed to advancing the implementation of their proposals. They are respected members of their professional communities (which is why they have been appointed as Steering Group and panel members) and have both formal and informal channels to facilitate the dissemination and implementation process. They make or strongly influence decisions in their respective organizations, provide opinions on important issues and proposals formulated outside of the foresight machinery for various bodies, are asked to deliver lectures at workshops and conferences, publish articles in professional journals and/or in the more popular press (weeklies and dailies), and are interviewed more frequently than others.

Other participants, namely experts responding to the Delphi survey and/or attending seminars and workshops organized by the foresight panels, also contribute to the final products by giving their opinion. They are also committed to implementing policy recommendations, although to a somewhat lesser degree (in principle, at least) than those who are more directly involved in producing the reports. They have more or less the same ways and means for influencing the dissemination and implementation process as outlined above.

The wider professional communities, business people, university lecturers and other researchers should be informed as extensively as possible because eventually implementation depends on their day-to-day activities. The more they know about the foresight process and products, the more they are in the position to align their actions with the foresight proposals.

Government officials, policy-makers and politicians clearly play a very direct role in formulating and implementing policies. A carefully balanced approach seems to be appropriate as far as their role in the various stages of the foresight process is concerned. In the so-called pre-foresight stage their participation at the foresight workshops is very likely to attract more attention since more people can be informed about the objectives, methods and expected results of the programme. This can be very useful. However, even then it should be emphasized that foresight is fundamentally not a political but a professional programme.

The next stage of the foresight process is more delicate in that aspect: the experience and insights of policy-makers are obviously crucial in shaping discussions, identifying

issues and formulating the various documents and conclusions. However, they should not represent any organization at this stage and their role must not advance the agenda of any ministry or government agency. Other views, obviously, should also be given the appropriate weight during these analytical activities. Because of these considerations government officials have been asked to join TEP panels as well as the Steering Group, but they have not been in dominant positions.

To regularly inform interested ministries and government agencies, an Interministerial Committee was formed at the very beginning of the process, and its members had the opportunity to represent the official view of the organizations delegated to them. (Ministries have also been asked to nominate panel and Steering Group members, but not necessarily their employees.)

Politicians and policy-makers are crucial to implement any proposal: without them no decision can be made on budget lines, organizations, concerted actions, etc. Therefore, as already mentioned, a series of discussions and meetings are being organized with politicians (parliamentary committees) and policy-makers for the implementation phase of TEP.

Journalists can also play both a direct and indirect role in the foresight process. Some of them can be panel members (as in the case of some TEP panels), or might be commissioned to write background reports (some TEP panels also did this). They need to be kept continuously informed through special briefing meetings, press releases and press conferences, allowing them to play their indirect role, that is, to inform the public. It is especially important that people be made aware of the impact of new medicines and other medical R&D results, food safety, biotechnology, information technology, new materials and energy technologies, etc., on their health, work and leisure time. In short, an efficient media strategy is crucial to a successful foresight programme.

It is practically impossible to involve lay people directly in the foresight programme. Although making all documents available through the Internet is a must, experience so far has shown that the public is not very active in reacting to foresight results even in those countries (e.g. the United Kingdom and Germany) where the use of the Internet is relatively high and foresight has a longer tradition than in Hungary. Citizens are represented to some extent by NGOs and they have been asked to nominate panel members and/or attend workshops organized by TEP (especially those active in the fields of environment, alternative agribusiness methods and energy technologies).

It is worth remembering a simple, but often forgotten fact in this respect: experts of a given profession are non-experts in many other fields. Hence when they are involved in various foresight activities as experts, they are also involved as non-experts and they can provide their views on a variety of issues (e.g. when education, health or the environment is discussed at Steering Group meetings). On the other hand, "nonexperts" are also exposed to experts' views, and they can share those observations with their respective expert and non-expert communities.

The use of international foresight experiences in Hungary

Having discussed the various foresight techniques it was decided in 1997 that TEP should be a holistic programme relying both on a large-scale Delphi survey and panel

methods (SWOT analysis, vision-building, explicit policy recommendations). Broadly speaking, this was the structure of the first UK technology foresight programme. In the course of TEP work, it has turned out that some modifications are necessary; most importantly another level of vision-building has been introduced, namely the macro level. Other techniques have also been adapted to the Hungarian settings (discussed in more detail in the following sections).

In the course of TEP foreign foresight experts were invited several times to give presentations. Some of these occasions have been devoted to discussing the overall picture or nature of foresight, others discussed very specific techniques (e.g. in training seminars). Two international workshops were organized to discuss the preliminary results of TEP and lessons of other national foresight programmes (German, South African, Swedish and UK). Hungarian experts have attended some specific meetings on foresight where they have benefited from both the formal presentations and informal discussions or had in-depth, face-to-face meetings with foreign foresight experts.

In sum, the international foresight community has been very helpful from the very beginning of TEP, providing the experiences of other foresight exercises. Hungary has tried to avoid the mistakes made in other countries (with some success), and adapted their methods and techniques to Hungary's circumstances.

The following sections offer a more detailed account as to the relevance of various foresight techniques in the Hungarian context.

Raising awareness

A narrow definition of foresight techniques would not include seminars on raising awareness. However, if we think of foresight methods, not only techniques in the strict sense, we should consider the role of awareness seminars. Foresight should be as participative as possible and it is crucial to inform the various actors (e.g. academic and business people and policy-makers) about the objectives and methods of a foresight programme from the very beginning, and even more importantly, to involve as many of them as possible in different roles (panel or Steering Group members, respondents of Delphi surveys, participants of foresight workshops, etc.).

For these reasons TEP, following the UK example, has put a strong emphasis on organizing awareness seminars across Hungary in the first stage of the programme (September 1997 through May 1998). Building on the contacts developed during this phase, dozens of further workshops were organized for the next stages of the programme: first to discuss the preliminary results and recommendations, and then to disseminate the final reports.

Delphi survey

In preparation for the Delphi survey a one-day training seminar was organized for panel chairs and secretaries, who also studied the French, German, Japanese and UK questionnaires. It has been the panels' responsibility to formulate statements for the Hungarian questionnaire. The overall structure (i.e., the variables, questions or column

headings of the questionnaire) was discussed and adopted by a joint meeting of the Steering Group and panel chairs and secretaries. Another training seminar was organized with an invited foreign expert on processing and interpreting the Delphi results.

The most important difference between the foreign and the Hungarian questionnaires has been that TEP panels formulated quite a few non-technological statements (issues related to human resources, regulation, policy, etc.) as opposed to the rather strict technological character of the German, Japanese and UK questionnaires. As already mentioned (see the section on scenarios, institutions and regulation), putting more emphasis on non-technological issues has been validated by the respondents (who were not involved in the formulation of the statements and have not "defended" their own work or ideas).

Another difference has been that experts have been asked for opinions not only on social and economic impacts, but also on environmental impacts.

Panel methods

TEP has relied to a large extent on the UK methods, as mentioned above. The panels have also organized consultative workshops, commissioned background papers, and on the basis of information obtained from these and other sources, have developed alternative visions (futures). These have not been fully fledged scenarios (i.e. an explicit chain of actions and events leading to an end result), yet they have been significantly more detailed than the ones developed by the panels of the first UK foresight exercise. Again, this is due to the very nature of the transition process: since major institutions have just been formed, TEP panels have put more emphasis on developing these alternative visions. It is worth recalling that the TEP panels were not organized along disciplines or economic sectors (as in the case of the first UK exercise), rather they have analysed complex issues (see the sections on education, employment and broad issues as panel topics).

Steering group discussions and report

The Hungarian Steering Group report is not just a summary of the panel reports (as opposed to the Swedish or UK synthesis reports), but does, of course, draw upon the panel results. In short, all the panel activities at a macro level were repeated: the current situation was analysed, visions were developed and policy recommendations were formulated.

When developing the Steering Group report and discussing preliminary versions, experts were invited to give their opinion at Steering Group meetings. The search for global and European scenarios and prospective studies was conducted as background information for analysis. Some were found, of course, but most were published too late for this purpose.

Conclusion and recommendations

The Hungarian foresight programme clearly shows that various foresight methods developed and applied in advanced countries can be relevant and useful in the con-

text of transition. Obviously, some modifications and adaptation to the local needs and circumstances are inevitable. Some more detailed, but still somewhat general and tentative conclusions are offered below. (More precise recommendations can only be made in the actual context of a given country.)

Most of the tentative conclusions are formulated in the conceptual framework of the so-called innovation system approach. This understanding of the innovation process emphasizes the importance of communication, mutual learning and cooperation among various actors (e.g. scientists and engineers, business people and policy-makers); strengthening existing institutions and building new ones; and developing 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) but economic, organizational and social ones as well.

Consideration of the following aspects of the organization and the management of the programme is crucial:

(a) The design of the programme should take into account:

- The level of socio-economic development.
- The size of the country in question.
- The socio-psychological legacy of central planning.
- The overall communication, cooperation and decision-making culture (norms, patterns, written and tacit rules).
- The legal institutional framework. etc.

(b) Objectives should be formulated clearly at the very beginning. It must be determined whether the programme is limited to assisting in the decision-making process of setting narrowly defined R&D objectives, or it is geared towards broader socio-economic needs and problems of the country in question. That is, what is the role of S&T developments, various policies and regulation in solving these broader problems, and what are the responsibilities of the various actors (government, scientists and researchers, businesses, NGOs, families, individuals)?

(c) Thorough consideration should also be given to the following questions in the framework of the overall objectives: What issues have to be analysed by that methods (Delphi survey, wide consultations and discussions, developing visions, etc.) and by whom?

Given the challenges and the very nature of the systemic changes, it seems appropriate to stress the importance of visions (i.e. futures, or fully fledged scenarios) for a transition country both at panel (micro, mezzo) and macro levels. In other words, there is obviously room and a need for methodological innovations. The decision on appropriate issues for panel discussion is also crucial in terms of the expected output. One possibility is to set up panels to analyse various disciplines and/or economic sectors (as in the case of the first UK foresight programme). A different approach would be to analyse

broader socioeconomic issues, like human resources, health, environment and business processes, with, of course, a strong emphasis on technological issues in that context. For transition countries the latter approach seems to be more appropriate; this approach has been followed by the Swedish and the second UK foresight programme.

There are a number of important cross-cutting issues in all countries (for the Hungarian case see the section on cross-cutting issues). Because of their very nature—being at the crossroads of various fields—it is simply not possible to find a single structure that would allow the necessary complex analysis of these issues. Therefore specific attention needs to be paid to develop, and apply, a mechanism that would facilitate adequate cooperation among the various foresight panels and experts who approach these issues from different angles.

The transition process also calls for specific policy recommendations (as opposed to, for example, the Austrian, German and Japanese foresight exercises). Again, the decisions on the objective, methods and scope of the programme (e.g. whether it has a technological or a broader socio-economic focus) would influence the issues for policy proposals (e.g. human resources; regulation, competition and innovation in various fields; foreign direct investment and regional development policies; and institution- and network-building).

The other major foresight method, namely the Delphi survey, can be useful in transition countries not only to collect information (experts' opinions) but also to disseminate that information (during the second round), and involve more participants in the process as opposed to the case when only the panel method is applied. However, the Delphi survey should be carefully designed and certain aspects need to be considered thoroughly. Examples of questions to be asked are listed below:

- Is there a sufficient number of technical/technological experts to run the survey, or is it better to target a wider, different audience?
- What structure is more appropriate: the traditional one aimed at collecting opinions or the more decision-oriented Austrian version?
- What is the appropriate balance between the strictly technological and non-technological issues in the statements?
- What are the appropriate questions (taking into account the nature of statements/issues and the country characteristics)?
- What is the appropriate size of the questionnaire (the number of statements and questions)?

For a successful, effective foresight programme strong emphasis should be put on organizing awareness-raising seminars in the first stage, and then on continuous, wide-ranging dissemination and discussions in parallel with the analytical activities. Without a carefully designed dissemination and implementation stage most of the efforts and resources committed to the programme in the first two stages (time of experts, taxpayers' money to cover the organizational 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" side, namely disseminating a new, consultative, future-oriented decision-making method and intensified networking, cooperation and institution-building activities. In other words, a foresight programme can strengthen the national system of innovation in two ways: through reports and recommendations as well as by facilitating communication and cooperation among various professional communities.

Finally, there is obvious scope for regional cooperation. It might be extremely useful to exchange experiences on methods applied in various countries, as well as identifying success and failure factors. Moreover, some analytical activities (issues that extend beyond national borders) might also be harmonized if there is a mutual interest in doing so. In other words, it cannot, and should not, be imposed by any national or international player. However, various international organizations, notably the EU and UNIDO, as well as national governments and professional associations might play a crucial role in facilitating this cooperation.

Technology foresight in the Czech Republic

Background

Historically, the orientation and pattern of industry in the Czech lands was always strongly influenced by the demand of large economic blocs. It was the Austro-Hungarian Empire in the beginning of the twentieth century, followed by decades of incorporation in the so-called "eastern bloc" ruled by the former Soviet Union. The country developed strong manufacturing branches, for example, machinery, basic chemicals, arms production, material processing and food industry.

The transition from (a political) bloc dependence to independence has created a challenging environment for the national economy. The history of the former Czechoslovakia and its economy was shaped by the renewal of independent status in 1918, by political changes as a consequence of the Second World War in 1945 and, naturally, by the end of the cold war in 1989. The country was often called upon to utilize its strong manufacturing capacities, skilled labour force and the corresponding infrastructure in new conditions. In the first half of the twentieth century, Czechoslovakia ranked fifth among the most developed world economies in terms of GDP per capita. Naturally, there was a decline of the country's position as a consequence of a divided Europe after the Second World War. Despite the political system, flexibility of the national economy and its core industry were always key conditions to succeeding in the changing environment. One of the prerequisites of success is knowledge of future market opportunities and technology possibilities. This is based on the critical evaluation of the country's resources and directing public spending to those research, engineering and technology development processes that are linked to favourable strategic possibilities. Such a task is usually accomplished through a systematic process of assessing market opportunities, strengths of national industry and

research based on the expected needs of the country. That process, usually called TF, is performed in all of the leading world economies and nowadays receives increasing attention in developing countries and in countries with economies in transition.

This section provides an overview of the policy and strategy for future technology development in the Czech Republic with a particular emphasis on the recent national TF project.

Policy and strategies for future technological development in the Czech Republic

In the 1990s, there was a lack of strategically targeted initiatives regarding future technological development in the Czech Republic. Due to the basic restructuring of the whole system, including the industrial base, a turbulent environment throughout the first half of the 1990s brought about frequent changes in the positions of responsible persons, and strategic policy documents were practically non-existent. Most of the initiatives were short-term, targeted to cope with urgent problems and to prevent widespread social dissatisfaction. The situation began to change towards the end of the decade, when the government decided to elaborate a basic document called the "National Research and Development Policy of the Czech Republic" (NRDP). At the beginning of 1999, nine working groups for the preparation of the NRDP were constituted. The project was managed jointly by the Ministry of Education, Youth and Sport and the Research and Development Council of the government. The working groups consisted of representatives of ministries responsible for respective research areas in the country (Ministries of Education; Youth and Sport; Industry and Trade; Health; Environment; Defence; and Agriculture); experts nominated by the largest research bodies (universities, the Academy of Sciences and the Association of Applied Research); deputies of important industrial associations and confederations; and other invited experts. Experts worked for six months in the following groups:

- Coordination.
- Research and development and transfer of results.
- Basic research.
- Applied research.
- Funding and indirect support.
- International cooperation.
- Infrastructure for research and development.
- Moral-ethical aspects.
- Analysis.

In June 1999 a conference open to a broad, interested public was organized to discuss a draft version of the policy documents. Following the recommendation made by the conference participants and considering contributions from an Internet discussion

forum, the final proposal of the NRDP was submitted to the government for approval in December 1999.

By adopting Resolution No. 16 of 5 January 2000, the government of the Czech Republic approved the "National Research and Development Policy of the Czech Republic" as a key strategic document defining the relationship of the State to research and development. A significant part of the document deals with oriented research—research, which in principle is oriented to achieve concrete results, needed, for instance, to solve a technical problem or improve the quality of life. By its definition, oriented research partly involves also basic research. Oriented research is "demand-driven" whereas non-oriented research is "curiosity-driven". NRDP declares the need for early identification of priorities for oriented research using some of the proven methodologies (or a combination of methodologies) of TF.

One of the basic objectives of prioritization is to create conditions for optimized spending of limited public funds to sustain an innovative science base, to support national wealth creation and to improve quality of life. It is generally acknowledged that the formulation of the priorities of the oriented research is complex and time-consuming as well as a financially demanding process. Such a process involves several stages:

- NRDP defines a limited number of thematic priorities—thematic programmes and a fundamental set of systemic priorities—cross-cutting (horizontal) programmes. Both groups reflect the assumed needs of the society in the time horizon of 10 years.
- Design of adequate concrete criteria for evaluation and decision-making during the selection of appropriate priorities of oriented research. The criteria should remain unchanged during the whole process until the priorities of oriented research have been implemented. The same criteria should also apply for the evaluation of research plans of research organizations.
- Selection of priorities of oriented research with a particular emphasis on matching the anticipated needs of citizens and the whole society.

The accomplishment of steps 2 and 3 is the principal task for a national foresight exercise.

Prerequisites and motivations for TF at the national and regional levels

Generally, the NRDP defines the following fundamental priorities of the National Programme of Oriented Research (NPOR) grouped into five thematic and three cross-cutting programmes. The thematic programmes include:

(a) Quality of life.
(b) Information society.
(c) Competitiveness.
(d) Energy for economy and society.
(e) Social transformation.

The cross-cutting programmes include:

(a) Human resources for research and development.
(b) Integrated research and development.
(c) Regional and international cooperation in research and development.

TF exercises, that focus primarily on detailed identification of priorities of the oriented research, should start from and be particularly based on:

(a) Assumed needs of citizens and society to that oriented research (with possibilities of international cooperation) may contribute and for that public support may be obtained.
(b) The requirements on the development of human, knowledge and material potential of the Czech Republic.
(c) The needs of development of research and development capacities in the Czech Republic.

In addition to the selection of particular (research) priorities of the individual thematic programmes, the results of the national TF exercise should also involve the recommendations for optimization of the structure and functions of cross-cutting programmes to create favourable conditions for systemic support of thematic programmes.

By the governmental resolution, the organization managing the TF project had to be selected in a public tender. The government commissioned the Ministry of Education, Youth and Sport to organize the tender and to represent the government in the exercise.

Projects submitted to public tender were evaluated in October 2000. The committee of experts governed by the Ministry of Education, Youth and Sport selected the project submitted by a consortium of the Technology Centre of the Academy of Sciences (leading project partner) and the Engineering Academy (project partner).

National TF programme

This section describes the recent Czech TF project, particularly its objectives and methodology.

Objectives

The Czech TF project follows the tasks outlined in the NRDP for oriented research. The principal objectives of the project may be summarized as follows:

(a) A proposal of priorities (sub-programmes) of thematic programmes of oriented research defined by the NRDP.
(b) Recommendations for the optimization of the structure and functions of cross-cutting programmes to ensure favourable conditions for systemic support of thematic programmes and the NPOR as a whole.
(c) A design of basic principles of the management of the NPOR.

Only the methodology for the first task will be described in further detail.

Generally, the basic objective of the national foresight exercise is to identify the most important technologies likely to be required by Czech industry and the service sector over a 10-year period, and to create the conditions for development of the NPOR that are designed to achieve strategic goals in the preferred sectors important to national wealth creation and improving the quality of life of citizens.

Methodology

Methodology of the Czech national foresight programme corresponds to the objectives and conditions imposed by the formulation of the governmental request. The main objective is to identify priorities of oriented research within the relatively short time of one year. Selected research priorities should be able to address the most likely social, economic, environmental and market trends of the next 10 years (the time-horizon of the study is the year 2010). Selection of priorities should be a combination of supply-driven and demand-driven attitudes with the emphasis on the latter.

Due to the above-mentioned conditions, the basic principles for the design of the foresight methodology are as follows:

(a) There is not sufficient time to perform a large-scale Delphi survey, that was the backbone of several foresight studies abroad (Germany, Hungary, Japan and the United Kingdom).

(b) The principal objective—identification of priorities of oriented research—may be accomplished using a modified method of "key technologies" (critical technologies, strategic technologies), that was successfully applied for instance in France, the Netherlands and the United States.

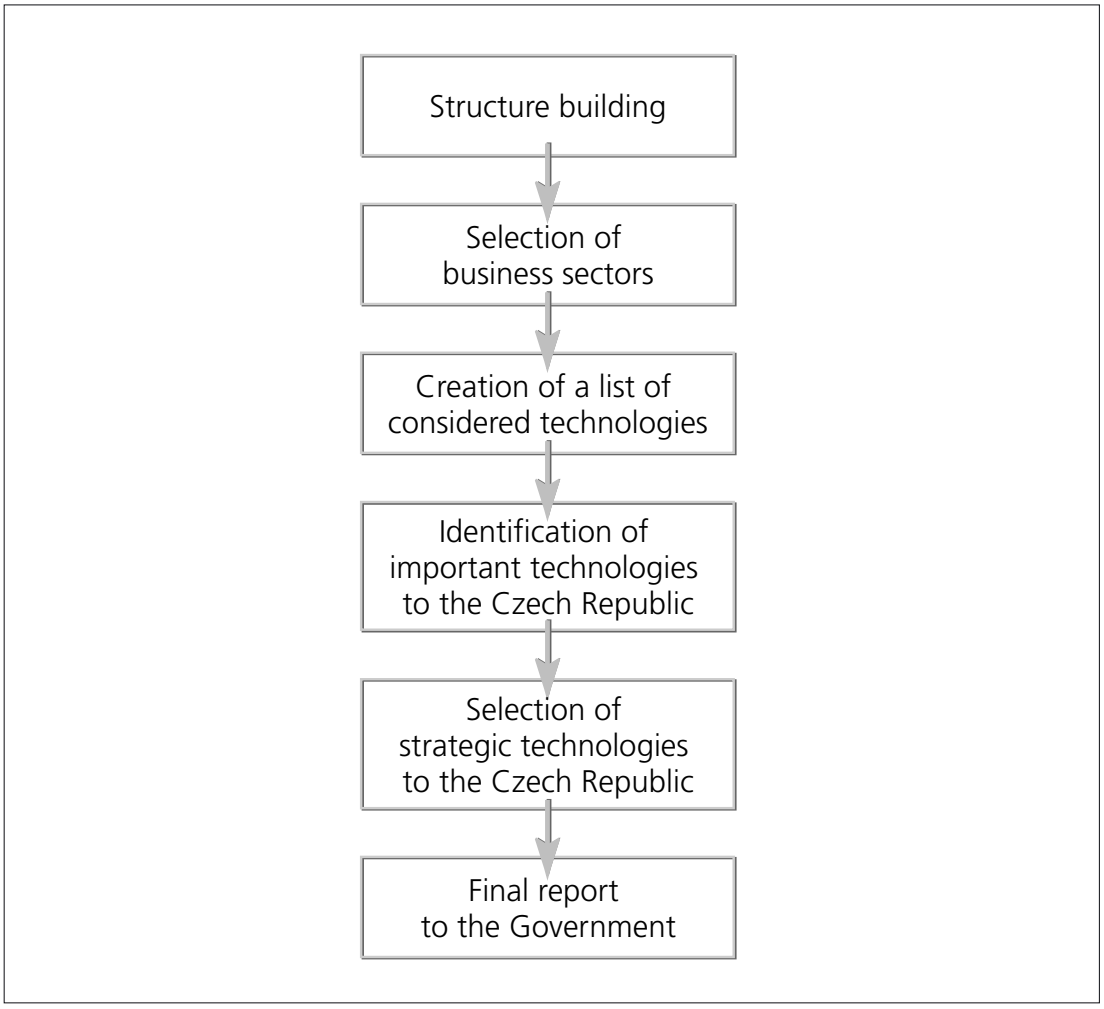
(c) An essential success factor is consensus building among various stakeholders—government, industry, commerce, academia and political circles.

(d) Input for the selection process should be collected from: potential "users" of results of oriented research (industry, entrepreneurs, commerce) to identify real needs of the Czech economy and society; "providers" of research results to evaluate the potential of the national research base to create required results; and government departments (ministries) to compare foresight findings with their strategic plans in the area of oriented research.

(e) To characterize the relative economic importance of individual business sectors, independent statistical data for each industry should be collected—e.g. its contribution to the GDP, its export potential, its potential to create a competitive advantage.

Methodologically, the foresight project consists of several consecutive stages as shown in figure XVII.

Figure XVII. Individual stages of the Czech technology foresight project



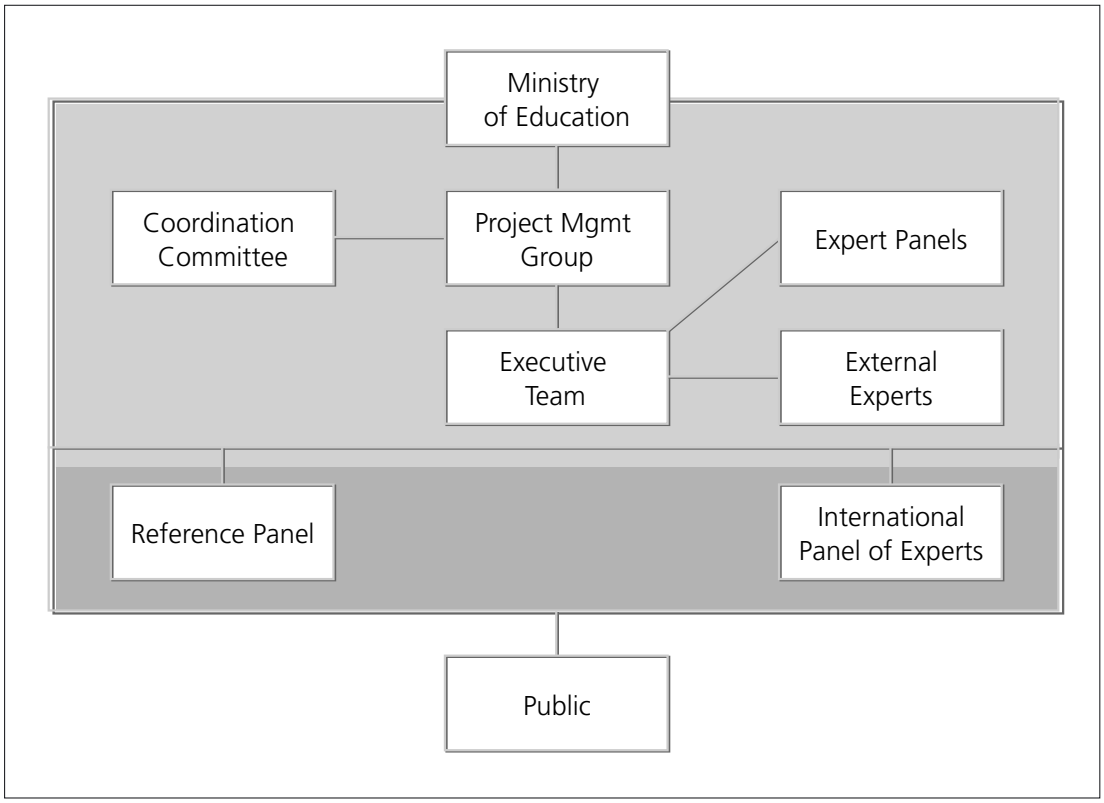
Source: Klusacek (2001).

The detailed methodology designed for the Czech exercise combines several patterns of foresight activities used in various countries, namely in Australia, France and the Netherlands. Individual steps of the Czech exercise are described below.

Structure building

The main project objectives may be achieved only through cooperation of a relatively complex structure in that all the important stakeholders are represented. The basic structural elements of the Czech foresight project are illustrated in figure XVIII.

Figure XVIII. Structure of the Czech technology foresight project



Source: Klusacek (2001).

The Ministry of Education, Youth and Sport is the principal project promoter and sponsor. The Ministry is not directly involved in project execution but it continuously monitors the progress of the project and approves nominations for the coordination committee and expert panels. The Ministry nominates permanent representatives to the coordination committee including the committee chairman and two secretaries. Ministry representatives are authorized to participate in the meetings of expert panels and meetings of the Project Management Group.

The coordination committee consists of top representatives of key stakeholders—governmental departments, research organizations, industry, political circles, business managers, market and social forecasters, etc. The committee is chaired by the Deputy-Minister of the Ministry of Education, Youth and Sport, and the administrative functions are ensured by two secretaries in cooperation with the executive team. The main task of the committee is to evaluate the project's progress, comment on its results, provide input on project modification and facilitate a broad consensus enabling the implementation of the project results.

The project management group performs the executive management of the project. The Group is formed by representatives of the Technology Centre of the Academy of Sciences (leading project partner) and the Engineering Academy of the Czech Republic (project partner) and is headed by a project manager who reports directly to the

Ministry. The Group manages the executive team and is represented in the coordination committee.

Expert panels consist typically of 10 to 15 leading national experts for a particular field. Each panel is chaired by a recognized expert ("a strategic thinker") preferably with mixed experience in research, industrial management and a knowledge of methods used in State administration. The chairman is assisted by a panel secretary who is also an expert in a particular field. In the panel, experts from research (providers of a new technology) and industry (users of a new technology) should be evenly represented. The panel outcomes are justified proposals of priority areas of oriented research including recommended measures for their implementation. A special panel prepares a proposal of the management system for the NPOR and designs underlying principles for the transfer of ongoing programmes of oriented research into the new NPOR.

The executive team organizes and supports the activities of expert panels, performs in-depth interviews of industrial managers and completes the quantitative analysis of significance of individual business sectors to the Czech economy. The team is led by the project manager and it cooperates with external experts.

External experts are leading national professionals from particular business sectors. They are invited to prepare a SWOT analysis of the sector and suggest the priority fields of oriented research to match the needs identified in the analysis.

The International panel of experts is a group of prominent international experts in the area of technology foresight. They provide their opinions on the project methodology and their views on the analysis and interpretation of results.

The reference panel is created from representatives of research institutions, industrial companies, associations of entrepreneurs and other organizations. The panel includes several hundred people who are electronically contacted regarding their opinions on the intermediate project results. The judgement of the panel is considered in the formulation of final versions of project documents.

The public were continuously informed about the project's course and results through a foresight website. Suggestions and recommendations of the professional public were used to modify the project conclusions.

Selection of business sectors

National economies comprise a large variety of economic activities based on different technologies and results of oriented research. Identification of business sectors accomplished by the projection of economic activities into groups with similar technological needs and requests for oriented research.

Identification of business sectors is based on the definition of the five thematic programmes (described earlier) by NRDP. As in the foresight study performed in the Netherlands, the intention was to keep the number of business sectors to a minimum, as these sectors would correspond to expert panels in the later stages of the project.

The classification of national economy sectors of the Czech Statistical Office and strategic plans of individual governmental departments (ministries) were used as source material. After consultations with experts the following 11 business sectors were selected ("social transformation" was added as a potential expert panel):

- Agriculture and food.
- Environment.
- Health and pharmaceuticals.
- Information society.
- Building and construction.
- Materials and their processing.
- Machinery, instruments and equipment.
- Chemical products and processes.
- Transport.
- Energy and raw materials.
- Social transformation.

Creation of a list of considered technologies

The list of technologies considered in the beginning of the project should meet two criteria:

(a) Include all the technologies needed by the business sectors listed in the previous section.
(b) Have a reasonable number of technologies deemed to be operable.

Similarly, as for the business sectors, a grouping of technologies is needed. Due to the time constraint, the list of technologies used in the Dutch study was used for this project. That list is a combination of results of previous TF studies performed in France, Germany, Japan, the United Kingdom and the United States.

The initial list of considered technologies consists of nine technology clusters subdivided into 46 technology fields. Industrial strategists would review the list to insert some additional technologies if needed. The nine clusters of the considered technologies are:

- Process technology.
- Biotechnology.
- Materials technology.
- Discrete production.

- Plastic moulding technology.
- Energy technology.
- Opto- and micro-electronics.
- Information and communication.
- Civil engineering.

Identification of important technologies to the Czech Republic

Identification of technologies that are important to the Czech economy and society was the next stage of the national foresight project.

In order to arrive at the important technologies three steps were combined:

- *In-depth interviews* (the demand side) of a representative sample of key companies from each business sector. A structured questionnaire was designed for this purpose. In-depth interviews were performed during face-to-face meetings with company managers responsible for the R&D strategy. To ensure fully professional communication external experts were invited to perform this task.
- *Judgements of expert panels* (mixed demand and supply side) constituted for each business sector. Composition of the panels for the business sectors is described earlier. panels completed a similar questionnaire as company managers in the previous step. Results obtained for both types of questionnaires were compared.
- *Judgements of independent experts* (preferably the demand side). Renowned national experts not included in the panels were asked for their opinions on important technologies for each business sector.

The respondents were requested to assign weights to the technology fields that are, according to their opinion, important to a business sector (a weight of 0 is considered not important, a weight of 3 is highly important). The results of the three steps above were compared to find out if there are any principal discrepancies between technologies preferred by different types of respondents. In the case of serious disagreement, the respondents were to be contacted again to achieve consensual results. The results were summarized in a "matrix of important technologies". Each column in this matrix corresponds to a particular business sector (12 columns in total); the rows correspond to a technology field (46 rows in total). The matrix is schematically illustrated in figure XIX.

Figure XIX. Matrix of important technologies

	Business sector 1	Business sector 2	Business sector 3
Technology field A	0	2	1
Technology field B	3	3	2
Technology field C	1	0	0

Source: Klusacek, (2001).

Naturally, some technologies are important to more business sectors than others. These technologies are likely to be selected as strategic technologies-priority areas of oriented research-described briefly in the following section.

Selection of strategic technologies to the Czech Republic

Strategic technologies correspond to the priorities of oriented research—the identification of that is one of the main objectives of the project. Two steps were used to identify the strategic technologies:

- Quantitative analysis of the relative economic importance of individual business sectors and technology fields to the Czech economy using independent statistical data produced by the Czech Statistical Office (e.g. their contribution to the GDP, their export potential, their potential to create a competitive advantage). The result of this quantitative work was a draft list of strategic technologies.
- Expert panels verified and refined the results of the quantitative analysis. The final list of recommended priorities of oriented research combined the results of a panel's opinion and that of the quantitative analysis.

Implementation

It was explained earlier that the results produced in this TF exercise should be used by the government for outlining the National Programme of Oriented Research (NPOR). Proposed priorities of oriented research should form the subprogrammes of thematic programmes. The identified systemic measures should outline the basic principles for the design of cross-cutting programmes to optimize the function of the NPOR as a whole. Suggested management and implementation principles should be used to create the NPOR management system and to transfer the ongoing, State-supported R&D programmes to the NPOR.

Constraints and results

The main constraint of the Czech national foresight project is the limited amount of time allotted for carrying out a detailed study. The project was supposed to be completed within 12 months. Due to the time constraint, only limited analysis could be performed. However, the output from this project, including the developed methodology, may be considered as input for future TF activities in the country.

The role of specific institutions in the national TF exercise

A number of institutions participated in the Czech TF exercise. The project was very close to the policy- and decision-making process as the results were ordered directly by the Czech government. The government was also the only project sponsor and promoter.

The key governmental departments (ministries) were represented in the coordination committee of the project. Also Senate, Parliament and other important institutions had their representatives on the committee.

The involvement of the decision-makers in the foresight project may have a positive influence on the implementation of its results. Further, the participation of decision-makers in the project from the very beginning may help them to gain a level of insight into the project achievements that would not be reflected in the final project reports.

Short- and long-term plans for the development of TF in the country

Over the last few years, the Czech government has become increasingly interested in using the results of foresight activities in policy-making in the areas of research, technology and innovation.

Short-term plans are focused on use of the one-year TF exercise to formulate priorities and operational principles of the National Programme of Oriented Research. However, it is widely anticipated that this first foresight activity will set out the conditions for establishing more sustainable foresight institutional structures and activities.

It is assumed that after the implementation of the results of this first exercise in the NPOR, the methodology and general experience will be evaluated in detail to formulate underlying operational and strategic principles for the coming (cyclical) foresight activities in the Czech Republic.

Experience in international/regional links in TF in the country

Activities in the area of TF are quite recent in the Czech Republic. Therefore, international links are in an early stage of development: contact has been established with the following organizations and institutions:

(a) PREST, University of Manchester, United Kingdom. Mutual cooperation started in 2000 when two Czech experts participated in the TF course organized by PREST in Manchester. Two PREST experts participated in the Czech exercise with support from the British Council.

(b) The Institute for Prospective Technological Studies (IPTS) of the Joint Research Centre of the European Commission, Seville, Spain. Two Czech experts are members of the “Thematic Network on Foresight Activities on Science and Technology” managed by the IPTS. The network was set up in June 1999 at a high-level meeting in Berlin. The initiative is part of a broader project—"Enlargement of the European Union”. One IPTS expert participated in the Czech exercise.

(c) The Fraunhofer Institute for Systems and Innovation Research (ISI), Karlsruhe, Germany. One expert from the ISI participated in the Czech foresight exercise with support from a bilateral Czech/German cooperation programme.

(d) UNIDO. Contacts with UNIDO have started with prospects of further cooperation in TF on the regional/international level.

Needs for international/regional development of foresight activities

The region of Central and Eastern Europe is undergoing a transition of its economy and a restructuring of its industry. Some countries are preparing their economies for early accession to the European Union, while other countries are still at the beginning

of a relatively long process of transition. In any case, a well designed and carefully performed foresight project in these countries may positively influence policy-making in science, technology and innovation.

Conclusion and recommendations

Several general statements and recommendations may be formulated:

(a) In the dynamic political and economical environment of countries in economic transition, TF activities are clearly a useful tool for decision-makers and strategic planners.

(b) It is not possible to define a single, best foresight technique for any situation or set of objectives. Each national foresight exercise has to be specifically tailored to the particular situation of the respective country, that country's targets and the time available for the study.

(c) Industry must have the innovative capacity to fully utilize the foresight results and recommendations.

(d) National teams should complete the national foresight projects since they have knowledge of tacit information, hardly accessible to foreigners. Direct participation of a small advisory group (5 to 10 people) consisting of experienced foreign TF experts may significantly enhance the project outputs and help to avoid some operational mistakes.

(e) Growing interest in foresight exercises worldwide has influenced the continuous development and enrichment of foresight methodology; it has also produced some duplication, particularly in introductory project phases but also in later analytical stages and interpretation of results. For that reason it seems useful to consider the development of cooperating structures that would share methodological principles and data.

United Kingdom

Introduction

The UK national foresight programme is managed by the Office of Science and Technology (OST). Initially announced in 1993, it is now in its third cycle. Over the last decade it has produced more than one hundred reports, involved tens of thousands of people, and had substantial impacts at home and abroad. But it has also undergone substantial changes, to anticipate that would have required immense foresight on the part of its originators. In many ways the national programme is now only a small part of the UK scene. This section provides a perspective on some of the main achievements and problems. The perspectives outlined here should not be taken as reflecting official views

From futures to foresight (a brief history of the future)

There is a long history in the UK of efforts to improve decision-making and public debate by thinking about longer-term trends, and about the long-term implications of

short-term decisions. This after all was the agenda of many of the classical political economists of the nineteenth century (largely discarded as "economics" became established as a narrowly defined discipline). Efforts to envisage desirable futures and directions of social development go back several centuries—Thomas More's *Utopia* is a major reference point, of course. (Early utopias were usually located in far-off lands or on other worlds. As the pace of social and technological change accelerated—and the world became better explored—it became more feasible to portray a better future as indeed being located in the future.) HG Wells called for "Professors of foresight" early in the twentieth century, and the UK has been a source of "genius visionaries" from H.G. Wells's era to those of Arthur C. Clarke and his younger contemporaries.

Wells's call for institutionalization of long-term visioning capability was not heeded for a long time. Even when "futures studies" became a global phenomenon in the 1960s, the UK tended to stand back from the wave of activity that saw other countries establish Commissions on the Year 2000 and similar bodies. Only modest activities were initiated, compared to those in North America and continental Europe. Still, the journal *Futures* was established in the UK, large companies such as Shell did develop their scenario analyses and long-term strategic plans, and a small futurist community came into being—though efforts to create networks among its members have had limited success.

Futurists sought to be more holistic than traditional forecasting exercises. Forecasting usually examines a narrow set of trends, using rather mechanical methods like modelling or extrapolation. Futures work seeks to connect together various driving forces, trends, and conditioning factors, so as to envisage alternative futures—rather than simply to predict the future. One of the very few academic centres of such work, the Science Policy Research Unit (SPRU) at the University of Sussex, had a world-wide impact with its critique of the Limits to Growth world model. And SPRU was later to be the source of studies of TF activities around the world that were to be influential in the shaping of the UK TF programme.

The second of the SPRU studies by Martin & Irvine (1989) referred in fact to "Research Foresight" (notably much of their work at this period was funded by the Netherlands government, that was to undertake its own substantial foresight initiatives in the 1990s). They saw TF, then, as primarily about informing research policies; as:

> "… 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 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)

The UK had long been recognized as having an innovation problem. Its relatively poor economic performance had long been attributed to recalcitrant trade unions and unmotivated managers. An alternative diagnosis had been offered by innovation researchers at SPRU, PREST, and elsewhere—that the UK suffered a serious failure of linkage between the scientific research base and industry.

It was argued, firstly, that too much science was being funded through inertia. This meant that scientists continued to direct finance to the ever-growing needs of their established colleagues, with little examination of alternative lines of research, or of the needs of other stakeholders. It was argued, second, that industry was failing to exploit the knowledge and inventions coming from public science. Also, industrial R&D was well below the levels of most of the UK's competitors, except for a few shining exceptions in pharmaceutical and other sectors. As the problem of the innovation system came to be recognized, the first question to be seriously addressed was how to redirect scientific priorities.

In 1986 the government's main advisory body on S&T matters, the Advisory Council for Applied Research and Development (ACARD) presented a report that outlined a set of questions for identifying promising areas of science, understood as those offering knowledge that could readily lead to exploitable products and processes. This seems to have resulted in little action, however. In the early 1990s an interdepartmental working group was set up to identify methodologies that could identify and prioritize emerging technologies of importance to the UK. This brought together the UK government's recently established Office of Science and Technology (the OST—based in the Cabinet Office, and thus with a good link to the Prime Minister) and the Department of Trade and Industry (DTI—whose own minister was an important member of government).

Four teams (including ones at PREST and SPRU, as well as a consultancy group and a German institute) were commissioned to work together to develop such methodologies. The scoping study (PA Consulting et al., 1992) suggested that an appropriate methodology would combine the use of expert panels, a Delphi, and a prioritization process to identify emerging generic technologies. The proposed methodology was piloted in late 1992. At the same time, Ben Martin of SPRU was asked by the Cabinet Office to (again) review existing research foresight practices, and to make recommendations for a national UK TF exercise. The 1993 White Paper on Science and Technology Policy, Realising Our Potential, officially announced the UK TF programme—making it clear that this was to inform decisions about how to allocate finite public resources to research and related activities:

> "No one nation can afford to sustain a significant independent presence in all of the burgeoning fields of scientific research. The government must therefore work closely with the scientific and industrial communities to determine the appropriate mechanisms for setting priorities both in terms of the areas of research to support, and the level of funds to be committed to them" (OST, 1993, p.2).

So foresight was to be closely tied to priority-setting, to informing the policies to be pursued by government, the Research Councils and other bodies it funded. It was to provide information for a wider community, too, whose decisions could not be directed by government. It was to draw on inputs from this wider community because it was recognized that much of the critical knowledge about key emerging technologies was not possessed by civil servants—even in the OST—nor even by leading academic scientists. Practitioners and researchers in industry would also need to be consulted. These points were made explicit in the White Paper: but something more was implied here. Alongside the goal of informing decisions on the balance and direction of pub-

licly funded science and technology, was another goal: that of forging "a new working partnership between scientists and industrialists best placed to assess emerging market opportunities and technological trends". This new "working partnership" can be seen as an effort to address one of the major problems of the UK innovation system—the poor links between industry and the science base.

Japan was held up as a country whose innovation system worked well (notably in a much-cited book by Freeman, 1987). Britain's massive Alvey research programme in information technology in the 1980s had been inspired by Japan's Fifth Generation programme, for example. The Irvine and Martin analyses of foresight had given considerable attention to Japanese experience, and made much of the technical tools, such as Delphi, used in Japan. But it was apparent that these tools could not simply be transplanted without modification to a very different environment, that they had been evolved in their particular form within a particular environment. Attention had to be given to those features of the UK environment that would have to be restructured if the visions generated by foresight were to be effectively linked to reality and action. This was built into the first cycle of UK foresight.

The first cycle

The first cycle of the UK programme involved a number of overlapping stages of work (Georghiou, 1996), of that the first was "preForesight".

Preforesight

Shortly after the publication of the White Paper in 1993, a Steering Group, chaired by the government's Chief Scientific Advisor, was established to oversee the running of the programme. Methodological principles for the programme were established, and consultation seminars held round the UK (not least, to assuage fears that this was to be an exercise in cutting costs of science!).

Following some consultation and conomination analysis (around 800 people are said to have been involved), 15 "sector panels" were set up—some covered technology or technology-push fields, some covered more user or demand-pull fields. An effort was made to extend the focus beyond manufacturing industries, where most earlier innovation policies had focused:

> "The recognition of the role of the service sectors in the innovative process is a major shift in official thinking and one that has been long overdue...the structure of the service sectors and their institutional settings have a powerful influence on a country's technological activity." (Richard Freeman, 1993),

These panels (figure XX) were charged with identifying key trends and drivers, benchmarking their sectors, developing scenarios, consulting widely with their communities through a Delphi and workshops, and constructing priorities and recommendations for action. Experts and stakeholders drawn from business, government and academia were appointed as panel members. These participants were identified and given some training—especially the chairs, facilitators and technical secretaries. Note, from figure XX that there was some change in panel structure over time—some groups were

seen to have been effectively separated or combined, and sustained lobbying brought a marine panel into being. There was also a change in the programme's title, from technology foresight to plain foresight—apparently the "technology" element deterred some potential contributors, and foreclosed the issues to be examined unduly.

Panels were really central to the foresight cycle to an extent that was uncommon in most other national exercises. Though following a common methodology, they had considerable freedom to interpret the details of this, and the pressure of time they were under meant that in practice some activities (like construction of scenarios) were typically neglected. They remained important in the dissemination and implementation stages of the cycle, that would have been far less effective without the proactive stand taken by many panels.

Figure XX. Panels from the first cycle of the UK (technology) foresight programme

Initial Panels	Later Revision
Agriculture, Natural Resources and the Environment	Agriculture, Horticulture & Forestry *(split)*
	Natural Resources & Environment *(split)*
Chemicals	Chemicals
Construction	Construction
Defence & Aerospace	Defence & Aerospace
Energy	Energy
Financial Services	Financial Services
Food & Drink	Food & Drink
Health & Life Sciences	Health & Life Sciences
Communications	
IT & Electronics	IT, Electronics & Communications (merged)
Leisure & Learning	Leisure & Learning
Manufacturing, Production & Business Processes	Manufacturing, Production & Business Processes
	Marine (new panel)
Materials	Materials
Retail & Distribution	Retail & Distribution
Transport	Transport

Source: Miles, (2003).

The panels had modest resources to spend on consultancy or other inputs, and made various uses of this—e.g. to analyse Delphi results, to prepare an improved version of their reports, etc. Each panel was provided with a facilitator (trained in the aims and methods of foresight) and a member of the civil services as a technical secretary (each of whom was shared between two panels). There was limited coordination across panels—it was left for the Steering Group to integrate the material they produced—and very limited resources by way of a general common framework of statistical indicators.

Main foresight

The panels proceeded, through intensive meetings, to consider key issues and trends (with the help of a questionnaire survey and consultations). They constituted subgroups where appropriate.

A major task was the preparation of questions for a Delphi survey, instituted in 1994, that was intended to allow panels to engage a broad base of expertise—it was sent to almost 10,000 people, with almost 3,000 responses received. Each panel had prepared its own survey within a common framework, and this process was very time-consuming—though valuable for focusing the activity of these groups. However, there were timing difficulties, that meant that the quantitative results of the surveys were only available at a very late stage, when the panels had almost completed their reports. Thus the data were not used as fully as they could have been, and the Delphi approach was felt by some participants to have been a failure—though the data have subsequently been used extremely widely. (The Delphi did provide a focus and stimulus for panel work, that was arguably vital to the success of some of them. This process benefit was not widely recognized, however.)

The OST estimated that some 10,000 people were consulted during 1994, through the Delphi and through a set of regional workshops that panels undertook. Even with this wide consultation, it was possible to find innovation-connected managers in large companies who were unaware of foresight, as discovered in the course of consultancy on "future trend scanning" for one firm to whom the programme proved very interesting.

Reporting

Towards the end of this year the panels prepared their final reports. These were reviewed by the Steering Committee. This prepared and published its own overall synthesis document, attracting a good deal of attention. It identified 28 generic science and technology and 18 infrastructure priority areas (figure XXI).

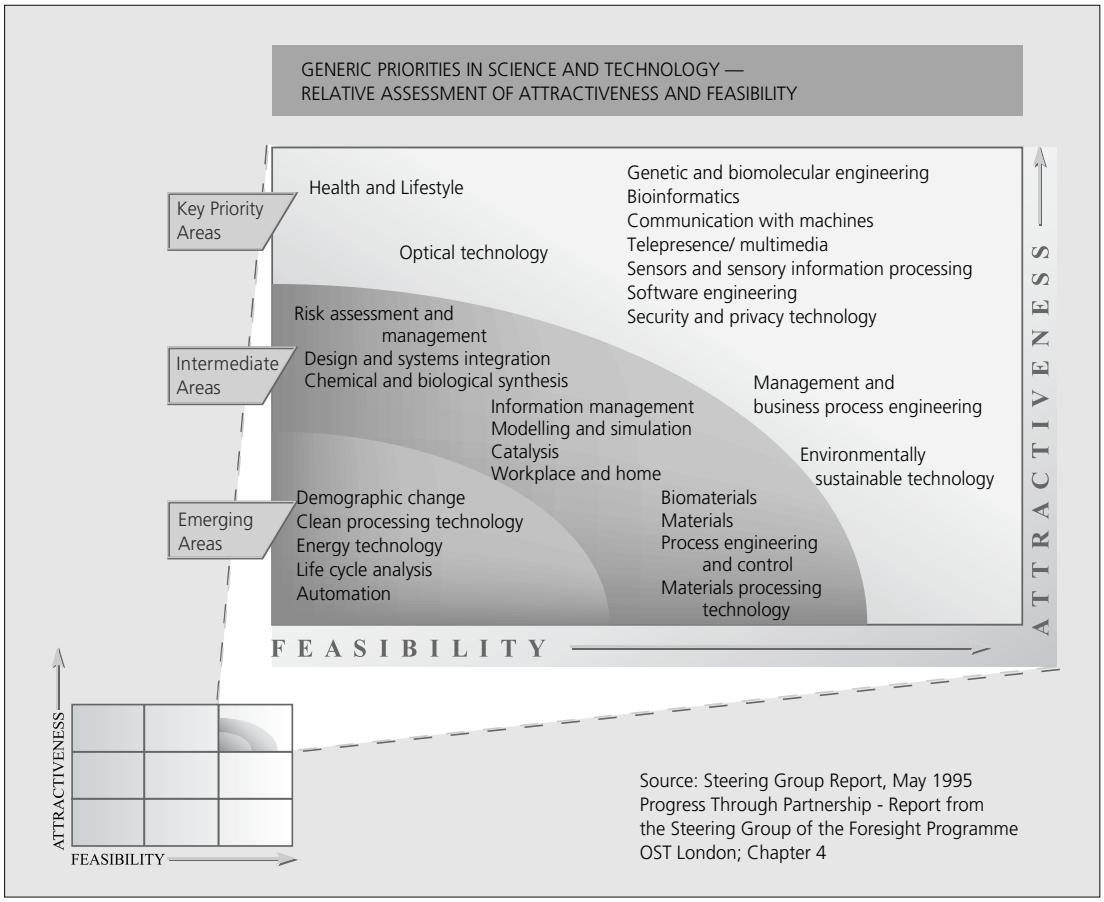
Through spring 1995 the panels' reports were also published in a number of batches. Some 360 recommendations for action were suggested. Though they did not attract the same level of publicity as the Steering Committee's report, they were typically examined in detail in the relevant trade press. It has to be admitted that they were very uneven in quality, though all were at the very least professional, and the best reports were outstanding.

Foresight implementation

It was apparent that the task of implementing the results of foresight had not been completely thought through when the programme was launched, and members of panels were heard to express uncertainty about just how their work was to be used. They wanted to see just how their priorities—and the background analyses that informed these—would be fed into policy-making—in the range of organizations that were seen as potential audiences for the work.

The panels played an important role as the "hubs" of dissemination and implementation of foresight. They continued to meet regularly into 1999, in order to coordinate and/or catalyse follow-up actions on their priorities. Some panels developed explicit implementation strategies of their own, assigning various panel members the task of making sure that relevant parts of government were responsive to their messages. Many panel-related initiatives are still ongoing, with workshops, newsletters, and demonstration projects continuing to flow.

Figure XXI. Steering Group recommendations



Source: May, (1995).

Between 1994 and 1999, over 600 foresight events were held and 130,000 copies of the foresight panel recommendations distributed. The impacts of this effort are hard to estimate, given the numerous channels that were in operation and the intertwining of foresight with other policy analyses and simple lobbying. But a reasonable estimate is that several hundred million pounds worth of research is "aligned" with, if not demonstrably a direct result of, foresight priorities and recommendations. Immediately after the panel reports were published in 1995, £30 million of government funding went into the Foresight Challenge Awards, supporting 24 research consortia. In 1997, the initiative was re-labelled as the Foresight LINK Awards. There have been three rounds of such awards involving funding of £29 million to 39 projects (a downward trend in the number of projects per round, from 18 through 14 to 7). Altogether, with industry support (in the tradition of earlier LINK schemes, government pays for the public sector contribution to the projects), all of these projects are worth a total of £152 million.

Also in the Public Sector, Research Councils and government departments prepared their responses to the exercise—and one research council (NERC) had already launched its own "miniForesight" exercise (widely seen at the time as an attempt to pre-empt

any negative conclusions from the main programme), by NERC. Other organizations have gone on to conduct their own foresight studies since 1995—and the impacts of these are in part traceable back to the OST programme, though they may not always align with OST priorities! Private industry's responses are harder to assess fully, but there is a lot of interest in the results, with bids being made to Foresight Challenge, and some firms and industry associations launching their own smaller scale foresight exercises. Such intermediaries became important agents for diffusing the results and principles of foresight, and OST made some basic tools (Powerpoint sets, etc.) available for this purpose.

The UK foresight programme attracted a great deal of attention in Europe and more widely. While several programmes had been launched at around the same time in Europe, this was seen as a particularly successful experience, with a good mixture of priority-setting (product) and networking (process) elements. It had combined wide and high levels of participation with technical sophistication, its results were readily available on the web, it had influenced policy and retained political support across a change in government. The UK programme alone certainly does not explain the great rise in popularity of foresight, but it surely played a role in shaping this movement in Europe and elsewhere (e.g. South Africa, and to a lesser extent Latin America and South Asia).

The second cycle

The first cycle of foresight was launched under a Conservative government, but the programme won all-party support. (The main political critique, apart from the academic sniping that is always to be expected when any significant initiatives are undertaken, came from some "green" activists. They were suspicious of the level of industrial participation in the programme, and the danger that this might mute dissent about, for instance, genetically modified organisms, nuclear power, etc.) The advent of a Labour government (with a vision of the "knowledge-based economy" alongside traditional concerns with social justice) if anything increased interest in the foresight programme.

However, one important development had occurred in the later years of the Conservative government: for reasons more of political personalities than of long-term strategy, the OST was moved from the Prime Minister's own Cabinet Office, to a location within the Department of Trade and Industry (DTI). In some ways this made sense, as foresight has important roles to play in innovation processes and other DTI responsibilities. However, it is significant that the Cabinet Office was to develop its own focus on long-term issues—culminating in the recent transformation of the Performance and Innovation Unit (PIU) into the Strategy Unit, while the DTI maintained its own futures group until very recently.

Following a process of consultation and a consultation report in October 1998, new foresight panels were established and the second cycle of foresight began in April 1999. Alongside the panels were to be task forces, and a new device—the web-based Knowledge Pool—was introduced. The intention was that the panels should publish their consolidated reports in November 2000, following that the panels would con-

tinue to pursue more detailed work and stimulation of action on their recommendations, while a third cycle of foresight could be planned. In rough outline this agenda was followed, though events did not unfold exactly as planned.

Consultation

The broad conclusions of a consultation process, that took into account discussions and surveys of participants in the first cycle of foresight, a review by the Parliamentary Office of Science and Technology, and other inputs, a number of main points were established. The existing programme was seen as a rare success that should be built upon. A new cycle was justified on several grounds. It should update and refine the "findings" of the first cycle—and, arguably, be more visionary and better integrated. The perception was that the high time pressures of the first round restricted the outputs in these ways—that better statistical and other information support could have been provided, that scenarios could have been systematically developed, that more challenging and "out of the box" thinking could have been encouraged. There was to be no Delphi.

Perhaps because some Labour Party supporters saw "wealth creation" as following too much of a free market agenda, it was decided to raise the profile of "quality of life" issues. Actually these had at least in principle stood alongside wealth creation in the first cycle—as is apparent, for instance, in the Delphi analyses (cf. Loveridge, Georghiou & Nedeva, 1996). But there were still concerns that it was the latter that was really driving things, among some Labour Party activists as well as in the environmental movement. An emphasis on economic as opposed to social concerns was, perhaps, reflected in the high levels of business representation on panels.

"(The Director of the programme at the time indicated that it was felt that the first round panels had not had sufficient representation from business and a specific effort was made to increase business participation in the second round. Specific efforts were made to appoint panel chairpersons from business." (Graham May).

Accordingly, another rationale for the second cycle was that it should include a wider variety of participants—including more representatives of small and medium sized enterprises, as well as people working for the voluntary and public sectors, etc. The second cycle was seen to be moving beyond the technology focus of the first cycle to examine the opportunities that arose from the interaction of innovations in science and technology with wider social and market trends. Participants in the first cycle would certainly have identified with this latter formulation, in fact—but the designing in of more work on social change from the outset—rather than as something that was "discovered" to be a requirement—did mark a significant change. The first cycle did run a substantial risk that "technology fix" solutions would be sought for problems that might well be social in nature. Could this be avoided in the second cycle?

Panels were still to be at the heart of the programme, and were to be encouraged to "think globally", identifying the challenges and opportunities that the UK was likely to face over the coming 10 to 20 years and beyond. But there was to be more interaction both across panels, and more widely. The networking function grew in importance—and the priority-setting elements of foresight were diminished. Implementation,

dissemination and impact assessment were to built in from beginning (though impact assessment was never properly put in place, despite a project being set up to make recommendations as to how it could be conducted).

The panels

Work was taken forward through a combination of three thematic and ten sector panels, each looking at the future for a particular field of concern. To some extent, as shown in figure XXII, the first cycle's sectoral panel structure has been retained: but the number was reduced to ten, with a more supply-chain-based approach helping here. (This was particularly influential in the case of the "food chain".) Some of the new panels are more overtly application-oriented—for example, in the place of the science-driven Health and Life Sciences panel, the new cycle offered a Healthcare panel.

Alongside the sectoral panels were three thematic panels, addressing broad issues with cross-cutting implications for science and technology—"Ageing Population", "crime prevention" (funded by the Home Office, that is responsible for policing) and "Manufacturing in 2020" (all issues widely highlighted as general challenges by panels in the first cycle). The introduction of these panels (apparently others were intended for the future) reflects the difficulties of effectively organizing cross-panel activities in the first cycle.

All panels were asked to consider the implications of their findings for another set of thematic issues. These were education, skills and training and sustainable development, topics that were seen to be so generic as to require embedding within each panel.

Figure XXII. Panels in the second cycle of UK foresight

Sector panels	**Thematic panels**
• Built Environment & Transport • Chemicals • Defence • Aerospace & Systems • Energy & Natural Environment • Financial Services • Food Chain & Crops for Industry • Healthcare • Information. Communications & Media • Marine • Materials • Retail & Consumer Services	• Ageing Population • Clime Prevention • Manufacturing 2020 Task Forces Around 50 task forces were said to be active, though probably only a handful met frequently and achieved a great deal. Examples of Task Forces include: Energy Futures: Environmental Appraisal; Nanotechnology; Retail Logistics; The Future of Information Relationships; The Learning Process in 2020; etc.

Source: Miles, (2003).

Task forces

While panels were intended to be relatively long-lived, they could examine specific issues or address specific problems by establishing task forces. These would be typically short-lived, and provided an opportunity to enlist a broader constituency of stakeholders into the programme, and could help promote the foresight agenda during later implementation phases. Some task forces were indeed following up on the recommendations of the previous cycle (e.g. the Foresight Vehicle Programme and Clear Zones stemmed from two of the first cycle's Transport Panel projects). Most of the task forces were set up by the sectoral and thematic panels to explore key important issues in detail, though some spanned the interests of more than one panel (e.g. E-commerce). While there were as many as 65 task forces documented, it is unclear how many were really effective. Over five hundred people were involved in this round of the programme as members of panels and/or task forces.

Associate programmes

Associate programmes, undertaken by other organizations (mainly professional institutions and research and technology organizations), were to support the central programme, by looking at specific topics from particular viewpoints, in parallel with the foresight panels. These received no government support, but retained a link with OST through memoranda of understanding for a specific period (the last of these expired at the end of 2001). Some of the groups established here worked effectively. But at this point in time use of the web was still not so far diffused that the Knowledge Pool (see below) could really function to link their activities. Also, there were unresolved (if foreseeable!) problems about third parties placing material on a government website.

The Knowledge Pool

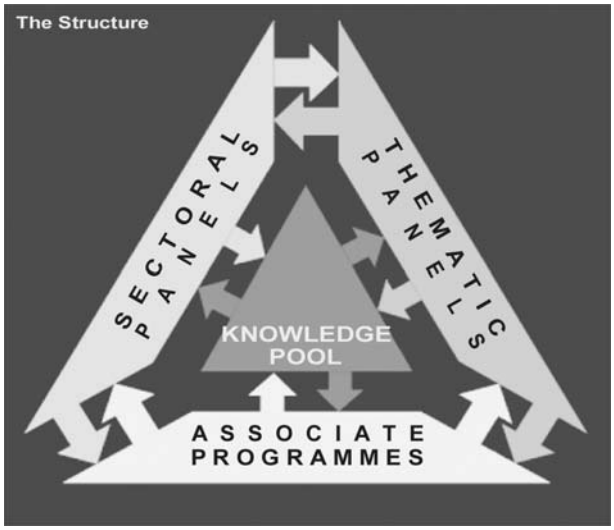
As figure XXIII shows, the Knowledge Pool was to lie at the heart of the second cycle. This was a much upgraded version of the successful foresight website (http://www.foresight.gov.uk) that was to go beyond a dissemination function, and serve as the main information gateway for national foresight. Drawing on sophisticated electronic libraries used in the newspaper industry, it was to provide general programme information, access to scenarios and views about the future, and management information and working notes for foresight panels. It was an extremely ambitious undertaking, and a personal view is that it proved an excellent resource for those familiar with foresight—but was daunting and difficult to use for newcomers, who might even be deterred by some of the sophisticated material made available (e.g. some visualization of scenarios). It also looked very costly. It did, however, attract some 46,500 monthly website visitor sessions on average.

Consultation, coordination, and reporting

Without a shared methodology like Delphi, panels lacked a common framework for data production and reporting, and for consultation with a wider community. Each panel was to develop its own consultation arrangements, setting these out in an action plan in summer 1999. Most opted for the preparation and circulation of consultation documents (both paper-based reports and material in the Knowledge Pool). Panels were

encouraged to host a variety of regional workshops and seminars during this period. Around 160 seminars and workshops (excluding internal panel and task force meetings) and around 52 regional seminars were reportedly held during the second cycle. 103 papers and reports were published. The final panel reports in December 2000 (included in this total) were to be followed by the foresight Steering Group producing a synthesis report. After this, the emphasis of panels and the programme as a whole was to be on implementation of recommendations.

Figure XXIII. Structure of the second cycle of foresight



Source: Miles, (2003).

A cycle interrupted

Some time after the panel reports were lodged, senior figures in UK science policy concluded that something was wrong in foresight. Some of the reports were openly criticized by the Science Minister, (it was also suggested that at least one of the reports was politically unacceptable as it recommended opposition policy (Graham May)). A review took soundings from various sources, and came to the conclusion that:

> "The current objectives were considered to be too broad: foresight ... should focus on those areas where it can add most value... focus on S&T, to identify new or disruptive technologies that are likely to have major impacts ... This should take account of socioeconomic factors as part of the environment... Resources should be focussed, to increase the impact ... by targeting fewer areas of activity…. in-depth review ... compelling and convincing messages….move towards a rolling programme, with possibly 3 or 4 projects running at any one time…."

What went wrong? Perhaps the agenda of foresight was too large. But this should not automatically be seen as a matter of foresight needing to remain narrowly focused on TF. More plausibly, the following elements were involved:

- The wider agenda of foresight meant that "ownership" by the OST was lost—topics of limited concern to science policy were addressed, there was a lack of clear linkages to policy timetables and levers.
- The lack of common methodology and integrative mechanisms meant that there was no "big bang"—and that quality control became harder to ensure.
- The Knowledge Pool was ahead of its time, oversophisticated for many of the people it was intended to attract, and mechanisms such as associate programmes needed other sorts of support.

The decision was made to radically restructure foresight, and a much scaled-down third cycle was launched in 2002.

Second cycle achievements

Most second cycle panels and task forces have completed their work—though there is some feeling that this was cut short by the foresight review. A few remain active under new ownership. For instance, the DTI, and the Ministry of Defence jointly fund a new National Defence and Aerospace Systems panel, derived from a second cycle panel, and a materials panel is being continued by the Institute of Materials. Another organization that has the important feature of a reputation for impartiality, the Carbon Trust, is continuing the Energy and Natural Environment panel (with more of an energy focus). There is also evidence that some associate programmes have successor activities (e.g. in a crime and security activity of the Home Office).

SMEs showed little interest in the first cycle of foresight, and such intermediaries as trade associations, were encouraged to engage their members in foresight. The support materials developed for this purpose were extended in the second cycle, with a foresight toolkit for use with SMEs and, in 2001, five foresight training centres appointed to train facilitators and to monitor quality in delivery. Regional foresight coordinators were initially set up to enable foresight panel recommendations to be integrated into regional innovation, economic and cluster strategies. (Though OST funding for these posts was ended in 2002, five coordinators continue to be supported by their local Regional Development Agency or equivalent, and other agencies have incorporated foresight activities into their work on innovation.)

The Young Foresight initiative is aimed at giving students direct experience in skills needed to create a successful product or service: from conceptualization, to design, to adaptability in the market place. It encourages students to anticipate future trends and consumer behaviour and design products that will perform well in a world that has not yet arrived. The project has been a partnership between the Department for Education and Science and OST foresight, and involves companies working alongside schools. Much of the early work has taken place in the north east of England, where 50 teacher/mentor partnerships are in place.

The third cycle

The aim of foresight is now seen as being "to increase UK exploitation of science". Recognizing that such opportunities may come from (to put it crudely) science-push or demand-pull, the aim is that at any time there will be three or four projects underway, at different stages of development, and balancing the two types of challenge. Thus the starting point for a project is either a key issue where science holds the promise of solutions; or an area of cutting edge science where the potential applications and technologies have yet to be considered and/or articulated more broadly. The first two projects, launched in 2002, were flood and coastal defence and cognitive systems, and two more were launched in 2003.

Each project has a dedicated project team in the Foresight Directorate, that is assisted by scientific experts (a criticism of earlier cycles was the limited resources for acquiring expert inputs). These OST teams are skilled in futures techniques and can draw on inputs and insights from a network of external experts. The projects are expected to evolve in different ways, reflecting the different types of problem they deal with. Thus there is not a common organizational model. Each project should deliver analysis about relevant developments in science and technology in the UK and the world, and deliver recommendations for action—by research funding agencies, business, government and others. The projects do not span more than a small range of topics, of course, and thus they cannot offer overall priority-setting. Their focus on identifying actions in specific areas is to be complemented by the creation of networks of relevant actors—again the details will vary by project type.

While it is too early to provide an assessment of the first two projects, they can be briefly outlined (mainly drawing on material on the website at http://www.foresight.gov.uk):

Project 1: Cognitive systems

Cognitive systems are defined as both biological and artificial systems that "respond to their environment, learn, reason, and make their own decisions". As this implies, there are strands of research coming from life sciences (neurology, cognitive studies, etc.) and from IT and physical sciences (learning systems, speech recognition, etc.). Experts have prepared state of the art summaries on the future prospects for various themes here.

The project aims "to provide a vision of future developments of cognitive systems through an exploration of recent advances in life sciences, physical science and related fields and their potential for interaction". Specifically, its objectives are to:

- Examine recent progress in these two major areas of research, encourage those active in these fields and their applications to network together and develop a common language.
- Scope likely developments in these fields over the next 10 to 20 years (in particular progress in capabilities to build artificial cognitive systems), and prepare forward looking documents.

- Articulate significant conclusions to a wider audience.
- "Help create the political, regulatory and business environment that will best position the UK to take advantage of developments in this area".

The Director General of the Research Councils (DGRC) is responsible for this project, with two senior professors supplying access to the scientific communities and a science writer helping to prepare documentation. The Minister for Science runs an advisory stakeholder group.

Project 2: Flood and coastal defence

It is estimated that some 1.7 million homes in England and Wales are potentially at risk of flooding, and over £200 billion of assets are at risk from flooding and coastal erosion. This project aims to produce "a long-term vision for the future of flood and coastal defence to inform policy" here…"to assess how big the future problem of flooding might be; assess if existing policies can cope; and consider new and radical responses to meet the future challenge". It is chaired by the government's Chief Scientific Advisor.

The project began by drawing together leading scientists to advise on the factors that may impact on future levels of flooding (e.g. changes in land use, demographic shifts, climate change, science and technology…), that will need to be combined to produce a set of flooding scenarios for the UK up to 100 years into the future. An analytical framework has been developed and key policy stakeholders brought on board. (Reflecting the nature of the problem, the project works with a very large number of stakeholders in industry, regional and central government, NGOs, and so on.) The coming phases of work will involve further analysis of the key factors that impact on flood risk; identification of the implications of the scenarios and consider the responses to flood risk; communication of results in a final report and other forms, and mobilizing stakeholders to implement recommendations.

Two more projects were launched in spring 2003. The projects are defined through a process of consultation with "the science base, government departments, research councils, devolved administrations and others". The 2003 round reportedly involved "the largest ever scientific horizon scanning exercise in the UK". Twelve ideas were generated during an intensive workshop with senior scientists, and these were used in web consultation and in meetings with scientific institutes and SF authors. The 2003 topics were finalized, and consultations are continuing with a further tranche of shortlisted projects already being considered. The two new projects involved, one focusing more on looking for solutions to a problem, and one looking for uses of emerging scientific knowledge.

Project 3: Cyber Trust and crime prevention

This aims to explore the application and implications of next generation IT in areas such as identity and authenticity, surveillance, system robustness, security and information assurance and the basis for effective interaction and trust between people and

machines. As well as producing reviews of the state-of-the-art in relevant areas of science, and providing futures studies (visions of alternative futures, analyses of drivers, opportunities, threats, barriers, models for decision-making), the project aims to establish networks of scientists, business people and policy-makers who can influence the future in the light of key challenges and potentials identified in these studies.

Project 4: Exploiting the electromagnetic spectrum

Focused cross-disciplinary efforts are expected to lead to new applications of the spectrum well beyond those we are now familiar with. The aim here is to provoke new thinking and insights and locate key fields for progress. This means providing a vision for the future exploitation of the electromagnetic spectrum. Again, state of the art reviews, visions for the future; and steps to that future are to be produced, for the key areas.

Beyond the national programme—foresight in the UK

The OST foresight programme, in its third cycle, continues to be an important and illuminating exercise. It continues to provide the wider community with a useful body of documents and experience on foresight in various fields. But it is less ambitious than the earlier cycles of the exercise. The third cycle has reduced the networking elements of the earlier exercises to a considerable extent, and is focusing on specific areas of technological opportunity rather than seeking to establish priorities across the board.

It might be thought that the "wave" of foresight is passing, that other policy fashions are going to replace it. Indeed, in some quarters the term "foresight" has become unpopular—though in some locations (e.g. the regions, where regional foresight seems to be taking off in the UK) it remains influential. But foresight practice is actually continuing to diffuse and develop in the UK. There are several reasons for this:

- First of all, the three cycles of the UK foresight programme have generated much wider awareness of the aims, methods, and utility of various forms of strategic analysis and action. Whereas "futures studies" was always a very marginal activity, foresight in one form or another seems to be well embedded in much of the UK system. There are academics, as well as consultants, who are applying the lessons of foresight to companies and government organizations.
- Various parts of the UK government system are promoting long-term thinking—notably the Strategy Unit of the Cabinet Office. (See the website at: http://www.strategy.gov.uk/). This unit has prepared and published studies of best practice in the field. It is promoting this sort of strategic analysis widely across the political system. For example, it has convened recent workshops on the future of local government. All government departments have been asked to adopt long-term strategic perspectives. More generally in government, there has been a (highly uneven) institutionalization of the notions of "evidence-based policy", and of more deliberative and participatory modes of governance, and much emphasis on strategic partnerships between public, private and voluntary agents. These developments reinforce and are reinforced by foresight approaches.

- European Union interest in foresight means that projects on regional foresight and IT-related foresight, for example, are extended into the UK (in some cases helping to network UK actors who were isolated from each other as well as more generally). (The European Commission's DG Research features a Directorate on TF and Socioeconomic Research, which has funded numerous projects, networks, and workshops here. For one output, see http://foren.jrc.es and for a brief account of relevant activities see http://www.cordis.lu/itt/itt-en/02-1/ire06.htm).

The result is that elements of foresight practice are now used commonly by government ministries and agencies, regional development agencies, learned societies, and industry associations. Some of this is very remotely connected to TF, but several lines of work are highly technology-focused. The examples below are drawn from public sector work of this sort—there is also a good deal of activity underway in many private companies, but this is not well documented.

Horizon scanning and foresight in food and environmental affairs

The Department of the Environment, Food and Rural Affairs (DEFRA) has been involved in foresight-related activities at least since the first cycle of OST foresight. Apart from being involved in the Agriculture, Natural Resources and Environment panel of that cycle (and being consulted and lobbied by other panels in connection with environment-related issues, such as the clear zone strategy of the Transport Panel), the Department acquired particular responsibilities because responsibility for the construction industry lies with it, rather than with the DTI. As the panel work in foresight grappled with a perceived resistance to change of the sector, so the Department took a lead role in initiating CRISP, a forum for innovation and long-term related work in the industry. This is one of the enduring activities from the first cycle.

Another initiative is a direct response by DEFRA to external drivers such as the Office of Science and Technology's Scientific Advice and Policy Making Guidelines (2000), and to a Strategy Unit report on risk and uncertainty. It is designed to support the Chief Scientific Advisor's role in Science in DEFRA. It also reflects the deep unease generated by the BSE crisis and subsequent inquiry into the policy failures here, that demonstrated how easily government can be caught off guard by emerging developments, and be unable to rapidly mobilize and adequately use relevant expertise. "Horizon scanning" is intended to improve DEFRA's capacity to assess the importance of a wide variety of developments and trends to its science and policy—to enhance anticipatory capabilities, and guide the Department in shaping "the day after tomorrow". The activity goes beyond trend-watching, and uses internal and external resources to undertake new research, the establishment of systems for evidence-based policy. SWOT-type analyses at DEFRA aims to identify both risks and opportunities. The three main activities undertaken were:

- Supporting scientific horizon-scanning research and activities, e.g. with scanning publications, "what if" scenarios, interviews.
- Building capability for horizon scanning within DEFRA and its partners.

- Using networks to communicate and support horizon scanning, both nationally and internationally, e.g. website consultation, workshops, liaison with parallel activities from other jurisdictions.

This may be called "horizon scanning", but the stated aims are close to those of foresight. Other initiatives are also undertaken by, for example, the Environment Agency, that is the body with responsibilities for pollution control, water quality, flood defence, etc. This is of course associated with the relevant panel of the third cycle of foresight, but key staff were also active in the first and second cycles, having a considerable impact on the scenario development work undertaken. These scenarios have been used constructively by the Agency in its dealings with the now privatized water companies, allowing it to examine the robustness of their projections against different trends. The Agency runs a centre for risk and forecasting whose work is centrally concerned with long-term, sometimes very long-term, analyses. For example, there is work on modelling the impacts of changes in agricultural practices on water quality. The agency is examining how further to develop its production and use of scenarios, internally and in liaison with other parties.

Scenario analyses oriented to generic technologies

In the last few years several significant applications of scenario workshops have been made to informing decisions in the UK:

- The ESRC (Economic and Social Research Council) commissioned CRIC and the Institute for Alternative Futures 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. The methods used were fairly familiar ones in the business futures field, supported by computer groupware that "captured" a good deal of material in real time. The results are written up in an issue of foresight, (Bezold and Miles (2002), and other articles in the same journal issue), as well as being available online; (http://les1.man.ac.uk/cric and http://www.altfutures.com) they went beyond the stated aim of priority-setting, to influence ESRC decision-making so that a new structure for the work on genomics was created, as well as the content of existing structures being elaborated.
- Earlier, in 2000, the ESRC responded to a request from the DGRC (Director General of Research Councils) for work on biotechnology and IT prospects for the UK. Accordingly, CRIC and PREST organized a pair of scenario workshops on these themes, with the aim of informing decisions about public expenditure on these areas—and not least to justify expenditure to the Treasury. A "success scenario" methodology was developed that allowed for the workshops to elaborate a vision of a desirable and feasible aspirational scenario, and to identify targets, action points, and other elements to manage the movement toward such a scenario. (http://les1.man.ac.uk/cric and http://www.ost.gov.uk/policy/futures/ict/intro.htm)
- In autumn 2001 the OST (again working effectively for the DGRC) commissioned CRIC, together with the National Physics Laboratory and the Institute of Nanotechnology, to run a similar "success scenario" workshop on UK prospects and potentials in the field of nanotechnology, The output of this workshop, with very little additional elaboration, forms the core of the DTI's policy document in the

field, New Dimensions for Manufacturing: A UK Strategy for Nanotechnology, (http://www.dti.gov.uk/innovation/nanotechnologyreport.pdf) and is believed to have informed policy statements before this.

These activities are foresight in all but name, with one qualification. The scenario development in these workshops has typically examined 5 to 10 year scenarios (the genomics workshop is an exception). But if the long-term focus is slightly less, the links to policy have been very strong.

Conclusions

foresight is embedded in the UK as never before. It looks to be an enduring feature of the political and industrial, the scientific and cultural landscapes. Only a few examples of technology-related foresight-type activities have been outlined above: the full range of activities constitutes a very rich and diverse environment. But it is an environment that is no longer dominated by the towering national OST programme. Different activities of a foresightful nature are underway on a very wide basis, even if many do not employ the term "foresight". And not everything labelled foresight is fully-fledged foresight.

Considerable ferment as a result of all this activity can be expected. One result is liable to be much more "codification" of the methods and approaches of futures studies, turning the crafts here into something more reproducible and subject to quality control. The results of application of such methods are likely to become more widely available—that may lead to some interesting political debates as very different visions are contrasted. (To date the mass media have regularly failed to recognize scenarios as tools for testing policy robustness, and instead portrayed them as secret and usually scandalous government plans…) There is liable to be much development of various sorts of computer and communications systems that can support development, visualization, and interactivity, and probably also consensus-building and prioritization techniques. Foresight professions and specialisms, and possibly new institutions, are liable to arise. New challenges associated with, for example, security, hazards, social innovations, are also liable to arise and be taken on board. Foresight about foresight is a very underdeveloped field, so these should be taken as informed speculations, and no more! It is even possible that the foresight wave really will subside… but for now two traditional sayings would seem to sum up the scene:

- "All that glisters is not gold"
- "The King is dead! Long live the King!"

What really lacks, however, now that the national programme has narrowed its focus, is any substantial effort to track what is going on, to evaluate the continuing influence of the earlier cycles of national foresight, or to record the various steps in the evolution of the programme and its spin-offs. It is remarkable how limited the analysis has been of such a dramatic policy initiative—and it is likely that this restricts the scope for policy learning to an extent that is hard to reconcile with claims that we have entered a knowledge-based society in that evidence-based policies are becoming the norm.

Some issues to consider

Geographical levels of foresight

Foresight takes place on various levels:

- Regional foresight: These activities are crucial in order to break down the results from the national level, but even more important to promote regionally based innovation-processes.
- National foresight activities.
- European Research Area: The EU is fostering various foresight activities. The objectives are:
    - — Transfer of methodological know-how.
    - — Transfer of topical foresight know-how.
    - — Building of the ERA.
    - — Guidance regarding the different national priorities in R&D.
- Bi-national cooperation: Currently UK and Germany are joining forces in their foresight-activities ("Hothouses").

Focused vs. distributed funding

- "Innovation": Innovation is not to be understood as a linear process, but as result of a complex, iterative interaction between individuals and institutions.
- This being the case, one should not be too focused in research funding since innovations rely on distributed links (networks).

Technology vs. services

- Foresight often is "reduced" to TF due to the fact that technology was the driver of the economy in the past.
- But if the future economy is much more driven by services, then foresight should be broadened in its scope.

Systems of innovation

A basic insight is that knowledge today is highly distributed, i.e. not concentrated in a few, large research institutions. Thus, the question is how to gather information and knowledge in a way, that government or research can use them as "strategic intelligence" (Kuhlmann, Smits, 2002). Related to this, recent findings in research on innovation-processes show that "key-links" become more important than "key-technologies". One major underlying trend is the dissolution of fixed boundaries between institutions. In other words, in order to be innovative, one has to seek and build up networks integrating various "knowledges".

Hence, foresight essentially provides two outputs. Firstly, it searches for trends and crucial questions regarding the future. It reflects on societal demand and technology-

driven developments. Second, it shapes modern landscapes of research and development. Thus, a main objective regarding the role of the State is in shaping the "settings" and architectures for innovation.

Endpiece

The Swedish TF project offers a useful lesson about the usefulness of foresight but also warns against expecting too much.

Hindsight

"The telephone is a fantastic invention—I am sure that every city will get one."

This quotation illustrates the difficulty of foreseeing the full use and consequences of new technology and new ideas.

The Swedish TF project carried out a separate study of earlier attempts at predicting the future, "Teknisk Baksyn" (technology hindsight).

This study discusses various difficulties and sources of errors that should be borne in mind. Among the factors contributing to the failure of previous predictions, it found:

(a) The belief that new technology will replace existing technology, and that this will happen relatively fast. In reality, competing technologies often coexist over a rather long period.
(b) The belief that new technology will only solve old problems and supplement existing technological systems. Instead, new technology often lays the groundwork for entirely new systems.
(c) The belief that new technology will function as a panacea for various social problems.
(d) The difficulty of seeing important links between different fields of technology in cases where this combination of fields is precisely what will offer major developmental opportunities.
(e) That those who have tried to predict the future have become bogged down in the actual technology and thus neglected the economic aspects.
(f) That people have been prisoners of the spirit of their times (or Zeitgeist), believing that the big issues of today will also be the big issues of tomorrow.
(g) That rational economic considerations are not the only factors behind the choice of a new technology. Seemingly irrational considerations often determine such choices.
(h) That the information on that future studies is based has often been insufficient. A great deal of technological development takes place secretly, mainly in the military sector.

No method in the world can provide a sure image of how the world will look in 15 to 20 years. The only thing that can be predicted with certainty is that unexpected things will happen. Technological development is not linear and predictable, any more than political and social development.

But the difficulties of foreseeing the basic outlines of the future should not be exaggerated either. Every generation perceives itself as living in an age of major changes. Perhaps the generation of August Strindberg (1849-1912) experienced larger actual changes than today's. It is quite certain that the world of 2020 will not have changed to the point of being unrecognizable. A large proportion of the infrastructure—such as buildings and roads—are renewed over longer periods than 20 years. The same is true of many technological systems. Most of the people who will be alive in 2020 are already adults, and many developments over the next 20 years will be based on technological advances that are already known.

REFERENCES

This module is mostly drawn from papers presented to events organized by UNIDO as part of its TF programme for countries in Central and Eastern Europe and the Newly Independent States. The papers are:

1. *Delphi Austria: An example of tailoring foresight to the needs of a small country,* Georg Aichholzer, the Regional Conference on TF for Central and Eastern Europe and the Newly Independent States, Vienna, April 2001.

2. *Technology foresight for strategic decision-making,* Philippe Bourgeois, the Regional Conference on TF for Central and Eastern Europe and the Newly Independent States, Vienna, April 2001.

3. *Technology Foresight Activities of Germany's Federal Ministry of Education and Research,* Volkmar Dietz, the Regional Conference on TF for Central and Eastern Europe and the Newly Independent States, Vienna, April 2001.

4. *Role and practice of applying foresight in the government strategic decision and policy making,* Henning Banthien, the TF Retreat, Moscow, November 2003.

5. *Technology Foresight in Hungary: Objectives, Methods, Results and Lessons,* Attila Havas, the Regional Conference on TF for Central and Eastern Europe and the Newly Independent States, Vienna, April 2001.

6. *Technology Foresight in the Czech Republic,* Karel Klusacek, the Regional Conference on TF for Central and Eastern Europe and the Newly Independent States, Vienna, April 2001.

7. *The Swedish Technology Foresigt Project,* Lennart Lubeck, the Regional Conference on TF for Central and Eastern Europe and the Newly Independent States, Vienna, April 2001.

Also included with the permission of the author is a paper by Ian Miles (with contributions from Mike Keenan), *Ten Years of foresight in the UK.*

Bibliography

Advisory Group on Nanotechnology, New Dimensions for Manufacturing: A UK Strategy for Nanotechnology, London: DTI, 2002 available at: http://www.dti.gov.uk/innovation/nanotechnologyreport.pdf.

Aichholzer, G. (2001). The Austrian foresight programme: organization and expert profile. *International Journal of Technology Management* (forthcoming).

Australian Science and Technology Council (ASTEC): Matching science and technology to future needs: 2010. International perspective, Canberra, AGPS, 1994.

Bezold C and Miles I (guest editors): "Introduction: From Forecasting the Future of Technology to Shaping the Priorities for Research" pp. 13-28, *Foresight*, vol. 4 no. 4 2002 ISSN 1463 6689, online to subscribers at http://www.emeraldinsight.com/fs.

Cole, H.S.D., Freeman, C., Jahoda, M., and Pavitt, K.L.R.: *Thinking about the Future,* London: Chatto & Windus; also published as *Models of Doom*, New York: UniverseBooks, 1973.

Cuhls, K. and Kuwahara, T.: *Outlook for Japanese and German future technologies,* Heidelberg, Physica-Verlag, Springer Publishers, 1994.

Cuhls, K., Blind, K. and Grupp, H.: *Delphi '98 Umfrage. Studie zur globalen Entwicklung von Wissenschaft und Technik.* Karlsruhe, Fraunhofer Institut für Systemtechnik und Innovationsforschung, 1998.

"Facts on foresight"—available at http://www.foresight.gov.uk.

Fleissner, P. and others. *Recent national foresight studies*. Seville, IPTS, 1998.

FOREN Network (IPTS, PREST, CMI and SI): *A Practical Guide to Regional foresight* IPTS, Seville, EUR 20128 EN 121 pp, 2001 available at:
http://foren.jrc.es/Docs/eur20128en.pdf .

Foresight in science and technology: selected methodologies and recent activities in Germany. *OECD STI Review,* Special Issue on Government TF Exercises, 17:71-100, 1996.

France, Ministry of Industry: *Les 100 technologies clés pour l'industrie française à l'horizon 2000,* Paris, Ministère de l'Industrie, July 1995.

Freeman, C.: *Technology and Economic Performance: Lessons from Japan,* London, Pinter 1987.

Freeman, C. and Jahoda, M. (eds.): *World Futures: the Great Debate,* London: Martin Robertson, 1978.

Gavigan, J.P. and Cahill, E.: *Overview of recent European and non-European national technology foresight studies,* Technical Report No. TR97/02, Seville, Institute for Prospective Technological Studies (IPTS), 1997.

Georghiou, L.: The UK technology foresight programme, *Futures*, 28(4):359-377, 1996.

Georghiou, L. *Report of the Evaluation panel, 2003: "Evaluation of FUTUR—The German Research Dialogue"*, PREST.

Germany, Bundesministerium für Forschung und Technologie (BMFT). *Deutscher Delphi Bericht zur Entwicklung von Wissenschaft und Technik,* Bonn, 1993.

Germany, Federal Ministry of Education and Research (BMBF). Proceedings-Report of the International Conference on "Forward Thinking". Hamburg, Germany, 14-15 June 1999.

Gibbons, M. et al.: The new production of knowledge: the dynamics of science and research in contemporary societies. London, Sage Publications, 1994.

Grupp, H.: Technology at the beginning of the 21st century. *Technology Analysis and Strategic Management,* 6(4): 379-409, 1994.

Grupp, H. and H.A. Linstone: National TF activities around the globe: resurrection and new paradigms. *Technological Forecasting and Social Change,* 60(1):85-94, 1999.

Havas, A.: *The Hungarian TF programme*. Leaflet available from the National committee for Technological Development (OMFB). Budapest, 1998.

Institute for Technology Assessment (Institut für Technikfolgen-Abschätzung, ITA): *Technologie Delphi I. Konzept und Überblick (Approach and Overview)*. Delphi Report Austria 1. Vienna, Bundesministerium für Wissenschaft und Verkehr, 1998a. *Technologie Delphi II. Ergebnisse und Maßnahmenvorschläge (Results and Recommendations)*. Delphi Report Austria 2, Vienna, Bundesministerium für Wissenschaft und Verkehr, 1998.

Institut für Trendanalysen und Krizenforschung (ITK): *Gesellschafts- und Kultur Delphi I. Ergebnisse und Maßnahmenvorschläge*. Delphi Report Austria 5, Vienna, Bundesministerium für Wissenschaft und Verkehr, 1998.

Irish Council for Science, Technology and Innovation (ICSTI): *Technology foresight Ireland*. Dublin, ICSTI, 1999.

Irvine, J. and B. Martin. *Foresight in science: picking the winners*. London, Frances Pinter, 1984.

Irvine, J., Martin, B., and Isard, P.: *Investing in the Future,* Aldershot: Edward Elgar, 1990.

Katzenstein, P.: *Small States in world markets. Industrial policy in Europe*. Ithaca (New York), Cornell University Press, 1985.

Keenan M, *Identifying emerging generic technologies at the national level: the UK experience,* PREST Discussion Paper Series No. 02-11 (forthcoming in the Journal of Forecasting, 2002 available at http://les.man.ac.uk/PREST/People/Staff/Michael_Keenan.html.

Keenan, M. and Miles, I. (eds.): *Practical Guide to Regional Foresight version 2* (available in various country versions with local editors), Brussels, European Commission DG Research, 2002

Keenan, M., Miles, I., Koi-Ova, J. (eds.): *Handbook of Knowledge Society Foresight,* European Foundation, Dublin, forthcoming 2003

Kozlowski, J. (2001): *Adaptation of Foresight Exercises in Central and Eastern European Countries,* paper to the Regional Conference on TF for Central and Eastern Europe and the Newly Independent States, Vienna, April 2001

Kretschmer, G.: CSIRO priority determination: methodology and results overview. Australia, 1991.

Kuhlmann, S. et al.: *Improving distributed intelligence in complex innovation systems,* final report of the Advanced Science & Technology Policy Planning Network (ASTPP). Karlsruhe, Fraunhofer Institute for Systems and Innovation Research (ISI), 1999.

Kuwahara, T.: Technology foresight in Japan: a new approach in methodology and analysis. *OECD STI Review,* Special Issue on government TF Exercises, 17:52-70, 1996.

Loveridge, D., Georghiou, L. and M. Nedeva: *United Kingdom TF programme. Delphi Survey*. Manchester, Policy Research in Engineering, Science and Technology (PREST), the University of Manchester, 1995.

Martin, B.: Foresight in science and technology. *Technology Analysis and Strategic Management,* 7(2), 1995.

A review of recent overseas programmes. *Technology Foresight,* 6. Office of Science and Technology, United Kingdom, 1995.

Martin, B. Technology foresight: a review of recent government exercises. *OECD STI Review,* Special Issue on government TF Exercises, 17:15-50, 1996.

Martin, B. and Johnston, R.: Technology foresight for wiring up the national innovation system, *Technological Forecasting and Social Change,* 60(1):37-54, 1999.

Miles, I.: "Services and foresight", *Service Industries Journal,* vol. 19 no. 2 pp 1-27 April 1999.

Miles, I.: "Scenarios and foresight—towards a constructive integration" presented at EC/Norwegian *Foresight to Scenarios—Landscaping Methodology and Tools* workshop at EFTA headquarters, Brussels, 5 July, 2002; published on CDROM by EC DG Research, 2002.

Netherlands, Ministry of Economic Affairs. *Technology radar*. Report in five volumes, The Hague, Ministry of Economic Affairs, 1998.

Organisation for Economic Cooperation and Development (OECD): Science technology industry. Special issue on governmental technology foresight exercises. *STI Review,* 17. Paris, OECD, 1996.

Radosevic, S.: Technology transfer in global competition: the case of economies in transition. In D.A. Dyker (ed.), *The technology of transition. Science and technology policies for transition countries*. Budapest, Central European University Press, 1997.

RAND Europe and Coopers & Lybrand: *Technology Radar, Main Report and Executive Summary*. Delft, Netherlands Ministry of Economic Affairs, 1998.

Rauch, W.: The Decision Delphi, *Technological Forecasting and Social Change,* 15:159-169, 1979.

Research foresight: creating the future. Zoetermeer: Netherlands Ministry of Education and Science, 1989.

The role of technology foresight in restructuring of S&T systems in Central and Eastern Europe: Presentation at the workshop "Foresight Methods: International and Hungarian Experiences", Budapest, 1-2 July 1999.

Royal Swedish Academy of Engineering Sciences (IVA): The foresighted society: a synthesis report from the TF project, Stockholm, IVA, 2000.

Rust, H.: *Österreich 2013: Eine Querschnittsanalyse des Programmes Delphi Austria,* Delphi Report Austria 4, Vienna, Bundesministerium für Wissenschaft und Verkehr, 1998.

Soete, L. Technical change and international implications for small countries, in C. Freeman and B.A. Lundvall (eds.), *Small countries facing the technological revolution*. London, Frances Pinter, 1998.

South Africa, Department of Arts, Culture, Science and Technology (DACTS): *Dawn of the African century: a nation at work through science and technology for a better future,* Pretoria, Department of Arts, Culture, Science and Technology, 1999.

Technology Radar, Methodology: Delft, Netherlands Ministry of Economic Affairs, 1998.

Tichy, G.: The decision Delphi as a tool of technology policy—The Austrian experience, *International Journal of Technology Management,* 1999.

Todt, O. and J.L. Luján.: Social technology foresight: the case of genetic engineering, *The IPTS Report,* 26 (July) 1998.

UNIDO. Technology Foresight: A UNIDO Initiative for Latin America and the Caribbean, Proceedings of the Workshop, Trieste, Italy, 7-9 December 1999.

United Kingdom Office of Science and Technology (OST): *Progress through partnership, report from the Steering Group of Technology Foresight Programme*. London, H.M. Stationery Office, 1995.

United Kingdom, Office of Science and Technology (OST): *The future in focus: a summary of national foresight programmes*. London, Department of Trade and Industry, 1998.

Wissenschaftsrat (2003): *Strategische Forschungsförderung: Empfehlungen zu Kommunikation, Kooperation und Wettbewerb im Wissenschaftssystem,* Essen. S. 46.

Additional sources

A useful list of links to foresight exercises can be found at
http://www.itas.fzk.de/eng/projects/fistera/overview.htm

Information on Japan's TF programme
http://www.nistep.go.jp

A searchable site providing details of foresight in Europe
http://les.man.ac.uk/eurofore/search

Links to National foresight programmes in Europe can be found at
http://www.cordis.lu.foresight

REVIEW QUESTIONS

Analyse figure II to establish the following from the information given:

1. The time horizon of the studies. what is the most common?
2. The methods used; that methods have been used most?
3. The objectives of the studies; that objectives are the most common?

You should note the main lessons you draw from each case study.

1. The time horizons of the studies vary from 5 to 30 years. The most common being 15 and 30 years.
2. Delphi, panels, critical technologies and scenarios are the most used methods.
3. The most common objectives are:

- Policy recommendations.
- Setting priorities.
- Anticipatory intelligence.
- Consensus building.

Points you may have noted in reviewing the case studies

France

- Focused on key technologies.
- Used a three stage sieving process.
- Had a business focus.
- Used to identify regional development potential.
- Panels/working groups.
- Selection criteria need justification to be accepted.

Germany

- Research is underlain by broad principles that focus on:
  - — Sustainability.
  - — The human base.
  - — Desirability of developments.
- An early warning process is used to select projects for funding.
- Delphi played an important role.
- The FUTUR initiative is:
  - — Wide ranging and includes social and economic issues as well as technology.
  - — It is participatory.
  - — The science/society relationship is central.

Austria

- The foresight exercise was tailored to Austrian needs.
- It aimed to identify opportunities.
- A society and culture Delphi had equal weight with the technology Delphi.
- Making the future through decisions.
- Clear impact on policy.

Sweden

- The study was not instigated by government.
- Panels.
- Scenarios.

Hungary

- Example of foresight in a transition country.
- Used foreign experience but adapted it for local use.
- Took into account transition issues such as attitudes and institutional difficulties.
- Used macro visions of the future to provide a context.
- Indicates roles of various actors involved.
- Importance of networking emphasized.

Czech Republic

- Programme and methodology tailored to requirements of sponsor.
- International experience used as a base.
- Use of international links.

United Kingdom

- There have been three rounds or cycles of foresight in the last 10 years.
- Each has taken a different form and used different methods.
- The use of formal methods has been limited; Delphi in round 1 and panels in the first two.
- There are many foresight-like activities but little coordination.

Module 5

TECHNOLOGY FORESIGHT AT THE SUPRANATIONAL LEVEL

At the completion of this module you should have:

- An understanding of the nature of foresight at the supranational level and the benefits it can create.
- Knowledge of some examples of supranational foresight.

Contents

1. INTRODUCTION

A clarification

The term region is used in two different and apparently contradictory ways. In this module it is used to define a group of countries which, taken together constitute a region, such as Central Europe or the Middle East. The second meaning, which is used in Module 6 Technology Foresight at the sub-national regional level, relates to areas within an individual country, for example Catalonia or the north-east of England.

The core idea of the regional initiative is to use the foresight process as a tool for regional research and development programmes.

Nevertheless, it has to be taken into account that TF studies, by their very definition, are undertaken with the assumption that the specific technological development takes place within a well-defined social and economic framework and its effects are beneficial to the local society. This means that final results will always have a national (or even local) character, since it is at this level that strategic political or business decisions are made. In this sense, regional foresight exercises contribute to creating a more comprehensive perspective that will help to better define national scenarios.

However, there are several reasons that justify the regional approach. The value of a TF exercise depends on one hand on the strength of the achieved expert opinion and consensus building, and on the other hand the capacity of the involved stakeholders to influence future trends and events. For most developing countries, conducting sub-regional and regional foresight exercises are more realistic, to reach both the necessary quality and basic sample size of experts' opinion collection as well as to form multi-countries groups able to get through their concepts of the future.

Additionally, regional initiatives aim at overcoming potential difficulties and excessive costs that constrain developing countries to undertake full-scale TF exercises at the national level. For example, the regional dimension of the UNIDO TF initiative enables less developed countries and small countries to be aware of global and regional trends, which could bring advantages and challenges to their economies. At the very least, national TF exercises will be networked, whenever possible, into regional initiatives for cost effectiveness in preparatory activities, and common awareness building and training.

The objective envisioned by UNIDO TF regional initiatives is to make a step forward and extract regional consequences and uses based on the national exercises in progress, in such a manner that the experiences accumulated in the countries mentioned, along with the contributions brought in by international experiences, may facilitate a process of joint reflection on key issues that may affect several countries. For this purpose certain productive chains and/or areas of knowledge, that present a common interest for more than one country in a region, are to be selected for foresight studies. The result to be achieved is the identification of the large trends of technological evolution capable of influencing these productive chains over the medium and long-term, so as to facilitate strategic decision-making in relation to these tendencies in each country. At

present, UNIDO is supporting foresight studies at the regional level in the following productive chains and sub-regions:

- Fishery industry in the Pacific coast of South America.
- Automotive industry in Central Europe.
- Agro-food industry in Central and Eastern Europe.

In summary, it is necessary to take into consideration that:

- Regional foresight study serves as a support for, but does not substitute for the national exercises.
- The exchange of knowledge in both directions implied by the relationship between the national and regional level of the foresight study constitutes, in effect a mechanism of international collaboration uniting the countries involved.

In consequence, one of the greatest achievements of a regional foresight approach is its contribution to structuring the technological and industrial communities of the target region.

Notwithstanding the advantages of the regional approach, it should be only applied in a demand-driven manner and in regions or sub-regions where its implementation is feasible, the socio-economic situations among the related countries are relatively comparable and/or the region experiences integration processes.

2. THE FUTURES PROJECT OF THE INSTITUTE FOR PROSPECTIVE TECHNOLOGICAL STUDIES

Many aspects of the development of technological and scientific knowledge present strong challenges to the economic system, to employment, education, our values and, last but not least, to our way of life. Social and economic developments, ethical questions and attitudes will all influence the development of technologies. TF attempts to permanently evaluate these challenges and identify for policy makers possible problems and opportunities. In recent years, one can observe a wide range of foresight activities developed at a national level. The results of those exercises, as well as the processes by which they have been developed have stimulated the creation of some level of national consensus about S&T policy directions and instruments in many countries.

In an attempt to progressively consolidate a European scientific and technological policy, the EU recently launched a series of proposals to reinforce the European research area. To create a common vision of challenges and opportunities that could underpin this policy, the EU has launched some major foresight initiatives and is attempting to strengthen the networking and exchange of best practices between the member States

and pre-accession countries. The Futures Project of the Institute of Prospective Technological Studies (IPTS) and the recent Futures for Enlargement project are examples of foresight exercises with such a supranational character. They intend to stimulate regional cooperation within the EU.

The Futures Project

The technological, economic and political landscape of Europe is undergoing profound and dramatic changes. Information and communications technologies are developing at a ferocious pace. Together with breakthroughs in life sciences, these technologies are transforming the way we live and the way we work, while the single currency, the enlargement of the EU, demographic changes, sustainability concerns and the wider context of globalization are transforming our economy. Each of these "trend" breaks is in itself a challenge. The fact that they will occur simultaneously and strongly interact with each other over the next 10 years is even more challenging for most policy areas and in particular policies relating to technology, competitiveness and employment.

Launched in 1998, with its first phase finished in early 2000, the IPTS Futures Project aimed to examine the individual and combined effects of these technological, economic, political and social drivers. The Futures Project especially set out to explore possibilities in technology, competitiveness and employment with a time horizon of 2010.

To address these issues in depth and with a cross-sector perspective, the project brought together nearly 200 experts and policy-makers drawn from industry, academia and government to take part in a series of brainstorming sessions, seminars and workshops during 1999.

In 1999 four panels of experts (that had started working in 1998) produced panel reports on the following issues:

- Demographic and social trends.
- Information and communication technologies and the information society.
- Life sciences and the frontiers of life.
- Natural resources and the environment.

The results of the work of the panels were presented and extensively discussed at a seminar in Brussels in July 1999 in which more than 80 experts took part.

In the second half of 1999, the project expanded on the policy consequences of the issues raised by those four initial panels and produced the technology, employment and competitiveness "maps" described below.

The **technology map** http://futures.jrc.es.reports/Futures.TechMap3web-vers.pdf is a European level analysis of six technology sectors:

- Information and communications technologies,
- Life sciences.
- Energy.
- Environmental and clean production technologies.
- Materials and related technologies.
- Transport technologies.

The analysis examines a selection of technologies in each sector and focuses on the timetable for commercialization, the strength or weakness of Europe and the relative importance of the technologies for economic and social development.

Four key themes for the coming years are analysed in the **employment map**. http://futures.jrc.es.reports/Employment-Map.pdf:

- The European workforce will age significantly and start to shrink.
- Fast technological change, especially in information and communications technologies, will create hard to match demands for technology related skills.
- The transition to a "mosaic society" will increase demands for personal services. Many jobs will be created, but what kinds of jobs?
- Europe faces a potential knowledge paradox in which new patterns of flexibility in work contracts may lead to under-investment in human resources. The result could put a brake on Europe's competitiveness and growth in the emerging knowledge economy.

The **competitiveness map** http://futures.jrc.es/NewCOMPFINAL.pdf analyses the main challenges and opportunities for Europe's economy with the time horizon of 2010 in order to indicate areas that will require the attention of European policy in the next few years. In the first part, emerging areas of growth of the European economy are identified, taking into account consumption trends and production strengths and potentials. The map concentrates on the geographic distribution of economic activities, both within Europe and globally. In this respect, the accession of new member States represents a particularly important driver of change. Finally, the map analyses the organizational challenges at firm and market levels in responding to a globalized and increasingly digitized economy.

In parallel to the work on the maps, the Futures Project focused on three cross-cutting issues—enlargement, knowledge and training, and the societal bill—which will play a role in the way Europe will look in 2010. Enlargement will substantially change the economy and governance of the European Union. Knowledge and learning are key drivers of the so-called knowledge society. The societal bill focuses on the next 10 years of European public finance, which is going to confront a number of major choices on how to finance pension systems, social protection, health-care systems, education and necessary investments for an environmentally sustainable society.

Finally, the Futures Project commissioned several short review papers on social issues that might affect the different policy areas. These papers were published in the *Futures Series*.

The thematic network on foresight in pre-accession countries

The IPTS designed its enlargement project http://www.jrc.es/projects/enlargement as an instrument for improving the level of information about the pre-accession countries in the European Commission, and for strengthening cooperative activities between the EU member States and the candidate countries as well as among themselves.

One of the main activities is organizing prospective seminars on S&T policy and its possible impact on socio-economic development as a means of establishing dialogue on techno-economic issues relevant to EU enlargement.

In particular, the enlargement project supports European decision-makers with foresight activities in their efforts to promote technological, economic and social development in Eastern Europe, to enforce the integration process and to improve the environmental situation in the whole of Europe. The Enlargement Project so far has worked mainly through networks and by stimulating prospective dialogues.

The main line of work during the year 2000 focused on exchanging "best practices" between EU member countries and the pre-accession countries. Three issues were tackled during that period:

- Awareness building on national foresight in the pre-accession countries and the EU.
- Exchange of experiences on foresight methodologies.
- Foresight on regional issues: the Baltic Sea as a European sea.

Enlargement Futures Project

At a high-level meeting in Tallinn (September 2000) participants suggested that IPTS launch a major foresight exercise, very similar to the futures project, with the aim of identifying the common challenges to the enlargement process over a time horizon of 2010. The project should have a duration of two years.

Beginning in October 2000, the IPTS worked on the Enlargement Futures Project and set up a Steering Group to pilot the development of the project over the following two years. The Steering Group brainstormed and defined the areas of work, and suggested experts for the different issues.

The Steering Group's brainstorming produced more than 80 different proposals, issues and challenges which were organized in the following four themes for analysis in the first phase of the project:

- Economic transformation.
- Knowledge, technologies and learning capabilities.
- Employment and societal change.
- Sustainability, environment and natural resources.

The objectives of the thematic panels are to provide a list of important social, economic and technological issues of change in pre-accession countries for the time horizon of 2010, and to develop a description of the plausible final stage of the selected issues.

In the following sections some of the issues raised in the report, "The Wider Picture: Enlargement and Cohesion in Europe," are discussed.

The challenges of enlargement

Democratic and political transformation

Despite their diversity, all pre-accession countries have full EU membership as a common policy objective. This entails a number of shared features for economic, social and political transformation in these countries.

The Central and Eastern European (CEE) countries are experiencing a complicated process of transforming their former political regimes into democratic systems. The biggest challenge is the establishment of an efficient governance system that is transparent and credible. Other challenges will come from the integration of the "acquis communautaire".

Economic transformation

Economic restructuring on an appropriate scale and scope is a basic prerequisite for full integration of the pre-accession countries into the EU. The economic transformation of former socialist pre-accession countries targets restructuring centralized economies into open market economies. The main thrust of the reform so far is related to the establishment of a new legal framework with the corresponding institutions, as well as carrying out structural reforms.

The structural reform of the economy has included privatization of State-owned companies and public property, modernization of enterprises, including the introduction of new technologies, the development of new forms of management and financial and economic principles.

Industrial restructuring has not yet been completed. Most pre-accession countries have achieved a profound reorganization of their industries and enterprises, including the establishment of new industrial structures, market integration with some EU-based companies, changes in ownership, etc. Rapid growth has been achieved in sectors that have

already undergone phases of restructuring and modernization, or have received foreign direct investment flows (e.g. the motor vehicle industry, food processing, telecommunications, and the software and personal computer industry). Trust in the governance system and belief in its efficiency are central to a continued flow of foreign direct investment. Domestic investment has been slow to develop. Again, while the issue of confidence in the governance system is closely linked to this development, it is not the only one. Domestic financial groups have been slow to evolve in most countries in transition. There is a risk of the emergence of a "dual economy" of modern, foreign-owned plants and a backward domestic industrial basis. There is a need to provide domestic enterprises with the opportunity to learn and participate in knowledge creation processes, and for them to develop their own specific innovation systems.

One can also find significant differences between pre-accession countries. Countries with a strong engineering tradition are on the way towards a more R&D intensive structure of production, services and trade. Other countries are following a strategy of development based on low-tech, labour-intensive and low-wage industry. These trends raise the critical issue of how to manage the cohesion process to maintain stability of growth and not to widen the gap between those countries with different rates of economic development. This also raises the issue of uneven regional development within the enlarged EU.

Development of the information society

The global challenges of the information society and the knowledge-based economy require special attention in the process of European integration. While proceeding with political, economic and social changes, pre-accession countries will have to try to reap the opportunities for economic growth and competitiveness that developments in information and communications technology present.

The EU/CEE Information Society Forum has signalled some basic common challenges for these countries: weakness of the regulatory framework (for example in data protection, intellectual property rights, security); diffusion of information and telecommunication technologies in SMEs and in the public sector; and training and education with new technologies.

Given the very fast pace of technological developments, this represents a major challenge. But it could also present countries with an opportunity to "leapfrog" countries that have invested heavily in older generations of technology.

A big challenge for the years to come is to avoid "info-exclusion", and a further splitting of society and regions into "info-poor" and "info-rich". Affordable access to information networks is a precondition for business participation in the digital economy, and for citizen participation in the information society.

Wide awareness building, life-long learning and the introduction of education in information and communications technology and new multimedia tools in the school curricula are some basic steps for meeting the challenges of the information society and the new digital economy. Furthermore, the development of new applications and their

wide use in all areas of social, economic and political life will challenge all European countries, and pre-accession countries in particular.

Agriculture

Agriculture, with its high share of GDP and the workforce, is important for all pre-accession countries, and its future will influence most of the 15 EU countries. The future of this sector is a key issue with respect to rural development. Industrial and service activities are essentially concentrated in the main cities, indicating the risk of a severe development gap between rural areas and urban centres. There is also a high degree of diversity among the agricultural sectors of the accession countries. This applies not only to productivity, which in the most advanced countries is 10 times higher than in the least productive ones, but also to patterns of specialization. Some countries are strongly specialized in one agricultural sector, such as forestry, presenting specific problems and opportunities with respect to the pulp, paper and furniture industries. Similar to industrial development, reinforcing the establishment of new, complementary patterns of specialization in agriculture in both the CEE countries and the 15 EU countries, should be considered as an option for the longer term.

The inevitable decline of agricultural employment in certain CEE countries, if not skilfully managed, could displace millions of people from low productivity agriculture. The phenomenon of rural-urban migration impacting overcrowded cities and the risk of major migratory movements within the future EU are highly probable if the process of transformation of agriculture is not tackled properly.

Transport and energy: mobility and sustainability in a larger Europe

The traditional service and infrastructure sectors are important in countries such as Cyprus and Malta, but are historically underdeveloped in CEE countries. The latter are transforming their service sectors and are on the way to building a modern infrastructure. It is expected that consumer services such as retailing, repair and tourism will continue to expand in line with the growing income of private households in CEE countries.

Special challenges arise from the growing need to upgrade and introduce structural changes in transport and energy. So far, policy has focused on international transport connections; however, local and regional transport will require substantial investments to increase accessibility to markets and movement of people. Increasing integration and increasing volume of material flows as many of the pre-accession country regions grow, are undoubtedly going to create major bottlenecks in transport networks.

Growth in transport will also have a significant effect on CO_2 emissions. About one third of those emissions originate in the transport sector. A relatively aged vehicle supply is only increasing the emissions levels.

The energy infrastructure of the pre-accession countries will undergo drastic changes. The existing installations/power plants are generally outdated and do not comply with the environmental standards of the European Union. The problem is aggravated by

the fact that the existing power plants are mostly coal-fired and thus increase CO_2 emissions. Gas and oil reserves in the region are small. However, the trend in the energy sector towards higher efficiency and lower prices for gas powered plants in combination with environmental concerns may lead to a change from coal to gas in compliance with EU standards.

The more favourable economic situation in the pre-accession countries will lead to an increase in electricity demand. To satisfy the demand by 2010 an increase of installed capacity of approximately 50 per cent is necessary. This requires substantial investment, not considering the need for replacement of the ageing nuclear facilities.

Nuclear power plants provide a significant contribution to total electricity generation. Current discussions on the security of nuclear power indicate that there will be increasing pressure to close these plants in the future.

Human resources and education: preparing for the "knowledge-based" society

The level of education, training and skills of human beings is essential for the sound and sustainable development of society. These factors represent the most important determinant of economic growth and a major source of innovation. A democratic society needs educated and well-informed citizens.

Recent data point out that the proportion of the population with secondary and vocational education in CEE countries is comparable with the average level in Organisation for Economic Cooperation and Development (OECD) countries. However, the share of such employees in the labour force is below the level of many OECD countries. Due to an imbalance of supply and demand of different skills, most CEE countries have a growing shortage of skills in some areas (e.g. business administration, commercial services and engineering skills in advanced technologies). The educational system is progressively taking care of this imbalance for new generations. However, tackling the imbalance in today's labour force will require a major effort of retraining and on-the-job training of the working population and of those who were left unemployed during the transition.

In some CEE countries increasing student numbers are observed without the corresponding increases in the number of teachers. Many young people have continued their education due to uncertain employment prospects during the transition. The level of enrolment in tertiary education has increased dramatically. However, this has also coincided with a dramatic reduction of government expenditures, which has left the educational system in a very difficult position. There are great concerns as to the quality, content and structure of education and training in the coming years.

Social trends

Since 1989, social security systems in CEE countries have gone through radical changes and are facing complex challenges related to the drop in economic output, rapidly rising unemployment and inflation. Labour markets have undergone shifts in the struc-

ture of employment, increased flexibility of labour law, introduction of self-employment, active labour market policies and reform of labour relations.

Rapidly growing unemployment is one of the most serious social problems. People starting their career, people with a lower level of education, people aged over 45 and minorities are particularly exposed to the risk of unemployment. There are also significant regional differences in the levels of unemployment in all CEE countries.

CEE countries have started to adopt EU norms concerning health and safety in the workplace, protection of workers" rights, free movement of workers, equal rights for both sexes, etc. Major changes have also been introduced in the health and social security systems, including changes in the institutional setting, introduction of various forms of private insurance and tightened eligibility rules and lowered benefit levels. CEE countries need substantial resources to improve the quality of health care and to overcome the lack of medical technology and shortages of medicines.

Major challenges for the coming decade are the restrictions due to budgetary constraints on one side, and the prevention of social exclusion caused by high levels of unemployment and deepening poverty, on the other.

The risk of uneven regional development inside CEE counties and the appearance of isolated, underdeveloped towns or regions with high levels of unemployment, skill mismatches and ageing populations should also be considered.

3. TECHNOLOGY FORESIGHT IN THE ASIA-PACIFIC ECONOMIC COOPERATION REGION

Overview and evaluation of the policy and strategies for future technological development in the APEC region

APEC (Asia-Pacific Economic Cooperation) currently comprises 21 member economies: Australia; Brunei Darussalam; Canada; Chile; China; Hong Kong SAR of China; Indonesia; Japan; Republic of Korea; Malaysia; Mexico; New Zealand; Papua New Guinea; Peru; Philippines; Russian Federation; Singapore; Taiwan Province; Thailand; USA; and Viet Nam. APEC has played an important role in promoting trade and investment in the region with the realization of bringing in science and technology as a catalyst for growth. In taking a closer look into the composition of the 21 member economies, APEC itself is the house of diversity in terms of physical characteristics, languages, economic status, capabilities in S&T, governance system, and political background. The fact that many of APEC economies suffered a great deal of from a setback in their national economic systems in the past years, during 1997-2000 to be specific, mostly in the Asian financial crises and the repercussion thereof, together with a contrast picture of a number of advanced economies that have reaped the benefits during the crises, has served as a foundation for reviewing the policies and strategies for future technological development in the region. Yuthavong (2001) made an interesting comment on the situation, "… while

much of the blame can be laid on the weak financial infrastructure and poor corporate governance, one of the root causes for development unsustainability is the lack of competitiveness of their economies resulting from the lack of innovative capability based on science and technology…". On the basis of these realities, this section offers two considerations for evaluating the policy and strategies of future technological development: the macro industrial and micro developmental considerations.

The macro industrial model

Through this consideration we are entering a time that humankind will develop an enhanced ability to solve the majority of economic, social, and technological problems. Much of the work can be possible through the economy of a number of advanced APEC member economies. The enhancement of the quality dimension will extend to human intelligence, facilitated by increased education. We are discovering that science will not be the only, or an exclusive domain of academics or professional biologists and physicists. Rather the innovations in computer and information technology will empower the non specialists to experiment on concepts and designs that may eventually be incorporated into scientific knowledge. Much on the negative side of this macro development is the concern for environment protection and a wider gap between advanced and underdeveloped economies that are housed in the APEC region.

The micro developmental consideration

The APEC economies also have their gaps in development that have severely occurred as a result of the economic crises. The end of the 20th and the dawn of the 21st centuries represent a true, tough time for them to redirect the course of their national development and policies. Lessons learned during the crises made many of the economies, for example Thailand, to be skeptical about mass industrialization and look into the micro enterprise-diffuse, small-scale ventures/businesses that can enable the sustainable futures. This type of development is exemplified by the business capitalized with small loans and subsidy either by micro lenders or government assistance programmemes that also aim to create local development initiatives and private/public partnerships. Through small, private/public agencies funding decentralized, sustainable enterprise and technology, emerging countries can begin to implement a new concept of development compatible with the 21st century emerging world economy and its resulting values.

The micro development model looks into the technologies that are inexpensive, easy to use that constitute the new vision and definition of development. These technologies are available, cost-effective, and sustainable and could mitigate the problems plaguing the developing world much more quickly, saving natural resources, human lives, social disintegration and other circumstances caused by the macro industrial development.

This section offers two viewpoints taking into consideration a general and broad scanning of the crucial economic consideration of the APEC economies, which to a certain extent could reflect the ability of each member economy in ascertaining the level of priority given to S&T planning and policy. What is important is the use of strate-

gic, long-term policy planning to enable the most plausible framework for S&T implementation. To this end foresight has become an important tool for the management of long-term planning. Foresight can be well-adjusted to the situation in both macro industrial and micro developmental models. The process of foresight is applicable to sectoral, national, regional, and global situation, putting both the macro industrial framework with the micro developmental situation.

Prerequisites and motivations for foresight at the regional level

Prerequisites: prerequisites for technology foresight at the regional level can vary, from one region to another, according to the purpose and rationale for the establishment and how foresight is being defined to serve the region. There are two important elements involved.

Setting the foreground for foresight

Setting the foreground is to locate an appropriate work parameter and scope for regional foresight to operate. The principal objective of setting up the APEC Centre for TF, for example, is to be the Centre to develop and diffuse foresight capabilities across the APEC through multi-economy studies, training, consultancy and related activities. Foresight for the Centre "…involves systematic attempts to look into the future of science, technology, society and the economy, and their interactions, in order to promote social, economic and environment benefit." According to the foregoing background, several characteristics of the work parameter could be determined: our foresight programme is a long-term vision (5 to 30 years, or covering more than three business cycles) into both internal and external factors affecting the region and economies; it is the foresight that is being used by national governments, organizations and firms in order to establish directions, choose priorities and manage change; the "technology" when it is used in foresight might imply new, emerging technologies, covering the opportunities and risks and including technologies that could be developed and modified to address social/economic problems—it is this technology that serves as "technology-push" as well as "social-pull"; our foresight encompasses participatory consultation and discussion amongst a wide range of stakeholders; and the foresight that is aimed at providing better decisions today in order to shape and create the future. This foresight is, therefore, applicable to both macro industrial and micro developmental entities.

Setting a legitimate synergy among the stakeholders

It is important that regional foresight be supported by regional governments, institutions (education, research and non-governmental organizations), business sectors such as trade associations, chamber of commerce, etc, and a strong endorsement by national/local governments. Once a good synergy among these stakeholders is established, it facilitates a good flow of funding resources, personnel, and activities. The legitimacy covers the implementation process of the results of foresight into actual

planning process, which is another prerequisite for both national and regional foresight programmes.

Motivation: A key element to motivate foresight at the regional is the need for better planning among various sectoral, national, and regional organizations. Foresight methods in technology as well as in social/economic areas help decision-makers to locate different alternative choices for the organizations in their decision-making process. It is obvious that leaders of many organizations are heavily burdened by matters of the present and are being prevented from taking a long-term look into the future. The lack of long-term planning causes untold loss and disaster, for example, natural floods, etc. And the case of the South-East Asia financial crisis in 1997 was another good example of the deficiencies in long-term planning and taking immediate action on the emerging issues that could have led to the crisis.

Reflecting the situations after the economic and political crises of the present in terms of both macro industrial and micro developmental economies, foresight has become integral to the planning of policy development combining strategic management and future studies into the process. This trend of including strategic management in the foresight process receives greater attention among foresight practitioners and will remain for some time.

Another point of motivations for regional foresight is when the region has a close proximity of networking and physical characteristics that support the work of the foresight centre. The similarities and shared common features in political, social, economic, and environmental aspects contribute to the motivation to initiate a regional foresight programme that can apply to the particular areas. To this purpose it is easier to locate the resources (people, finance, expertise, and work synergy) that are needed for the various foresight activities.

The rapid change and globalization process also contributes to the motivation, either for sectoral, national, and regional level, to develop a tool that can help them to plan ahead, anticipating what might come next and the challenges that would affect the people, social, economy, region, and the world. This trend is increasing as long as the word “change” still exists.

Present regional technology foresight programme

This section focuses on the experience of the APEC Centre for Technology foresight within the Asia-Pacific region. If one defines “region” as the area that has a close proximity of location and physical identity, the definition might not be well applied to APEC—since its members comprise economies that are scattering around the Pacific rim—from North America to the south of the continent and from Russia down to the economies in the South Pacific. APEC, then, is the group of economies gathered together for the common objectives of promoting sustainable economic growth in the Asia-Pacific. It is one of the world’s first post cold war, information age multilateral institutions. Because of its highly decentralized nature the most important elements

of governance structure are implemented through the APEC process, through the working committees, and the leaders. And the APEC Centre for TF could fit into a regional foresight centre through this definition and through its activities that cover economies under the APEC umbrella.

The idea of an APEC Centre for TF was first proposed at the first APEC Ministers Conference on Regional Science and Technology Cooperation in Beijing in 1995. A comprehensive feasibility study was carried out, which included and APEC TF Symposium with over 100 participants from 16 different economies, and a survey of member economies to determine the topics of most interest to them. The CTF was subsequently launched in February 1998, with a small core staff team in Bangkok under the auspices of the National Science and Development Agency of Thailand. CTF aims to serve and involve all APEC member economies through work coordination with the APEC working committee on Industrial Science and Technology Working Group (ISTWG) and relies on the support of several international experts and on the self-funded participation of member economies in its activities. Since 1998, the CTF has established itself, undertaken and published a number of technology foresight studies at international and sectoral levels, organized conferences, seminars and training courses, created a web site and built up international linkages.

The core objective of the APEC CTF is: "To develop and diffuse foresight capability across APEC through multi-economy studies, training, consultancy and related activities."

Given the wide scope of its operations, across economies and in many different kinds of organizations, the centre has adopted a broad definition of foresight, which can be further refined to suit the needs of particular projects:

> "Foresight involves systematic attempts to look into the future of science, technology, society and the economy, and their interactions, in order to promote social, economic and environmental benefit."

The APEC CTF has pioneered the use of foresight at the international level, by carrying out five APEC-wide foresight studies on varied topics of great regional importance. Criteria for choosing the APEC-wide projects are:

(a) The topic that concerns most member economies, with at least four agreeing to participate in the study and potential to share the results with all the rest.
(b) The topic that transcends national boundaries, so that the study can go beyond anything that might be achieved by a national or bilateral study.
(c) The topic that is of general, public concern/benefit, and could attract wider participations from concerned stakeholders.
(d) The topic that has important technological components but not necessarily "high-tech" ones.

The five projects are: "Water Supply Management", "Technology for Learning and Culture", "Sustainable Transport for APEC Megacities" and "Healthy Futures for APEC Megacities" and "Nanotechnology—the Technology for the 21st Century". (The reports for each of these projects are available under publications from the Centre's website)

Water Supply and Management (1998)

- **Objective:** to develop a strategic and coherent view of the challenges, threats and opportunities associated with water supply and management in and across the APEC region.
- **Key outcome:** new paradigm of water management needed: recognizing water as a precious and valuable resource to be used economically and socially to maximum advantage.

Technology for Learning and Culture (1999)

- **Rationale:** ICT are transforming the basis of education and culture
- **Key outcomes:**
  - — Five crucial "technologies" identified (wireless/satellite technology; data storage for digital library and museums; virus-immune software; language translation and teaching; and much cheaper hardware to increase accessibility).
  - — High technology dependence creates vulnerability.
  - — Ready access to Internet in schools, and for the wider community is critical.

Sustainable Transport for APEC Megacities (1999)

- **Rationale:** Traffic congestion is a major threat to urban environments. Productivity and health costs due to pollution in Asian urban centers ranges from 1-5 per cent of GDP.
- **Key outcomes:**
  - — Public (mass) transport must be prioritized, and private (individual) transport curtailed.
  - — Promising technologies for 2020 include hydrogen-fuelled vehicles, intelligent highway systems, automated urban freight distribution systems, transport logistics, plus technologies that reduce need for travel such as telecommunicating, internet shopping, etc.

Healthy Futures for APEC Megacities (2000)

- **Rationale:**
  - — The size and number of APEC megacities is increasing significantly, but their sustainability is a major concern.
  - — Megacities are complex ecosystems.
  - — Healthy people and communities depend on a healthy environment.
- **Key outcomes**—actions to create healthy megacities are possible; key policy areas can be identified, including managed growth, integrated planning, use of IT and stakeholder participation in planning.

Nanotechnology—the Technology for the 21st Century

- **Rationale:** The impact of nanotechnology could be as great as the "ICT revolution"—developments at nano-level will be applied in such diverse areas as medical care, electronics and IT, automotive and industrial equipment, telecommunications, environmental monitoring etc.
- **Key outcomes:** A number of policy implications and recommendations including: broader recognition in the region, identification and assembly of resources for R&D as a national programme, increased multidisciplinarity in universities, adequate funding to develop and foster expertise, etc.

As for the outcomes and implications for the APEC-wide projects, they have created opportunities for policy-makers of the participating economies to meet and learn from international colleagues. The results serve, to certain extent, as the catalysts for future deliberations in the S&T policy planning for the concerned economies. Lessons learned from those projects create opportunities for deliberations at the national level. The breadth and depth presented in the various phases of project development and implementation add to more learning and study phases at the national and sectoral levels within multicultural and multi-disciplinary group, thereby gaining greater level of understanding, greater future orientation, and knowledge of foresight methodologies. Such studies also provide opportunities to see how other economies are tackling complex problems and monitor the areas that are not currently a priority (e.g. nanotechnology) but that should not be totally ignored as their impact in the future may be eminent.

Impact and experience of using TF for industrial development policy in the APEC region

A number of economies in the APEC region conduct the national foresight project for specific national objective. Perhaps, it is correct to say that foresight is better known at the national level. National foresight is based on the assumptions that progress in the world will become increasingly dependent on science and technology, and the resources will be limited and so governments need a rational way to determine how to allocate them. National technology foresight studies analyse the importance of various technologies to the many different sectors of society and economy. They may study a technology or technology clusters and examine what the implications of those technologies may be, and/or they may attempt to identify and understand what emerging technologies could make a contribution to solving, or at least managing, social problems such as polluted cities, poverty or an ageing population. National foresight also serves to increase dialogue between people working in the different sectors of the economy at its different levels—government officers, policy-makers, industrialists, educators, researchers, etc.

National foresight usually contains some benchmarking activities to help economies to position themselves globally, work out their strengths and then promote them. For example in the APEC region an early foresight study of biotechnology in Canada, which strongly recommended that the government prioritize this field, can be par-

tially credited with the very strong performance of Canadian biotechnology industry today, which is the second leading economy in the world. National foresight does not just apply to big economies alone, small economies can also benefit from foresight, particularly if the need is to find the niche areas where there might be a chance to outperform the larger economies. Overall, foresight provides a kind of guideline for government policy and company strategy for individual sectors or departments to set their own priorities. In order to provide examples, this section covers three economy samples: Japan, Republic of Korea, and New Zealand. Two economies, Japan and Republic of Korea, have been very active and regularly carried out their national foresight activities at different levels. New Zealand carried out the national foresight projects during 1998-1999; and foresight has subsequently been institutionalized within various governmental and private sectors. The three economies are actively in the forefront of foresight exercise practices in the region.

Japan: Japan is among a number of advanced APEC economies that have a long history and experience in foresight. In the study it covers the extensive involvement of many key stakeholders from government, universities, industry and research organizations. The foresight activities are categorized in four types: holistic STA Delphi survey; macro-level for ministerial level; meso level for group of companies; and micro level for individual groups of companies and research institutes. The most well-known element is the large-scale Delphi surveys that have been conducted every 5 years since 1971, with a time-frame of 30 years. Evaluations of the methodologies have shown that experts; predictions organized through the Delphi surveys are not perfect but are much better than chance, and they have been an extremely valuable guide for planning. The results of these Delphi surveys have been used to set national priorities for research in basic science, for developing applied S&T and for planning infrastructure to support emerging technologies. They led directly to the educational policies that created such a large pool of well-educated and competent people to support the country technology-based future.

Republic of Korea: The Republic of Korea has its own national foresight programme which has assisted the Government in exploring the future of science and technology using the Delphi technique. Special reference is made to the "Second Survey of the Technology Forecast & New Technology in Korea." The study bears significant importance to the economy in that it has reviewed the expected development course of science and technology, which is the core component of the high-tech society in the 21st century for Korea. The study looks into the time-span of 25 years from 2000 to 2025 and aims to help formulate national S&T policy and strategic R&D plans. Fifteen science and technology areas are covered. The survey is made to cover the top 100 subjects in significance, and the relationship between significance index and R&D level in all 15 areas.

The Delphi technique is used to predict technological development, reflecting the intuitive thinking of the experts on anticipated time of technological completion and the significance of future technology.

The Delphi survey is carried out by the Technology Forecast Committee under the initiative of STEPI (Science and Technology Policy Institute) and divided into 16 subcommittees specializing in a specific technology field. Based on the results of the two rounds

of effort, members of the subcommittees form a theoretical analysis framework and provide a chart of each field's future technological prospects. The survey indicates the need for S&T to put more emphasis on the importance of R&D. Scientists should take a more cautious approach to S&T development, particularly with respect to the financial crisis and the IMF-mandated restructuring process, both in the public and private sectors.

New Zealand: The foresight project, run by the Ministry of Research, Science and Technology in New Zealand, focused on exploiting knowledge for future prosperity and well-being, and national development as a knowledge society. The project used three scenarios in order to stimulate thinking about how to accentuate positive trends and avoid problems. Rather than projecting into the future with assumptions about how today works, foresight as used involved constructing a vision of a desirable future, and then identifying strategies to get there. The project yielded 14 strategic goals and sector strategies for key sections of the economy. The results of the project were clearly reflected in the government focus from what it wants to spend to what it wants to achieve through its investment.

Several considerations and observations can be derived through the experience and impact of technology foresight in the APEC region: the importance of technology foresight has strongly been felt among economies in both macro industrial and micro developmental sectors. Foresight itself is developing dynamically and efforts should be made and given to work out an optimal combination of techniques. Malaysia and Viet Nam, for example, are undertaking their foresight exercises and in the process of establishing their national foresight programmes. In early 2000, APEC CTF ran a two-day scenario workshop in Malaysia to assist in developing the Master Plan for the Malaysian construction industry. Another three-day training in foresight was arranged for Ministry of Science, Technology and Education to plan for the national foresight programme. In April 2001, the APEC CTF launched a foresight activity in Food Processing in Viet Nam and assisted in the planning to establish a national foresight centre for the National Institute of Science and Technology.

Short-term and long-term plans for the development of TF in the region

Since its establishment in February 1998, the APEC CTF has undertaken the projects to include five areas of activities: multi-economy foresight studies; national and sectoral foresight studies; training, workshops, and public seminars; APEC technology foresight network; consultancy; and web site and publications. In 2002-2003, the centre has received funding from APEC to conduct another multi-economy project on "DNA Analysis for Human Health". The APEC CTF is also working out plan to cooperate with other international organizations such as ASEAN and UNIDO on foresight projects on a nanotechnology workshop and business development respectively. The APEC CTF has commitment to provide the multi-economy projects; national and sectoral foresight studies, training, workshop and public seminars; and consultancy as well as offering regular services on the foresight technology network, publications, and web site. The APEC CTF web site: http://www.apectf.nstda.or.th is available for the public to obtain more detail and updates on the centre's activities.

Conclusion and recommendations

The experience of the APEC CTF in conducting activities for APEC indicates that regional foresight work can be done and that its outcomes can be beneficial. However, it is important to consider whether the very modest impact on policy justifies the effort. In the context of the APEC CTF, with its core purpose to "develop and diffuse foresight capability across APEC" the answer is clearly positive, since the outcomes are supplemented by significant process benefits that serve to raise foresight awareness and increase foresight capacity in the region.

The question remains about whether the impact on policy-makers can be increased. The APEC CTF certainly saw each project as a learning process and modified its techniques with each project to increase effectiveness and impact. There were lessons from foresight work at other levels that could be applied here. The difficulties, however, of operating within the APEC context should not be assumed to apply to all projects at an international level.

Foresight itself can be used very well in both macro industrial and micro developmental levels. For the advanced economies, foresight can definitely assist them to enhance their level of high technology for a more advanced and beneficial programme to humankind. Warning may have to be given to both advanced technologies and social and environmental concerns.

For the less developed economies in the micro developmental economies, there is a strong need for a systematic and rational method of exploring the future implications of technology to development and prioritizing investment and growth process. Less developed economies also need to enhance communication between different sectors of society—researchers and research users, government and enterprises, educators and industries. Foresight exercises can also be a means of establishing or revitalizing connections between the different parts of national innovation system (NIS)—this is especially important for developing economies whose NIS may have weak linkages or lack some vital components. Foresight can start to build the required linkages and networks and identify the component that needs more attention.

4. THE BALTIC STRING

The following example reflects both meanings of the term regional. The Baltic STRING is a set of sub-national regions that have been working together across national boundaries.

Background

Since the end of the 1980s, the European Community has reserved substantial funds to promote cross-border cooperation between neighbouring border regions and to help these regions develop regional policies. Much of this support over the last decade has

come through the INTERREG initiative, although cross-border cooperation has also been supported within the framework of Phare and Tacis programmes in Central and East European countries and in the Newly Independent States.

Subsequently, a large number of cross-border arrangements have emerged, aimed at furthering general European integration, improving economic development, bringing people closer together and solving joint environmental problems. But as cross-border cooperation has progressed and acquired more and more concrete contents, the need has arisen for adequate organizational forms and actors capable of taking the initiative, deciding on actions and implementing them. In many border regions, activities have often tended to be framed by national interests and not by a broader cross-border outlook. In long-term cross-border cooperation activities, misunderstandings and conflicts may arise due to information gaps as knowledge about systems, rules and norms is embedded in national identities. In such circumstances, it is hoped that foresight methods (in the sense of participative exploration of joint interests) can offer a more promising way of addressing the sensitivity of the national border and for giving meaning to the construction of cooperation across borders and boundaries.

In the South-western part of the Baltic Sea, a diverse group of regional authorities concluded a two-and-a-half-year strategy process on how to jointly create a sustainable basis for growth and development in an increasingly globalized world. This project is called the STRING project (South-western Baltic Sea Trans Regional Area Inventing New Geography), and the strategy process it involves has been guided by a regional foresight approach to ensure that the articulation, execution and exploitation of joint efforts were coordinated across three national borders. Thus, whilst the STRING project is nested within the guiding principles of the structural funds, the spatial planning perspective and the use of foresight methods have offered an open strategy process, which is qualitatively different from the normal programme procedures and the anticipated distribution of funds.

The regional authorities involved in the STRING project are: The Öresund Committee (S/DK), a cross-border cooperation committee with Danish and Swedish local and regional authorities; the County of West Zealand (DK); the County of Storstroem (DK); the City of Hamburg (D); and the State of Schleswig-Holstein (D). The STRING area has a population of 7.9 million inhabitants and covers an area of 36,800 km^2. The density of population is 215 (hab./km^2) and the annual gross domestic product per capita is one of the highest in Europe at €27,500.

Scope

The main aim of the STRING project has been to develop a common strategic platform and jointly address common conditions, options and challenges. Networking among specialists, planners and decision-makers has been another explicit aim of the project. An implicit aim is to influence the political agenda on a possible future link across the Femer Belt between Denmark and Germany. Thus, target groups for the project include regional and local authorities, universities and research institu-

tions, centres of education and vocational training, trade unions, chambers of commerce, business development organizations, cultural institutions, Agenda 21 actors and other NGOs.

The project had a total budget of €1.3 million, of which €0.7 million was co-financed by INTERREG IIC. It had a duration of 30 months (January 1999-July 2001), which may seem a long time, but experience from various bilateral cross-border cooperation programmes in the region taught the STRING partners that it takes time to develop a common language and give meaning to the common vision and strategic action plan. The time horizon for the exercise is 10 years, to 2010.

Above all else, the STRING project has been about building bridges—in the sense of both the physical constructions across the sea and the social constructions across institutional and spatial boundaries. The overall aim has been to create a STRING of interrelated and dynamic urban and rural locations including towns, cities and villages. The idea of the STRING project is thus to reach a critical mass by building bridges in order to cope with future changes in society on a regional, European and even on a global level. As for the physical bridges, the project has kept alive the political debate on the "missing" link across the Femer Belt to conclude the so-called Scandinavian link from Sweden over Denmark to Germany. As for the social construction, the project has brought people and systems together across three national borders within a long-term strategic cooperation framework.

Building momentum

Commitment was steadily built up throughout the process (e.g. in this case from the initial project application for INTERREG IIC funds) through the various workshop meetings, to the political forums and public conferences that occurred later in the project. It was always believed that this broad support would be sufficient to make it possible to embark on concrete projects within strategic action fields giving shape to the vision of a high quality area based on innovation, entrepreneurship and sustainability.

One thing that turned out to be an important feature of the STRING strategy process was the cautious building of democratic legitimacy, linking each step of the foresight process to the democratic institutions of the region. The idea was not to build yet another political-administrative structure—rather, the idea was to create a dynamic political forum where political representatives of the STRING partners could meet, discuss and give direction to the project. The political representatives actively participated and committed themselves to the formulation and implementation of the strategy and the action plan. They met in five political forums during the course of the process, often in relation to the thematic workshops and the conferences (see below). These forums constituted the milestones of the project and opened up the project to a broader perspective and focus. How each political representative gave an account of agreed policies and ideas to his/her constituencies was a matter for each representative and the government system he/she represented—members included, for example, a county mayor, a town mayor, a city mayor, and a State prime minister.

The broader public was informed through political resolutions, together with newsletters, reports and a project web-page (www.balticstring.net). Although these decisions were made politically accountable to the citizens living in the region, the political representatives were fully aware that the future of the STRING region was closely related to bringing the activities much closer to the people. In 1997 unexpected civic resistance to closer cooperation across the Danish-German land border, in combination with widespread scepticism about the European project, had taught the promoters of the new region to be much more sensitive to the complexities of European integration. However, the STRING partners also agreed that public ownership would be closely related to implementing decisions and producing concrete results affecting daily life. The STRING project should make a difference to citizens living in the region, and should enhance it as a place to live and work. In other words, it had to offer flexible solutions to everyday problems in a cross-border region, such as transportation, recognition of diplomas and credit transfer systems, tax systems, cultural life, integrated coastal management, etc.

Structure and organization

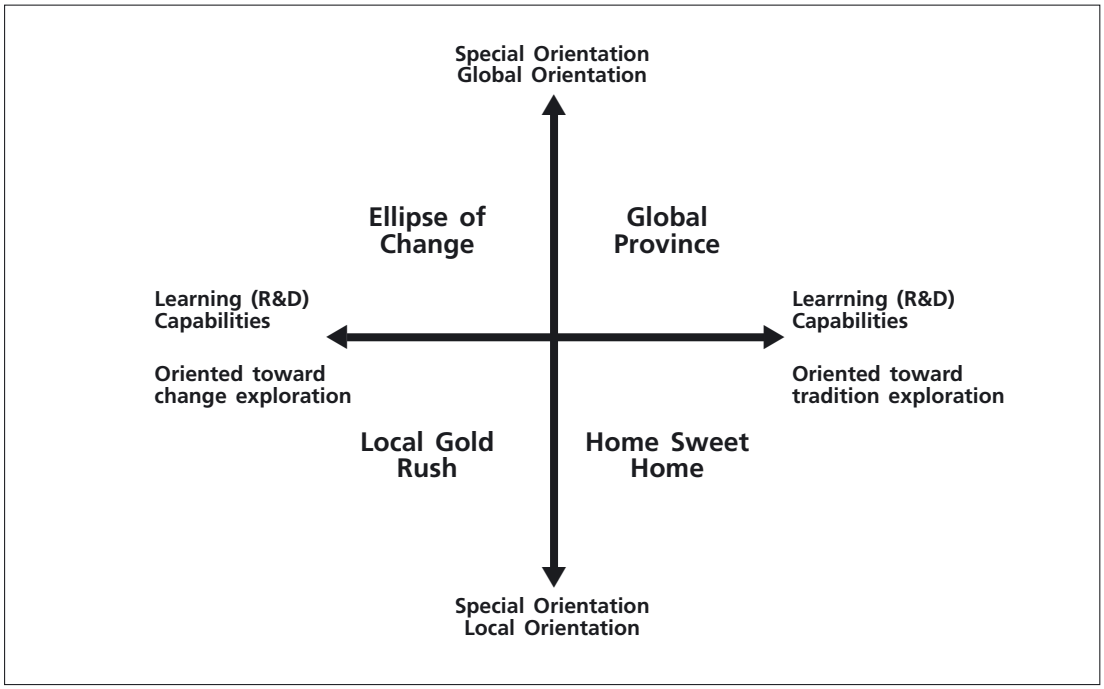
Language, in the literal sense of the word, was one of the first things to be agreed upon as the cooperation crossed three countries, each with its own language. From the very beginning it was agreed that the common language should be English so that all participants could communicate on equal terms. It was also a particular challenge to develop a common administrative language bringing together divergent administrative and political decision-making cultures and practices.

The overall process was managed by a steering group consisting of regional administrative leaders and a small project secretariat whose officials were appointed by each STRING partner from their own staff. They met regularly and communicated in between meetings by e-mail. This project secretariat, which was not tied to a particular physical location, was the driving force throughout the whole process.

The formulation of joint interests and actions was made in an open process involving more than 100 experts from universities, research institutes, chambers of commerce, local and regional authorities, associations and organizations (STRING, 2000). The experts came together in thematic working groups, each of which was chaired by a key official from one of the STRING partners. The experts were appointed by each STRING partner on the basis of their personal merits, and not, as is often the case, on the basis of the organizations they represented. This meant that new networks were created, and old ones were given new meaning.

Methodology

Within thematic workshops, experts identified driving factors for the future development (10-year time horizon) of business and industry (local versus global spatial orientation; learning capabilities oriented towards tradition; history and stability versus rapid change and innovation) and later elaborated four equally plausible scenarios (the



"ellipse of change"; "global province"; the "local gold rush"; "home sweet home"). Communication between the participants was supported by reports and discussion papers produced by consultants. One theme was barriers to, and potential for, business development; a second theme focused upon the urban-rural dimension and the strengths of polycentric urban structures; and a final theme addressed sustainable mobility. As the contracts for these reports were signed prior to setting up the thematic working groups, they did not fully reflect the information required by these groups. However, some adjustments were made and additional papers produced. Thus, one lesson learned from this process was that working groups should be actively involved in formulating the terms of reference of external reports so as to ensure they closely match their requirements.

The project secretariat and the chairmen of the thematic working groups assured coordination between scenarios for the future development of the STRING region, a common vision and a strategic action plan (see below). They also managed the overall process and decided to use the scenario framework of one working group to guide the final work of the other two groups. The scenarios were used as a starting point for developing a preferred vision of a STRING region, characterized by a high quality of life based on innovation, entrepreneurial spirit and sustainability. The vision was agreed by all thematic working groups and later presented to the political forum of the STRING partners.

Outputs and outcomes

The STRING partners reached a commitment to implement the strategic action plan, both during the whole process and also in the concluding conference in June 2001. The strategic action plan comprised seven areas of strategic priorities for future activities:

- Business development—based on innovation and creativity.
- Learning society—social capital as a prerequisite for technological innovation.
- Exchange of knowledge—to foster potential synergies between private corporations, public research institutions and academia as well as between different academic disciplines.
- Mobility of people—meaning physical mobility as well as professional, educational, mental and cultural mobility.
- Infrastructure and transport—aimed at improving technical facilities.
- Environment, nature and landscape—as a general challenge for regional development.
- Culture—as a result of the uprooting of traditional national values in favour of "glocal" (i.e. simultaneously global and local) values.

Some projects were already agreed and initiated during the strategy process, e.g. the Baltic Sea Virtual Campus project involving Swedish and German educational partners, whilst others were ready for take off. These projects were called "lighthouse" projects, since they were intended to illustrate and breathe life into the ambitions of the overall political project.

The outcome of the strategic process has been the development of a common vision and strategic action plan comprising a number of strategic action fields, such as business development, education, infrastructure, and culture. In addition, a number of concrete projects—the so-called "lighthouse" projects—have been planned (and some have even been implemented) and are useful for testing and illustrating the ambitions of the project. Thus, the STRING partners are continuing to cooperate and build on the established process and structure to undertake key projects within the strategic action plan. As the project has built upon existing collaborations and networks, these have been given new meaning. By the involvement of a wide range of experts throughout the process, new networks have been established and new opportunities created.

Reflecting on the process it has been concluded that the management structure needs to be lean, transparent and effective, consisting of the monitoring of activities, a steering level to secure continuous coherence between goals and activities, and a virtual project secretariat made up of officials from the STRING partners.

REFERENCES

This module is based around the following papers:

Technology Foresight for Central and Eastern Europe and the Newly Independent Countries—Regional Dimension and Initiative, Ricardo Seidi da Fonseca, programme Manager, Industrial Promotion and Technology Branch, UNIDO, Technology Foresight Summit, Budapest, 27-29 March 2003.

Technology Foresight as a tool for European Integration and Enlargement, Gustavo Fahrenkrog, Institute for Prospective Technological Studies, at the Regional Conference on Technology Foresight for Central and Eastern Europe and the Newly Independent States, Vienna, 4-5 April 2001.

Technology Foresight in the APEC Region, Witaya Jeradechakul, Executive Director, of the APEC Center for Technology Foresight, National Science and Technology Development Agency, Bangkok, Thailand, International Conference on Technology Foresight for Ukraine, Kiev, 10-12 September 2002.

And by permission of the authors an extract from:
Practical Guide to Regional Foresight in the United Kingdom, Ian Miles and Michael Keenan, European Commission 2002.

Bibliography for TF in the Asia-Pacific Economic Cooperation Region chapter

APEC CTF (1997): Technology Foresight: Proceedings of APEC Symposium on Technology Foresight, Chiang Mai, Thailand, 10-13 June 1997, second edition.

APEC CTF (2001) APEC Centre For Technology Foresight: Annual Report 2001. National Science and Technology Development Agency, Thailand, Bangkok, May 2001.

Jewell, Tamsin and Sripaipan, Chatri. Multi-Country Foresight as a Contribution to Addressing Globalization. Conference Proceedings of the 6th International Conference on Technology Policy and Innovation—Kansai 2002.

National Institute of Science and Technology Policy (NISTEP): Proceedings of International Conference on Technology Foresight—The Approach to and Potential for New Technology Foresight, Ministry of Education, Culture, Sports, Science And Technology, Tokyo, Japan 2001.

Yuthavong, Yongyuth: "The Future of Science and Technology in Southeast Asia", *International Journal of Technology Management*, vol. 22, nos. 5/6, 2001.

Bibliography for the the Baltic STRING chapter

Holst Jørgensen: Birte, Building European Cross-border Cooperation Structures. Institute of Political Science Press, Copenhagen University, 1999/2.

Holst Jørgensen, Birte, *Cross-border Cooperation and European Enlargement*, The NEBI Yearbook 2001/02, North European and Baltic Sea Integration, Berlin: Springer-Verlag.

STRING, *Inventing New Geography. Strategic Possibilities for the Southwestern Baltic Sea Area*. County of Storstroem (leading partner), Nykoebing, 2000.

Additional sources

Futures Project of the Institute for Prospective Technological Studies—Further details of the project are available at http://futures.jrc.es/menupage-b.htm.

More information on APEC are available at http://www.apecsec.org.sg and on the APEC Centre for TF http://www.apectf.nstda.or.th.

REVIEW QUESTIONS

1. What do you think are the benefits to be gained from supranational foresight activities?
2. Outline the main features of the IPTS Futures and Enlargement Projects. How important are the issues raised by the enlargement project reflected in your own experience? Would a foresight exercise be a useful contribution to their consideration?
3. What are the main lessons to be gained from the APEC example? How would you ensure prerequisites and motivation were in place to support a foresight exercise?
4. Outline the main features of the Baltic STRING project.

Review question 1

- Regional activities
  - — provide more expertise than is available to any one country
  - — are more cost effective
  - — develop common awareness

Review question 2, IPTS Futures project

Futures project

- Concerned with technology, competitiveness and employment to 2010
- Set up four panels

  - Demographics and social trends
  - Information and communication technology and information society
  - Life sciences
  - Natural resources and environment

- Policy consequences examined through three maps

  - Technology
  - Employemnt
  - Competitiveness

Enlargement project

- Focused on techno-economic issues
- Aimed to promote technological, economic and social development in Eastern Europe and to

  - Assist integration and
  - Improve environment

- Worked through networks
- Steering group brainstorm identified four themes

  - Economic transformation
  - Knowledge technologies and learning capabilities
  - Employment and social change
  - Sustainability, environment and natural resources

- Challenges of enlargement

  - Democratic and political transformation
  - Economic transformation
  - Development of information society
  - Agriculture
  - Transport and energy
  - Human resources and education
  - Social trends

Review question 3, APEC

- Macro-economic environmental issues

  - Impact of information technology
  - Environmental protection

- Micro-economic issues

  - Importance of small scale enterprise and support for them
  - Low cost technologies
  - Foresight has a role at sectoral, national, regional and global levels

- Prerequisites for foresight
  - — Clear purpose
  - — Commitment from sponsors (governments in this case)
- Motivation need to be clear
- Important role for TF centre
- Criteria for projects
  - — Of concern to most members
  - — General public concern
- Projects useful in learning across the organization
- Importance of process benefits of foresight
  - — Especially enhanced communication

Review question 4, Baltic STRING

- Increased cross-border understanding
- Concerned to address common issues
- Importance of involving existing political structure and gaining commitment
- Public involvement
- Steering group, secretariat and expert working groups
- Identified driving forces -> created four scenarios -> drew up a common vision and strategic action plan

Module 6

TECHNOLOGY FORESIGHT AT THE SUBNATIONAL REGIONAL LEVEL

This module deals with foresight at the regional or subnational scale.

At the completion of this module you should have:

- An understanding of the role of foresight at the subnational, regional scale
- A clear idea of the issues involved in setting up a foresight exercise at the regional scale, and
- Knowledge of examples of regional foresight from a series of case studies

Contents

Figures

1. INTRODUCTION

In this module the term regional is taken to mean subdivisions of a nation state.

Regional foresight is the application of foresight methods (involving some combination of five essential elements—anticipation, participation, networking, vision, action) to inform and orient decisions that are taken at the subnational level. This may be a region of a federal state or otherwise, a metropolitan area, or some other subnational aggregation or local system of actors. The important thing is for there to be a minimal degree of local identity and political leverage available.

Regional foresight is a means for those who share a common territory, to control their future development better. For foresight to be worthwhile they must want to do this, and be empowered with at least some of the means for effecting it. A major distinguishing feature of regions as compared to other territorial levels is the geographical proximity of actors and the limited spatial range. (Of course, some regions—especially in more outlying areas—can be vast, and sparsely populated; and regions in some of the larger countries may be of equivalent size and population to the whole of some smaller countries. All of these characteristics are relative ones.) Proximity can make the networking elements of foresight easier to implement. In some cases it may appear that all key players are already familiar with each other and the resources they have to contribute to foresight—although so far, experience in small countries, as well as in regions and cities, suggests that established networks can be valuably infused by new knowledge and new members. However, some sorts of expertise and knowledge relevant to regional issues may be hard to access from within the region, so the question of links to parties outside the region is an important one for planning regional foresight.

Different types of regional foresight can be envisaged. Notwithstanding the jurisdictional regional context, individual foresight activities do not have to be all embracing. It is quite possible for foresight activities to engage quite specific groups of actors (e.g. clusters of SMEs, or certain segments of the population). This will reflect the resources that can be brought to bear, and, of course, the objectives of the activity, the features of the issues being tackled, etc.

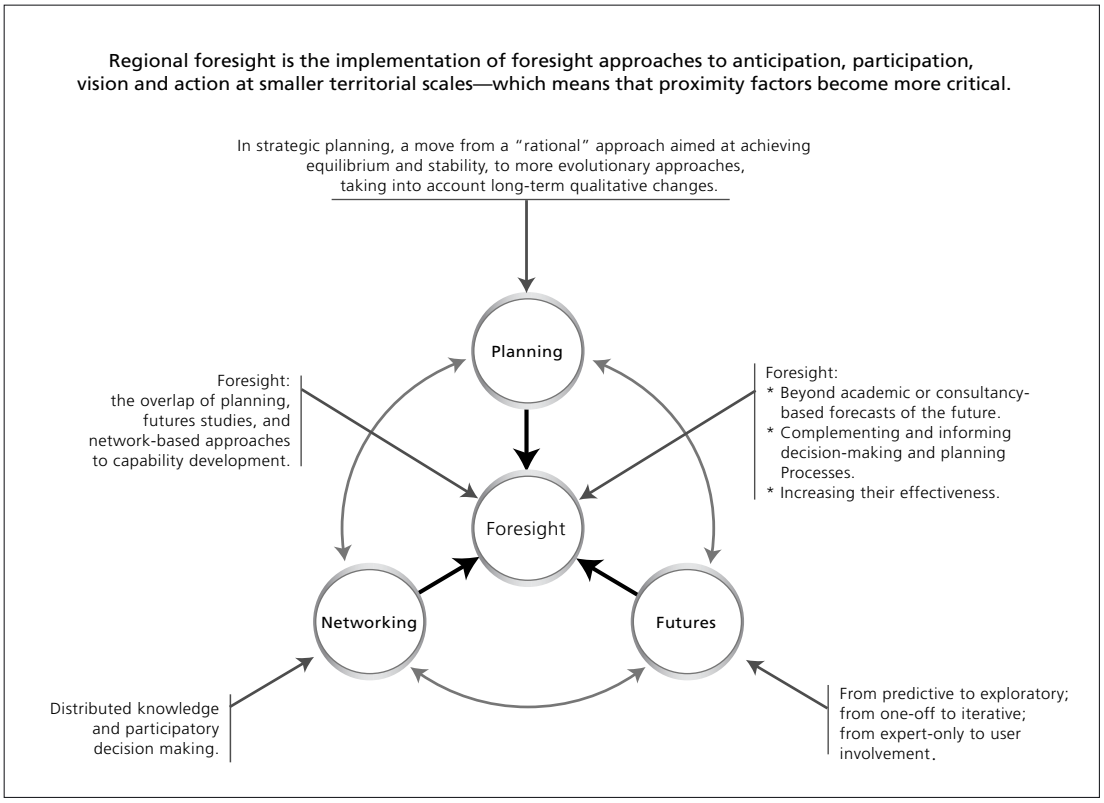
Some important changes highlights the increased importance of foresight:

> In *strategic planning*, there has been a move from a "rational" approach aimed at achieving equilibrium and stability, to more evolutionary approaches. 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.
>
> *Policy development* has seen a shift from an elite-driven/top-down to a broader, more participatory approach. This reflects pressures for greater democratization

and legitimacy in political processes. Decision-makers also have to live with the fact that knowledge is distributed widely. Thus intelligence-gathering and networking methods have also to evolve.

In futures studies there have been several important developments. One is a shift from emphasis on predictive approaches to more exploratory studies, and from one-off studies to more continual iterations of the process of envisioning future challenges and opportunities. Equally important is increasing recognition of the need to involve "users" in the process of study, rather than to present them with a vision or set of visions of the future that descends from "on high". Part of the reason for this is that "futures researchers" have found that such involvement is often essential for the messages of their studies to be absorbed into policy-making in systematic and ongoing ways.

Figure I. What is regional foresight?



Source: Keenan, Miles, (2002).

Although globalization is acknowledged as one of the major forces in economic development, economic and social development is contingent on regional structures and activities. As much as global economic forces, and international and national policies and conditions shape and penetrate regional activities, it is the regional responses to these challenges that ultimately determine the fate, quality and speed of regional development. Physical proximity and local familiarity still play a major role, and global and international competitiveness depends increasingly on an active search for, and development of, regional strengths and particularities. Regional innovation systems associated with region-specific innovative networks seem to govern the opportunities for a region to become a dynamic and forceful player in both local and global environments. In addition, a regional focus helps all actors to become aware of their potential capabilities and with that to improve their performance. Regions are the engines for innovation, market success and job creation, and have the potential to develop a stronger identity and a strategic vision of their present and future path to prosperity.

Regional foresight fills a demand for ways to address strategic questions in a geographically restricted but socially comprehensive manner. On a regional level, a wide constituency of societal stakeholders can be involved, while also making use of innovation networks operating beyond traditional boundaries.

Regional foresight, it is argued, can:

- *First* identify local resources and potential.
- *Second* provide the platforms on which regional innovation systems can be established and perpetuated.
- *Third* clarify and validate the institutional competencies and powers in a region with links to national and European innovation policies and networks.

Hence regional foresight has the potential to respond to a wide range of societal concerns including regulation; prosperity and wealth; public health; cultural identity, social learning and training; employment; social inclusion, etc. In an economic community, consisting of strong, responsive relationships between the economy and community regional foresight can play an important role since the opportunity arises for individuals as well as local “leaders” to influence local and regional futures.

Regions are arguably well-suited to the participative and vision-building features of foresight. The stronger links between regionally-based actors, the immediacy and sensitivity of people to changes in their region, and a heightened level of awareness and commitment to community, should all render such approaches valuable in regional settings.

Figure II. How can regions use foresight to do things better?

Foresight can help regions to break down barriers, and to articulate long-term visions and explicate their present-day implications.

What do we mean by "region"?

We consider regions to cover subnational areas where the essential criterion is "geographical proximity" and "limited spatial range". This covers rural communities, town- and city-regions, historical regions, regions marked by specific economic activities or cultural identity, and political regions (autonomies, counties, provinces). The discussion is also relevant to cross-border regions. Many of the issues discussed will also be highly relevant to smaller countries.

Different types of European "regions" include:

- *Large regions with high autonomy—like the autonomous regions in Spain or Länder in Germany*
- *Large regions with limited political autonomy—as in France, UK, Italy*
- *Large regions with a strong economic identity but transcending political and administrative boundaries—like the areas around Aachen, Maastricht, Liege*
- *Large city regions—like London, Paris, Berlin*
- *Rural/small town regions—Macedonia (EL), Alentejo (P), Savoie (F)*
- *Regions with a strong historical/cultural identity—Wales, Basque Country, Flanders*
- *Regions with a distinctive geographical dimension—Alpine regions like Tirol, island regions like Corsica or the Canary Islands*

The objective is to highlight key factors that you can use to characterize your region and its development problems, and to identify where, and in which circumstances, specific types of foresight actions might be beneficial. It should also help you judge how relevant the foresight experiences of other regions may be to you. The aim is not to pin down a precise definition of regions, let alone to create a general-purpose typology of regions.

Source: Keenan, Miles, (2002).

2. PROBLEMS AND CHALLENGES IN IMPLEMENTING REGIONAL FORESIGHT

Conceptual:

- *Terminology:* lack of distinction between foresight, technology assessment, strategic planning, future studies, regional planning, regional development, etc.
- *Governance levels:* differences and commonalities between regional, national European and international levels (difference between levels may affect actors, policies and goals).
- *Image:* often regarded as a luxury or insignificant addition to planning.
- *Diversity:* problems in dealing with diversity in cultures and social systems.
- *Integration of inputs:* scientific expertise, procedural expertise (communication skills), economic experience and citizens' attitudes.
- *Integration of actors:* scientists, technologists, industrialists, policy-makers, regulators, consumers, NGOs, bystanders, etc.
- *Legitimising foresight:* claim for significance, power or collective influence. Collectively binding decisions or pure recommendations?
- *Continuity:* creating an ongoing activity rather than a one-time event.

Methodological:

- *Scope of methods:* lack of systematic screening of methods and instruments; lack of communication tools to facilitate data collection and interpretation.
- *Participative research:* lack of knowledge on context and purpose-dependent.
- *Participation methods:* problem of aggregating diverse evaluations; lack of methods to foster learning and mutual understanding.
- *Validity:* many interactive instruments are idiosyncratic in nature; lack of techniques to test validity.
- *Experience:* lack of best-practice case studies; lack of data on learning experiences.
- *Diversity:* lack of sensitivity to context; missing context-dependent methodology.
- *Evaluation:* lack of appropriate indicators; lack of benchmarking methods.

Procedural:

- *Motivation*: lack of commitment, particularly from industry representatives; problem in sustaining motivation and participation.
- *Support:* lack of financial support; lack of organizational or institutional support.

- *Continuity:* lack of continuity; process is likely to collapse after project or funding is completed.
- *Application in candidate or cohesion countries:* imposition of successful models of current member States to candidate or cohesion countries (imperialism); application in regions with no tradition of participation and joint problem solving.

However, foresight demands new orientations to policy-making. These may be unfamiliar to regional actors, and may prove difficult to accommodate in current regional institutions. Regional actors are liable to be entrenched in a compartmentalized division of responsibilities, with "turf wars" about who is responsible for this or that issue. The breaking down of such barriers may be resisted, even by new incumbents of policy positions.

One important set of factors shaping regional foresight activities is the institutions and social capital in the region. The barriers that foresight can confront can extend beyond the chief policy-making agencies, into the wider social context in which such capital is based. There are various ways in which such social capital may be organized (e.g. cooperative versus competitive cultures; interactive versus individualistic modes of learning; associative consensus versus polarized interest groups). This sort of organization, and the cultural traditions associated with it, will influence how rigid the barriers mentioned above may be, and how they may best be overcome.

3. THE DRIVERS OF REGIONAL FORESIGHT

What drives the establishment of a foresight project? Is it the economy or the culture? Is it the entrepreneur or the citizen? Is it the technologist or the bureaucrat? The answer is that all of these may influence the decision-making process but the real initiator is the politician or policy maker. In truth, most large-scale foresight projects have been heavily dependent on public money, although a few cases exist in which large companies have turned to foresight for their own needs at a time of uncertainty or perceived external threat.

Typical circumstances that create interest in foresight include national, regional or local economic instability, demonstrated by a reduction in relative GNP, high unemployment, falling educational standards, contracting industrial base, etc. The political desire is to turn this negative environment around so that economic growth will occur accompanied by a general improvement in the wealth of the population and its quality of life.

Another key question is "who needs foresight?" Professor Jerzy M. Langer of the Polish Academy of Sciences suggested that the answer is threefold:

- Policy-makers
- Society at large
- Science itself

He also suggested that, within the current debate on foresight, far too much attention is being paid to policy and governance and not enough to the practical application of foresight methodologies. In his own words he was surprised to observe that foresight was "mainly dealt with as an advisory tool for setting up medium and long-term policies, which means governance … I want to stress its societal value, as well as its linkage to science itself. It looks to me as a somewhat unexplored avenue".

4. WHICH KIND OF REGION IS MOST IN NEED OF FORESIGHT?

Nothing suggests that emerging economies are any less likely to benefit from foresight than the wealthier countries. Indeed the reverse may be true. If we accept that foresight is as much a tool for culture change as economic forecasting, then developing countries have much to gain.

If we further accept that foresight measures need to be very broadly targeted at all of the constituencies mentioned by Jerzy Langer, then it follows that regions with the greatest need for foresight may well be those in which:

(a) There is a resistance to change within regional institutions. This has prevented effective investment in infrastructure, utilities and education, thus depriving industry of the logistical and R&D support needed for global competitiveness.
(b) There are endemic weaknesses within the industrial demography. The focus is still on traditional rather than knowledge based sectors. Large companies are down-sizing, rates of SME formation are too low and there is a high dependence on foreign direct investment;
(c) There is a continuing failure to convince individuals in society of the importance of innovation and wealth creation. The region has been too slow in creating the dynamic mechanisms necessary for equipping the workforce for a rapidly transforming economy.

The concept of targeting institutions, industry and individuals in parallel (it may be called the three "I's") is a very attractive and useful one. After all, these are distinct and separate units of decision-making within our society. The reason why regional foresight is seldom applied in an effective way is that policy-makers typically install a "top down approach" and progress is blocked by the endless debate that takes place at the institutional level.

Often, there are real opportunities for developing countries to benefit from early application of regional foresight (Ollivere, 2003). Policy-makers in these counties are well aware of the connection between culture and the economy and the need for tools to stimulate a step change in the attitudes of individuals towards enterprise. Moreover, with the expected advances in technology in the new millennium, it is likely that individuals in all societies will become more and more dependent on science but less and less understanding of its basic principals or direction.

Proficiency in managing the processes of change across all sectors of society is a key priority. The establishment of regional foresight centres providing information, advice, training and other services to the general public will increasingly be seen as a necessary investment. Such centres will act much less as a tool for devising policy than as a mechanism for strengthening entrepreneurial culture and fostering a new generation of competitive SMEs.

5. A TEMPLATE FOR ESTABLISHING REGIONAL FORESIGHT

In the following pages a systematic attempt will be made to progress through all the essential steps in setting up a regional foresight project. The objective is to produce a template of best practice based on experience. Figure III provides an outline methodology for this exercise that involves setting up a physical focal point and a variety of outreach projects aimed at different target groups.

Figure III. Steps in the development of a regional foresight centre

STAGE OF DEVELOPMENT	ACTION STEPS	Step #
(a) Planning Phase	Undertake mapping exercise	1
	Agree scope of regional programme	2
	Select appropriate host/focal point	3
	Appoint director/chief executive	4
(b) Project Set-up	Prepare detailed business plan	5
	Allocate premises & equipment	6
	Recruit operational staff	7
	Establish regional governance structure	8
(c) Service Development	Quantify service requirements	9
	Select and test pilot services	10
	Design a balanced regional offering	11
	Evaluate outputs and client benefits	12
(d) Marketing and Delivery	Determine operating methods	13
	Create "intelligent front end" resource	14
	Extend the scope and range of foresight	15
	Disseminate foresight skills and capability	16
(e) Stabilization	Collaborate with international networks	17
	Invest in local research capability	18
	Apply integrated benchmarking strategy	19
	Achieve long term financial security	20

Source: Ollivere, (2003).

The precise format of the end-product will vary considerably according to the environment and the dominant priority of its paymasters and sponsors. Whatever the background conditions, however, no support structure will survive in the long-term unless it accurately identifies market needs, understands its client base and delivers useful services.

It follows that the logical sequence of establishing foresight structures will have much in common from place to place. This discussion of the developmental process should be both sequential and questioning in nature to reflect the dynamics of a growing organization and anticipate the problems to be encountered at each developmental stage.

The planning phase

Step 1—Undertake mapping exercise

Initial market research should be commissioned to validate the broad objectives set by the funding body and to undertake a mapping exercise of all organizations currently offering relevant services (e.g., technology watch, managing change, scenario planning, training etc). The latter will help to prevent duplication and to build cost-effective partnerships. It will also help to identify gaps in provision compared with best practice models in other regions.

Since a regional foresight centre is responsible for a specific geographical area it should be able to define its aims in the local context. This requires an understanding of issues much wider than technology. One useful approach is to produce a template of the so-called STEEP factors (Social, Technological, Economic, Environmental and Political) that determine the nature of the region. An understanding of these issues will provide the foundation for more detailed research.

Step 2—Agree scope of regional programme

Having established the current level of activity and the potential future demand for foresight related services, the next step is to define a central mission and set of objectives for the new project. These will originate from the aims of the sponsor but will become much more focused as a result of research, test marketing and subsequent experience.

The mission itself should be short and to the point—clearly identifying the "primary" reason for existence. In some historical cases, national foresight has been introduced for quite narrow reasons such as to reduce a perceived gap in scientific or commercial achievement in key technology areas. In the context of regional foresight, there is normally a broader motive to improve the quality of life or address specific social problems (crime, ageing population, etc).

A typical regional mission statement might be to "improve prosperity and quality of life in region X by assisting its people and organizations to anticipate future developments and their likely impact on society." What this statement asserts is that an understanding of the time dimension enables regional regeneration and unlocks potential at every level.

Specific objectives need to be more focused and will be dependent on local circumstances and the priority target groups identified by those responsible for strategy. In almost all cases they will include provisions for industry, education, research and public utilities. In the north east of England, the foresight programme is structured around five main strands of activity, based broadly on target group, and a total of 15 work-packages, endorsed and funded by the Regional Development Agency.

Step 3—Select appropriate host/focal point

A focal point is needed to drive the programme at the regional level. Although foresight must be seen as inclusive—and will fail if it is not—a single organization or prime agency should take the lead role. This prime agency will not own foresight but will be empowered to manage and coordinate its many activities.

Responsibility for identifying the host organization belongs to the strategists. In some cases there might be an obvious candidate, which has already been involved in similar programmes and has significant resources at its disposal. In others there may be a number of options and it might be decided to issue a competitive tender. Another possibility would be to create an entirely new organization for this specific purpose. As a general rule the latter solution carries a high degree of risk and is likely to slow down the implementation process.

Experience in the UK and elsewhere suggests that the prime agency role in foresight should be allocated to a non-government body or professional service provider. Wherever regional foresight has been administered directly by government bodies, the experience has tended to be short-lived. Commercial consultants, on the other hand, may be very effective in fulfilling certain parts of the programme, but it is questionable whether they should take the lead role. Research institutes may also be deemed unsuitable on the grounds that too much emphasis will be placed on science itself and connections with industry will not be credible. Ideally foresight should be delivered by an independent, not-for-profit organization with significant in-house marketing capability, a broad customer base and the experience of managing key public projects.

Step 4—Appoint director or chief executive

The selection of a motivated and competent director is of the outmost importance and should occur at the earliest opportunity. The success or failure of regional foresight will depend on this—more than any other factor controlled by the sponsor. Timing is important. Although listed as step 4, the appointment could take place even earlier in the sequence. If possible the director should be actively involved in assessing the market, setting objectives, business planning and the appointment of operational staff.

Figure IV. Attributes of a foresight leader

Experience and Skills	Personal Qualities
Business competence *	Creativity/imagination
Computer literacy	Commitment and drive *
Industrial awareness	Entrepreneurial talent
Technology appreciation *	Leadership ability *
Presentational skills	Marketing flair
Written communication *	Political acumen *

Source: Ollivere, (2003).

The most important attributes of a potential director are listed in figure IV. All 12 qualities are important and a good candidate should be able to demonstrate most of them in an interview situation. The list has been arranged alphabetically but, if the items had to be ranked, those marked with an asterisk are probably of greatest significance (Ollivere, 2003).

Project set-up

Step 5—Prepare detailed business plan

Sound business planning is essential for success even where the project is confident of long-term funding. Essentially this involves converting the mission and objectives into a detailed plan of action governing future activities over a three-year time-span. It is beyond the scope of this section to provide substantial guidance on business planning issues. However, the foresight centre should aim to operate as fully accountable business unit—in a similar way to its private sector clients operating in the open market. It should carefully avoid duplicating or undercutting existing activities in the region and should employ professional systems to measure performance and value for money in all its services.

Typically a foresight business plan may consist of three broad sub-sections covering (i) strategy, (ii) operations and (iii) management. Section one will describe the overall aims and objectives expanded into a series of sub-strategies to work with public bodies, universities, industry, schools and the general public, etc. Section two will describe a methodology for breaking down each "line of action" into discrete operational tasks and allocating responsibility. Section three should provide detailed financial projections for the period of the plan and outline appropriate management and marketing systems. The plan will also address issues of governance, external partnerships, quality control and staff development.

Step 6—Allocate premises and equipment

It is difficult to generalize about the physical resources required by a foresight centre. Many different models exist but a few general rules apply. For example, the location should be accessible from all parts of the region. The accommodation itself will be determined by the scale of activities. In creating a self-sustaining programme it is always better to start small and avoid unnecessary overheads especially where long-term leasing or rental agreements are involved. Co-location with complementary agencies is often a good option during the start-up phase. However it is important for marketing purposes to preserve a clear foresight identity.

As regards equipment the main items will be related to standard office functions and computing. Information technology is typically the biggest area of capital expenditure and vital to success. Computers should be as sophisticated as the budget allows with full networking facilities and proprietary software. The latter must be purchased directly and upgraded regularly. Since workshops and short courses are such a common feature of foresight, it is important to have easy access to training rooms and a good library of educational materials.

Step 7—Recruit operational staff

Foresight is much more of a "people business" than most observers realize. Like any intermediary function success depends greatly on the quality of employees. Early appointments are especially important since this is the time when the organization is most vulnerable. The project director will be operating on a limited budget and often cannot afford highly qualified experts. In this situation he or she may choose to employ a small core staff of three or four "generalists", and access expert skills on an ad hoc basis when needed.

Choice of personnel will depend on the model of foresight being employed. Assuming that the model is "networking" rather than "scientific" then the skills required are marketing, facilitation and communication. The function of staff within this model will be to stimulate external activity through the use of a wider network of volunteers and partners. Even where the model is strongly focused on technology, the customers of foresight are still likely to be business people, civil servants and educationalists. It is important to speak their language.

Step 8—Establish regional governance structure

In regional foresight the central unit must be managed by the host or contracted organization but governance of the wider programme is a matter for all stakeholders. These will almost certainly include the funding bodies and representatives from industry and the research community. Whatever type of executive body is selected, it should be responsible for overall strategy or direction; but not necessarily for detailed operations.

The dilemma of governance is as follows. Foresight should be inclusive otherwise it cannot significantly impact on economic development or social change. However, trying to include everyone may lead to endless debate about programme content and delivery method. Often the agenda is captured by academics or civil servants who have the time and inclination to pursue foresight for its own sake. Industrialists soon lose interest.

The truth is that foresight should be targeted towards those actors and players that are capable of turning discussion into commercial benefit and/or social improvement. Generally speaking, those groups that are tightly specified, cogniscent of targets and subject to timescales are more likely to achieve results. Strong management is essential and the best way to achieve this is to empower a single agency to be responsible for operations, whilst safeguarding the right of stakeholders to set strategic direction.

In north-east England, for example, governance is provided by an Executive Board (meeting monthly) and Steering Committee (quarterly) representing industry, higher education, and business support. Other committees are formed to control fixed-term actions. Day-to-day management and operations are based at the Regional Technology Centre (RTC North) where a full-time team of four foresight project managers work alongside a large number of business support and technology transfer personnel.

Service development

Step 9—Quantify existing provision

Another early-day task is to measure the scale and focus of current activity. This is really an extension of the mapping exercise carried out in stage one and will enable the foresight team to target new services more accurately. One method is to create a matrix with the vertical axis listing all innovation projects and services considered relevant to foresight. Along the horizontal axis enter the names of organizations offering the service, accompanied by an assessment rating of how well this is being performed and the extent to which it satisfies total demand.

This kind of approach yields a mixture of quantitative and subjective data but is useful for sharpening up strategy and developing foresight partnerships. Professional "mapping" of services will go further by identifying gaps in the current support infrastructure and identifying specific groups of companies currently not engaged by innovation and technology transfer support.

Figure V. Audit of innovation projects relevant to foresight

Activity Description	Provider 1	Efficiency + Market Coverage	Provider 2
1. High technology seminar	University dept.	M + 40%	
2. Sector mapping project	Agency X	H + 75%	
3. Engineering programme for schools	Consortium A	M + 55%	
4. Technology skills audits	Agency Y	L + 25%	
5. Technical problem shooting	Business Link	H + 85%	
6. IPR management training	University office	L + 35%	
7. Industrial market research	Consultancy	H + 65%	
8. Cluster development (sectoral)	Consortium B	M + 15%	

Source: Ollivere, (2003).

Step 10—Select and test pilot services

This is a natural sequel to the mapping process described above. Existing services that fit the plan but are being poorly delivered, may be adopted as potential improvement projects for the wider foresight partnership. Services that are not present within the host region but have proved successful elsewhere in Europe will be a high priority. However, these are more difficult to specify and may become the subject of specially funded pilot actions delivered directly by the central foresight unit. In such cases the following logical sequence may be applied.

- Should we be doing this? (if yes) Search for successful examples.
- Is this service transferable? (if yes) Calculate cost and method of delivery.
- Are resources available? (if no) Consider options to secure funding.
- Is the target group aware? (if no) Develop improved marketing strategy.

Step 11—Design a balanced service offering

Five basic categories of service typology can be recognized, based largely on target group. These are summarized below.

- Public information—resource gathering, inquiry handling and awareness actions to increase general knowledge of foresight and the range of tools and techniques available.
- Institutional foresight—aimed at policy-makers, utilities and public bodies and using Delphi studies, fixed-term task groups, event facilitation and input to long-term regional plans.
- Technology foresight—monitoring of global scientific trends and market applications to assist high tech organizations in targeting their R&D products and services.
- Industrial competitiveness—assisting local business to anticipate change and prepare for future markets—cluster development, sector studies, scenario planning, product concepts.
- Individual enterprise—work with schools, colleges and community bodies to increase business skills and science appreciation, e.g. competition, curriculum and project actions.

Until now, regional foresight projects have tended to specialize in one or other of the above categories depending on the local environment, host organization and funding priorities. There is an increasing trend, however, towards creating a broader portfolio and reducing the strong technology focus of earlier times. It is also highly likely that the profile of activity will change over time. Newly formed programmes are often characterized by an abundance of information services and events while mature ones employ group facilitation and direct consultancy to a much greater degree. In developing a work programme, the management must be realistic about the variety of services that can be reasonably delivered with the staff and funding available.

Step 12—Evaluate outputs and client benefit

The orientation of services towards client needs is especially important in the early stages of a foresight programme because this is when people really have to be convinced that foresight is a practical proposition for self improvement—not an exotic intellectual exercise. When new services are first implemented, high priority should be placed on designing analytical systems of measurement including “expectation versus exit” questionnaires, stage-post telephone surveys, ROI (return on investment) calculations, etc. Inputs will be of three types:

- Process measures—the degree of activity generated in delivery of the service.
- Participation measures—the extent of interest or response showed by the target group.
- Benefit measures—the resulting improvements experienced by the client.

All of these are important in themselves. Higher levels of activity (mailings, visits, events) are likely to attract more response (replies, meetings, attendance) provided that the activity is well targeted. Higher levels of participation should in turn lead to greater client benefits (e.g. earnings, products, new skills) provided that quality standards are maintained in areas of real need. Keeping these three types of measurement in proportion is key to the overall success of the programme and, arguably, more important for foresight than standard business support processes.

Marketing and delivery

Step 13—Determine operating methods

When the service mix has been selected the next step is to decide on how it will be delivered. Which companies constitute the principal target group? How will they be accessed? Will it be done directly by core foresight staff or contracted out to external agents? For each foresight product or service, a systematic process should be undertaken to determine the most efficient and cost-effective delivery method.

These are questions of "operating efficiency" and are closely related to the amount of human resources available. During the early stages of development it is advisable to avoid employing permanent staff where there is no internal track record and no guarantee of demand. The use of a register of external consultants is an excellent way to reduce risk when testing the viability of services. Equally it is a useful strategy for smoothing out the peaks and troughs of a variable workload without the need to adjust staff numbers. Another advantage of this strategy is that it creates a powerful network of foresight "champions" who will market regional foresight.

Step 14—Create "intelligent front end" resource

Whatever external delivery method is employed, one or two full time staff will be needed to manage the central resource base and coordinate external operations. As the regional programme evolves, additional staff employed at the centre will help to create that extra sense of critical mass needed for strong marketing.

The intelligent front end has two components—firstly, a responsive inquiry-handling system and second the resource-base itself. Herein lies another argument for placing regional foresight alongside an established organization with permanently attended facilities and information resources. A separate foresight identity and resource platform can be built within this framework. Maintaining a high quality inquiry point is especially important in a knowledge based activity, such as foresight, as well as systems to ensure efficient servicing and tracking of inquiries.

Initially resources may include literature and materials provided by the national programme. Certainly this was true in the UK, where the operation of 16 expert panels produced many reports that were backed up by materials developed by a large staff of civil servants and industrial secondees at the Office of Science and Technology. Consultants were subsequently commissioned to produce high quality facilitation manuals and scenario planning aids for use in the regions. Nevertheless, it will be the ambition of every regional foresight programme to develop tools of its own, either unique or adapted to the local environment.

Step 15—Extend the scope and range of foresight

As stated earlier there are at least three recognized domains of regional foresight.

- The first sees policy-makers at the heart of the debate and better strategy as the output.
- The second sees scientists at the centre and superior technology as the output.
- The third sees foresight as a subject for public debate leading to cultural change and improved understanding of science and attitudes towards enterprise.

Although, these issues determine the detailed content of foresight programmes there is little disagreement among practitioners that foresight should make use of the multiplier effect. The early Delphi studies run by national governments in the UK, Japan and elsewhere created networks of experts drawn from industry and academia. More recently and on a more limited scale regional programmes have been doing the same thing. Foresight techniques can be usefully employed within groups based on key industrial sectors or technology clusters.

One of the main differences between existing regional projects lies in the extent to which group activities are used to either accumulate or disseminate foresight knowledge. In the author's opinion both strategies should be employed. Expert task groups should be assembled to study very specific regional issues (e.g. R&D exploitation, tourism, health). They should be contracted to do this for a fixed time and with a clear objective on which to make recommendations. The central foresight unit should coordinate these expert groups on behalf of regional government

Step 16—Disseminate foresight skills and capability

As regards dissemination, it is important to extend foresight skills (not just data) to individuals who can best exploit the knowledge. In the north-east of England this has been done in areas as varied as defence diversification, offshore engineering, information technology, lifelong learning, crime prevention and ageing population. The central foresight unit should play its part facilitating such events but—more importantly—it should train other agencies to facilitate their own events and become familiar with foresight tools and techniques

Foresight can be a powerful tool for regeneration especially in regions where culture change is considered a priority. To get the most out of foresight it must become a "mass participation" activity, involving individuals as well as organizations. But individuals do not readily accept the outputs of strategy reports or studies. The way to reach them is in the context of their everyday lives, in their place of work, leisure or learning. Hence, the importance of working with schools and underprivileged communities as in the technology outreach programmes associated with Federal Government Laboratories in the United States.

Creating an accredited facilitator network can be an effective means of dissemination. Individuals are selected from a cross section of organizations, trained in facilitation

techniques and provided with professional materials. In return, they act for an agreed period as "network champions" spreading foresight skills to other individuals within their own businesses or communities.

Stablization/sustainability

Step 17—Collaborate with international networks

Foresight is a relatively new discipline, at least in the context of economic regeneration. At the international level there is much to be gained from an exchange of experience, because more and more regions are investing in foresight programmes—often constructed for different reasons and in highly contrasting political and social environments.

An example of good practice is the FOREN network, a project led by the Institute for Prospective Technological Studies (IPTS) and three other main partners but contractually linked to approximately 20 regions from across the whole of Europe. Each region supplied a policy representative and a foresight specialist, which provided an additional helpful dynamic.

Collaborative action between and within regions must be based on the principle of mutual benefit. No partnership will survive for long if all the giving is in one direction or all the experience is exactly similar. In constructing a foresight network it is recommended, therefore, to select partners who are from sufficiently different environments and stages of development to be able to learn something new from one another.

Step 18—Invest in local research capability

Part of the remit should be to develop a regional observatory of science and technology trends. Initially this might be a small-scale monitoring function coupled with a system of on-line alerts designed to inform businesses of anticipated changes in their own sector. A more sophisticated technology scan facility will go further to collect data about actual developments in technology implementation (case studies) and specific R&D opportunities with commercial potential.

Assistance and encouragement should be given to universities to incorporate foresight in both their teaching curriculum and research projects. Framework six includes opportunities for EU funded R&D. These fall under the headings of science and society (especially the promotion of science awareness) and new and emerging science and technology (the identification of science impacts). Such activity can help to build up an indigenous resource base.

A third area for investment might be a physical centre, specially equipped for foresight training and facilitation. The future focus centre at DII's in London provides an example. It includes a high-tech "immersive theatre" for playing out scenarios, a creativity lab for ideas generation and a flexible workspace for individual research. The DTI is now actively encouraging UK regions to build similar but less expensive facilities and offers training for operators.

Step 19—Apply integrated benchmarking strategy

There are two important elements of sustainability. One is about demonstrating benefit to stakeholders and the other is about securing long-term financial support. Of course the two are inextricably linked since long-term funding support—whether from the public or private purse—will depend on the foresight programme being able to prove its worth.

Step (19) is an extension of step (12) in which performance measures are applied to individual services. Benchmarking the entire regional programme of foresight activities will be a complex task because of the many different delivery agencies and participants involved. Nevertheless, it will be necessary as a means of convincing funding bodies of the need to invest in long-term facilities and resources. It is beyond the scope of this section to define a benchmarking strategy but the following observations are made:

- Regional benchmarking must begin with a baseline study that provides a quantifiable starting point in all relevant areas.
- Realistic targets must be established and goal units must be constructed that measure both throughput and benefit.
- The measurement itself must be seen to be impartial and only recognizing results which can be genuinely attributed to foresight intervention.

Step 20—Achieve long-term financial security

The second element of sustainability is concerned with money. Regional foresight programmes are almost always initiated by public funding, usually of fixed duration and for not more than three years. Within this period it is up to the operating organization to replace some or all of the grant money with alternative sources of income via commercial fees, industry sponsorship, etc.

Self financing is seldom considered a priority by those running foresight programmes. The activity is widely seen as strategic rather than competitive—too “soft” a discipline to attract commercial income. This is dangerous thinking. Government grants have a habit of tapering out more rapidly than expected and without quantifiable evidence of demand, it will be difficult to argue the case for continuance. The willingness of customers to pay for services is by far the best evidence of demand.

Although it is not realistic to expect foresight to become entirely commercial, the introduction of a charging policy must be an important strategy in a mature regional programme. The starting point is to divide services into categories according to whether their potential for generating income is low medium or high. For example, basic information services and promotional events have low potential. Focused activities, such as scenario planning workshops are in the medium category and clients should bear a proportion of the costs. In-depth consultancy projects benefiting individual corporate clients should ultimately aim to attract fees at full market rates.

The table below (figure VI) shows how the manager of a well-established programme might prepare a "price list" of free, subsidized and commercial services. The figures are quite meaningless in themselves but for illustrative purposes they calculate costs per unit of service delivery. These are a compound of time (10 units = 1 man/day) incremented by overhead (time + 50 per cent) and direct expenditure (variable according to service). The important thing is that the customer is given some indication of the true value of the services provided.

Figure VI. Exemplar "price list" of foresight services

Service	Target Group	Cost per unit (T+O+D)	Grant %	Cost to Client
1) Inquiry handling	General public	3	100%	0
2) Awareness event	Special interest groups	125	100%	0
3) Foresight award	Schools and colleges	550	100%	0
4) Diagnostic visit	Small companies	12	75%	3
5) Scenario workshop	Industry sectors	240	75%	60
6) Information audits	Organizations	80	50%	40
7) Facilitator training	Support agencies	300	50%	150
8) Technology watch	High-tech subscribers	120	20%	24
9) Change consultancy	Management teams	225	0%	100

Source: Ollivere, (2003).

Current examples of regional foresight do not benefit significantly from commercial income. More often their strategy has been to seek additional public sector income from EU or local authority sources. Foresight programmes in the UK have been significantly enhanced by finance in those regions eligible for ERDF support. However, a growing number of private sector consultants are now offering services such as corporate visioning and management of change. There is no reason why these high level and strongly focused skills cannot be successfully built into the framework of a public project.

Whilst commercial income is desirable, it is likely to be in short supply for some time to come. This is especially true in the regions of Central and Eastern Europe which face enormous additional difficulties in terms of modernizing their economic and social systems, including attitudes towards enterprise. It follows that these regions must initially seek to make the most efficient used of pump-priming finance by transferring knowledge and best practice from outside and by concentrating on a skills-based approach that produces practical results in the shortest possible time scales.

Some observations

Some important observations that have been made within this section, and which are based on practical experience and knowledge of foresight applications are summarized below:

- Regional foresight can be applied both in the areas of short-term possibility and long-term probability. The first is the natural domain of an anticipative business. The second is the province of policy-makers operating a strategic futures programme.

- Foresight can be a useful top-down tool for decision-makers at national or regional level. However, in order to achieve a real impact it must be converted into a bottom-up activity—a "mass participation sport" empowering people to influence their own future prospects.
- Decisions are made in different ways by individuals, institutions and industry. Foresight is a very difficult discipline to market—especially to small companies—and those responsible for promoting regional programmes must address all three levels.
- Technology trends may be predictable but their long-term applications are not. Foresight is relevant to all aspects of social and economic development. A balanced work-programme will contain cross-cutting activities bringing industry, education and public services together.
- Greater impact may be possible in poorer, less confident regions, because foresight makes people think creatively and takes them out of their current environment. But foresight is not, in itself, a creative activity—it is hard systematic work.

A successful regional foresight programme will take many years of time and effort to establish. It normally requires a "champion" or lead agency with good contacts and resources, supported by government and delivered through a complex network of external facilitators, expert groups and intermediaries. If the process is well managed, foresight will produce remarkable results and in time will come to be regarded, not as the exotic pastime of an intellectual, but as a perfectly natural way for ordinary people to solve problems and exploit opportunities.

6. ISSUES TO CONSIDER IN ORGANIZING A REGIONAL FORESIGHT PROJECT

Resources

In thinking about the nature of the resources available in your region, it may be helpful to distinguish between:

- *Institutional capital*—the capacity of the formal institutions in a region to concentrate on problem-solving, capacity to act, speed in decision making, organizational flexibility and intelligence and inter-organizational relations.
- *Cultural capital*—the heritage of traditions, values and beliefs, language, social relations, etc.
- *Symbolic capital*—the potential to mobilize energies to the task of region building, generate self-references, build corporate territorial images.
- *Psychosocial capital*—a key element of which is trust (in the community and in its development potential, and in enabling cooperation in setting up groups and associations).

- *Cognitive capital*—the collective know-how (as opposed to individuals' human capital) much of which resides in the knowledge infrastructure organizations (universities, research centres) and firms.

Beyond the local institutional and social capital, some other important characteristics of regions relevant to their foresight activities are:

- **Governance.** Successful regional foresight requires political leverage that can enable its initiatives and proposals to be acted on. Cooke et al (in *Regional Innovation Systems—The role of governance in a globalized world*, UCL Press Ltd. 1998) distinguish three types of governance. Grassroots (local coordination of actors, highly applied orientation of technology-related activities), Network: (high coordination between networked actors including firms, funding organizations and research organizations) and Dirigiste (high coordination and central management of key assets such as funding and research competence).

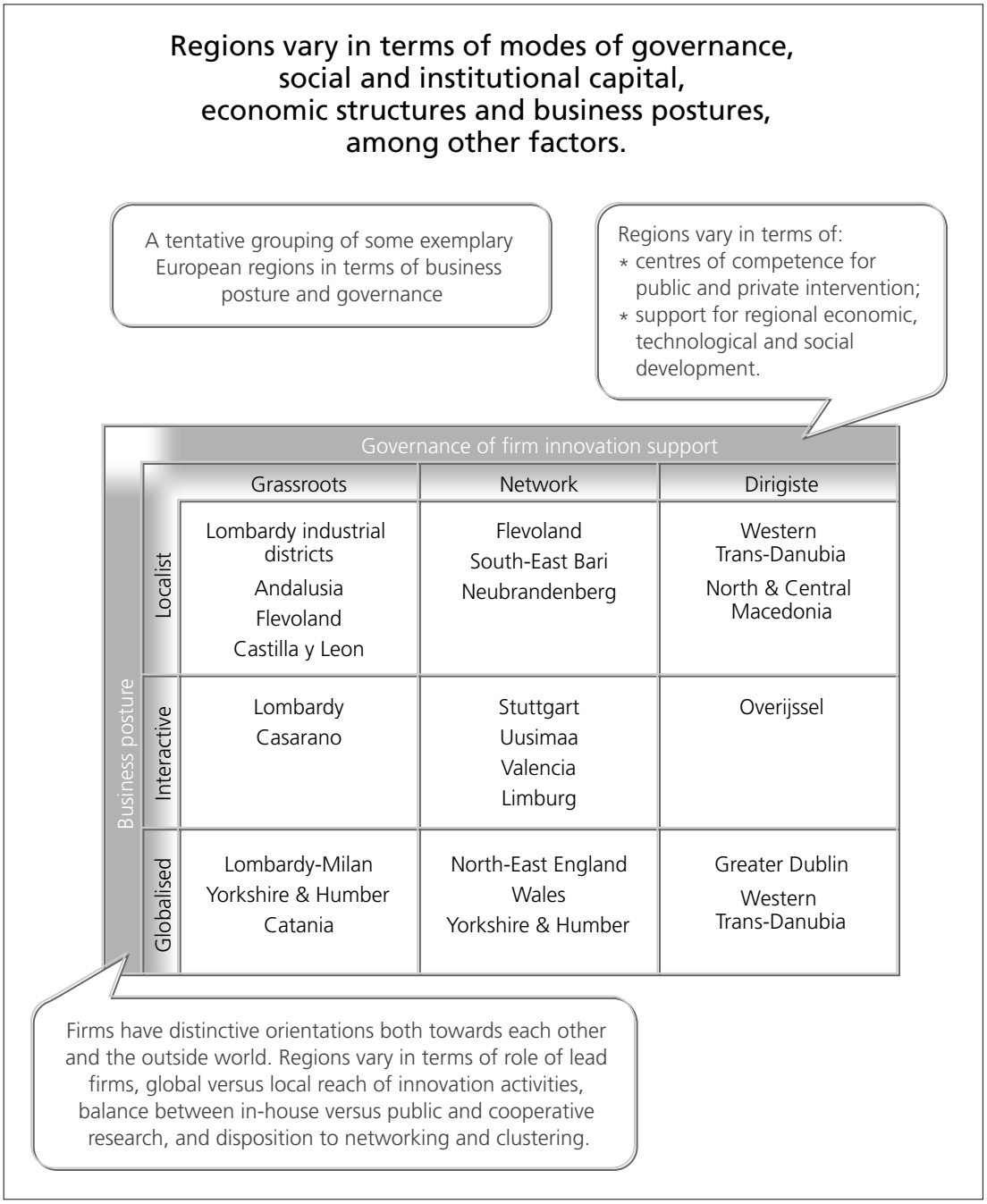
- **Business postures.** Cooke et al (1998), focusing particularly on innovation dynamics, identify three regional types. The localist type has few if any: large indigenous firms, or branches of externally controlled firms; local research organizations capable of combining with regional industrial clusters; public R&D/innovation resources (there may be some small private ones). There will often be high "associationalism" among entrepreneurs and between them and regional policy-makers. The interactive type features more of a balance between large—indigenous or inward investing—and small firms; there is widespread access to regional R&D resources and to outside sources when required; and also a balance between regional government promoting innovation and large private firms with laboratories; and high "associationalism" between—local and regional networks, forums and clubs. The globalized type features a significant presence of global corporations, often supported by (supply-chain dependent) SMEs; R&D is largely internal to firms and privately financed, though there is some SME-oriented public innovation infrastructure; local "associationalism" is heavily influenced by the needs of larger firms.

Figure VII illustrates these two dimensions. Additionally, regional foresight will be influenced by the region's:

- **Financial and budgetary competence.** Regional financial competence relates to the degree of local control—private and public—over major financial issues. For example, are there local capital markets, local credit-based systems involving regional administration in loan-guarantees, regional public budgets? Budgetary competence can take various forms—regional government may administer decentralized spending (channelled from central government) as in France, Italy and Spain; undertake more autonomous spending, where regions determine how to spend a centrally allocated block grant, is the case in Scotland and Wales; or possess regional taxation authority, again in Scotland, and in the Basque country.

- **Infrastructure.** Regions vary immensely in the influence they can exert on "hard" infrastructure (transport, telecommunications) and "soft" or knowledge infrastructures (universities, research institutes, science parks and technology transfer centres).

Figure VII. What features of a region influence the approach to foresight?



Source: Keenan, Miles, (2002).

Why and when should the decision be taken to undertake regional foresight?

Regions can have very different reasons for undertaking a foresight exercise. These will depend upon their characteristics, priorities and objectives. The motivations may be mainly reactive:

- A national agency has requested that you contribute your region's views into a national exercise, or
- You may have learned of the results of a national exercise, and be concerned as to what their implications are for your region.

At the other extreme, much more proactive reasons may be involved:

- In the absence of a national foresight approach, you want to make use of this set of policy tools.
- You may be concerned about the future prospects for a particularly important sector of your economy, and wish to gain insight on the challenges and opportunities it may face in the future.
- You may be interested in building a future vision for your region, because you are dissatisfied with the perspectives on regional development that emerge from other levels of government.

The particular style of foresight you adopt will be shaped by the objectives you are pursuing.

Independently of these considerations, the decisive factor in launching a foresight, exercise—especially one involving a range of societal and economic sectors—can also stem from a fortuitous or special combination of circumstances that spell either a major threat or major opportunity for the stakeholders concerned. Examples of these could include:

- An external (i.e. national government) threat to reconfigure regional/local government institutions and reallocate competencies.
- A threat to the local economy, for example, the decline of a local industry, the withdrawal of a major inward investor, etc.
- For less-favoured regions, the need to prepare for the major impact of EU enlargement on structural and cohesion funds.
- For rapidly developing regions, there may be a desire to avoid falling victim to the problems that come with rapid success and growth, such as infrastructural bottlenecks, skill shortages, wealth imbalances, etc.

Three main rationales for foresight activities are to:

- **Inform policy-making**, so that decisions taken by key actors in the commissioning body are more aware of longer-term developments and how these are liable to interact with current policy decisions. Often a foresight exercise will be stimulated by the need to take a particular decision. But the knowledge developed, and the foresight capabilities that have hopefully been embedded in the organization, should have a wider significance.

- Help **build networks** among the people centrally involved with shaping the future of a particular topic. They will be brought together to work on their visions and assessments of the future. The purpose of this is to help them become better able collectively to understand the challenges and opportunities they are liable to confront, and the strategies and objectives that others might pursue.
- **Develop capabilities** widely throughout a region to facilitate the development of a "foresight culture". The aim of this is for people of various kinds to be able to define and embark upon their own foresight activities, to forge their own foresight networks. This is probably the one that has been slowest to be recognized as a practical goal—but it is often very relevant at a regional level.

In practice a mixture of these three reasons is often in play. In practice, too, there may be other goals that stimulate regional interest in foresight. It may be kicked off by a national exercise, or an effort to make the region's voice heard within the context of such an exercise.

A regional foresight activity will, of course, exist in the context of activities undertaken in other regions and quite possibly at the national level. It will almost always be desirable to make use of foresight outputs and experiences from such other sources. The exceptions may be where there is a radically different foresight philosophy being adopted elsewhere, or where there is a strong need to differentiate regional activities—for instance where a national programme is seen as not paying sufficient attention to regional issues. There may also be sensitivities involved where the networks established in different exercises overlap.

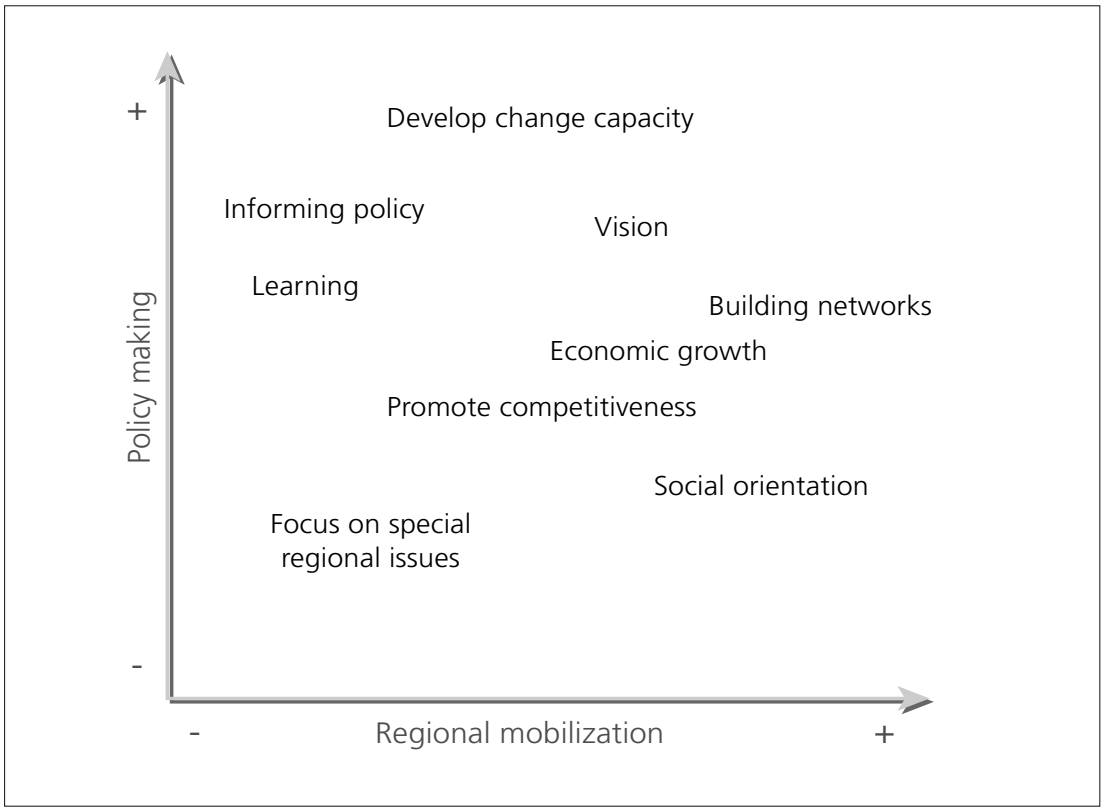
Beyond using outputs from other exercises (and supplying outputs to them, as well), other types of link may be fostered. Liaison with other exercises may be a means of learning good practice, practical problems of using specific approaches in specific contexts, scope for pooling resources, and so on. To date there has been limited experience of active regional exercises being strongly linked to active national ones. Unless the region is in a high degree of conflict with national authorities, this can nevertheless often be an ideal to aim for. Finally, international organizations, such as the European Commission, can play a role in collating information about foresight and fostering its use in particular settings. Such activities may be sources of information and practical help for new foresight activities.

Foresight is essentially about helping to confront challenges more effectively. The focus and approach of your regional foresight activity will depend upon the specific challenges confronted. There are, of course, various ways in which this can be done, and a range of objectives is integral to most foresight activities. These objectives should be clearly stated, and internally consistent. In the first instance, it is often important to avoid being too specific: in order to gain widespread support for your activities early on, consultation with key regional players is required. This can help ensure early buy-in to the exercise. The involvement and mobilization of regional actors is one of the key success factors and can be seen as an objective in itself.

One can plot some typical objectives for regional foresight, as shown in figure VIII in terms of the emphasis on:

- The mobilization of regional actors and consensus building.
- The ability to inform and shape policy-making and decision-making processes.

Figure VIII. Some typical objectives for regional foresight



Source: Keenan, Miles, (2002).

Who should lead?

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 is 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. There must be established a good measure of shared agreement as to the nature of these challenges at an early stage in the foresight activity.

In scoping foresight it is important to measure these challenges against regional actors' and institutions' remits, decision-making powers, and capabilities. This will make it easier for you to identify which foresight outputs can be followed up locally and which will require action at other territorial levels. In terms of the inputs that foresight requires, it will help identify where outside expertise and agencies might be required. A crucial issue for participation and network building that will help you consider is whether the expectations of participants are realistic.

Once you have identified the challenges in broad terms it is important to consider the extent to which the organizations based in your region, 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 administrations 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.
- Other issues will have a national or global reach and therefore the crux will be to identify the appropriate perspective to take at the regional level, and consider how regional foresight considerations might be linked to those at higher territorial levels.
- The challenges to address may be highly pertinent to your region—but the political competence to deal with the issues may or may not reside in your organization, and other regional bodies will have to be brought on board very early on if the chances of connecting to critical users are to be maximized.

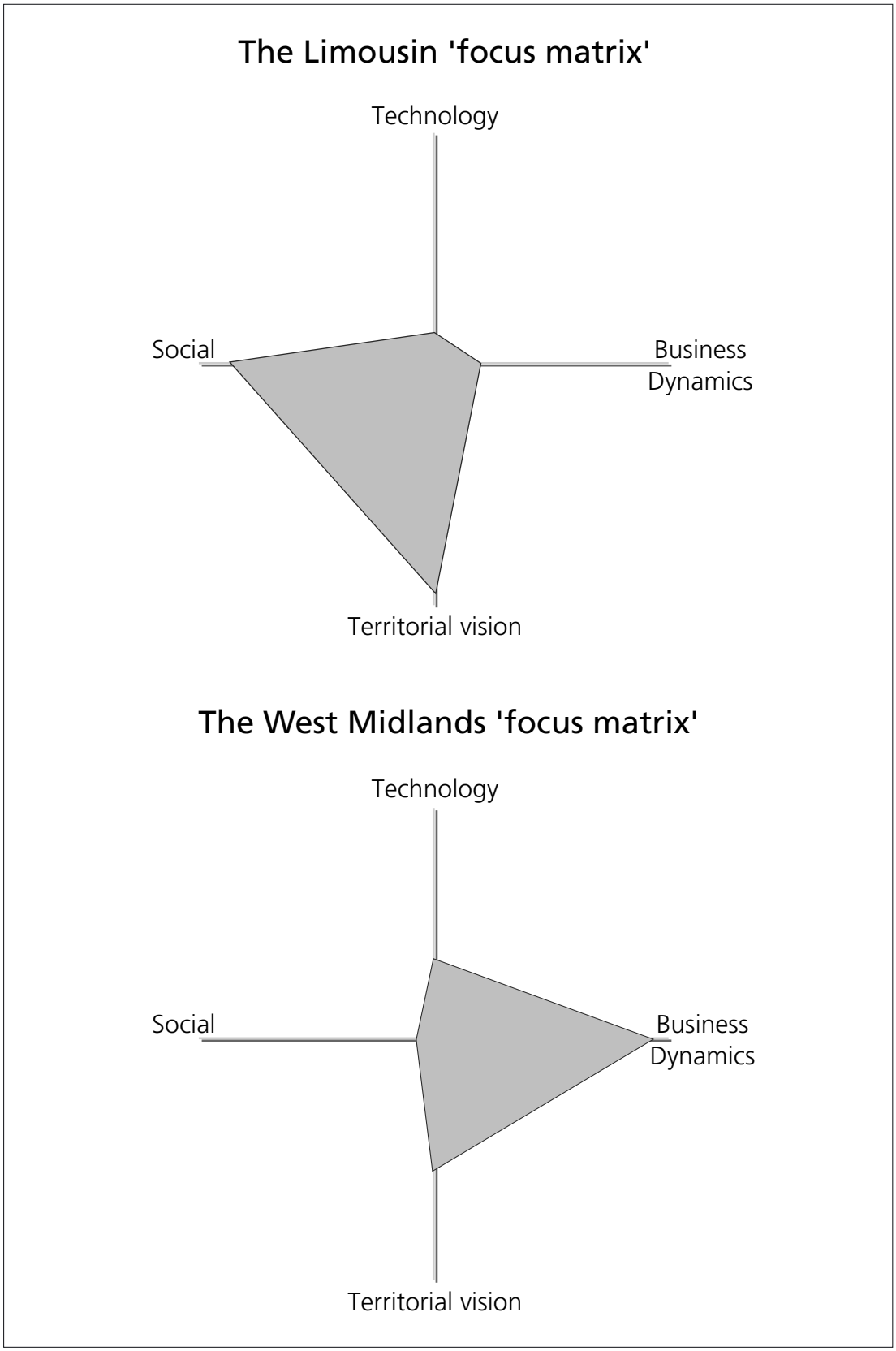
These are just a few of the considerations to bear in mind. However, the underlying questions of competence, prerogative and authority, are absolutely vital. Since foresight is a participatory process involving time and commitment from stakeholder representatives, your activities must carry a stamp of approval strong enough to assure participants that they are engaged in a worthwhile endeavour. This in turn implies that foresight findings and outputs must be followed-up and acted upon. Otherwise, stakeholders will not give you a second chance. Similarly, care must be taken not to promise too much to too many regional players.

Selecting the focus of the exercise

The focus of foresight will flow from the challenges that have been identified. A broad classification of areas that can be the foci of regional foresight activity distinguishes between the following areas:

- **Social:** the emphasis is on human development, covering issues such as demography, settlement, mobility, identity, sense of belonging, citizenship, networks, human capital, education and training, and health care.
- **Science and technology:** the emphasis is on technological developments on the one hand, and market opportunities and social needs on the other. This has been the most common focus at the national level, but is where results at the regional level are often less relevant.
- **Business dynamics:** the stress is on economic development, with activities often focused upon enterprise clusters, SMEs, industry associations, etc.
- **Territorial vision:** the region is considered as a whole in a larger system as a nexus within which major global issues and trends—geography (resources, environment, etc.), geopolitics, economy and human development, for instance—interplay.

Figure IX. Two examples of focus in regional foresight



Source: Keenan, Miles, (2002).

In fact, most regional foresight exercises do not have a single focus, but a combination. The striking contrast in foresight focus between the two regions can be largely explained by the extent of regional devolution in both countries. In France for example, "territorial prospective" has become firmly established over the last 15 years, and there is a strong territorial and social agenda that reflects the development of regional devolution during this time. In contrast, there has been little devolution to English regions such as the west Midlands (until the recent establishment of Regional Development Agencies (RDAs)—which have a predominant business focus). It is therefore unsurprising to see that the English region's foresight activities are skewed towards business dynamics.

These two examples illustrate the importance of considering what power and competence regional-based institutions and processes have to influence or respond to particular challenges. Such an assessment will need to be made, preferably in consultation with major regional players, prior to any decision on the focus of regional foresight activities. The history of foresight in the region should also be considered, as well as the experiences encountered in any existing activities. As well as providing possible results and benchmarks for your work, they could provide important lessons as to the political, social and cultural issues that have to be taken into account if the exercise is to be a success.

Positioning foresight

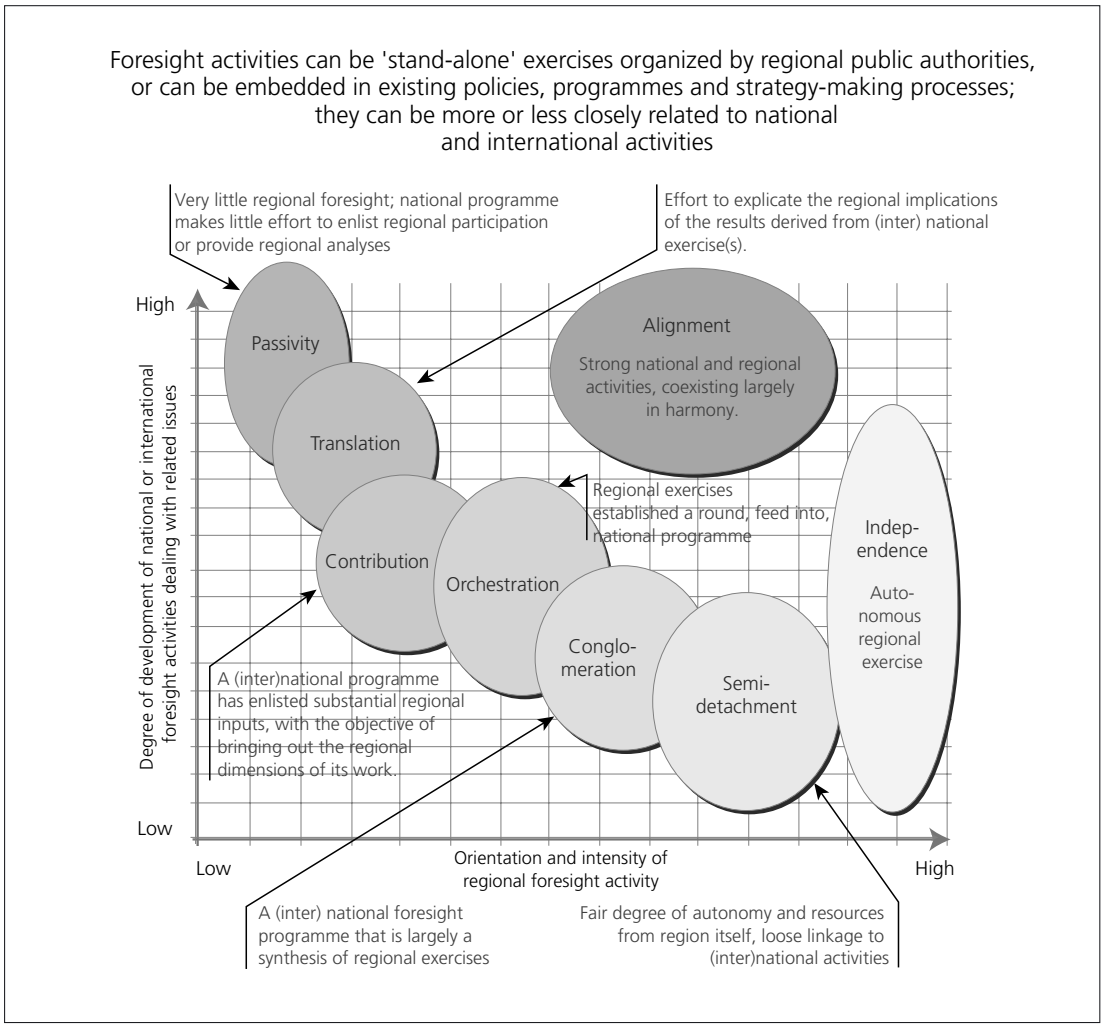
In some regions, foresight activities have been organized by regional public authorities as relatively "stand-alone" exercises. This is perhaps most evident in France, where a number of regions have organized major territorial prospective exercises with the objective of generating overall territorial visions. Such exercises are often located in strategic positions, e.g. central planning departments or other central agencies, such as the office of the regional "governor". By virtue of their broad focus and central position, these exercises often address cross-thematic and cross-sectoral issues, which can be missed by existing institutions and processes. But this can make their results difficult to implement, especially if regional government and/or business are organized along "traditional" lines.

For this reason, some people argue that regional foresight should not be detached, but rather embedded into existing policies, programmes and strategy-making processes. This requires a quite different mode of organization from a more centralized exercise. It is likely to be more discrete, using existing policy or business support programmes and frameworks. Such approaches also tend to be more process- than product-oriented, explicitly seeking to influence processes and behaviour at the micro-level. The recent UK approach to regional foresight is perhaps closest to this model, as exemplified by the north-east England and west Midlands case studies provided later. However, as the Uusimaa case study suggests, there is a danger that foresight activities can become totally subordinated to everyday information needs, whereas foresight should really be about thinking "outside of the box".

The following diagram (figure X) sets out a "spectrum" of relationship between regional foresight and activities at higher territorial levels. Alignment is something of an

ideal. It will need reconciliation of coordination and autonomy in various ways—for example, there may be a separation of themes to address (e.g. national technology focus, regional cultural focus), or high levels of shared membership of working groups. At the other extreme, independence characterizes some of the Spanish regional activities, for example. There may be no national programme; or it may be viewed (rightly or wrongly) as inappropriate to regional concerns. regional political sentiment or ambition may mean that a regional programme is prioritized as an element in fostering local identity and political autonomy. While there is likely to be informal and formal contact between individuals and/or agencies at different levels and in different regions, in these circumstances there can be divergence in methods and philosophy of foresight. Across the spectrum of linkages we see activities ranging from the "translation" of materials to suit local contexts, efforts to establish participation from and workshops in regions, coordination of training and milestones, and the like.

Figure X. How could foresight be "positioned" vis-à-vis existing policies and programmes



Source: (the illustration is a modified version of that presented in I. Miles and M. Keenan 2002, "Bringing It All Back Home: Linking National and regional foresight", IPTS Report no 61, February 2002, pp 29-35, online at http://www.jrc.es/).

Coverage

It must be recognized from the outset that it is impractical to set out to cover all possible regional themes and/or sectors. The choice of themes to prioritize mostly depends upon the objectives and foci of your foresight activities (figure XI).

For example, if a predominantly sector development focus is to be followed, are all business sectors in the region to be covered? This is highly unlikely—not least due to the costs and coordination efforts involved—and so some form of selection among sectors will be necessary. The same selection challenge will apply where themes or problems are taken as the starting point, as in the more territorial and social-type exercises.

How this selection has been made within regions has often not been 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 organizational decisions. Lobbying by interest groups is another influence; and this certainly is an area 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.

In relatively centralized regional foresight activities, logistical and coordination concerns naturally limit the scope of activities. More distributed foresight activities, initiated and coordinated by a wide variety of regional players, in theory allow for a whole multitude of themes and sectors to be simultaneously addressed.

There are two major problems that such more distributed approaches confront. Firstly, perhaps inevitably, these initiation efforts must be targeted, given resource constraints, bringing you back to the original selection challenge. This situation is perhaps best illustrated by the UK national foresight programme's regional experience in the early years of the 21st century. The programme put emphasis on stimulating regional players to initiate and organize their own foresight activities: but it proved impossible to select and target more than a handful of business sectors (or clusters) for attention at any one time. Another way to deal with this selection challenge would be to put in place a "rolling" programme of regional foresight activities, with perhaps four or five different themes and/or sectors addressed each year. Second, a problem of these more distributed (and often-piecemeal) activities is that they are poor at providing regional "vision". This is because they tend to focus on a small number of themes and/or sectors, they often lack region-wide visibility, and they tend to miss cross-cutting issues. Despite such problems of coordination and synthesis, they may be highly effective.

Time horizon

Foresight is essentially concerned with increasing the time horizon of planning activities. This is not just a matter of "stretching" existing horizons, extending familiar plan-

Figure XI. What types of themes and/or sectors should an exercise cover?

Themes and sector coverage depends upon objectives and foci of the exercise; some of the more grandiose exercises have covered around 20 areas, although fewer than 10 is more typical.

Region	Examples of themes or sectors addressed
West Midlands	Creative industries Medical technologies Engineering design
Limousin 2017	Services Agriculture Identity, images and creativity
Catalonia 2010	Telecommunications External transport links Catalan identity
Uusimaa	Knowledge intensive business services (KIBS) Employment in voluntary sector
Nord—Pas de Calais	Waste Materials New Services Urban Structure

How many areas to cover? Some French exercises (e.g. Limousin, Grand Lyon) have set up around 20 working groups, with each looking at a particular theme or sector. In other places, only 5-10 such groups have been established. There are often attempts to tackle cross-sectoral and/or cross-thematic areas, where synergies are thought to lie. The examples above show that a broad range of themes and sectors, both emerging and long-standing, has been addressed by regional foresight activities.

Source: Keenan, Miles (2002).

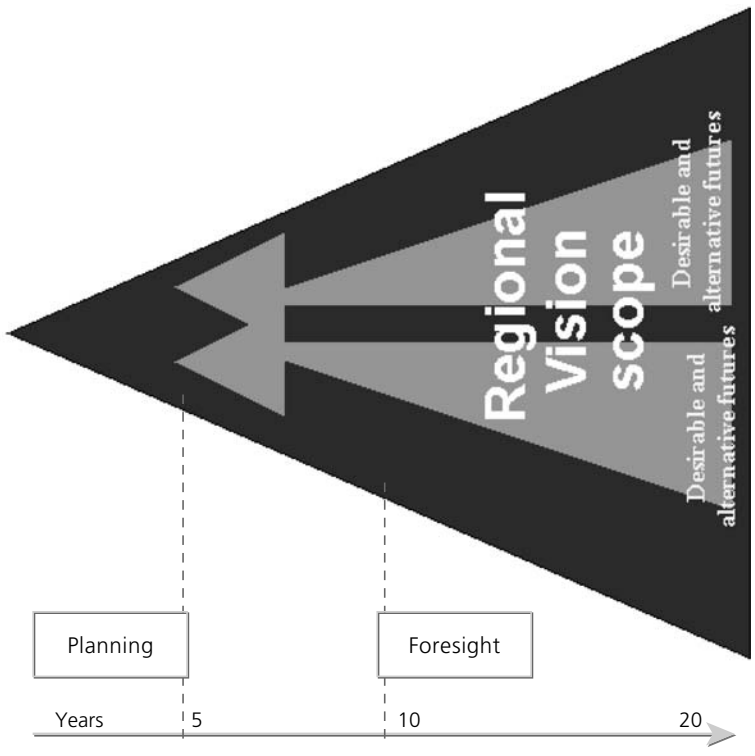
ning and intelligence-gathering into a longer-term future. A major point about the longer-term is that it brings into relief trends, countertrends, and possible events that are of limited concern in the short term. Such developments may well not be crucially important to one's immediate prospects—but if they are not taken into account until the problems start to manifest themselves, 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. Similar issues are confronted in infrastructural developments, or in the cases of energy or water systems, or restoring natural environments, for example.

The time horizon of regional foresight activities varies considerably in practice. What is thought of as the "long term" varies considerably across different cultures. In the French "territorial prospective" studies, the time horizon has tended to be around 20 years. In contrast, studies oriented towards sector development, such as have been undertaken in the UK, often have significantly shorter time horizons—sometimes as little as 5 years. These differences reflect different users as well as different issues and cultures. Thus, regional planners are more likely to find longer time horizons useful than, say, small- and medium-sized enterprises (SMEs) (see figure XII).

An apparent paradox of regional foresight is that whilst a long time horizon provides the opportunity to develop a broad vision for the territory, most players' expectations are for short-term activities. In fact, there is no paradox here—regional foresight is instigated in order to think about possible futures, with a view to changing what we do today for the better. Regional foresight is about readjustment, in the present, to create more agile regions for the future.

Figure XII. What would be the most suitable time horizon for regional foresight

Time horizons tend to vary from 5 years up to 20 years, reflecting the varying identities of projected beneficiaries; as a rule of thumb, the time horizon of regional foresight should at least be beyond the normal planning horizons of the players involved.



West Midlands	Baltic STRING	Catalonia 2010	Limousin 2017	Grand Lyon Millenaire3
5 years	10 years	20 years	20 years	20 years

Source: Keenan, Miles, (2002)

Who should be involved?

A broad range of regional actors, including regional governments, universities, businesses, chambers of commerce, local media, industry associations, other NGOs, and the population at large, can all potentially be included in regional foresight (see figure XIII). Again, the focus of foresight activities will have a significant bearing here, with sector development-type exercises tending to engage mostly business interests, whilst social and territorial foresight will most likely see attempts to engage with the wider public.

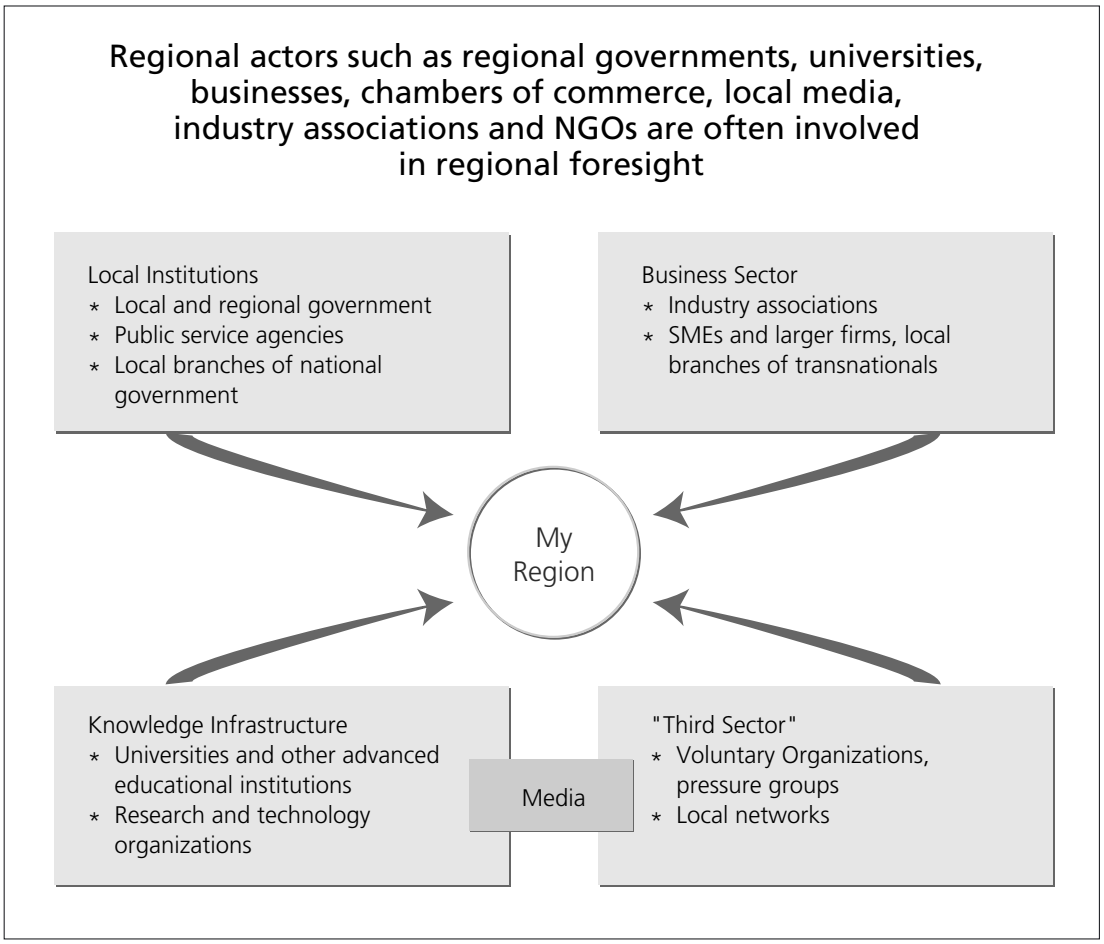
Regional foresight exercises can potentially involve thousands of participants from a wide variety of organizations and backgrounds, and this has been the case in a few exercises. Even here, of course, it is typical for some groups to be more actively engaged than others. National foresight exercises have typically shown a preference for engaging "experts", a reflection of their early preoccupation with science and technology issues, although this is now changing. Notions of "expertise" are likely to be broader at the regional level, particularly where more socio-cultural issues are concerned.

A further issue on involvement concerns regional politicians—what should their role be in regional foresight? There is no clear-cut answer to this question. Much will depend upon the political culture of the region, and indeed, the nation-state. Deep political involvement can mean that things get done more quickly, but there are risks of becoming enmeshed in electoral processes that could result in an exercise being "tainted".

It should be borne in mind that wide engagement is often expensive and difficult to coordinate, which means that many exercises show a preference for the establishment of stakeholder and/or expert working groups that are considered as spokespersons for a particular area. You will have to assess the level of commitment expected of such participants, in terms of the amount of time and effort that they will need to devote to the exercise. This will require some careful planning, and participants will need to be told at the start what is expected of them. Nevertheless, you will probably underestimate the effort involved, but the spirit of participants normally compensates, since the foresight process typically enthuses individuals to work beyond the confines of the normal "call of duty" (although this should not be taken for granted).

However, panel and working group arrangements are often coupled with "windows" of wide consultation, where instruments, such as questionnaires, workshops and public meetings, are used at fixed points in the process. The latter are seen as important, since they lend regional foresight activities wide visibility. They can also provide a check on domination by any one particular group and they confer wide ownership of the outputs of an exercise. Moreover, the wider the involvement in regional foresight, the wider foresight process benefits will be dispersed.

Figure XIII. Who should be involved in regional foresight exercise?



Source: Keenan, Miles, (2002)

Duration and cost

The duration of a regional foresight exercise will depend upon its focus, objectives, coverage and the extent of participation. But if case studies are indicative anything from six months to three years should be anticipated (Keenan, Miles, 2002). Foresight can also become a "continuous" regional activity.

As for costs, little systematic financial data exists on regional foresight. Moreover, if the costs of national foresight exercises are to be considered as an indicator, regional costs are likely to vary, depending on both the location of activities and their scope. Clearly, territorial prospective-type exercises, as seen in France, will be relatively more expensive, by virtue of their duration and scope. However, more modest approaches are possible and these will require fewer financial resources.

The financial burden of regional 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. Core, and usually centralized financial costs are most likely to result from such elements as:

- The running of a project management team.
- The organization of meetings and events, travel and subsistence of at least some of the participants (you might also have to consider paying some participants to give up their time for your foresight exercise—this is uncommon, but in some regions, it might be necessary).
- Publicity material.
- Extensive consultation processes (e.g. questionnaire surveys).
- Other activities, both routine and one-off, associated with an exercise.

A good way to begin to estimate financial costs is to develop an outline of what a foresight exercise might look like in your region. It is a good idea to keep your outline flexible, so that you can add and remove different activities, thereby increasing or reducing the costs. Experimentation is recommended, and it is probably a good idea to develop a range of options.

Sponsors

Sponsors can be from either the public or private sector and are sometimes from both:

- The most common **public sponsors** are national, regional and provincial authorities (usually making the largest contributions), some municipalities particularly interested and involved in the project, universities and large national research centres, and centres of innovation. Furthermore, special contributions often come from organizations and institutes whose mission is the promotion of development and innovation activities, i.e. foundations whose aims are to analyse and study the development of socio-economic scenarios. Further important contributions may come from national and European Community public programmes set up to finance studies and analyses. Such contributions are often disbursed through the activities of the EC's RTD framework programme or ERDF, as well as through national research programmes, such as those set up in many EU countries to explicitly focus on foresight activities.
- **Private sponsors** may include large enterprises, which are particularly interested in the results of the activity (in some cases large regional firms may be interested in actively promoting their home territory—for customer or staff recruitment, or to win community support), banks and other financial institutions, entrepreneurial associations (especially in the case of foresight activities specifically oriented towards enterprise), research centres and centres of innovation (such as science and technology parks), business innovation centres, etc. In some cases, contributions from private sponsors may be offered in the form of co-financing of activities promoted by the European Structural Fund or similar mechanisms.

Generally speaking, both public and private sponsors should support the activity throughout its entire duration. Hence, the activity programme prepared at the initial stage of the activity will need to give clear details of the total duration of the activity,

the ways and means by which it will be updated, and the relative financing requirements. The activity programme should also include the consequent hypothesis of identification of resources. This programme must be as detailed as possible, highlighting the number of players involved, the events planned, the expected results, and the activities designed to encourage participation at territorial level. The programme should also describe how final results should be disseminated and enhanced (emphasising the points of interest to each category of sponsor). However, sufficient flexibility needs to be built into the activity programme to take account of possible and unforeseen developments during the course of your foresight activities.

There may be scope or even necessity for sharing of costs across two or more sponsoring bodies, e.g. a public-private partnership of some form. If foresight is intended to become a continuous activity in your region, it is certainly possible that sponsorship "duties" could be transferred to other organizations that might directly benefit from the foresight exercise. Carefully consider the advantages and disadvantages of such an approach. For example, could it lead to a special interest group "capturing" foresight?

Finally, it should be kept in mind that the time costs of participants in working groups and workshops are usually borne by their employers. This "informal" sponsorship should never be taken for granted and will need to be acknowledged. It is often the most important input that organizations can make, and were it to be costed, it would often far outweigh the formal expenses of the exercise

7. CASE STUDIES

Catalonia on the 2010 horizon (Spain)

Background

Catalonia is an autonomous community within Spain with a population of 6 million (Barcelona 1.6 million) occupying an area of 31,930 square kilometres. The primary impulse for this major regional foresight exercise was the need and desire felt by the Catalonian regional government or generalitat, in the late 1980s to anticipate future developments and generate a wide-ranging debate on the long-term positioning of Catalonia as a key Mediterranean region—in terms of both the internal view of what constitutes Catalonia for Catalonians, and the outwardly projected image and interconnections with the rest of Spain, Europe, and especially with the Maghreb on the south-western shore of the Mediterranean. This led to the establishment by the generalitat in 1989 of the Institut Català d'Estudis Mediterranis (ICEM) now called the Institut Català de la Mediterrània (ICM—Catalan Institute of the Mediterranean). Over the three years to 1992 Catalonia 2010 became the defining project for the ICM.

Scope

The study was very broad covering all aspects of Catalonian society—culture, politics, economics, demographics, spatial planning, etc. One of the intermediate outputs show-

ing the wide scope was the decomposition of the Catalan "system" into the six major sub-systems shown in figure XIV, each driven by a number of key factors.

The scope of the study was also particularly marked by a strong outward orientation via explicit consideration of external interdependencies with other European regions and the Maghreb, and the recognition of the rise of a trans-national space for co-operation in which regional authorities increasingly collaborated.

Building momentum

Direct sponsorship by the Presidency of the generalitat, gave the project a high degree of visibility and buy-in by the many stakeholder groups with a vested interest in the project—both within the political and policy making institutions and the wider economy and society. At the outset, meetings were held with each department of the regional government to present the study and to identify relevant future-oriented work and a strategic plan in all the areas covered. At this stage also, a selection of experts covering the different areas was made in order to drawup the first list of key variables for the study. Stakeholder interest, input and involvement in the project during the three-year implementation phase took different forms—from those 13 lead-experts involved in the working group, a broader group of 42 experts directly involved in the preparing of the report and detailed background documentation (e.g. commissioned studies, etc.) to the group of over 200 experts involved in sub-system panel discussions Delphi and other types of surveys, and workshop seminars aimed at the detailed elaboration of themes and issues underpinning the study.

Figure XIV. Morphology of the Catalan system

Morphology of the Catalan System	
Sub-systems	**Key factors**
1. Demographic evolution	Fertility Longevity Migratory balance
2. Territorial planning: land-use, infrastructure & communications	Natural resources Spatial distribution of population & activities Internal transport External transport Telecommunications
3. The productive system	Dynamics of world growth Catalan economic competitiveness
4. The labour market & social protection	The evolution of the dependency ratio The financial balance of the social protection system
5. The dynamics of Catalan society	Catalan identity Ways of life in Catalonia Catalan trends & desires
6. The geopolitical & institutional framework	European perspectives Mediterranean perspectives The Spanish model of "autonomy" in the international dynamics

Source: Keenan, Miles (2002).

Structure and organization

The study was coordinated by ICM (Maria Àngeles Roque) and Futuribles International (Hugues de Jouvenel) and had a lead working group of 13 people. The study was conducted in four main phases. The first phase consisted of a systems analysis of Catalonia looking ahead 20 years to 2010 to identify the main variables impacting on the development of the region. The second stage consisted of studying and analysing the morphology of the Catalan system projected ahead 20 years. This resulted in the identification of the six sub-systems listed in figure XIV, which then defined the main architectural elements for the subsequent parts of the study. The third phase consisted of a detailed analysis plus the elaboration of a series of hypotheses and associated micro-scenarios for each of the sub-systems. The fourth phase was devoted to the elaboration of global scenarios. The main working group took charge of this final global scenario definition phase.

Methodology

The study used a variety of methodologies:

- In the initial systems-analysis phase, a cross-impact matrix was developed involving 45 different variables requiring the working group to provide a response to 1980 questions (i.e. the cause/effect relationship between the 45 variables scored with a coefficient of 1 (weak), 2 (medium) or 3 (strong)). The so-called MICMAC method was used to identify the variables of highest impact and highest dependence. (MICMAC stands for "cross-impact matrix—multiplication applied to classification"—see Godet (1993) *From anticipation to action—A handbook of strategic prospective*, UNESCO Publishing).

- In working out the morphology of the system leading to the identification of the six sub-systems, trend analyses were carried out on the variables with due attention paid to possible break-points or inflection-points either brought on by events or conscious actions. This was associated with an analysis of the strategies of the different actors involved—including possible alliances, conflicts and their means available for action.

- In the longest and most difficult part of the study—analysing and projecting the sub-system dynamics—different methods were used. As in the previous phase many desk-research type studies were undertaken, and a large number of surveys with different sectors, specialists and actors representing different components of Catalan society. The forward-looking survey used a single-round Delphi, while more opinion-poll type surveys were also used for the collection of information on aspects such as Catalan values in the 1990s.

- Of all the background publications and reports produced for the study, a sample of 41 is included in the bibliography to the final report, indicated by an asterisk.

- The final scenario building part, worked from the sub-system partial scenarios to the global ones with the aim of revealing an overall synthesis of the dominant trends and the main risks of discontinuity, plus the challenges these entail and the

policies that would be possible to put in place over the long term. Five global scenarios were drawn up covering three different perspectives—trend scenarios, contrasted scenarios (best case/worst case) and normative scenarios—i.e. the desirable future as follows:

— Transition trend scenario to 2000—*catching the train on the run.*

— Favourable trend scenario to 2010—*Catalonia, the motor of Europe.*

— Pessimistic breakdown scenario to 2010—*a marginalized Catalonia.*

— Alternative discontinuous break scenario to 2010—*a new development strategy.*

— Involuted discontinuous break scenario to 2010—*an introspective Catalonia.*

Outputs and outcomes

The principal tangible output was the publication of the final report of the main findings and synthesizing the work carried out over the three years of the study. The report was edited in Catalan, French and Spanish. In intangible terms, the impact was very high indeed. The report and the findings of the study became virtually obligatory reading for all political and institutional actors in Catalonia—not just within the regional government, but also at the level of city councils and municipal authorities all over Catalonia, and in the private sector. It became a highly used reference work in all aspects of political and policy discussions, and in a very explicit way, introduced a whole new vocabulary and set of concepts into the political debate. A series of 24 debate and diffusion seminars took place all over Catalonia tailoring each time the content and delivery to the geographical location, the situation in which the seminar took place and the profile of the participants involved, for example:

- In the EADA (economy circle) on "the economic future and business competitiveness scenarios".
- In the College of Solicitors on "professional collectivities".
- In the faculty of Political Science and Sociology on "prospective methodologies".
- With the leaders of political parties on "political institution building".
- With the faculty of Education Science on "migration and multiculturalism".
- With the culture departments of both the regional government and Barcelona City Council on "identity and culture".

A summer school was also organized at the Menéndez Pelayo International University entitled "Mediterranean Foresight. Catalonia 2010". The study received a lot of press coverage in the form of synthetic articles, opinion pieces and, in some newspapers, special reports analysing the contents of the global scenarios. The study has been a highly cited reference work in subsequent studies and works on Catalonia, such as for example, the symposia "Catalunya demà" organized by the regional government from 1997 to 1998 to debate the future of Catalonia.

No specific evaluation was carried out. In terms of follow-up and renewal, a more recent publication "L'espai mediterrani llati" (the Latin Mediterranean space, 1999), includes a chapter that proposes a revision of the parameters proposed in the original global scenarios. It points out that some of the scenario elements have been realized, some trends have been broken giving rise to new situations and parameters and some challenges remain unresolved. A new normative trend scenario is proposed.

Uusimaa (Finland)

Background

The Uusimaa Employment and Economic Development Centre (EEDC) is a regional organization of the State in the Helsinki metropolitan area. The EEDCs, of which there are 15 altogether in Finland, were established in 1997 to support the development of business activity and employment at the regional level. Two years earlier an extensive foresight operation within the framework of the Objective 4 Programme of the European Social Fund (ESF) was set in motion in Finland. The operation was coordinated by the Ministries of Labour and Education. The Ministry of Labour placed particular emphasis on the development of foresight within the EEDCs and set up a support project for this. Project funding enabled the centres to employ one person full-time for six month to initiate foresight activity. The activity was able to continue after this period within the framework of the ESF programme, although a foresight project clearly concerning a specific branch or subject had to be formulated and funding applied for on this basis.

Foresight activity within the framework described above has been initiated to a greater or lesser extent in several EEDCs. The Uusimaa EEDC is very strongly committed to foresight. After the activity of the nationwide support project finishes, the Uusimaa EEDC will continue activity by allocating a proportion of the ESF funds within its own discretion to foresight. This decision concerns the entire new EU programme period, i.e. it will apply until the end of 2006.

Four factors have had a major impact on the shaping of foresight activity in the Uusimaa EEDC:

- General practice regarding foresight in Finland.
- Regional organizations' previous experiences of planning and forecasting.
- Nature of the foresight information needed, based on the tasks of the EEDCs.
- Special position of the Uusimaa region as a national centre.

Unlike other European countries, specific, extensive foresight exercises have not been implemented in Finland. Instead, foresight and foresight-type activity can be found distributed across many organizations, both in the public and private sectors, e.g. in ministries, research institutes, educational institutes, branch-specific organizations, etc. In

forecasting work there are also often some foresight activities included, for instance, in the form of scenario writing. Similarly, in the anticipation of qualification requirements, which is traditionally based either on large-scale quantitative forecasts or barometric corporate questionnaires, longer-term foresight studies have recently been gaining ground.

Finnish regional organizations have a long tradition of foresight-type work undertaken in connection with forecasting and planning. Already by the 1970s, for example, scenario projects and Delphi studies had been carried out in the Helsinki region through the cooperation of the State regional organizations and the municipalities. In recent years, foresight has achieved a new significance with the turbulent and uncertain economic development. The need for flexible positioning that focuses on understanding and "making" the future has grown, and foresight is seen as responding to this need better than forecasts and the detailed plans that emerge from these.

The range of tasks for the EEDCs is very broad in scope. It includes the development of technology and regional innovation activity, the development of business activity, particularly for small and medium-sized enterprises (SMEs), activity that increases and maintains employment, and the development of employees' qualifications. Practically, this amounts to funding for enterprises, organization of assistance from consultants, and the organization of further training for the unemployed as well as for those in work. The EEDCs carry out at regional level the tasks that come within the areas of responsibility of the Ministry of Trade and Industry, the Ministry of Labour and the Ministry of Agriculture and Forestry.

Almost one third of Finnish business is concentrated within the Helsinki region and the business carried out in the area is very often of national importance. For this reason the Uusimaa EEDC cannot restrict itself to a purely regional standpoint in its foresight activities. A constant interaction with organizations undertaking national foresight as well as networking with regional organizations in different parts of the country has been an important objective for EEDC foresight.

Scope

The following starting points have been adopted for foresight in the Uusimaa EEDC:

- Linking of various traditions and approaches regarding foresight.
- A broad scope, in which the projects carried out by the EEDC itself, as well as the foresight information obtainable through networking, are specified.
- Continuity of activity.

The Uusimaa EEDC combines three different approaches related to acquiring futures information: *(a)* technology foresight; *(b)* anticipation of qualification requirements; and *(c)* forecasting. Of these three, technology foresight constitutes the basic framework. The aim in EEDC foresight is both to collect industry-based information and to examine more general social questions such as the development of the information society, the ageing of the population and marginalization problems linked with long-term unemployment. This broad scope, coupled with the limited resources available,

makes it important to consider carefully which foresight projects the EEDC will itself implement and for which matters it can resort to information available from others. The solution adopted is currently as follows:

- For quantitative forecasts, the EEDC will rely almost entirely on data produced by ministries and research institutes.
- The EEDC defines the most important branches and social questions for its region and its own foresight exercises are focused upon these.
- Concerning other branches and subjects, foresight information produced by networking partners is compiled and worked up to a form suitable for the EEDC's own needs.

The nationwide support project for EEDC foresight has compiled the most important regional forecasts describing economic, employment and population growth as the "TOP 15" indicators, available through the Internet. At this stage the forecasts mainly extend to 2010. Concerning the results of foresight projects, there is no summary information, by branch for example. The support project has, however, set up an Internet portal where information on ongoing and completed projects is available, and where links to original material can be found.

The Uusimaa EEDC has strived for a more systematic division of labour in foresight between regions. This means that each region would specialize in its own characteristic branches and questions and, by networking with other regions, would produce information that would also be applicable on the national scale. In this way (and despite scarce resources), it is intended that regional foresight work will be of benefit to many organizations, in addition to the interests of the region concerned. Based on this principle, the Uusimaa EEDC has chosen two subjects in which it has specialized at this stage and for which it has done foresight work during the last two years:

- Future prospects for knowledge-intensive business services (KIBS).
- Future employment possibilities in the voluntary sector.

The themes chosen are based on the special nature of Uusimaa, which is characterized on the one hand by the fastest growth in the country, and on the other by long-term unemployment and the related marginalization risks. KIBS are the fastest growing of the various branches, both in Finland and internationally, and in Finland, over one half of the turnover of these services is produced in the Helsinki region. The voluntary sector, which in Finland is smaller than in many other European countries, has been shown by international studies to be important for maintaining employment and for reducing long-term unemployment.

In summary, the foresight work of the Uusimaa EEDC includes special projects, and parallel to this, the continuous acquisition and provision of foresight information for supporting practical work, both within its own organization and for its partners. The following sections describe in more detail how the continuous interaction between foresight and practice has been attempted.

Finally, regarding the time horizon of the foresight, 10 to 15 years has been commonly used. This means that when collecting information from networking partners, foresight exercises with this time horizon are focused upon. Sometimes the time horizon is longer, e.g. in the "Manpower 2020" project of the Labour Ministry. However, in the EEDC's own projects, it can also be shorter. For instance, in the KIBS study, interviewees were asked to think about the situation after 5 years and after 10 years. The shorter time period was needed because the basic information on this sector was very deficient. In the voluntary sector project, the time horizon used has also been 5 to 10 years (for much the same reasons). Deciding on the time-horizon has seen the need to balance two opposing factors: *(a)* the desire for foresight to be really future-oriented, and not too short-term; *(b)* the danger that a very long time-horizon (30 years or so) would make the application of the results difficult in practice, especially at the regional level.

Building momentum

In Uusimaa important measures for involving various stakeholders in foresight activities have been *(a)* needs analysis for foresight, *(b)* a start-up plan for foresight, *(c)* creating network connections, and *(d)* foresight training.

Needs analysis for foresight: When the foresight activities in the Uusimaa EEDC were just starting-up, a central objective set was that foresight would serve practical work in terms of both strategy and planning, as well as at the practical decision-making level. In order for this objective to succeed, the personnel must themselves feel that foresight information is necessary and they must know how to use it. The needs analysis was carried out to clarify the types of context in which employees in different positions would need information on the future, whilst at the same time, brief training sessions were held on foresight thinking, foresight methods and the results of foresight projects. The needs analysis and training were carried out in 19 small-group sessions for the approximately 160 employees of the Uusimaa EEDC.

The ***foresight start-up plan*** contained the following sections:

- Summary and conclusions of the needs analysis.
- Plans for EEDC's own foresight projects and for acquisition of other foresight information.
- Organization of foresight.
- Linking foresight to leadership, strategic planning and decision-making.
- Regional cooperation and networking for foresight.
- Foresight training plan.

Creating network connections: After the work for the start-up plan, foresight had already become a familiar concept within the EEDC's own organization. The EEDC's first project of its own was started for the KIBS sector. In order for the objective of a nationwide division of labour to be successful, networking with two other EEDCs was

established in the project. During the duration of the project, numerous other network connections were established, with, among others, professional associations specific to the branch. Similarly, a foresight project that was later started for the voluntary sector enabled the establishment of network connections with public sector actors, as well as with many associations. When the foresight activities of the Uusimaa EEDC became known in other organizations conducting foresight, cooperation also started with these. This reinforced the position of foresight within the EEDC, as information concerning the future development of many branches and social phenomena could be acquired quickly.

Foresight training has had an important position in making foresight well known and in committing different stakeholders to cooperation. Subsequent to the training in connection with the needs analysis, almost 40 other training sessions have been held and around 1,300 participants in all have attended these. A great part of the sessions has been directed to the personnel working in the local employment offices operating under the EEDC (employment advisors, career guidance officers), and to cooperation partners of the EEDC (teachers and student advisers in schools and in other educational institutes, municipal business advisers, etc.) The basic content of the training has been as follows:

- "From forecasting to foresight"—the "philosophy" of foresight.
- Foresight methods.
- The mega trends and weak signals of economic and social development.
- Results of branch-specific foresight projects.
- Where to find additional information on foresight.

Structure and organization

foresight activity in the Uusimaa EEDC began in spring 1998 when a project group was set up for this purpose. At the end of the same year, a full-time project manager was employed and at the end of 1999 a full-time project researcher was taken on. The current decision to continue the foresight project until 2006 starts from the premise that the two people mentioned and the foresight group are responsible for the foresight activity. The network connections also play a decisive role in the foresight work of the Uusimaa EEDC. One can say that the organization of Uusimaa foresight consists of three parts:

- A project-type two-person foresight unit.
- A foresight group as a regional form of networking.
- Cooperation projects as a means of other networking.

A total of 16 people belong to the foresight group. The EEDC's own departments and most important units are primarily represented there. Two regional councils, the City of Helsinki and the National Technology Agency (Tekes) are also represented. Of the

network connections that have been implemented through projects, the following can be mentioned:

- The Ministry of Labour's Manpower 2020 project, in which the Uusimaa EEDC is involved in working groups dealing with regional occupation structures and the impact of the development of the information society.
- A project of the provinces for developing an anticipation system for qualification requirements.
- A scenario project for the Confederation of Finnish Industry and Employers.
- The EEDC is also involved in the secretariat of the Ministry of Trade and Industry's nationwide project for developing technology foresight.

Methodology

Face to face thematic interviews in leading companies were used in the KIBS foresight project. The method of mega trend and weak signals analysis was adopted in summarizing the results and drawing conclusions. The results were evaluated in a seminar for representatives from enterprises in the KIBS sector, actors in the public sector, and researchers. A panel discussion of company representatives from different KIBS sub-branches occupied an important position in the seminar. The results were also dealt with an several smaller occasions with, among others, the professional associations in the branch.

In the project concerning the voluntary sector, the foresight work was done in four expert groups. Two of these dealt with the development outlooks for the largest areas within the voluntary sector: *(a)* social and health-care and *(b)* training, culture and youth work. The two other expert groups were theme-specific, dealing with *(c)* the future development of the voluntary sector in relation to the private and public sectors, and *(d)* the voluntary sector from the perspective of citizens' scope for influence.

The foresight project employees, as well as the foresight group in Uusimaa, have strived continuously to increase their methodological know-how in foresight and futures studies. Contacts have been made with researchers and research institutes on EEDC's own initiative, as well as through the nationwide project. An important foresight support in Finland in terms of methodology is the Finland Futures Research Centre operating within the University of Turku, around which has been built a network academy for futures research covering all universities in Finland.

Cooperation with other actors conducting foresight is important, not only for acquisition of information, but also in terms of learning and practising foresight methods. In Uusimaa EEDC, for example, quantitative forecasting methods have become familiar through network projects, and more experience in practical application of scenario work has been acquired in this way. The current Manpower 2020 project of the Ministry of Labour involves both forecasting and scenario writing and the foresight project of the Confederation of Finnish Industry and Employers now being started is mainly based on scenario work.

Outputs and outcomes

The results from the KIBS project are being used within the EEDC in the planning of further training for employees and in the planning of supporting activities for SMEs. Two special projects for the support and development of enterprises are ongoing in the EEDC, one for start-up businesses and the other for fast-growing businesses. In the KIBS project, there has been close cooperation with the latter project, since the branch particularly emphasized at this stage has been the information technology sector.

In the case of KIBS, the EEDC's plan for nationwide division of labour and specializing has been realized even on a continuous basis. From the beginning of 2001 onwards, the EEDC's foresight project manager, in addition to the foresight work, has assumed responsibility for the nationwide follow-up and development of the KIBS sector, in Sectoral Expert Services—an activity of the Ministry of Trade and Industry. Along with this task, the results of the KIBS project have been presented in different parts of the country, particularly in the various EEDCs, but also at other occasions held by organizations from both the public and private sectors.

At the time of writing, the voluntary sector foresight project that started later was just at the finalization stage, but it was anticipated that the results of this project will be used, above all, when planning actions are designed to alleviate and prevent long-term unemployment. Foresight information from sources other than the EEDC's own projects has been used, for example, in the foresight training described above. Another important use of this information is in supporting strategic planning, one practical form of which is the yearly analysis of changing trends in the EEDC's operating environment.

The Uusimaa EEDC's strengths in foresight so far are primarily the extent to which people within the organization are aware of foresight and the continuous growth of skills in the use of foresight information. The results of the EEDC's own projects have proved beneficial in practice and there is currently a continuous demand for foresight training. Networking with organizations from the public sector is extensive at both regional and national level.

Because the foresight activity in the Uusimaa EEDC is of an ongoing nature, one cannot actually talk about "process renewal", but rather of the special foresight topics in the near future as well as of challenges in the development of foresight, the latter reflecting also deficiencies of foresight work done so far. The topics and challenges that are now considered most important in Uusimaa are the following:

- To extend the topic of KIBS to service innovations and foresight in services more generally.
- To develop a closer link between technology foresight and anticipation of qualification requirements.
- To further increase the interaction between foresight studies and practice.
- To create a "real" foresight culture in the Uusimaa region.

Extending the KIBS project to cover service innovations and the service branch more generally is a central topic in the foresight of Uusimaa EEDC over the next few years. In this regard the centre will be working in close cooperation with the National Technology Agency (Tekes), which has set the development of the service sector by means of technology as one of the focal points of its activity. Cooperation with Tekes has also been initiated in the search for such methods whereby technology foresight and the anticipation of qualification requirements can be better linked. Representatives of the Ministry of Education and municipalities are also involved.

Although the Uusimaa EEDC has, in certain respects, been successful in connecting foresight with practical work, it is believed there is room for improvement. The "reputation" of foresight within an organization depends to a large extent on how the actors at different levels experience the service they receive from the foresight unit in terms of their practical information needs. On the other hand, there is a danger, especially at regional level, that foresight becomes totally subordinated to everyday information needs and actually has the same function as former planning units. This danger has been recognized in the Uusimaa EEDC and in order to avoid it, the independence and research focus of the foresight unit continue to be emphasized.

In terms of networking, connections with the public sector are good and cooperation in different directions is continuing. One shortfall in the foresight of the EEDC so far has been an inadequate amount of practical cooperation with the private sector, although the picture is brighter for KIBS. In further work there will be special emphasis on building network relationships with the SME sector in other branches that are important for the Uusimaa region. Using network connections, in addition to continuing foresight training, the aim is to raise the status of foresight to a level where the Uusimaa EEDC can talk of a real foresight culture.

North-east England (UK)

Background

Situated on the east coast of England facing Northern Europe and Scandinavia, the north-east is a largely rural area. However, most of its population of 2.6 million are concentrated along the three great commercial rivers of the Tyne, Wear and Tees where economic development is concentrated. The region consists of four sub-regions: Northumberland, Tyne and Wear, County Durham and the Tees Valley.

The Region's economy until relatively recently was based mostly on smokestack industries, such as coal and steel, shipbuilding, and chemicals. The decline of these traditional industries has necessitated significant economic restructuring, although chemicals remain important. Today, the region's strengths lie in automotives, electronics, advanced engineering, including offshore oil and gas, pharmaceuticals, chemicals and metal manufacturing. Levels of unemployment are higher than the UK average.

The need for foresight was felt to be particularly acute in north-east England because of the inward migration of large foreign-owned firms to replace traditional activities such as coal mining, steel and heavy industry. The resulting shortage of R&D facilities, indigenous entrepreneurs and creative new product design caused concern amongst policy-makers who felt that the region was heading towards a less competitive future despite the short-term rise in manufacturing employment.

Foresight has had a formal presence in the region since 1996, first as part of regional efforts to rollout the results of the national exercise. During this first phase (1996-1997), the foresight initiative was managed by Newcastle University (Regional Centre for Innovation and Design—RCID). In its second phase (1998-present), the responsibility for running the programme has passed to the regional Technology Centre in Sunderland (RTC North), which is working closely in partnership with the regional Development Agency, ONE North East. This second phase has seen the region assume ownership of the foresight process, and is the phase that will be mostly focused upon in the following section.

Scope

The primary aim has been to increase the competitive standing of regional industry and society through improved appreciation, anticipation and exploitation of future developments in science and technology. The approach has been perhaps more "bottom-up" than in other regions, with those responsible for promoting foresight actively seeking to embed the practice in a distributed manner. Specific objectives within this aim have been to:

- Establish an accessible focal point, inquiry service, and project management centre to support and promote the "flagship" foresight programme.
- Provide coordination services to support "external" foresight panels and projects including meetings, network events and literature distribution.
- Create proactive mechanisms for collating and disseminating information about developments in new technology affecting key sectors of the north-east economy.
- Deliver an industrial outreach programme focusing on the promotion of foresight through best practice techniques and the subsequent introduction of company-specific measures to a selected number of SMEs.

Several hundred organizations have been involved, both in consultation and operational activity. A 10-year time-horizon is typically used. For much of its six-year duration, the regional foresight effort has been run on a shoestring budget, with funding available for one full-time position in RTC North plus some event organization. In total, this has formally amounted to about € 80,000 per annum. However, the organizers of the regional activity have been especially resourceful in leveraging resources from other actors, including industry, the national government and the EU in supporting, for example, regional events and sectoral activities. Associated projects, such as Young Foresight, are funded separately, with the RTC North appointee essentially managing a central work programme and coordinating associated projects within regional organizations.

The north-east region is a leading player in the adoption of Young Foresight. This programme sits alongside the national foresight programme and provides opportunity for students (14 to 18 years of age) to design products and services for the future (from conceptualization, to design, to adaptability in the marketplace) as part of the UK design and technology national curriculum. Through the use of industry mentors, Young Foresight encourages students to anticipate future trends and consumer behaviour and design products that will perform well in a world that has yet to arrive.

Building momentum

The first phase of the project was specifically dedicated to building momentum. Over the period March 1996 to December 1997, a wide-ranging dissemination exercise was carried out to publicize the results of the national programme and options for regional implementation. This resulted in a much wider appreciation of the objectives of foresight and the specific benefits to be derived from participation by different interest groups within the business and academic communities. The fact that the RTC North took responsibility for the programme in 1998 has achieved better access for participants but also induced a high degree of interaction that takes place with SMEs from that location.

Vigorous leadership via focus groups in all the focused areas resulted in the establishment of active foresight networks. Through a combination of surveys and events, they have addressed specific topics, some of which were subsequently worked up into collaborative bids between industry and universities to access funding for innovation and product development.

The ongoing, distributed and bottom-up nature of foresight in the region essentially means that selling the concept and building coalitions of interest is a never-ending activity. As the programme moves from sector to sector, as well as to new domains (e.g. through Young Foresight), momentum-building activities start up again. Typically, these make use of events, such as workshops and conferences, as well as surveys, to elicit wide interest and adoption of foresight.

Structure and organization

Despite the "bottom-up" nature of regional foresight in north-east England, activities are more or less coordinated through four levels of "governance". A Steering Committee acts like a board of directors and has overall authority. It meets every two months and has equal representation from senior figures in industry, academia and development organizations. An Executive Board is a subset of the Steering Committee that meets more frequently (monthly) to implement policy but not to create it. A technical evaluation panel is responsible for assessing funding applications for SME foresight projects. Finally, a foresight FORUM constitutes an advisory body that guides the "flagship" programme via its quarterly meetings. Membership of the latter is open to all who wish to join. The others are all by appointment.

As already hinted at, foresight in the north-east involves many different activities. Amongst these are:

- The "Flagship" programme, which is cross-sectoral and includes quality of life issues (age, physical environment, crime, transport etc)—they are driven by the FORUM membership and its quarterly meetings.
- "Technology Scan", which is about keeping abreast of all new technologies but particularly those which have great potential to affect the regional economy.
- "Industrial outreach", which is perhaps the most difficult area since it deals with how foresight can be made relevant to SMEs including audits and opportunity reviews as part of a structured methodology for future competitiveness. We will say more on this below.

Sector panels are organized separately in response to perceived demand, and are normally chaired by an industrialist who is supported by the coordinator from RTC North. By their nature they tend to be more focused than other parts of the work programme. This panel model was adopted from the outset and has continued to be used. Thus, a number of sectors were identified for initial development and significant activity has taken place in the following areas over the last 5 to 6 years:

- Manufacturing—lead organization—Thorn Lighting
- Energy—lead organization—TNEI
- Marine—lead organization—AMEC Process and Energy
- Chemicals—lead organization—EPICC
- Leisure and Learning—lead organization—Sunderland University
- Cross-sectoral—lead organizations—RCID/RTC North

The intention has been that these panels should all become fixed time-scale and mission based. These initial sectors were identified by a scoping study carried out by CURDS (Newcastle University), which attempted to match foresight issues with regional requirements.

Methodology

Scenario workshops have proved very popular, both in relation to the offshore sector and vocational education. Opportunity mapping has occurred in energy and environment sectors. High-tech seminars have been organized in IT, communications, chemical sensors, nanotechnology and other specialist areas. Some events are multi-faceted incorporating a speaking programme with an exhibition, workshops and demonstrations. The choice of method is generally a matter for the committee or panel concerned. In the flagship programme, the RTC North coordinator decides. Foresight north-east offers project-based support to SMEs in identifying future R&D and new business opportunities.

Perhaps a good way to further examine the deployment of foresight methodology in north-east England is to look closely at a practical example such as an exercise

carried out in 2000 with the offshore sector in the region. For over two hundred years, the north-east of England was a world leader in the design and building of ships. The massive decline in demand during the 1970s and 1980s was a major blow to the region's economy, but it has led to the opening up of a whole new industry. The huge increase in investment in North Sea oil and gas extraction during this same period represented an opportunity for the companies and workforce previously employed in the building of ships to move into the building of offshore oil platforms. A healthy offshore industry has therefore developed over the last 20 years to supply platforms and services to the major oil companies.

In order to gain a better understanding of the sector and it's future, a series of workshops were held at which 20 managing directors from SMEs in the sector came together in order to pool their ideas and knowledge of the industry. They were asked to look at the regional sector in terms of its current position and strength and to develop a possible scenario for the sector in 2010, both of these in relation to the global marketplace. The resulting ideas were compiled into a series of maps that showed not only the constituent players and factors in the sector, but also the level of capability or importance of each area.

More specifically, the exercise was organized into four quite distinct tasks:

Task 1—*Produce a broad outline of the sector.*

Task 2—*Produce a more detailed map of sector components.* Once the broad outline was agreed, participants were asked to make individual contributions to enable a detailed mapping of the sector as it currently exists. It was emphasized that all inputs, drivers and outputs must be included so that the relative importance and sustainability of these could be discussed in the next session. The resulting map showed the main components in more detail, with the relevant linkages between them. It also indicated their perceived capability or strength within the sector, ranging from vital or world class, through to minimal or no capability whatsoever.

Task 3—*Produce a global scenario for 2010.* The next stage was to produce a worldwide sector map for 2010 using two separate facilitation techniques and then combining the results. The techniques used were as follows:

- A simple projection of current knowledge based on brainstorming of the collective knowledge of industrialists in the group (i.e. the conventional wisdom approach)
- Consideration of opposite but pre-defined sets of circumstances—market economy and green economy (as outlined in UK national foresight workshop materials).

The resultant map described the global market in 2010, with different colours used to indicate the importance of each area from "vital" to "none". Seen in isolation it simply painted a picture, without indicating the relevance to the current position, or any actions that should occur as a result. It was therefore compared with the earlier map, which describes the level of current regional capability, in order to gain an understanding of the changes that are likely to take place over the next ten years, and their

impact on the regional sector. This indicated those areas that were likely to grow or decline in importance, particularly those that were seen to be strong or vital in 2010.

In order to focus on a manageable and achievable number of issues, a number of "filters" were applied to each of these areas. First they were assessed in terms of their impact on job and wealth creation. For example, offshore processing was rated as being vitally important for the industry, but it will actually have very little impact on employment. Secondly, they were then assessed in terms of whether it was possible to achieve anything in the region, given current levels of capability and expertise. For example, having no current presence in exploration and field development makes it very unlikely that the region could develop this capability to a sufficiently high level.

Task 4—*Determine actions and strategies resulting from the scenario*. Having described how the global and regional sector may look in 2010, the next and most critical stage was to examine the actions that should result from this analysis. An assessment was made of which changes were likely to have the greatest impact and which action could bring the greatest benefit to the region. A final map was constructed, which showed the same areas in the sector but described them in terms of whether they represented an opportunity, are under threat or are a necessity in order for the sector to be competitive in 2010.

Outputs and outcomes

Soft outputs include the knowledge transfer and improved working relationships that result from network activity. These are very valuable yet difficult to quantify, so case studies are used to demonstrate the success of foresight with individual companies. Outputs of the FORUM meetings have been most influential on regional policy. Government Office north-east (national governments presence in the regions) representatives have made funding available for pilot projects as a direct consequence of such meetings, whilst ONE north-east uses these meetings to forge a link between foresight and its own Strategic Futures programme, which is one of the delivery mechanisms of its Regional Economic Strategy (RES).

In general, expectations have been satisfied. As regards the events, individuals do seem to get a lot out of the scenario workshops because they permit original thinking with like-minded persons outside the organization. Formal seminars do not generate the same level of interest unless the technology has "curiosity value". A good example of the latter was a micro-engineering lecture and demonstration provided by a Swiss engineering organization. As regards the SME programme, detailed project work with companies tends to follow a similar pattern. In the early stages the client is interested in technology per se, and in information about its own core business. In the later stages the client becomes more interested in market issues, regulation and the core business of suppliers and customers.

A specific web site "foresight north-east" (www.foresight.org.uk) has been launched to disseminate the foresight activity and to support the continuous development of the programme.

Grand Lyon (France)

Background

Lyon is a rich city, a fact that permeates both the public sector (tax revenues are high) and the private sector. The Lyonnais workforce is highly skilled and the city contains higher than national-average proportions of scientific and research workers. The industrial base has evolved through high value/design added textiles (silk) to speciality chemicals, and currently research and development in all domains of health and environmental industries feature strongly.

The city is currently engaged in a largely successful campaign to attract (back) to the city headquarter functions of major companies and administrative hubs of the public sector (still largely centralized on Paris), and international coordinatory hubs such as the international crime centre and database "INTERPOL". Its SME sector also demonstrates a greater propensity to "rejuvenate" itself than the national average, and unemployment traces a path below the national average. Quality of life is high—in terms of beautiful surroundings and temperate climate. The city and Rhône Alpes region therefore experiences in-migration of highly qualified personnel, and this trend seems set to continue.

Traditionally the city has had a reputation for displaying a "conservative" business ethos, and a high degree of collusion between the interests of business/the economy and the powerful local political elites. This traces through the political landscape. Arguably, the left of centre (UDF) administration of ex-French prime minister Raymond Barre (1995-2001), who presided as Mayor over the Lyon City administration and was co-terminously President of the wider "Grand Lyon" administration, has used the open/participatory methodology of Millénaire3 to address the image and reality of this "exclusive club", pressing the need for citizenship and local participation in the future "imagining" of the city.

Thus, in December 1997, Raymond Barre launched the Millénaire3 approach, designed to provide the conurbation with a comprehensive, integrated development project with the stress on sustainable development. There were two rationales for this move: to boost the conurbation's status among major European cities in the context of worldwide inter-territorial competition; and to improve its internal social cohesiveness.

Scope

Millénaire3 has enjoyed the personal endorsement and support of the nationally, internationally, and locally influential Mayor, Raymond Barre. He personally initiated the project in 1997, two years after his election to office. The project is therefore not without resources and top-level political support, as reflected in the administrative structures put in place to deliver it (see below). A further significant point is that Millénaire3 is not a separate or isolated initiative, but the evolutionary child of a "futures" perspective, which can be traced through previous administrations. In 1989, Michel Noir was elected Mayor on the back of a "new" economic development strategy, which "envisioned" the city some 20 years ahead. Called "Lyon 2010", in fact, much of the

content of the plan was a continuation of infrastructure projects initiated by his predecessors. Millénaire3 is therefore the latest in a long line of such strategic initiatives.

Yet, the contemporary "futures" reflective thinking that is embodied in Millénaire3 demonstrates a shift in focus, away from the built environment, and towards a more humanist/social/inclusive agenda. Under the banner of "the intelligent city", the objective is to nurture an environment where knowledge is "federated" and shared across participant-agents of the city and internationally. This coincides with the promotion of the city as "open" to multiple sources of new ideas and contributions of innovative thinking. Alongside this new agenda and set of priorities is the view that previous administrations had largely "dealt with" deficits of the built environment and infrastructure.

Thus, Millénaire3 is intended to contribute to realizing the following overall broad objectives for Grand Lyon:

- Reducing social disparities and reconciling the city's historico-cultural identity with today's realities.
- Creating systems facilitating project-style approaches to ongoing development and increased employment opportunities.
- Providing access to information and communication technology, encouraging their appropriation and promoting recognition of the resultant new forms of social bonding.
- Working towards a system of local government more open to dialogue and partnership, more propitious to effective public-sector action and aimed at restoring local government to its rightful place.
- Turning the Lyon Urban Community into a European metropolis of the first rank in terms of environmental management and business activity relating to environmental issues and markets.

Millénaire3 is an ongoing activity that has an annual budget of €1.4 million, which is provided exclusively by the Grand Lyon public authority. The time horizon used is variable but stretches as far out as 20 years. With its participative emphasis, thousands of people from many walks of life have been engaged in Millénaire3 through a variety of means (see below).

Building momentum

Millénaire3 is heavily branded and a great deal of effort has been expended in raising awareness and interest in the project internationally to the extent that the initiative has come to the attention of international policy-makers and observers, e.g. OECD. Central to its execution has been the effective use of marketing techniques in awareness raising, communication, promotion, producing the sustained commitment and involvement of a range of audiences. The "lead" agency, has, for all this, clearly and undeniably been the local authority, Grand Lyon.

Millénaire3 is present at a host of different events, including forums, trade fairs, seminars and the like. Within the conurbation, the foresight approach has also been presented to community associations, administrative departments and other bodies in the interests of across-the-board appropriation. It has also given rise to a range of publications—7,000 copies of the seven *Newsletters* detailing application of the approach were distributed, while the *Millénaire3 Bulletins* covering the debates—23 issued to date—are available free on request. "Subject Booklets" are intended as aids to decision-making on such matters as dance, nightlife, theme parks and carnivals. The 6,000 print-run *European Cities in the Making* Newsletters are the voice of the Eurocities Economic Development and Urban Renewal Committee (EDURC) and bring the development strategy experiences of other European cities to bear on Lyon's thinking in this domain. Lastly, Millénaire3 has its own Internet site, www.millenaire3.com, which allows participants to follow the approach's progress and participate directly in discussion of the issues.

Structure and organization

Millénaire3 is entirely coordinated, managed, resourced, and reported on by officers and politicians of Grand Lyon—the conurbation scale of government. The unit responsible for the execution, communication and (importantly) promotional aspects of Millénaire3 is the "Mission Prospective et Strategie" (MPS)—the Forward Planning and Strategy Unit. The unit reports directly to the Secretariat General—the nerve centre of any local authority. Here, are typically located cross-departmental coordinating activities, where cross-departmental input, response or priority is required. Importantly, in terms of "departmental hierarchies", placing units within this department affords them symbolic privilege, and also symbolizes a project/unit beyond and above inter-professional or inter-departmental conflicts and boundaries. That the MPS is thus located indicates its degree of symbolic importance and "leverage". It is not, for example, located in a "planning department" where "strategic planning" might more traditionally reside. Official or formal communication from the unit is addressed from the vice-president charged with the future strategy of the conurbation, reinforcing the point that it is politically endorsed at the highest level.

The MPS is an eight-strong team and is charged specifically with:

- Organizing Millénaire3.
- Ensuring full-time monitoring of all topics relating to the conurbation's development.
- Coordinating the Development Strategies for European Cities. Working Group set up by the Eurocities Economic Development and Urban Renewal Committee (EDURC).

The approach adopted has seen the establishment of working groups for key phases of the project, whilst at the start, a committee of "wise ones" was assembled to deliberate on the strengths, weaknesses, opportunities and threats facing Grand Lyon.

Methodology

Driven by the objective of "permanent consultation", and past criticism concerning "distance" between elected representatives and the citizens of Lyon, a great deal of emphasis has been placed on the participatory involvement of a large number of Lyon citizens, reflecting, systematically the whole range of sub-groups and interest groups (e.g. informants from higher education, schools, voluntary groups, business, etc), and geographically focused groups of Lyonnais society in the various thematic strands of Millénaire3 (see below).

Methodology has taken the form of the slow build up, over three years, of a database of participating groups and individuals, who have responded to "trawls" or requests sent out across Lyon through the press, leaflets, and targeted letters to attend various meetings, "open forums" and group discussions. These are supplemented by in-depth interviews (almost "journalistic" in style) with key "experts" from the city across the various themes. Thus the methodology is more akin to a large-scale, longitudinal and on-going research programme. "Consultation" has not taken the form of eliciting responses to a set of proposals, but rather it has sought input through discussion, and provides output in the form of research reports of findings, which have fed into the formulation of proposals. A set of proposals for the development of the city over the next 20 years has now been produced following this "reflective" period, under a committee comprising the six vice-presidents of Grand Lyon, chaired by Raymond Barre.

The approach is said to be in keeping with Habitat Agenda articles 44 and 45 adopted in Istanbul, where local authorities were invited to adopt a participatory approach for development at all levels, and particularly at the local one, based on a continuing dialogue among all actors involved in urban development (the public sector, the private sector, NGOs and communities). In practice, a number of tools have been used to foster public debate, including:

- Regular forward planning sessions, which provide a forum for public debate on such issues as socio-cultural change in the Lyon conurbation, memory and identity, work and job training, intellectual life, leisure, etc. These sessions have attracted between 100 to 250 people and last for one half to one full day.
- Small "working groups", which have been set up to find solutions to the challenges currently facing Lyon and to draw up proposals for concrete action. These groups are made up of civil servants, elected members of the Urban Community Council and representatives of other bodies and civil society.

It is interesting to note that little attempt was made in the 23 "themed" reports produced by the exercise to derive a single "shared" vision. Rather, the future is glimpsed through a range of perspectives and viewpoints.

The systematic and sustained nature of the methodology, covering a three-year period, with dedicated staff time and resources, has been a key feature of the initiative. It has not been a "quick" or "reactive" response mechanism. The initiative culminated with

a presentation of the set of proposals to underpin the development project of the Lyonnaise conurbation, on 19 September 2000. All participants from all forum meetings were invited, as were "all citizens concerned about the future of the metropolis". Also present were politicians and officers of Grand Lyon, together with representatives from other cities and international invitees, to witness the "elaboration" and culmination of three year's work. Following this meeting the Grand Lyon Council met to vote on the proposals (see below).

Outputs and outcomes

In September 2000, Millénaire3 presented Lyon's civil society with its "Conurbation Project: A Competitive, United City—21 priorities for the 21st Century". The outputs of the project were also debated by the Urban Community Council at this time. Summarized in the form of five main strategic lines, the results reveal expectations having more to do with "How?" than "What?" issues. The conurbation project is a full-time affair and with residents now an integral part of the process, the first issue was how to establish and organize the appropriate preconditions for public debate. Once a simple territorial planner and provider of urban services, the Lyon Urban Community is now also assuming the role of motivator and facilitator of all-round development, concerned not only with economic growth but also with social unity.

The five lines of strategy set out in the conurbation project document are as follows:

- A city receptive to other cultures and the world.
- An attractive, liveable city.
- A city that fosters the spirit of enterprise.
- A city conducive to lifetime learning.
- A city putting the accent on consultative democracy.

The priority areas identified had, as their target audience, mostly the regional government. With this in mind and with the Millénaire3 emphasis upon participation, the consultative democracy priorities have been immediately addressed with the establishment of a Development Council, which involves civil society in conurbation development as provided for by the legislation on territorial planning and sustainable development. Comprising representatives of official bodies, well-known specialists, representatives of community associations and residents from economic, social, cultural and environmental circles, the Council works closely with the President of the Urban Community. With more than 300 people involved, its work has been divided into five working groups, each of which addresses one of the strategy lines set out in the Conurbation Project document. As a permanent monitoring tool, the Council will warn of any new challenges that arise in terms of the conurbation's overall development performance.

Reflecting on the whole process, whilst Millénaire3 has involved a broad range of stakeholders, the types of reactions and degree of commitment have varied widely. Four main categories of actor have been identified by Millénaire3 officials:

- **Groups that joined immediately:** civil servants and administrative departments (especially at State level), together with members of community associations. The civil servants need a sense of social purpose, while the associations are home to people with specific projects and interests in search of an audience for their ideas.

- **Groups showing increasing commitment:** academics, researchers and representatives of the cultural scene. Relevant problems and issues arise in all these domains, but it took a certain amount of time to get the approach's message across.

- **Groups that have moved from a background role to an expression of increasing interest:** the reactions of decision-makers—especially politicians, the crucial element—ranged from scepticism about the method's innovative character to a genuine interest that may or may not lead to commitment. Contributing factors here include the destabilizing effect of community involvement and the break with the traditional reliance on specialists. For politicians, the shift from purely representative to participatory democracy generates anxiety about new forms of opposition, whereas the approach can in fact reinforce their power and status. For the major institutions, the issue is governance, their anxiety being sparked by fears of a global Urban Community takeover. Over time, however, these points of view have evolved positively.

- **Groups of the relatively uncommitted:** the business world (company heads, executives) and students have shown highly varied, fairly passive reactions. Their mode of functioning is far removed from that of the public-arena actor—company heads have their special timetables, students their "zapping" style of behaviour—and the preconceptions and entrenched codes on both sides are hardly conducive to cooperation with the public sector stakeholder and the politician.

With Millénaire3, the Lyon Urban Community set out to modernize its approach to the shaping and implementation of conurbation strategies. The approach now being applied is also bolstering the Urban Community's role as coordinator and mediator at conurbation level. Based on cooperation between stakeholders, Millénaire3 has already made possible greater synergy between three vital functions: public debate, networking of stakeholders, and projects. Public debate is a core aspect of Millénaire3: by generating exchange and helping create a climate of mutual confidence, it yields new ideas and contributes to project construction. Situated at the interface between all the relevant fields, networking of stakeholders facilitates the de-compartmentalization that Lyon so badly needs. Via its organization of debates and ongoing dialogue between stakeholders, Millénaire3 plays its part in this process. Last but not least, this approach is leading to the emergence of new projects or increased visibility for existing ones. In this respect, the Urban Community works as a facilitator in its setting up of a host of partnerships. At stake here are ongoing, everyday functions and everything depends on their synergy: public debate is vital to a climate of trust, but cannot on its own sustain that trust indefinitely. Only projects and concrete initiatives can ensure continued stakeholder mobilization; and this in turn is essential to achieving the goals chosen by stakeholders and civil society for a project vital to Lyon's future.

West Midlands (UK)

Background

The west Midlands lies at the heart of the United Kingdom and has a population of some 5.3 million people. It is the country's manufacturing and agricultural heartland and the hub of the national transportation network. The region covers an area of 13,000 square kilometres, its western edge bordering Wales.

Historically the urban areas have been internationally famous for manufacturing a wide variety of products. North Staffordshire is the centre of UK ceramics, Birmingham has long been known as "the city of a thousand trades", Coventry grew with the bicycle, vehicle and aircraft industries and the Black Country towns of Wolverhampton, Walsall and Dudley were the focus of metal production and fabrication. Restructuring of those industries has reduced the number of people working in the sector, but the west Midlands is still the UK's main manufacturing centre. Manufacturing now produces 30 per cent of the region's GDP and 27 per cent of employees rely on manufacturing for their livelihood although growth in the service sector—particularly retail, distribution, hotel and catering and business services—has been the fastest of any UK region.

Many manufacturing businesses have diversified away from their traditional markets in order to reduce dependence on the automotive sector, but key products are also designed and made in plastics and rubber, electronics and telecommunications, food and drink, jewellery, glass and leather and ICT software. As with other UK regions business growth has been in the small- to medium-enterprise sector.

The region became involved in regional foresight in 1999 as a direct result of the UK national programme implementing a policy of encouraging regions UK and small- and medium-sized enterprises (SMEs) to adopt foresight. The development of a programme within the region was also one of the first initiatives set up by the development agency, Advantage West Midlands, established in April 1999, and was a delivery mechanism of its Regional Innovation Strategy (RIS) published in June 1999.

The central objective of the regional programme has been "to utilize the proven and respected methodology adopted by the UK foresight programme and to build on this for the development of a regional foresight programme that actively involves the SME community in the region". The programme was part-financed by the European Regional Development Fund and the key partners in its delivery were Advantage West Midlands and Coventry University Enterprises.

Scope

The regional foresight programme sought to demonstrate that regional foresight can encompass clear and tangible benefits for industry in adopting long-term visionary planning for the region as a whole. It was designed to act as a first concrete step to begin to change the culture of business planning that currently exists in many of the region's business and industries (i.e. short-term focus). In order to achieve this strategic aim and to increase in quantifiable terms the number of companies in the west Midlands par-

ticipating in the longer term strategic planning, the programme had a number of long-term and short-term objectives. The most important long-term objective was to provide a source of knowledge and expertise based on the work of the regional foresight panels to instil confidence in the region's business and industrial communities. Amongst the more immediate objectives, the programme was designed to:

- Create for the west Midlands region a regional foresight programme that commands the same respect as that enjoyed by the national foresight programme and, in so doing, to ensure that the west Midlands becomes a "region of excellence" in terms of the interaction between regional policy and business practice
- Provide access to a knowledge base for SMEs considering involvement in adopting a culture of long-term business planning
- Offer non-discriminatory access to the foresight process for small and large companies alike
- Target several important sectors in the west Midlands on which the work of the regional foresight panels will be based and to ensure full inclusion of information currently available
- Provide access to best practice examples in other regions of the UK and Europe within the regional foresight process so that companies in the west Midlands can see the tangible benefits of visionary planning
- Ensure that the foresight process has a place within the long-term regional strategy of the west Midlands
- Effect a small "milestone" change in culture among selected sectors of west Midlands business and industry so that exemplar companies can assist in the sustainability of the foresight project for the region in the longer term.
- Coordinate existing research and to commission new strategic research in the sectors chosen so as to ensure that a "knowledge" base within foresight is underpinned by information that is accurate and current. Specifically this would be targeted at the sectors selected by the project in the first instance.

The 10 to 20 year time-horizon of the national programme was thought to be "off-track"—if the regional project can push SMEs to think 3 to 5 years out, then they consider themselves to be doing well. For this reason, the exercise has a relatively short time-horizon of 5 to 10 years. The budget for the project was £472,000 (approx. €750,000) over two years (2000-2002), with 50 per cent funding coming through ERDF, which is considerably more than other UK regions have had at their disposal to undertake foresight exercises. The programme is now to be extended to 2004 using regional funding only (see below).

Building momentum

Private sector involvement (the main target audience) in the west Midlands regional foresight programme has been achieved through:

- A partnership with the west Midlands Industry Foundation (WMIF).

- Regional foresight panels (see below).
- The involvement of industry associations and professional bodies in the dissemination of information and the regular programme of seminars which was targeted at their members (e.g. the west Midlands Business Consortium—a network of over 50 west Midlands business clubs).

It was important to establish, at a very early stage, the distinct nature of this project as a regional foresight activity with a clear focus on how foresight could benefit SMEs and other organizations in the region. For this reason the project was designed to include a large launch seminar for the whole of the region followed by several mini launches at sub-regional level.

Working with the national foresight programme managers, the programme also included in these seminars practical case studies on how the foresight process has affected the thinking of national government and provided some case studies of foresight adoption from the west Midlands region.

Throughout the duration of the project, regular regional foresight events were planned to explain the development of the project and to generate ideas on how the work of the regional foresight could best be implemented to improve the long-term competitiveness of industry in the region. The stimulus for these ongoing seminars was the work undertaken by the regional foresight panels.

A variety of printed literature and stationary was designed to support the promotion of the project and encourage the creation of a corporate image for the project as a whole. It was essential for the west Midlands region to be aware of the regional foresight programme at an early stage as the long-term sustainability of the project would be dependent on the penetration into the consciousness of the region's industry. The printed literature included brochures, letterheads and business cards and step-by-step guides to the foresight process that would include case studies and clear descriptions of the results of the national foresight process and addressed the potential benefits to west Midlands industry of their involvement in regional foresight.

One of the most important sources of marketing material for this project was the "interactive" web-based information made available to those in the region who might benefit from becoming involved in this west Midlands regional foresight initiative. A dedicated website was created in order to provide information on both events generated by the project and relevant information on sectors and markets being examined by the foresight panels. To view the west Midlands regional foresight website visit: www.foresightwm.co.uk

In addition to the project website, publicity for the programme was developed through press releases detailing seminars being delivered by the network.

Structure and organization

The project coordinator was Advantage West Midlands, the regional development agency, which formally came into existence in April 1999. The work in which Advantage West Midlands is involved incorporates functions that are targeted at improving the eco-

nomic competitiveness and social well-being of the region. For the most part, the regional development agency is not a delivery mechanism for individual initiatives within the region but is concerned with the development of strategy and policy, which is implemented by the west Midlands regional partnership of business support organizations. Thus, in the case of the regional foresight programme, the principal contractor was Coventry University Enterprises Ltd. (CUE), which has considerable experience in delivering projects on a regional basis that are targeted at the SME community, and the Centre for Local Economic Development (CLED), which is one of the region's premier research and consultancy organizations in the area of economic development.

The UK's national foresight programme was used as the benchmark for the regional project. Accordingly, a steering group was appointed and a sector panel approach adopted. In selecting sectors to be targeted, Advantage west Midlands and its partners identified five sectors that were characterized as a mixture of strategic and traditional industries for the region and "areas" of business activity that are expected to grow rapidly on the basis of current "predictions". This mixture was chosen to provide the project, and more importantly the region, with a test bed on regional foresight activities that could help support or counter the predictions on which the selection was being made. For these reasons the following sectors were identified as those on which the project would be focused:

- Medical technology.
- Ceramics.
- Engineering design.
- Tourism and leisure.
- Creative industries.

The regional foresight panels were intended to mirror but not replicate the work of the national foresight thematic panels. Moreover, it was hoped that they would add credibility to the implementation process and, just as importantly, provide "local ownership" of the foresight process in the west Midlands region. This was achieved by involving industrial and other representatives from the west Midlands region in the regional foresight panels. It was also central to the success of the programme to involve representatives of the SME community in the west Midlands in the foresight panels. The panels were comprised predominantly of leading industrialists and business sector representatives from within the region. These individuals were asked to perform one of the key functions of the foresight process in examining issues, utilizing research and data and creating "visionary" scenarios for the region and specifically individual sectors and to make recommendations on actions which can create a more competitive environment in the west Midlands (see below).

Methodology

Prior to the creation of the sector panels, focus groups were established to define the objectives for the panels, their membership, and the background research required. Following the meeting of these focus groups, the Centre for Local Economic

Development (CLED) was tasked with developing a review of the various sectors related to the programme. These reports were designed to give a broad picture of the sector to serve as a framework within which discussions relating to the issues faced by the sectors in the west Midlands could take place. As such, they gave an overview of the strengths, weaknesses, opportunities and Threats (SWOT) faced by each sector and the social, technological, economic, environmental and political (STEEP) issues.

These SWOT and STEEP analyses made it possible for panels to identify where competitive advantage in the region exists and to diagnose weaknesses in the general environment. They enabled the panels to map the region's future activity around its customers, its supply base, learning and skills and its universities. Essentially, the process was about capturing the distinctiveness of the region and developing goals to identify the next steps forward. The scenario method was used to do this.

The meetings of regional foresight panels in the west Midlands region were facilitated by an experienced consultant who encouraged the group (by reviewing the work undertaken by CLED) to evaluate the distinctive capabilities and core competencies of the region on which the future could be developed. Key driving forces for the development of each sector and for the region were then identified by each foresight panel. Further research was then undertaken in these areas (e.g. trends in medical device technology from the United States)—research groups were established for this purpose and were briefed to assimilate the results of existing research and to incorporate this information into a "knowledge pool", which included new empirical and primary research commissioned by the project. Using all of this regional intelligence, the panels developed regional scenarios. These scenarios focused on a period of between 5 to 10 years and included a time-line identifying key events and interventions. In addition to a direct focus on sector developments, the scenarios also included consideration of more social issues, including the ageing population and issues such as health in inner city areas.

- There were three proactive mechanisms by which representatives of the west Midlands SME community were involved:
- Representatives of SME enterprises who are recognized for their success in specific sectors were invited to join the regional foresight panels as full members. This ensured that issues affecting SMEs were embedded into the discussion process.
- In addition to the provision of research and information from the "knowledge pool" to the regional foresight panels (which underpinned much of their deliberation), evidence from "witnesses" representing the SME community also formed a part of the process.
- In order to engage the SME community in the process at regional level, the business link network and other business support organizations were invited to contribute to the direction of the regional foresight programme by:
  - — Providing information and research conducted in the sub-regions which could assist in the foresight process.
  - — Attending as representatives of the SME community when meetings of the project management group took place.
  - — Providing evidence for the regional foresight panels.

Outputs and outcomes

The outputs of the panels and the wider programme were packaged and disseminated to the target audience, i.e. SMEs. By adopting a sectoral approach within the region, the programme management team quickly became aware of key bodies in the region with an SME membership. Rather than directly target individual SMEs, a strategic decision was taken to work with these membership organizations related to the chosen sectors. This focus enabled the programme management team to identify the major issues concerning regional SMEs and to design seminars and workshops to address these.

Three key dissemination mechanisms were utilized:

- **Seminars and workshops**—A large variety of events took place, with over 150 people attending an ICT event to just six people attending a foresight interactive toolkit workshop (see below). The events were also distinctly different with leading industry figures (some of whom were involved in the national foresight programme) presenting their views at larger events and with the project team and other facilitators leading smaller groups.
- **SME assistance programme**—The programme has also worked with individual SMEs and networks to encourage them to think proactively about their future. Project work in this area has assisted these organizations in developing a vision for their future, and evaluating their strengths, weaknesses, opportunities and threats and examining the STEEP factors that could affect their business. This has resulted in the establishment of new SME networks, the development of new products, and companies accessing new markets.
- **SME foresight toolkit**—In delivering assistance to SMEs the programme management team recognized the need for a "vehicle" to enable other businesses to adopt the principles of foresight. Funding was then allocated to develop an interactive toolkit for use by SMEs. The toolkit was designed to be highly user-friendly both in terms of the content and the way it is used. Throughout autumn 2001, seminars were held in the west Midlands for SMEs to support them in the use of the toolkit, which is now available online at the programme website.

Engaging SMEs in the programme has been a complex task. The west Midlands, as a diverse region, has a plethora of business support activity and it has proved difficult to develop the programme to ensure the engagement of regional SMEs. In this environment, the programme benefited greatly from its linkage to the national foresight programme and by being managed by the regional development agency, Advantage West Midlands.

In addition, the programme has linked its activity to the work of local business groups ensuring that the needs of their member SMEs are met. In the programme's work with these SMEs, the project team also tried to ensure that their business objectives were met. This was achieved by relating the seminars and workshops to topical issues, including accessing new markets or developing new products, and sessions were designed to ensure that every SME left with a either a new technique they could apply, a view of their future markets, or a new business idea. This activity was supported by the development of the foresight toolkit.

On a programme level, the west Midlands approach to regional foresight has resulted in over 3,000 SMEs advised, over 500 SMEs assisted and nearly 200 SMEs "improved". On a more visible level, the project has created 33 jobs and levered around €3.5 million of investment in two years. On a practical level, and from a regional and business viewpoint, the outcomes have included:

- New business start-ups.
- Strategic partnership between regional companies.
- Development of new products.
- Evaluation of strategic direction within the business.
- Strategic response to succession planning.

All of the events were evaluated using a standard feedback sheet. With over 500 companies attending the events, this provided a valuable feedback mechanism for the project. The results show that the workshops and seminars were well received by the business community, with nearly all of those companies attending seeking to embed foresight within their business process. However, another perspective on these workshops and seminars is offered by the response rate to invitations to these events. At around 5 per cent, this shows the difficulty in engaging with SMEs on a large-scale and highlights the resources needed to make this type of regional foresight approach a viable exercise.

But on the positive side, regional foresight has now become an integral part of the work of Advantage West Midlands. Primarily linked to innovation, the use of foresight is highlighted within the agenda for action (linked to the regional economic strategy).

Following the successful programme outlined above, the agency has committed itself to the continuation of foresight in the region until December 2004. A formal model has been developed, which will see SMEs assisted in identifying future trends and opportunities to generate business growth, through the facilitation of businesses and business networks. The programme will use a three-phase process of engagement:

- Phase 1: Will identify the key long-term trends and drivers in technologies/markets. Working with key business groups, the findings of this "futures research" will be brainstormed and subsequently consolidated. This will lead to the identification of key strategic issues facing a particular group. Information will be gathered from foresight reports and other sources of research.
- Phase 2: Themed workshops will be developed based on the key strategic issues facing the group—these will be targeted at known clients within the area of activity and will additionally attempt to engage with new clients.
- Phase 3: Where applicable, networks (4 or 5 companies) will be established to support collaboration, the development of ideas and to share experiences. In addition, practical "how to" sessions can be developed, based around identified key strategic issues relevant to companies.

The weakness of the west Midlands foresight approach to date has been ensuring its development into mainstream delivery, but this extension will enable the region to further develop its foresight activity before it becomes fully mainstreamed within the UK Small Business Service and their Business Link network. In addition to supporting the development of the RDA cluster approach, the newly emerging foresight programme in the west Midlands region will support the development of high technology corridors, where there is particular potential to attract and grow high technology industries included in the target clusters.

REFERENCES

This module is based on extracts from:

1. *Practical Guide to regional foresight in the United Kingdom*, Ian Miles and Michael Keenan: European Commission 2002 available at http://foren.jrc.es/Docs/euro2018en.pdf. Copies of the guide for EU member States are available in 12 languages on the FOREN website.
2. *The Potential for regional foresight: Mobilising the regional foresight potential for an enlarged European Union—an essential contribution to strengthen the strategic basis of the European Research Area* (ERA) STRATA-ETAN Expert Group, Final Report, European Commission 2002 available at ftp://ftp.cordis.lu/pub/foresight/docs/regional_foresight.en.pdf.
3. *Foresight as a Tool to Enhance Regional Development*, Gordon Ollivere: UNIDO TF Summit, Budapest, 27-29 March 2003, http://www.unido.org/file-storage/download/?file_id=10585.

Bibliography for Catalonia on the 2010 horizon (Spain) chapter

Hugues de Jouvenel i Maria-Àngels Roque (dirs.), *Catalunya a l'horitzó 2010. Prospectiva mediterrània*, Barcelona: Enciclopèdia Catalana, 1993 (Catalan edition); *Cataluña en el horizonte 2010. Prospectiva mediterránea* Madrid: Ediciones de la Revista Política Exterior, 1994 (Spanish edition); *Catalogne à l'horizon* 2010 París: Economica, 1994 (French edition)

Maria-Àngels Roque (dir.): *L'espai mediterrani llatí*, Barcelona: Proa, 1999 (Catalan edition); *El espacio mediterráneo latino*, Barcelona: Icaria, 1999 (Spanish edition); *L'espace méditerranéen latin*. La Tour d'Aigues: éditions de l'Aube, 2001 (French edition).

Bibliography for Uusimaa (Finland) chapter

Kekkonen, K. (1998): *Instruments, tools and policies to anticipate the effects of industrial change on employment and vocational qualifications. Country report: Finland*. ESF Publications 20/98. Ministry of Labour. Helsinki.

Nieminen, J. (1999) (ed.): *Methods and Practices of regional Anticipation in Finland*. ESF Publications 45/99. Ministry of Labour. Helsinki.

Toivonen, M. (2001): *Main Development Features of Knowledge Intensive Business Services, in Toivonen M. (ed.): Growth and Significance of Knowledge Intensive Business Services*. Uusimaa T&E Centre's Publications 3. Helsinki.

"Anticipation of Industrial Changes and Training Needs at regional Level". Workshop held in the connection of International Congress "Enterprise, Work, Education in the 21st century. Anticipating Changes in Working Life and Education", 13-14 December 1999, Helsinki.

Additional resources

Regional foresight -FOREN
http://foren.jrc.es.

Innovating Regions in Europe—IRE Network
http://www.innovating-regions.org/.

Regional prosperity through Innovation in Europe—RINNO
http://www.rinno.org.

European Regions Knowledge Based Innovation—ERIK Network
http://www.eriknetwork.net.

Regional Futures UK
http://www.regionalfutures.org.uk.

REVIEW QUESTIONS

1. Why is foresight of significance at a subnational regional scale?
2. What difficulties may be experienced in setting up a regional foresight exercise?
3. How would you apply steps in setting up a regional foresight exercise?
4. What objectives do you think would be appropriate for a regional foresight exercise? Are there any reasons why you would not embark on such an exercise?
5. Issues that need to be considered in organizing a regional foresight project (who should lead; focus; positioning; coverage; time-horizon; involvement; duration and costs; sponsors). How would you make decisions about them in setting up a regional foresight exercise?
6. What lessons do you draw from the case studies?

Review question 1

Importance of qualitative issues in strategic planning.
Greater participation in policy.
More continual process of envisioning the future.

Regions are a major factor in economic development.

Regional foresight, it is argued, can:

— firstly identify local resources and potential.
— second provide the platforms on which regional innovation systems can be established and perpetuated. and
— third clarify and validate the institutional competencies and powers in a region with links to national and European innovation policies and networks.

Review question 2

(a) Conceptual:
- *Terminology;*
- *Governance levels;*
- *Image;*
- *Diversity;*
- *Integration of input;*
- *Integration of actors;*
- *Legitimizing foresight;*
- *Continuity*.

(b) Methodological:
- *Scope of methods;*
- *Participative research;*
- *Validity;*
- *Experience;*

- *Diversity;*
- *Evaluation.*

(c) Procedural:
- *Motivation;*
- *Support;*
- *Continuity;*
- *Application in Candidate or Cohesion Countries.*

Review question 3

Stage of development	Action steps	Step #
(a) Planning phase	Undertake mapping exercise	1
	Agree scope of regional programme	2
	Select appropriate host/focal point	3
	Appoint director/chief executive	4
(b) Project set-up	Prepare detailed business plan	5
	Allocate premises and equipment	6
	Recruit operational staff	7
	Establish regional governance structure	8
(c) Service development	Quantify service requirements	9
	Select and test pilot services	10
	Design a balanced regional offering	11
	Evaluate outputs and client benefits	12
(d) Marketing and delivery	Determine operating methods	13
	Create "intelligent front end" resource	14
	Extend the scope and range of foresight	14
	Disseminate foresight skills and capability	16
(e) Stabilization	Collaborate with international networks	17
	Invest in local research capability	18
	Apply integrated benchmarking strategy	19
	Achieve long term financial security	20

Review question 4

To inform policy-making.
To build networks.
To develop capabilities.

Insufficient support.
Just because others have done it.
If the exercise cannot be tailored to local circumstances.
Where there is no chance of consensus.
If resources are not available.

Review question 5

Those who can influence the outcome.
The challenges faced by the region.

Stage of development	Action steps	Step #
(a) Planning phase	Undertake mapping exercise	1
	Agree scope of regional programme	2
	Select appropriate host/focal point	3
	Appoint director/chief executive	4
(b) Project set-up	Prepare detailed business plan	5
	Allocate premises and equipment	6
	Recruit operational staff	7
	Establish regional governance structure	8
(c) Service development	Quantify service requirements	9
	Select and test pilot services	10
	Design a balanced regional offering	11
	Evaluate outputs and client benefits	12
(d) Marketing and delivery	Determine operating methods	13
	Create "intelligent front end" resource	14
	Extend the scope and range of foresight	14
	Disseminate foresight skills and capability	16
(e) Stabilization	Collaborate with international networks	17
	Invest in local research capability	18
	Apply integrated benchmarking strategy	19
	Achieve long term financial security	20

Appropriate place in the region's power structure.
Depends on objectives.
Determined by topics and local culture.
Stakeholder important to the issues considered.
Depends on resources available.
Important to gain commitment of finance and time.

Review question 6

There is no single way to run a regional foresight exercise.
Local circumstances are crucial to the design.
There is no single method to use.
Many examples of regional foresight exercises exist from which to learn, but they do not provide a blueprint to copy.

Module 7

FORESIGHT AT THE COMPANY LEVEL

At the completion of the module you should have:

- An understanding of why companies have become interested in foresight.
- How companies have used foresight.
- Knowledge of the methods they have used.
- Information on two case examples of company foresight.

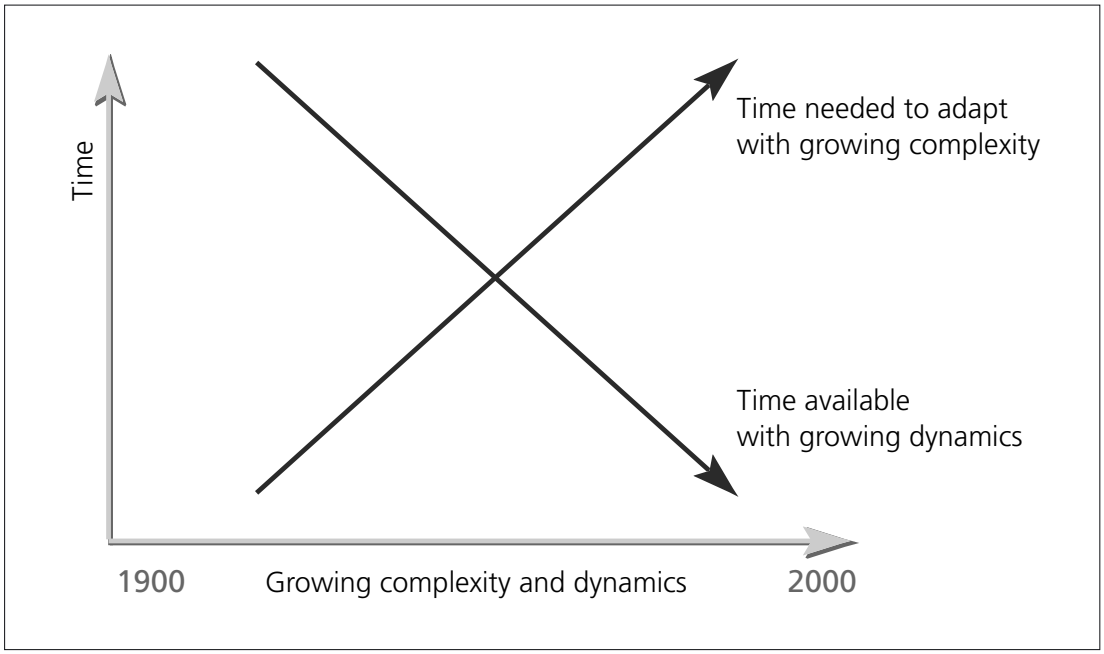
Contents

Figures

1. WHY COMPANIES NEED FORESIGHT

The dynamics of change in the corporate environment have increased strongly during the last decade. Not only several sectors of industry, but also the global economy as a whole are characterized by fundamental change. This can be exemplified by the creation of completely new industries (e-commerce or bio-technology), but also in view of fundamentally changing technological possibilities in communications methods, such as e-mail or mobile phones. Major causes for such change are the reduction of protectionist measures on a national level, a newly introduced, market-oriented order for nearly 3 billion people on a worldwide scale, the creation of new global institutions, all in combination with newly developed technological possiblities and institutional structures.

Figure I. Time constraints



Source: Graf, (2003).

Highly dynamic and complex environments tend to open a gap in human capabilities to cope with such change (figure I). This gap opens as—on the one side—the time necessary to cope with increasing complexity and dynamics increases strongly and—on the other side—the time available for such a reaction decreases. It is therefore necessary to develop management instruments that will increase our ability to master internal and external complexity. "In response to the increasing turbulence of the environment, management systems have been forced to become progressively more responsive and more complex" (Ansoff). Ashby's law of requisite variety clearly states that an effective management system has to comprise as many potential aspects as the system which is intended to be governed. This can be translated into the requirement, that management methods in an increasingly complex environment have also

to be more complex in order to be able to solve the coming problems. Linear extrapolations, therefore, have to be substituted by systemic approaches in order to prepare the relevant information which is necessary for future decisions.

The purpose of forecasting, therefore, is to significantly contribute to improving the information base for decision-making. During the last decade it has become more and more widely recognized that many aspects of problem solving can no longer be tackled in a targeted fashion using conventional procedures and methods of thinking. The perceived condition of a world that is changing at an ever faster rate as well as the depth and severity of the problems to be overcome have led to a search for fundamentally new approaches and a new way of thinking. What is needed is a holistic and integrated way of thinking, based on a wide horizon that investigates relationships and associations, taking into account a great number of influencing factors.

2. THE COMPANY RESPONSE

In the last two decades several large enterprises in such diverse sectors as energy, automotive, telecommunications and information technology have established foresight groups and strategic planning processes, which analyse the long-term prospects of new technologies and their impact on markets and corporate strategies. DaimlerChrysler's Society and Technology Research Group (STRG) is one of the first future research groups to be established within a company. Since 1979 it has investigated, in close cooperation with its customers, the factors shaping tomorrow's markets, technologies and products. Its focus is social science-based futures and business environment research to support strategy and product development processes.

The premise of the work at STRG is that it is not possible to predict the future, but it is possible to prepare for an uncertain future by thinking through a variety of possible developments and analysing the forces that influence them. Finally, preparation for the future involves an understanding of the way each of us shape it. In order to deal with the uncertainty inherent in technological and societal developments it is imperative to develop a set of methods grouped around the scenario technique. A scenario process is typically organized as a structured and focused communication process between experts from different disciplinary backgrounds and from different corporate functions about potential future developments, their driving forces and the interactions between them. The process follows seven steps:

(a) Definition of topic: what is the issue to be analysed?
(b) Influencing factors: what factors have an impact on the issue?
(c) Projections: how could the influencing factors develop?
(d) Networking of factors: what cross-impacts exist?
(e) Scenarios: what consistent images of the future can be inferred?
(f) Disruptive events: what events could lead towards radical trend deviations?
(g) Strategies: what strategies/actions/ideas fit the scenarios?

In terms of technology foresight, a crucial step in the scenario process is to study the interactions between societal and technological developments. For this purpose STRG takes a close look at social trends and changes in consumer behaviour that are relevant to the diffusion of new technologies into the marketplace. Thus, STRG's foresight activities regarding future technologies are always embedded in a broader analysis of developments in the societal and economic business environments.

According to the study of 18 companies (Becker, 2003) foresight activities can be classified in terms of the overarching goal or rationale that underlies their implementation. Generally speaking, most corporate foresight activities are grounded on two main motives: either there are specific characteristics of a company's business operation that inherently demand such a long-term orientation, or foresight activities are undertaken as a proactive step to better cope with the uncertainties in their business environment. In other words, there are both reasons internal and external to a company that provide an impetus for doing foresight.

Two typical internal drivers for foresight could be identified:

- In industries characterized by long product cycles and high development/investment costs (such as the automotive or chemical/pharmaceutical industry), long-range monitoring and planning is an inevitable prerequisite to any strategical RTDI decision: to successfully innovate, one has to early identify changes in markets and technologies, as both the product development and the restructuring of the corresponding production system takes a long time. (As one participant put it, "it needs a long-term perspective to identify potential new areas in which to build up competence, because the actual development of new competencies and human resources does at least need 10 years.")
- Also for firms that pursue an "innovation leader-strategy", foresight seems inevitable, as they have to constantly monitor and react on the innovation activities of their competitors to secure their technological leadership in the market.

As external drivers for a foresight activity the following points were mentioned:

- A major motive (especially for firms in fast-changing sectors such as consumer goods and ICT) was to "never be surprised by future developments in the (business) environment", but to be aware and possibly influence them. Thus, companies use foresight as part of an early warning system in order to identify future threads and opportunities for their businesses. In a similar vein, some firms also employ foresight to prepare for possible "wild card"-events and sudden shocks (like the 9/11-terrorist attacks) in the political, economic and societal sphere.
- In order to better understand the social/cultural context of the use of technology, firms in particularly technology-intensive sectors also use foresight more broadly to build up knowledge both about emerging technologies and their future users.
- Foresight could also be the way to open the company to the outside world and to find starting points for innovation transfer, cooperation and best practices.
- Finally a lot of firms felt that foresight provides important background information about the future conditions and contexts in which the company will have to

operate, Thus, foresight analyses of the business environment often serve as the starting point for the development of a corresponding corporate strategy. Such foresight activities that help to better embed the corporate strategy in their socio-economic context are found in a lot of sectors.

Objectives of foresight

The ultimate objective of all foresight activities is to ensure that developments in the areas of science, technology and society that are likely to ensure future social benefits are identified promptly. Although all corporate foresight activities share this final goal, it is useful to categorize foresight in terms of its more intermediate functions and impacts for the company:

(a) Anticipatory intelligence, i.e. providing background information and an early warning of recent developments.
(b) Direction setting, i.e. establishing broad guidelines for the corporate strategy.
(c) Determining priorities, i.e. identifying the most desirable lines of R&D as a direct input into specific (funding) decisions.
(d) Strategy formulation, i.e. participating in the formulation and implementation of strategic decisions.
(e) Innovation catalysing, i.e. stimulating and supporting innovation processes between the different partners.

3. CHALLENGES OF FORESIGHT

When one looks at the historical record of forecasting technological developments and their impact on society and markets, one cannot evade the fact that many if not most forecasts have gone wrong. An analysis of the host of failed forecasts reveals a couple of frequent misguided approaches (figure II):

Figure II. Frequent flaws in foresight activities

- Linear extrapolation of trends (life-cycle curves, quantitative forecast models)
- Underestimation of basic innovations in the early stages (e.g. new, broader applications are out of perspective)
- Incremental innovations: overestimation of speed of change (e.g. the speed of diffusion of new products is often overestimated)
- Technical feasibility is often equated with market demand (but: technology forecasts are not market forecasts)
- Abandonment of continuous monitoring (one-time assessment of developmental dynamics: "now we know where it is going")
- Inclination towards quantification where qualification is sufficient (exclusion of areas of influence/impacts that are not quantifiable)

Source: Ruff, (2003).

Linear extrapolation of trends

A flaw that was particularly prevalent in the golden age of linear modelling in the 1970s but is still entrenched in a lot of forecasts is the use of linear extrapolation models, which have been applied to economic and energy forecasts and others. Metaphorically speaking, linear extrapolation is like sitting in a car with a covered windshield with only the rear mirrors available for orientation. This means that one can only look back on the distance covered so far and try to make a good guess at what is going on along the road ahead. Evidently, in a dynamic and "curved" environment this no longer works.

Underestimation of basic innovations in the early stages

Another major flaw is the underestimation of basic innovations in the early stages. There are some outstanding historic examples: Albert Einstein, for instance, said in the early 1930s: "There is not the least indication that we can ever develop nuclear energy". Or in the recent past (1977), people active in the computer business, such as Ken Olsen, Chief Executive Officer of Digital, said: "I don't see any reason why single individuals should have their own computer". There are many similar examples showing that outstanding experts in their respective fields were evidently unable to anticipate the disruptive and innovative consequences of their research or business activities.

There is also a related anecdote from the company history of Daimler-Benz: a market forecast of Mercedes-Benz in the year 1900 came to the conclusion that the worldwide demand for cars would not exceed 5,000 especially because of the lack of available chauffeurs. This example also illustrates how basic innovations are often underestimated. The dominant social model at that time was that people were driven around by chauffeurs and did not drive their cars themselves. This social model was so deeply implanted in the consciousness of people (including early market researchers) that they could not imagine a basic change.

Incremental innovations: overestimation of speed of change

Many contemporary forecasts of new technologies overrate the speed of diffusion of new products and services, underestimating the conservatism of customers and overestimating their willingness to accept changes. A typical example of this is provided by many prognoses of industrial analysts on the diffusion of third generation mobile telephones (with Universal Mobile Telecommunications System (UMTS) standard). These prognoses often assumed that the introduction of technical equipment with the new, powerful standard would directly cause users to relinquish their old mobile telephones and replace them with new ones. The possibility that many mobile phone users would be satisfied with today's second generation (Global System for Mobile Communications (GSM) and the coming intermediate generation of equipment (General Packet Radio Service (GPRS)) for some time to come was not taken into account.

Technical feasibility is often equated with market demand

A further flaw in prognoses may be that the technical viability of the new products and services is equated with the market's potential demands, without the latter actu-

ally being proved. For example, the proponents of automatic car driving simply assume that many drivers would allow themselves to be driven by such an autopilot system as soon as it became technically feasible. This disregards the fact that automatic driving comes up against substantial acceptance barriers with drivers as a result of fundamental safety concerns and the fact that most drivers will not change to an electronic system because they enjoy driving and the subjective feeling of control.

Abandonment of continuous monitoring

A flaw that is often encountered in companies is connected with the rise and fall of strategic planning efforts in the business cycle. During or after a crisis, companies often expand their field of strategic monitoring and planning. However, once a thorough strategic analysis and contingency plan has been made, the attention of the top management shifts to other topics and the strategic exercise remains a one-time assessment of development dynamics. It is evident that such an approach is risky and paves the way for the next crisis.

Inclination towards quantification where qualification is sufficient

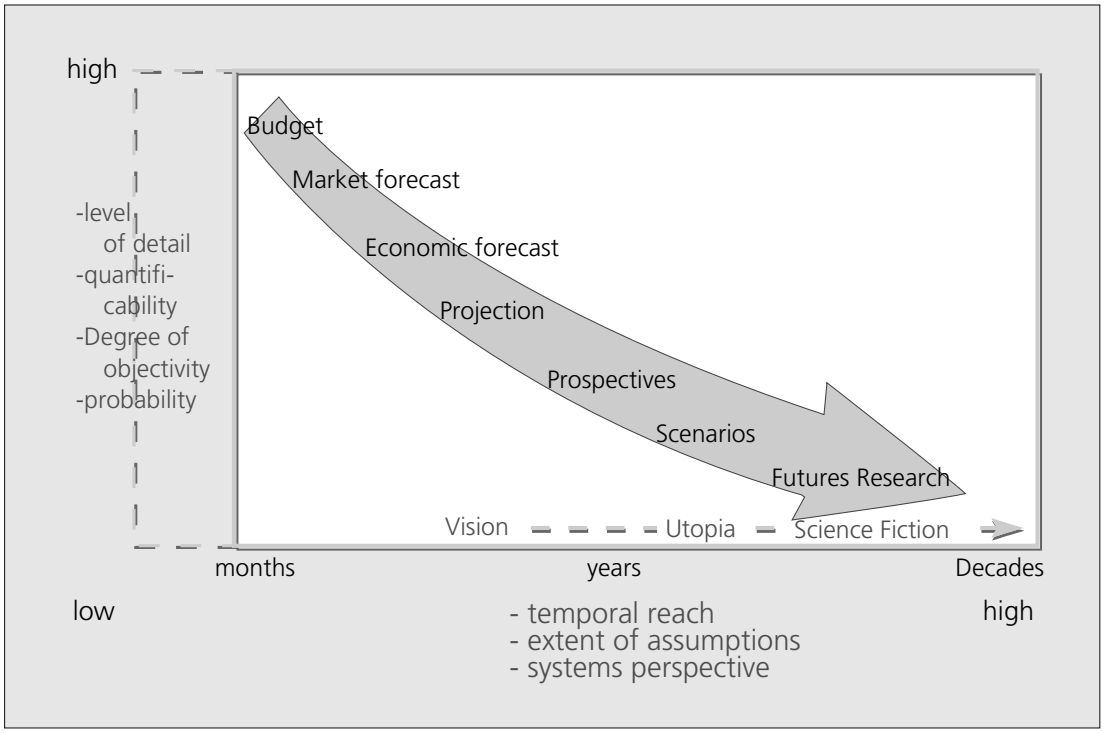
Another flaw in foresight results from the high regard for quantitative simulations in futures research and also the simple fact that numbers are more easy to deal with than phenomena that can only be described qualitatively. One consequence of this is that influencing factors are often excluded because they cannot be quantified. Thus the field of observation is often narrowed. Another consequence is that, even if qualitative factors can be quantified, the quantification is often used as the critical variable, and important additional information may be lost. An example of this is that when forecasting economic developments (e.g. stock markets) psychological factors, which are difficult to quantify, have long been neglected or even ignored. Only with the rise of the new discipline of behavioural finance in the last few years, have forecasters and analysts tried to rectify this imbalance.

4. DIMENSIONS AND LEVELS OF CORPORATE DECISION-MAKING

In accordance with the breadth of the issue “future”, decisions can be distinguished according to their importance and meaning, a differentiation that finds its expression in economics in the terms “business cycle” and “growth”, and in business administration in the terms “operative” and “strategic (normative) management”. At the same time this differentiation means that for each of the processes addressed we have to consider differences in their distances into the future, reflected in variations in the required information. With a view to a forecast, the number of assumptions that must be made also increases and the demand for a systemic perspective becomes all the more important.

Depending on the level in the decision-making hierarchy there are different requirements for an information system (both at the level of companies and the level of national economies). This means that there have to be different kinds of forecasts of varying information depth in order to be able to provide information adequate for the decision in question (figure III). For long-term basic decisions on a corporate policy or strategic level, information about the environment is required that has a long-term structure and focus in order to reduce the uncertainty of decisions and to better be able to estimate their long-term effects on the ability of companies to survive and develop.

Figure III. The broad field of prospectives

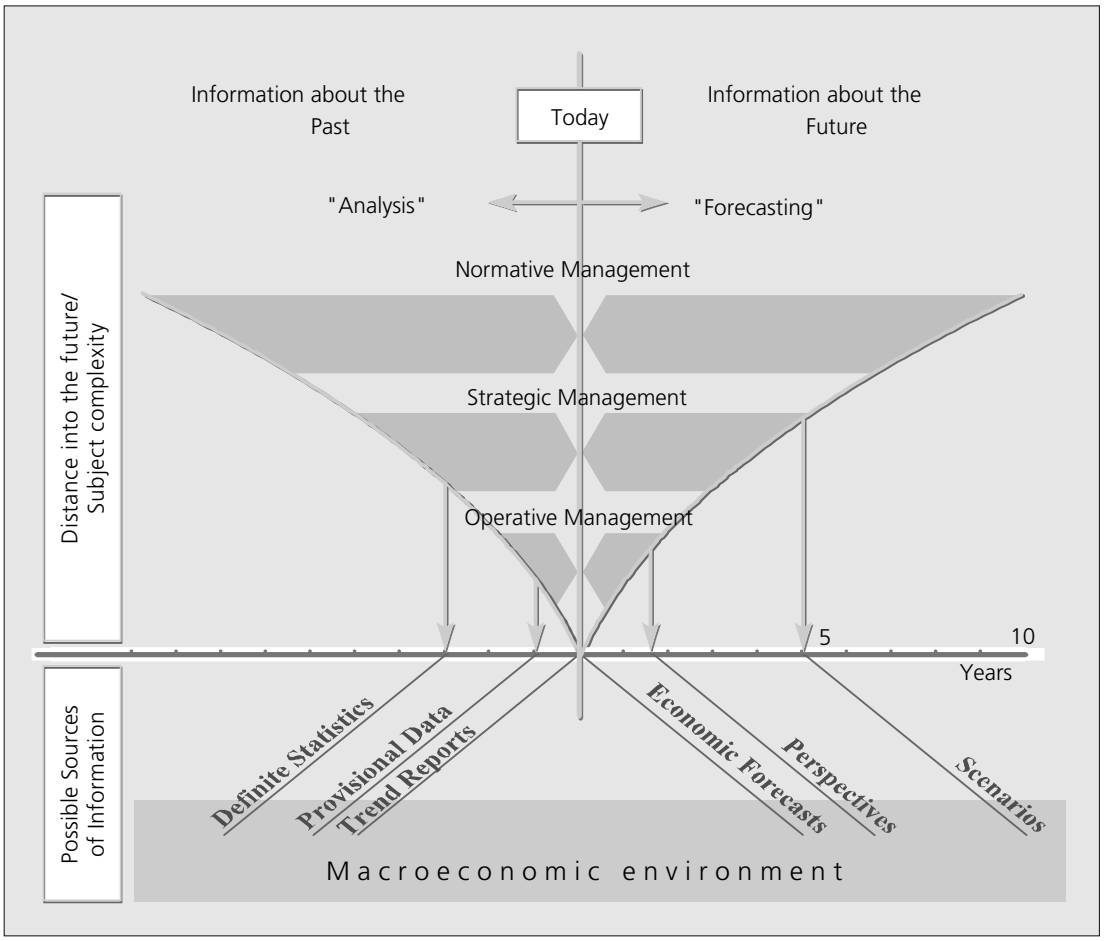


Source: Graf, (2003).

Figure IV and figure V compare such an information-based concept with the "integrated management concept" of Bleicher and show clearly the parallelism of the two approaches. It has to be taken into account that naturally what matters is not only forward-looking information, but that the system in question also has to be positioned in its previous environment. For such a purpose its reactions in the past to changes in the previous environment can be investigated in order to be able to obtain information as to the effectiveness of measures, and possible effects of alternative actions. At the same time this comparison indicates that the amount of information also has to increase with a growing time horizon (i.e. increasing complexity of the environment with increasing distance into the future and subject complexity).

Additionally, figure IV indicates the information that has to be drawn upon in order to answer the respective issues investigated. We can also relate the three major issues in economics to these three levels of management. While the level of normative management focuses mainly on issues of growth and evolution, strategic management pays particular attention to structural changes in the economy. Finally at the operative level, the state of the economy and short-term changes in an economy's utilization of capacity are at the forefront. This is where the respective views of business administration and economics meet in such studies. The view of economic forecasting also has to be in keeping with that of business administration and economics.

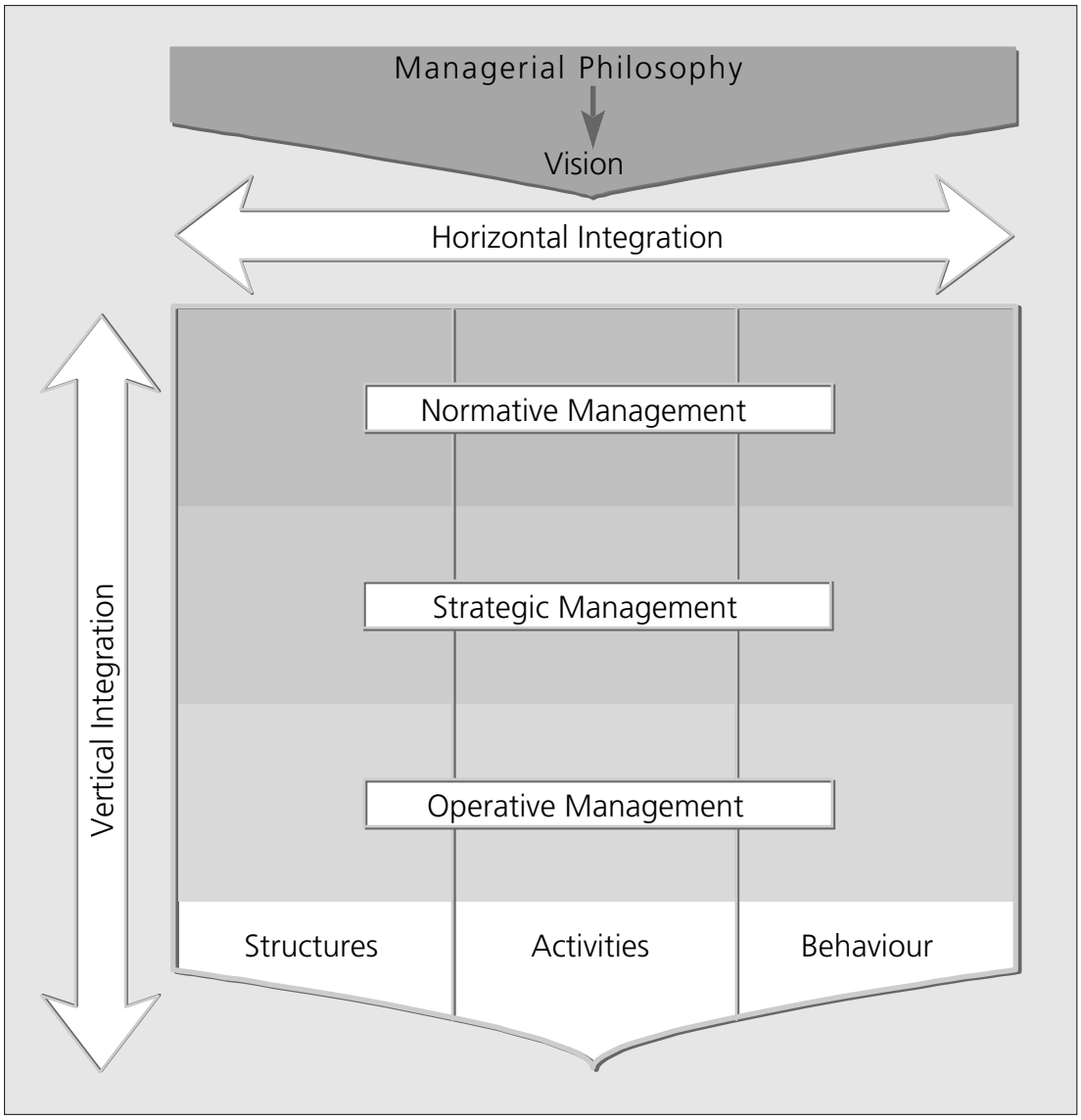
Figure IV. Interrelationships between normative, strategic, and operative management



Source: Graf, (2003).

A decision's distance into the future is closely connected with the importance of the subject matter for an economy's or company's ability to develop and survive. It can be assumed that the depth of required information increases with increasing distance into the future because, in the long-term, the number of (structural) changes increases rapidly. So there is a rapid increase in the degree of complexity of the subject inves-

Figure V. Schematic depiction of information from a time perspective

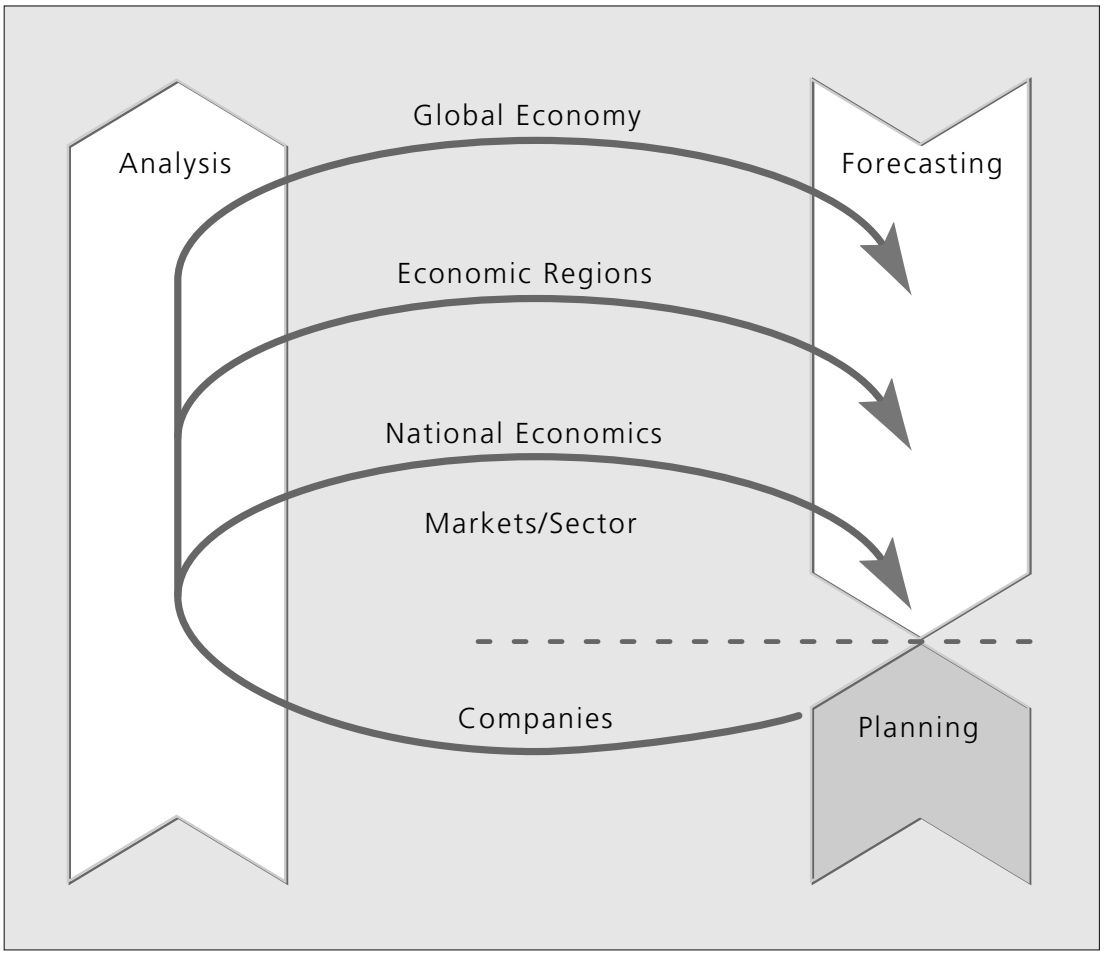


Source: Graf, (2003).

tigated and therefore also of the decision itself. Figure VI shows the various levels of economic activity, which, starting from the company level, cover an ever widening range, even extending as far as the global economy. At the operative level identification of short-term fluctuations in markets, sectors and national economies is usually sufficient, while at the strategic level additional information also on global economic regions is indispensable. At the normative level general global economic conditions have to be taken into account by necessity so that, due to the effects of the growing international division of labour, sufficient information is made available for decisions having long-term effects.

In each case it has to be kept in mind that, from an economic point of view, phenomena are being investigated that definitely differ. In the normative area the focus is mainly on issues related to growth potentials of national economies, world regions, even the global economy as a whole. The issue of a sustainable evolution of the global economic system is also considered particularly important. In contrast, the operative level deals mostly with issues of short and medium-term fluctuations in the utilization of production capacity (of growth potential). Finally, with strategic management it is also important to take into account structural changes in composition (mix of goods, range of sectors, regional breakdown, etc.)

Figure VI. Levels of economic activity



Source: Graf, (2003).

Figure VI also shows that issues related to positioning of a company within its general conditions, i.e. the analysis, progresses from the bottom to the top, from the specific to the general, and that consequently it is also being determined during analysis what information is relevant for each issue. Therefore, operative issues will have a sig-

nificantly "smaller scope" than issues of normative management. In contrast, forecasting does the opposite, i.e. goes from the more general to the more specific, and progresses top down.

Finally, figure VI. indicates that in such a study, forecasting applies exclusively to the issue of the relevant images of the development of a company's environment, i.e. strives to clarify those general conditions crucial for a company's development. Consequently, a forecast on possible trends of its framework forms the indispensable basis for managerial decisions. However, it is in our opinion not very useful to speak of "corporate forecasts", even though there have been, on various occasions, approaches referred to as "economic forecasting" in the literature under the title "corporate forecasting" (and also "business forecasting") that, in the end, turned out to be budget calculations. Such attempts start from wrong assumptions about the nature and possibilities of economic forecasting. At the corporate level it is inevitable that the desires or budgeting ideas of management regarding the future development of business are included. In such cases we consider it wrong therefore to use the term "forecasting". Forecasting always refers to future development of a company's environment: as indicated in figure V, forecasting at any rate ends at the markets/sectors level. This is where corporate planning and foresight begin.

5. FORESIGHT IN A BUSINESS CONTEXT

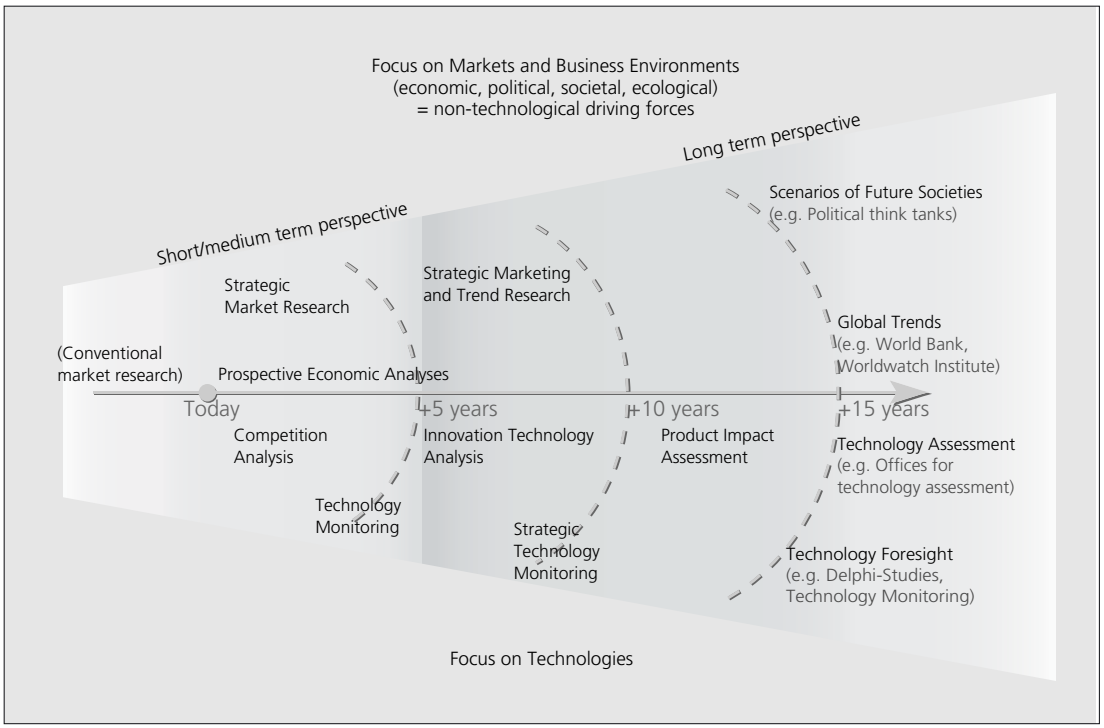
Fields of foresight activities of relevance to companies

Technology foresight is defined today as a "process involved in systematically attempting to look into the longer-term future of science, technology, the economy, the environment and society with the aim of identifying the emerging generic technologies and the underpinning areas of strategic research likely to yield the greatest economic and social benefits" (Martin, 2002). This contemporary definition has largely extended the scope of earlier definitions, which in the literal sense of the concept restricted the meaning to a study of technological developments, as reflected in the initial national technology foresight exercises by Delphi surveys. It is a matter of opinion whether the "postmodern" extension of the definition is still properly reflected by the name "technology foresight" or if the concept should be renamed "society and technology foresight". At any rate, with such an extended definition, technology foresight encompasses a diverse range of approaches to research into the future (see figure VII).

The various approaches can be broken down into four categories:

(a) Time-frame of the foresight endeavour.
(b) Focus of the foresight (focus on technologies vs. focus on non-technical topics).
(c) Regional scope (local, national, regional, global).
(d) Focal perspectives and interests of the players engaging in foresight activities.

Figure VII. Landscape of foresight activities with relevance in a business context



Source: Ruff, (2003).

The various approaches to foresight and their major features are characterized in more detail in figure VIII. Despite the variety, the overview is still not complete, and the focus here is on approaches and concepts that are directly or potentially relevant for companies and long-term business strategy.

Historically, foresight activities were triggered by the prospect of the accelerated pace of science and technological innovations. Thus, most foresight projects in the public and private sector until the early 1990s focused on technological developments. In the public sector, offices for technology assessment have been extensively institutionalized as preparation and support for political decisions by national governments (Bröchler, Simonis and Sundermann, 1999). The technology assessment field that emerged from the early 1970s in the United States and from the 1980s in most Western European countries is a research concept dealing with the likely or already observable effects of new technologies, with special emphasis on secondary and tertiary effects (Büllingen, 1993). Technology assessment has typically focused on new "big" technologies such as nuclear technology, analysis of the human genome or space exploration, and on regional or local environmental issues.

A few companies have also adopted the technology assessment approach and adapted it to the needs of companies as "product impact assessment" (see Minx and Meyer, 1999). As companies mostly deal with products, i.e. integrated instead of "pure" technologies, the focus of "product impact assessment" is oriented more towards applica-

Figure VIII. Selected fields of foresight and their relevance for companies

Field of foresight	Major focus	Time- frame and scope	Major players	Relevance for corporate foresight in multinational companies
Competition analysis	Monitoring of technological and market positions (corporate strategies) of major competitors	Short- to medium-term (1-5 years) Specific technology fields and markets	Private business intelligence (e.g. business consultancies) corporate units for competition analysis	Very high relevance: standard feature of most corporate strategy processes; very high relevance in highly competitive industries
Technology monitoring	Monitoring of short- to medium-term technological innovations in science, research and industry, analyses of patents/licences	Short- to medium-term (1-3 years) Specific technology fields and markets	Private business intelligence (e.g. business consultancies) corporate units or projects	Very high relevance: standard feature of most corporate strategy processes in high-technology companies
Strategic technology monitoring	Monitoring of long-term techno-logical innovations in science, research and industry, analyses of research topics and strategies in science and industry	Short- to medium-term (1-3 years) Specific technology fields and markets	Private business intelligence (e.g. business consultancies) corporate units or projects	High to very high relevance: highly relevant for companies with long product development cycles and high investment risks
Product impact assessment/innovation and technology analysis	Analysis of likely or observable effects of new products, focus on secondary or tertiary effects	Medium- to long-term (5-15 years), regional, national or market area-related scope	Public research institutes (e.g. environmental research institutes). Few projects within companies	Low to high relevance: highly relevant for companies with high risk potentials (e.g. chemical and pharmaceutical industries)
Technology assessment	Analysis of likely or observable effects of new (basic) technologies, focus on secondary or tertiary effects	Medium- to long-term (5-25 years), regional, national or local scope	Offices for technology assess-ment (support for national governments). Public and private research institutes	Low to high relevance: relevant for companies with high or uncertain risk potentials and dependency on few basic technologies (e.g. mobile communications industry)
Technology foresight (narrow definition)	Projections of likely technological innovations in the long-term future (e.g. "classical" technological Delphi studies)	Medium- to long-term (5-30 years), national scope	Public and private research units	Low to high relevance: relevant for companies with high potentials for shaping markets by "technology push" strategies (e.g. life science and health industry)

Figure VIII. *(continued)*

Field of foresight	Major focus	Time- frame and scope	Major players	Relevance for corporate foresight in multinational companies
Prospective economic analyses	Projections of economic growth/sector-specific forecasts (GDP, interest rates, sectors, etc.)	Short- to medium-term (1-3 years), regional and global scope	Public and private economic research institutes Corporate economic research units	Very high relevance: relevant for investment policies, projections of earnings/returns
Strategic market research	Anticipation/projection of customer needs in the short- to medium-term	Short- to medium-term (1-3 years) Regional or national market areas	Market research institutes Corporate market research units	Very high relevance: relevant for product strategy, innovation process, fine tuning of products and services shortly before launch
Strategic marketing and trend research	Anticipation/projection of customer needs in the long-term	Medium- to longterm (3-10 years) Regional or national market areas	Strategic marketing research units Corporate think tanks	High to very high relevance: relevant for product strategy, innovation process, early warning systems; highly relevant for industries with long product development cycles and high investment risks
Global trends	Broad-range analyses of future developments in economy, politics, societies, ecology on a global or macro-regional scale. Focus on global issues	Long-term (10-50 years Global scope, sometimes with regional differentiation	Public and private future research units (e.g. political think tanks, World Bank, Worldwatch Institute, Millennium Project of the United Nations)	Medium to very high relevance: relevant for long-term strategic planning (e.g. change of core business); highly relevant for multinational companies with issue-sensitive business (e.g. energy industry, resource-dependent industries)
Future societal change	Driving forces of social change/scenarios of future societies, mostly national or regional focus (e.g. European Union)	Long-term (5-20 years) Sociocultural units (cultures, countries, subcultures)	Public and private social research units (e.g. political think tanks, Institute for Prospective Technology Studies of the European Union) Few corporate think tanks	Medium to high relevance: relevant for long-term strategic planning; highly relevant for companies with high sensitivity to societal changes, e.g. social issue management

Source: Ruff, (2003).

tions and the impact of product usage. It also varies in terms of scope and time frame compared with typical technology assessments in the public sector. The one-sided focusing of technology assessment on the risks of new technologies has recently led to a reorientation with the introduction of the concept of "innovation and technology analysis" (Baron et al., 2003). This approach has as an objective the need to identify development and application opportunities for new technologies earlier and to tackle opportunities and risks in a balanced way.

Very relevant for companies in the technology sector is the field of technology monitoring, which is usually pursued in a short- to medium-term time frame. Technology monitoring consists of the continuous monitoring and scanning of emerging technologies including an evaluation of which technologies could and should be integrated into the technology roadmaps of research and development units. Some companies, especially innovation leaders in technology, have extended the time-frame of these monitoring activities to a long-term horizon (strategic technology monitoring)

Technology monitoring is often closely linked with competition analysis. However, beyond the technological scope, competition analysis also encompasses the monitoring of strategies and market positions of competitors, thus taking the non-technical business environment and markets factors into account.

Most foresight activities focused initially for the most part on technological developments. Only a few studies have systematically incorporated economic, political or even societal perspectives. With the growing awareness of the relevance of political and societal factors, more and more foresight studies have integrated the impact of the economic, political and social environment in the analysis. This change is also reflected in the changing definition of technology foresight. Further evidence of this "societal evolution" of the understanding of technology foresight is the extension of the technology Delphi studies from a pure technological focus to include economic and social topics (Cuhls, Blind and Grupp, 1998) as well as the shift from Delphi studies (with more or less closed expert circles) to a broader public involvement of experts, stakeholders and citizens, for instance in the current FUTUR project initiated by the Federal Ministry for Research and Technology in Germany (Cuhls, 2000).

Foresight activities regarding the economic and market environments have been a standard functional element in most large multinational companies for quite a time (e.g. large companies in the energy, banking, chemical or automotive branch). Most of these companies have an economic research unit and also a market research unit, which deals with the customer needs of tomorrow in at least a short- to medium-term perspective.

A rarity is still the field of "Strategic Marketing and Trend Research", in which future customer needs or requirements regarding products and services are anticipated in a longer-term time-frame of 5 to 10 years. As conventional methods of market research have limited scope for anticipating future customer needs, the field of advanced marketing has developed its own set of methods, combining methods from market research with those from futures research. Examples of companies with specialized groups in this field are Philips with its Advanced Design unit or DaimlerChrysler with its Society and Technology Research Group.

Even longer-term foresight activities regarding economic, political and societal developments are usually conducted by specialized think tanks in the political or private sector or by non-governmental institutions. In the field of global trends, a broad diversity of institutions are involved including the World Bank, the Worldwatch Institute, national intelligence agencies (e.g. the Central Intelligence Agency) and the United Nations University with the Millennium Project, to mention just a few. Only a few companies deal systematically with this field of advanced global foresight: some think tanks in the energy industry (e.g. Shell), the financial and insurance industry (e.g. Swiss Re) or the automotive industry (e.g. DaimlerChrysler), for example.

Another relevant field of foresight is future societal change. The focus here is on long-term societal changes (e.g. in social structures and lifestyles) and on the generation of scenarios regarding future societies. This type of foresight is mostly conducted by supranational or national think tanks and research institutes (e.g. Organisation for Economic Cooperation and Development, the European Union's Institute for Prospective Technology Studies, foundations by political parties) or public and private social research institutes. Only a few companies take a look at this field, because social change is still very often regarded as a non-business topic. But multinational companies are becoming increasingly aware of the relevance of this research field as they experience the impact of social changes on their corporate strategy portfolio and corporate image.

6. MAJOR CHARACTERISTICS OF FORESIGHT IN THE PUBLIC AND PRIVATE SECTOR

In science and technology policies, the standard appeal for closer collaboration between the public and private sector in the fields of foresight is regularly encountered. Usually both sides affirm this general objective and some shared premises in the basic approach. However, for a realistic appraisal of opportunities for collaboration an awareness of the differences in interest, time frames and the process requirements regarding foresight in the public and private sectors is also required.

The major shared premises and differences in foresight activities are shown in figure IX. Within the private sector, the focus is on large multinational companies, which basically have the resources to initiate corporate foresight activities on their own.

The basic common feature of public and private sector activities is in the general objective, which is to anticipate future developments in science, technology, economy, politics and society.

In the more specific goals some differences in priorities emerge: whereas public sector activities by their very nature focus more on collective visions for technology, consensus-building and creating legitimacy for technology policies, companies focus primarily on market-related opportunities and risks. Of course, both the public and private

Figure IX. Foresight in the public and private sector—major characteristics

	Foresight in the public sector	Foresight in the private sector
General objective	Anticipation of future developments in science, technology, economy, politics and society	
Specific objectives	• Generating ideas and visions for technology and innovation • Identifying/prioritizing related policy measures	• Identifying opportunities and risks in markets, technologies and the business environment • Identifying strategic options
Major players	• Governmental bodies • Expert communities • Non-governmental organizations	• Strategic planning units • Research and technology units • Corporate think tanks
Time-frame	• 5-20 (50) years	• 2-15 years
Duration of typical projects	• 1-3 years	• 3 months to 1 year
Major methods	Technology monitoring/scanning Environmental monitoring/scanning Analysis of patents/licences Expert panels/interviews Delphi studies Participatory methods Technology sequence analysis Time series forecasts Trend impact analysis Systemic modelling Scenario construction (and others)	

Source: Ruff, (2003).

sector can subscribe to these other objectives as well. When seeking to conquer new markets, companies rely on the "social capital" of the legitimacy and societal acceptance of technological innovation. Similarily, the public sector fosters societal discourse on technology for the sake of creating economic and social benefits. But beyond this reciprocal agreement, there remains a basic difference in terms of perspectives and the prioritization of specific goals.

Another difference lies in the organizational contexts and cultures of the major actors involved in foresight. In the public sector there is a more heterogeneous set of players, ranging from governmental or administrative bodies to (scientific) expert communities, non-governmental organizations and other collective or single stakeholders. Companies usually institutionalize foresight activities in strategic planning units, research and technology laboratories or corporate think tanks and thus have a more homogeneous set of actors and less organizational complexity to handle.

A major difference lies in the time-frame. Public sector activities mostly consider a time-frame of about 5 to 20 years ahead, in some cases even up to 50 years (e.g. the project "Visions for a sustainable Europe", Rotmans, Van Asselt and Anastasi, 2000) or even 300 years (e.g. the Millennium Project of the United Nations University). In the private sector a 10- or 15-year perspective is already considered "very long term". Even among strongly capitalized large multinational companies, only a few take such a perspective.

Another difference, which is probably the greatest stumbling block to collaboration between public and private players in the field of foresight, is the duration of typical projects. Projects in the public sector often run for a couple of years until final results are presented, communicated and implemented. In the business context results including at least the first steps towards implementation are usually expected within less than a year. In some sectors, like the information and communications branch, typical time allocations for strategic projects are even shorter. This difference in the time logic of public and private activities is the main reason why only a few public-private collaborations in the field of foresight have come about to date and why companies even reject public funding programmes on a national or regional (e.g. European) level. Sometimes, the length of the application phase for public funding already exceeds the strategic planning cycle of the company for which the results are urgently needed. More fast-track funding for public-private collaborations would boost the involvement of companies.

In terms of methods deployed, there are only minor differences between the public and private sector. Delphi studies are more typical for publicly funded research, as they entail considerable costs and, because of their iterative character, are also time-consuming. Expert interviews, technology monitoring/scanning, scenarios and sensitivity analyses are major elements of the generic pool of methods. Because of their interest in exploiting economic opportunities, companies usually deploy a more differentiated set of methods regarding the evaluation and structuring of intellectual capital (e.g. patents/licences). Also the strategy and implications phase of foresight activities is methodologically more developed and differentiated in corporate foresight.

To sum up, public and private sector activities in foresight share some basic features but are also characterized by a number of crucial differences, which have to be taken into account and resolved if collaboration between public and private players is to be put into perspective.

7. FORESIGHT IN COMPANIES

From the study of 18 companies (Becker, 2003) the following insights can be provided.

The breadth of coverage

The breadth of coverage took a number of forms:

(a) Holistic, i.e. foresight concerned with the entire spectrum of science and society.
(b) Macro-level, such as foresight that covers a range of disciplines.
(c) Meso-level, i.e. foresight relating to a single scientific field, technological area or product range/ sector.
(d) Micro-level, i.e. foresight for a specific research project or product.

With regard to the firms in the sample, the distribution across those four categories was far from even: Out of 19 firms, only two reported that their foresight activities mainly cover (or provide only input for) an individual project or a specific decision. Six firms focus their foresight efforts on the meso-level: Here, the analyses usually cover a somewhat broader area, as they have to provide input for the strategic decision-making process in entire subject areas of research. Nevertheless, those activities are also still rather specialized and centred on specific issues in R&D such as the long-term planning of research programmes in certain technological areas or business units.

A considerably broader foresight approach was used by those companies that used foresight information as a basic input for both the decision-making process in different business areas and for the corporate strategy development. Here, the analyses comprehend the monitoring not only of special fields of technology but also of the more general trends in the social, economic, political and regional sphere. Not surprisingly, most of the firms that undertook such a foresight were operating in sectors that are strongly globalized (such as financial services or the chemical/pharmaceutical industry), which implies that their business activities will also be strongly dependent on changes on a global level.

Some firms finally reported to be engaged in more holistic foresight activities. Here, foresight was not only used as an input for strategic decision-making, but it also served as a tool to develop more comprehensive "visions" of the future that not only painted a picture of the company's future but that of the societies and regions in which it is embedded. Those holistic—and thus rather unspecific and broad—analyses are mostly undertaken to better understand the structural changes in science and society and intend to provide a rough orientation for many different occasions.

The location of foresight within the company

Generally speaking, foresight in enterprises can take place at three different organizational levels: Firstly, at the corporate level, mainly by corporate research or by the staff of the corporate development department; second, it is performed—often much less extensively—by the divisions, technology centres and business units themselves; and third by temporary task forces that overlay those two structural levels by a third, "lateral" or "virtual" structure.

Firms may also use external consultants to undertake specific exercises.

With regard to the companies in the survey, nearly all of them reported as conducting foresight at the corporate level. Here, long-term strategic thinking predominates, and the foresight activities are usually directly attached to the administration of corporate research or corporate development. In a number of cases, there is also a special office exclusively concerned with foresight efforts. It either consists of research workers permanently (i.e. full-time) engaged in foresight activities, or it is a unit that is staffed by both permanent futurists and personnel that have been temporarily assigned for the duration of a certain foresight project.

According to Becker (2003) the approaches could be classified into three types:

(a) The collecting post

In firms with a comparatively low degree of foresight activities, future-related research is mostly done in conjunction with—and strongly embedded in—other strategic R&D activities (This embeddedness is most clearly illustrated by the fact that those foresight units don't have their own budget but are subsumed under the general budget for corporate R&D). It is mainly concerned with providing basic background information (such as competitor or patent analyses) for the decision-making processes in these areas.

Because of the relatively low need for foresight input, the persons responsible for foresight are just part-time "futurists", (i.e. foresight is only one of their several tasks) and thus only seldom form a separate unit. Because of the limited analytical capacity, most foresight activities have to focus on the search and collection of future-related information that is already prepared by others and easily accessible. In practice this means that they rely strongly on an internal network of observers and experts to provide them with the necessary information. In addition, they also re-direct a lot of their own foresight work to specialized agencies or consultancies, i.e. a lot future-related knowledge is just "bought" from the outside. Not surprisingly, these foresight activities have a relatively low visibility in the company and are known only to those who are directly involved in it.

(b) The observatory

In contrast to the first type, the observatory truly is an autonomous foresight unit with a full-time staff and a budget of its own. Moreover, it also has a clear mandate to focus on future-related issues. Its particular trait is that is fulfils a highly specialized and rather singular purpose for the company, be it the identification of socio-economic forecasts or forecasts of, for example, future traffic flows. Out of its single-minded function it follows that it also has a single addressee in the company—in most of the cases, the corporate development department.

In order to provide such a long-term strategic intelligence, the activities of these foresight units include not only the re-use of already existing data, but they also regularly generate new, future-related knowledge. To do so they all rely not so much on internal networks (and their external information sources) but on their own external contacts. Needless to say, these networks are mostly made up of specialists from the same or similar fields of expertise, and only seldom tap into the broader areas of foresight.

(c) The think tank

The most broad and elaborate foresight work is done by special units which act as a forward-looking think tank for their company, i.e. a group of full-time futurists, experts and researchers who explore all kinds of future-related issues not only in the immediate business environment but also in the wider socio-economic, cultural and regional sphere. They have a much wider range of tasks than the observatory, and thus

have to be more generalists than specialists. This is not to say that they don't have considerable knowledge in certain areas—on the contrary, those think tanks are often staffed by a number of highly trained experts from different fields, but their purpose is not to analyse only the developments in their individual fields of expertise but to connect them to a bigger picture of the future.

To fulfil their tasks the think tanks have built up a global network of experts both from within the company and the outside. Some of them even have established a job rotation or other long-term cooperation with outside research centres or institutes. In any case, however, these think tanks are widely respected both within the company and outside, and they are called upon for many tasks, some of which even go beyond and above classical foresight (such as Philips´ "foresight for innovation"); and sometimes they even conduct foresight activities for selected external clients such as major suppliers or customers.

Users of foresight

A distinction again has to be made between different organizational levels—i.e. users at the top management level of the corporate research or corporate development department, users in the middle and higher management of the different strategic planning units in the divisions and business units, and the individual user (i.e. researcher) in the different research centres, laboratories and product development departments.

Among the firms in the survey, three different orientations can be distinguished: In the first, the foresight efforts are strongly oriented towards providing information for the top management level (i.e. the executive vice president for technology or corporate strategy), who represents their priority customer. This addressee group was mainly found among the foresight groups with a "collecting post" or "observatory"— function. The second model is more broadly oriented at high-ranking managers on both the corporate research/corporate development level (such as members of technology councils or strategy committees) and in the strategic planning units of the different business units. In fact, most of the companies in the survey named decision-makers from this level as their main client group. Some companies, finally, included a third group of addressees in their efforts, namely the individual researchers and other interested employees. However, this third group of "customer" was only served in addition to one of the previously mentioned groups, that is to say that the foresight analyses and results originally produced for others were later made available to the rest of the company.

The last point leads to another important feature of foresight activities—the way the information is (freely or restrictively) disseminated and shared across the company. In a lot of firms, foresight still operates according to the "need to know" rule, i.e. the results are usually made available only to those directly involved in the process (i.e. clients, informants, and fellow researchers). In a second group of firms, access to that information is more open: all those within the company who are interested can get the results on demand, but sometimes only after a "grace period" to prevent their misuse. A last group of firms, finally, puts no restriction whatsoever on the availability and accessibility of their foresight results: They are open to everyone in the company, mostly via Intranet or some

commonly shared databases. In some of these cases a selection of their foresight work is even accessible from the outside (i.e. it is on the Internet), and thus also gives an opportunity present it to—and to possibly gain feedback from—a much wider audience.

Scope

The first decision in the foresight process is whether to delimit a specifically relevant area of observation of identification of new trends for the search (an "inside-out" perspective), and to start with an oriented search, or to commence the search with a broad, non-limited orientation (an "outside-in" perspective) and evaluate the relevance of those search results for the firm in a second step. The enterprises interviewed made use of both approaches in their foresight activities, with the "inside-out" perspective predominating, since a broad, non-specifically oriented search takes up a lot of time and an "information overload" is soon reached.

Time-horizon

The firms displayed a wide variety in the time-horizons under observation, which lay between periods as short as 2 to 5 years up to a period of up to 20 to 30 years. However, most of the interviewed firms mentioned time-horizons between 5 to 15 years.

Methods

The methods used included:

- Publication analyses.
- Patent analyses.
- Benchmarking analyses.
- Market analyses, trend analyses.
- Database research.
- Company's own, delimited Delphi survey.
- Technology calendars and roadmaps.
- Creativity techniques (brainstorming, intuitive thinking).
- Various scenario techniques.
- Competitive technology intelligence (technology monitoring).
- Trend extrapolation.
- Systems dynamics simulation.
- Multilinear modelling.
- Internal innovation or future workshops.
- Systematic questioning of customers.
- Risk analysis/cost analysis.

In quite a number of firms, rather simple tools predominate: in the field of qualitative methods this was indicated by the extensive use of cognitive methods like brain-

storming-exercises, intuitive thinking, or expert consultations. Typically, these instruments do not demand much preparation or analytical rigour, and thus can be easily employed. In the quantitative field, the same could be said for such simple statistical/econometrical methods such as patent and publication analyses, benchmarking exercises or market forecasts.

Nearly all firms reported that they relied on those tried and true instruments for their foresight activities—some of them even exclusively (Company A, P&G, Volvo). Apart from that, however, a more elaborate and sophisticated approach are in use in some of the companies—especially in those with their own future "think tanks". Among those more complex approaches, causal and structural methods like scenarios and simulations are the most common. In addition to that, some firms also conduct their own mini-Delphi and future workshops/future conferences.

Thus there seems to be a definite predominance of methods based on the interaction between different players and which are rather person- and communication-oriented. Great importance is attached to methods involving a high proportion of interviews with internal or external experts, and to teasing out ideas in common meetings or workshops. Quantitatively oriented instruments, on the other hand, are only used for certain questions, but this general absence of quantitative methods could also be seen in a positive light—it certainly indicates a paradigmatic change in the general understanding of foresight: While the older "forecasting" approach often dealt with probability predictions and any sort of statistical/econometrical methods in order to give a clear forecast of the future, the "foresight"—approaches of today are seen as systematic processes to identify and explore different futures, and the increasing use of cognitive and scenario methods (and their emphasis on communication and learning processes) reflect this new view.

What are the current problems in conducting foresight, and what could be done better?

Current problems of corporate foresight

Although most firms in the survey reported as being quite satisfied with their foresight activities, there were some critical points in which improvements could or should be made. The following points were mentioned as problems of the current foresight practices:

(a) Methodological problems

— Foresight needs a better/stronger methodological grounding, especially with regard quantitative analyses and economical modelling, in order to achieve a greater accurateness of its results.

(b) Organizational and managerial problems in the foresight process

— Foresight results have to be better delivered and disseminated to the relevant target groups (such as R&D people). It has to create a higher commitment of those groups to contribute to and use the results.

— Foresight may not be done for its own sake but must generate relevant information, that is to say one always has to make sure that it is problem oriented and ends up in concrete results and real products.
— Moreover it also crucial that the long-term trends and other typical results of a foresight exercise are "broken down" and "translated" into present decision options to be of use for the decision-makers in the company. In this context, one should also try to better differentiate between foresight activities that provide an input for specific product developments and those that support the innovation activities in general.
— There is a lack of feedback from the users of foresight data—more feedback would be helpful to help learning and to make foresight predictions more accurate and more user-friendly/customer-oriented.
— The positive effects of foresight-activities on the business operations are not always attributable and easy to prove. Therefore it is also important to develop ways to better measure the benefits that foresight activities have on business success—it is much easier to communicate and promote foresight activities with clear costs and benefits indicators.

(c) Overall integration of foresight activities in the company

— Corporate foresight is often too fragmented (i.e. there are no centralized offices/departments but a lot of lone hands) and too segmented (i.e. the activities are too specialized and to uncoordinated to give a complete picture).
— Foresight needs to be re-positioned in the company—it mustnot be limited only to R&D decision-making issues but more broadly used for corporate development and strategic planning.
— Foresight has to be integrated more strongly in the corporate culture (via monitoring systems, future workshops, or in mission/vision statements).
— A central dilemma is the current "shareholder value" mentality in the top management that obviously doesn't put much emphasis on long-term thinking.

(d) Other issues

— Corporate foresight could certainly profit from the use of more external know-how, but so far there is a lack of networks of (internal and external) foresight professionals.
— Because of the missing networking there is too much repetition and not enough efficient re-use of previous work.
— There is too much uncertified knowledge in the field, and it is sometimes very difficult to separate the good experts from the bad ones.
— There are no efforts (and maybe no capability) so far to integrate micro-, meso, and macro-level aspects in foresight exercises.

What could be done to further promote corporate foresight?

(a) Better communication and stronger impact of its results

— Create an understanding of the added value that foresight can bring to the company: it is crucial to better communicate its use (i.e. how to use it) and

its usefulness (for example, by illustrating the benefits with exemplary case studies, etc.); moreover it is important to establish a wide network of stakeholders/partners within the firm.

— In order to better communicate foresight results and activities, it could also be helpful to develop some exemplary and concrete "hands on" products (such as a monthly magazine, an Internet tool, etc.) that could be given away to illustrate the practical utility of foresight.

— Foresight has to become more "focused" and should provide only relevant information, with a clear definition of the research questions and objectives. It should be more realistic and more cautious in its predictions (really revolutionary innovation only rarely takes place) and it should pursue more business-oriented goals.

— In this context, it might also be helpful to develop some standard measures and key indicators (in cooperation with other companies) that then could be continually monitored and updated.

(b) Higher strategic relevance for the company

— Foresight has to move from an illuminating to a more operative/decision-making role. It should be used to develop a more future-orientated corporate strategy—for example, it could help to find new markets or customer needs, and only then would first-mover advantages and a sustainable company growth be realized.

— Foresight should not only be seen as a tool for selecting and prioritizing R&D activities, but could be employed for vision building as well. This, of course, would mean that one has to develop new participative tools that involve all the different stakeholders of a company.

(c) Further methodological and infrastructure development of foresight

— Organize more generic foresight meetings with futurists from other companies to let them share their individual insight on new trends and drivers, and to jointly analyse the interactions between those new developments.

Areas for further development

Further potentials of foresight were mainly seen in two fields—new methodological approaches and new subject areas for foresight:

(a) New foresight approaches

— Foresight exercises and the presentation of its results must better reflect the mentality of its target audience. For example, at the top hierarchical level, managerial competencies and interest are focused on certain, business related areas (finance, marketing, etc.) and technology is often seen as a specialist thing. To be successful, one has to do (or at least, communicate) foresight results with a mental model that fits the strategic reasoning of those people, i.e. one should think in the client's language.

— Better cooperation and consultation between different foresight exercises (in different companies or different sectors) could save a lot of repetition and would

provide a broader database for decision-making. The client in the one sector is the producer for another sector, and thus one should encompass the whole innovation chain when doing foresight. To this end, one would have to develop a common methodological base and a specific professional standard in foresight in order to make common activities easier to manage and integrate. This would include efforts for a better qualification of futurists on an international level, and the development of more cooperative processes and methodologies.

(b) New fields for foresight activities

— Foresight might be an interesting tool for the long-term development of brand and corporate images.
— There is a huge lack of knowledge about the future development countries (such as China and other newly-developed countries in Asia) that will become important markets in the future. Thus, foresight activities need to focus on these regions more strongly and need to integrate the know-how of futurists and other experts from those countries.
— Likewise, there is barely any knowledge on the future development paths of industrial relations, of future working structures and future needs of human resources, both in new markets and in Europe.

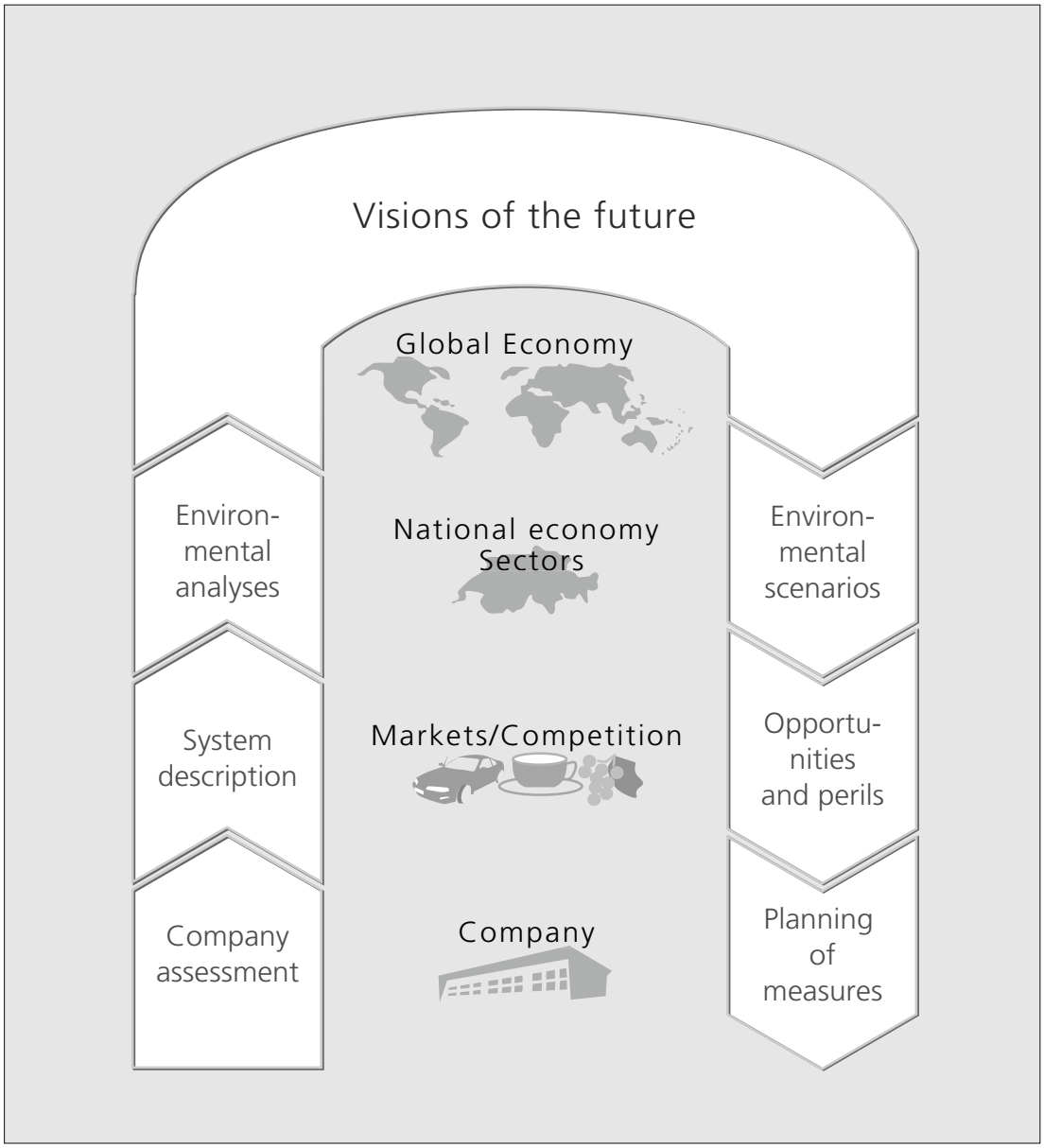
8. SCENARIOS IN THE STRATEGIC CORPORATE DECISION PROCESS

For decision-making in increasingly complex and dynamic environments scenarios are by now the most important instrument for dealing with the future. Historically, the first uses of scenarios, as well as the entire area of strategic management, originated from warfare and military policy. This narrow and not very pleasant emphasis on military aspects was continued and supplemented in economic and social policy scenarios, i.e. alternative futures with respect to food, energy and technology policy aspects. Market and competition-related scenarios are usually of central interest to companies because they provide bases for decision-making by frequently focusing directly on the investigation subject.

However, only rarely can the isolated investigation of an issue be conducted successfully by considering only one aspect. A company's local market is, above all, a part of regions and sectors. It is therefore part of local or national demand. However, it cannot be seen—especially under the banner of trade liberalization—as detached from international, technological, and market developments or a company's competitive position. Preparation of a locally applicable decision is increasingly also influenced by developments that appear to be beyond the actually investigated issue. Even with task-oriented emphasis on individual aspects, thorough assessment of alternative futures also requires a comprehensive study of the entire system as well as the interrelationships between individual parts.

The demand for systemic comprehensiveness by investigating all aspects at the same time would, however, lead to excessive complication. Overload of developers and users when assessing holistic, alternative futures is counteracted by structuring and differentiating viewing levels. From the perspective of a corporation's division in a particular country, the superior level is the national market of demand and its sectors including all suppliers. These, in turn, are part of a national or transnational region, which in their entirety form the world. Figure X illustrates this situation, repeating the structure shown in figure VI, adding the necessary steps in this process.

Figure X. System view and path of analysis: bottom up and top down



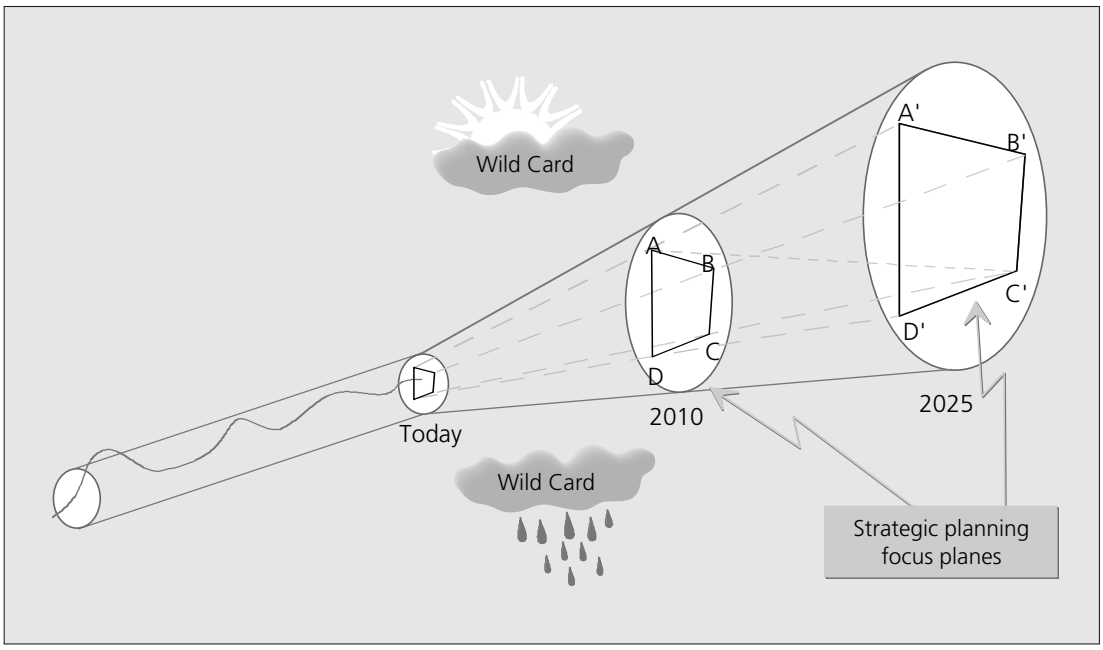
Source: Graf, (2003).

Therefore, decisions regarding, for example, product features in international competition necessitate separate, transnationally adjusted surveys initially at the national level. These surveys will then allow situation and task-specific aggregation so that a perspective relevant to a decision can be created. Possible perspectives are, for example, a "global product manager's" global view of product features, the regional or country-specific view of distribution policy measures via a "marketing manager Central/Eastern Europe", or the view of a "production manager" comparing locations of the production process itself.

The investigation of alternative futures as a preparatory step for making decisions in companies starts with the relationships of causes and effects within a market or sector. The influences between market/sector and region/country connect these two levels. Irrespective of the perspective and the specially investigated aspects, "Starship Earth" forms the highest level of aggregation. These classic levels for developing scenarios for companies are also shown in figure VII.

How to use scenarios

Figure XI. Space of possible scenarios

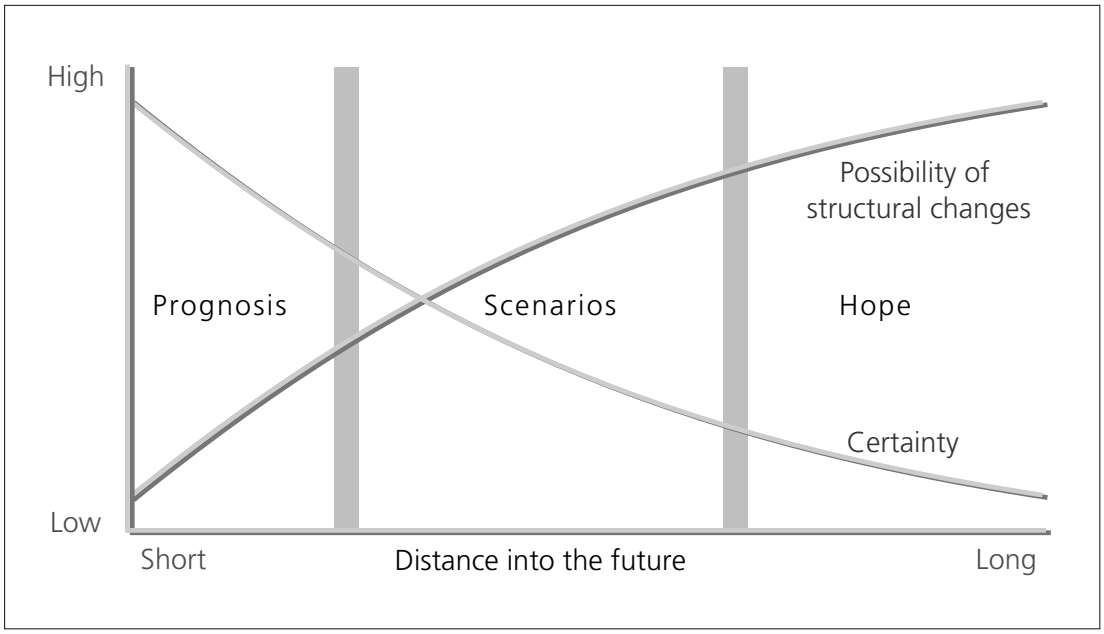


Source: Graf, (2003).

The scenario technique can be well illustrated on the basis of the scenario cone (see figure XI). The present is located at the starting point of the cone. The widening cone represents the future's complexity and uncertainty. This is because the further we move from today's situation into the future, the greater becomes uncertainty (figure XII). At the same time, dynamics increase, i.e. the change in the structures of the system observed and the complexity of the subject become greater with increasing distance into the future. This illustrates that prognostic statements in the sense of "this is how it will be" are limited to only a very short time segment, because the structural com-

ponents are subject only to minor changes during that time period only. However, the time segment allowing sensible scenario statements is ultimately also limited: hopes, ideals and Utopias can only be outlined. Nevertheless, it should be noted that fixed time periods can rarely be assigned; they have varying lengths depending on the investigation subject and also on the economic sector under consideration.

Figure XII. The balance of predictability and uncertainty in the business environment



Source: Graf, (2003).

At the starting point of the cone the relationships in the system observed and the factors influencing them are known. This system is reflected in a company's output and position in the market and an economy's attractiveness as a business location and geographic situation.

In scientific circles it is a controversial issue as to whether the cone's beginning can be depicted as a point, or whether it should be a plane that includes the various points of view of individuals, companies, institutions, political parties, etc., when evaluating and interpreting the present. There are already differing views of reality when perceiving the present that are determined by different assessments. It is exactly such perceived structures that often determine the choice of possible images of the future. Therefore, a crucial element of scenario thinking is realizing that the view of the future is often restricted by a specific view of the present. Such limitations have to be overcome if the field of possible alternatives is to be fully investigated. This has to be regarded as a critical element of scenario thinking.

If, at a future point in time, a cut is made through the cone, then at that time all possible and conceivable futures will be located on the intersecting plane. This means

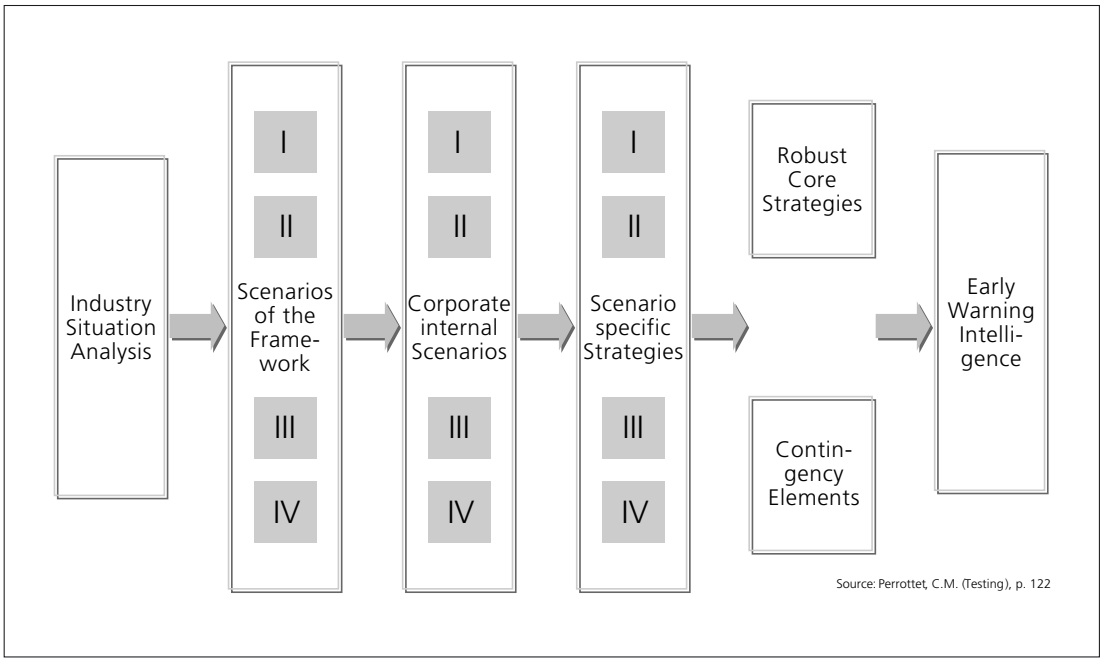
that, theoretically, a very large number of conceivable futures will result from diverting the "cathode ray" of the "Braun tube" scenario cone developed on the basis of the past. This picture also illustrates the increasing size of the plane of possible long-term futures, which in the end cannot be tackled within the corporate planning process. However, when facing such variety, resignation and return to familiar extrapolation along with its pseudo-security are, by no means, appropriate. Increasing complexity cannot be taken into account via complexity reduction, rather only by increasing the complexity of the solution approach in accordance with the new general conditions. Therefore, it is important to consciously face future insecurities and to work out various reaction possibilities from one's own point of view.

Scenarios in strategy development

Scenarios can, on one hand, serve as an early warning system for potential and undesired developments (see figure XIII). Therefore, companies using global scenarios employ them before starting their strategic planning process as a guidance system for entering into further work. In addition, global scenarios are used in the final phase of such planning processes in order to examine the sensitivity of plans and intentions with respect to potential developments on a global scale. Such external scenarios are commonly developed and understood as images and models of the external world as a framework for corporate activity.

Based on such scenarios specific internal or corporate scenarios will be developed, taking into account possible measures and developments that may be shaped by the cor-

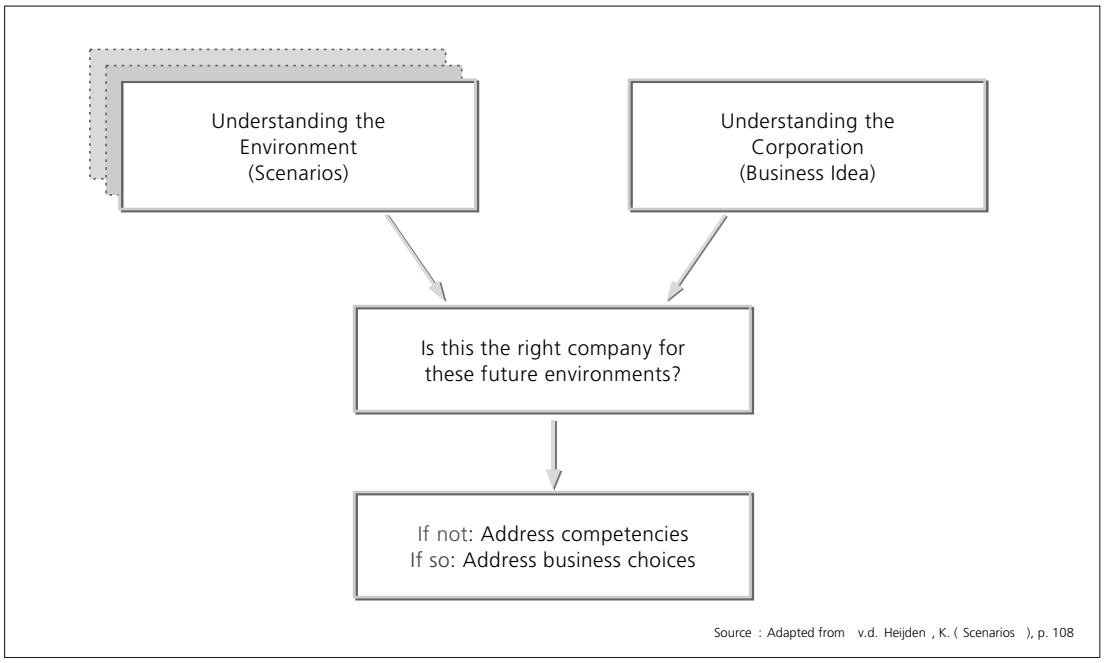
Figure XIII. Scenarios to develop long-term strategy



Source: Graf, (2003).

poration itself. Such scenarios reflect the specific corporate goals and are developed within the external future frameworks, showing at the same time possibilities for one's actions. Analysing commonalties and differences between such internal scenarios will point out the central elements of the strategy under development. The central objective here is to establish the fit of a corporation within its framework in the light of different scenarios of the latter (figure XIV). This process serves for testing a business idea in a set of scenarios, developing at the same time a value judgement for the scenarios in the set. This is mostly related to the degree of change that a scenario requires in the business idea. If little change is required, a scenario is considered a good future, in which growth is possible on the basis of exploitation of existing strengths and competences. If the existing formula does not do so well, the particular scenario is seen as less friendly. The narrower a business definition, the more likely it is that certain futures are seen as uncomfortable.

Figure XIV. The fit between environment and corporation



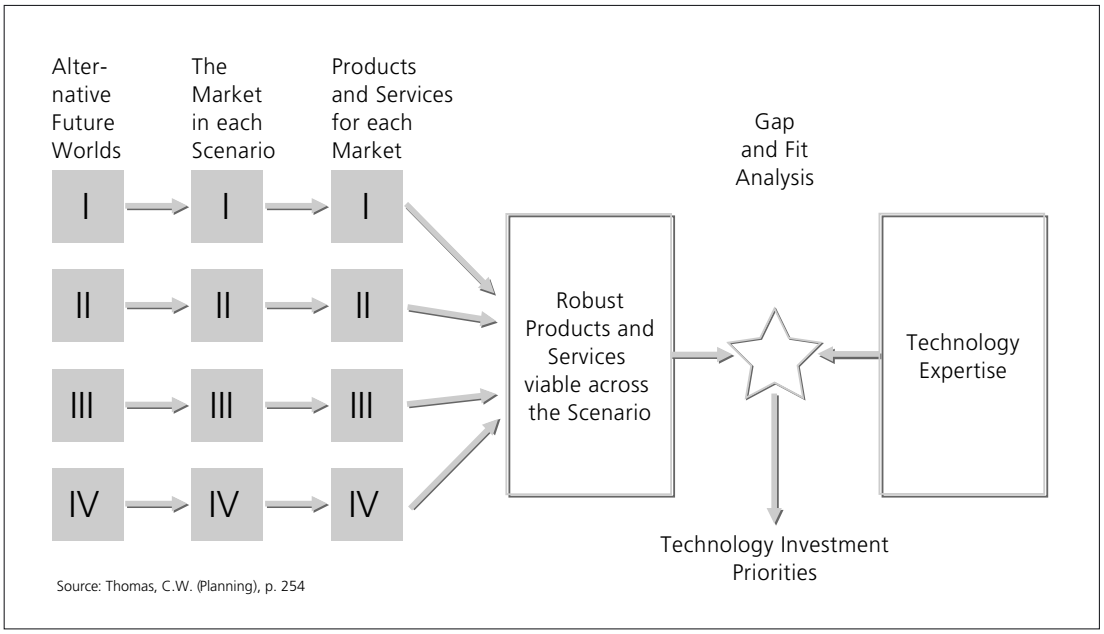
Source: Graf, (2003).

Testing technological capabilities

Figure XV and XVI exemplify the process of testing a business idea in a set of scenarios. For example, in figure XV a set of products doesn't yet exist but probably will be needed in all the scenarios identified. Then this set is used to evaluate current technology alternatives. The goal is to select a core set of technologies that supports likely customer needs in a range of futures and that corresponds to corporate goals. This approach should be a continuing part of the technology evaluation process. Figure XVI exemplifies an approach evaluating several potential products with the main goal

to find the core technologies across product lines. That core set of technologies, those that are needed regardless of the product finally choosen, will become the priority technology investment. Scenario-based planning for technology decisions can, therefore, be a powerful tool to manage uncertainties that surround important technology investments. It has, however, to be underlined—and as shown by the analysis of Alice Amsden in her book *The Rise of the Rest*, that a successful industrial development for latecomers in the globalization process is based on robust manufacturing experiences relying on technologies that have already been commercialized elsewhere. A most important step of successful "learning organizations" in such a framework, therefore, depends initially on a basis of technologies that were already developed by firms from other countries. This leads to the conclusion that for corporations in the CEE and NIS regions a close cooperation with partners from other countries is paramount. Joint ventures, foreign direct investment and/or foreign ownership are a major characteristic in this learning process. Governments have to accept that the later a country joins the global economy in chronological history, the greater is the probability that its major manufacturing firms will be foreign owned. This required participation of foreign knowledge and capital will, however, take place only if secure property rights are warranted.

Figure XV. Technology needed for future products

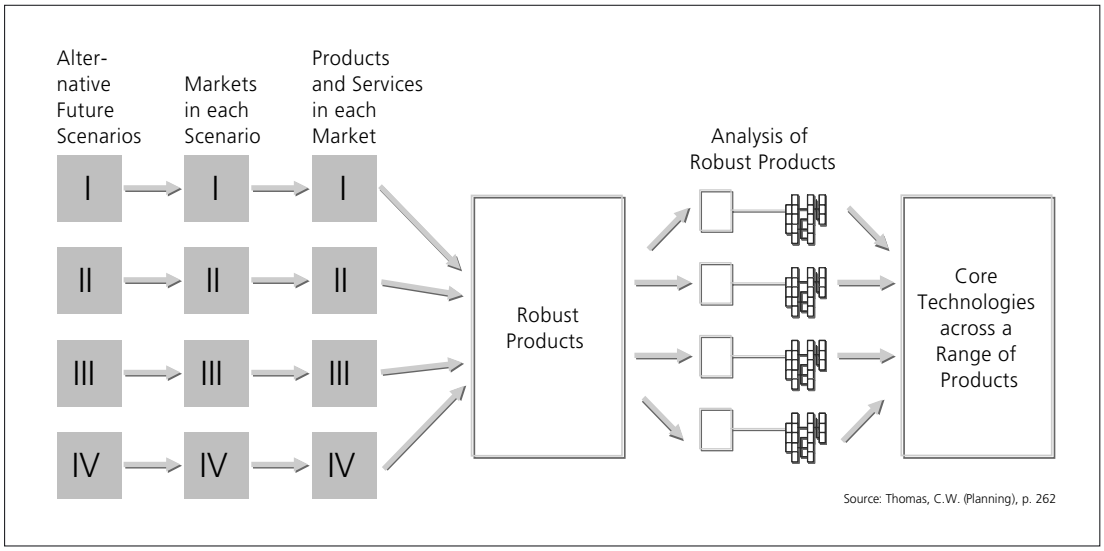


Source: Graf, (2003).

Manufacturing as the heart

Developing market access and success in globalized frameworks is—like economic development as such—a process of moving to a set of assets based on knowledge, exploited by skilled labour. The knowledge needed to compete in world markets comprises unique

Figure XVI. Using scenarios to indentify core technologies



Source: Graf, (2003).

skills and capabilities, novel product concepts and idiosyncratic production systems. Knowledge is the key to economic development. The industrialized countries therefore, are often characterized as "knowledge societies", a notion, which is misleading in so far as such knowledge cannot easily be bought and utilized directly. Rather, it involves a learning process and it would be much more appropriate to use the notion of a "learning society" in our context of "learning organizations" (Peter Senge).

The transformation involved requires attracting human and physical capital into manufacturing, the heart of modern economic growth. It is in the manufacturing sector that knowledge-based assets have been nurtured and most intensively used. The greater such assets, the easier the shift to industrial production and to the supply of modern services.

Globalized markets, therefore, are forcing corporations to acquire knowledge based assets as a set of skills that allow its owner to use and distribute a product at above prevailing market prices (or below market costs). The requisite skills are both managerial and technological in nature. They are science-based or artisan and are embodied in an individual or firm depending on the scale of the physical plant and the complexity of the production process. Three generic technological capabilities that nurture knowledge-based assets may be distinguished (see figure XVII):

- Production capabilities, i.e. the skills necessary to transform inputs into outputs.
- Project execution capability, the skills necessary to increase production capabilities and capacities.
- Innovation capability, the skills that are necessary to develop and design entirely new products and production processes.

Figure XVII. Required technological capabilities

Source: Graf, (2003).

Transferring information into knowledge

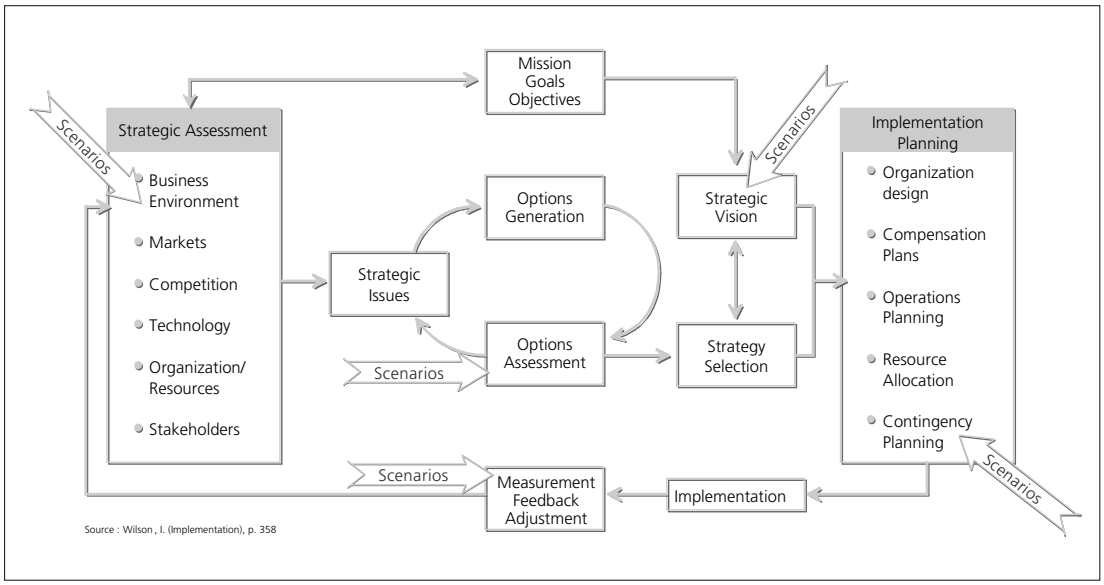
Knowledge is a special input because it is difficult to access, whether by "making" or "buying". Market success in our globalized frameworks results from an optimization process in the combination of knowledge as found and developed in the heads of the people working for a firm with the knowledge incorporated in investment, in machinery, and equipment, a combination of facts that interact in intangible ways. Knowledge is quite different from information. Perfect information is conceivable—with enough time and money, a firm may learn all the relevant facts pertaining to its business. Perfect knowledge, however, is inconceivable, because knowledge is firm-specific and kept proprietary as best as possible to earn technological rents for the corporation.

Transformed information into knowledge is used to develop price (or cost) advantages in order to increase market share. As already outlined above, knowledge of the future is always incomplete and uncertain, it is therefore imperative to analyse the relevant alternatives. Making the right choices out of these alternatives is the most important part of leadership. Every other element of management relies on making good decisions. Developing such strategies (= proprietary knowledge), taking into account the different possibilities of development in the corporate frameworks, the scenario approach is the only way to gather the relevant information as a basis for knowledge development. In such a process of strategy development it is of utmost importance to start from a clear decision focus as guide for all the necessary steps to be undertaken.

Another useful area of application of scenarios is the preparation of contingency plans. This allows checking the strategic significance of trends, uncertainties, and assump-

tions for the future development of a company's general conditions. In this context the development of alternatives to a basic scenario that, for example, starts from the present corporate strategy, proves an excellent instrument. It provides a test for the robustness of present strategies and simultaneously reinforces the realization that other scenarios are also possible. At the same time it is important to make it clear to management that working with scenarios must have pronounced effects on the existing strategic planning system. Figure XVIII illustrates how much innovation has to be introduced into the planning process when working with scenarios, because scenarios start from many areas of this process and should ultimately also show effects.

Figure XVIII. The use of scenarios in strategic management



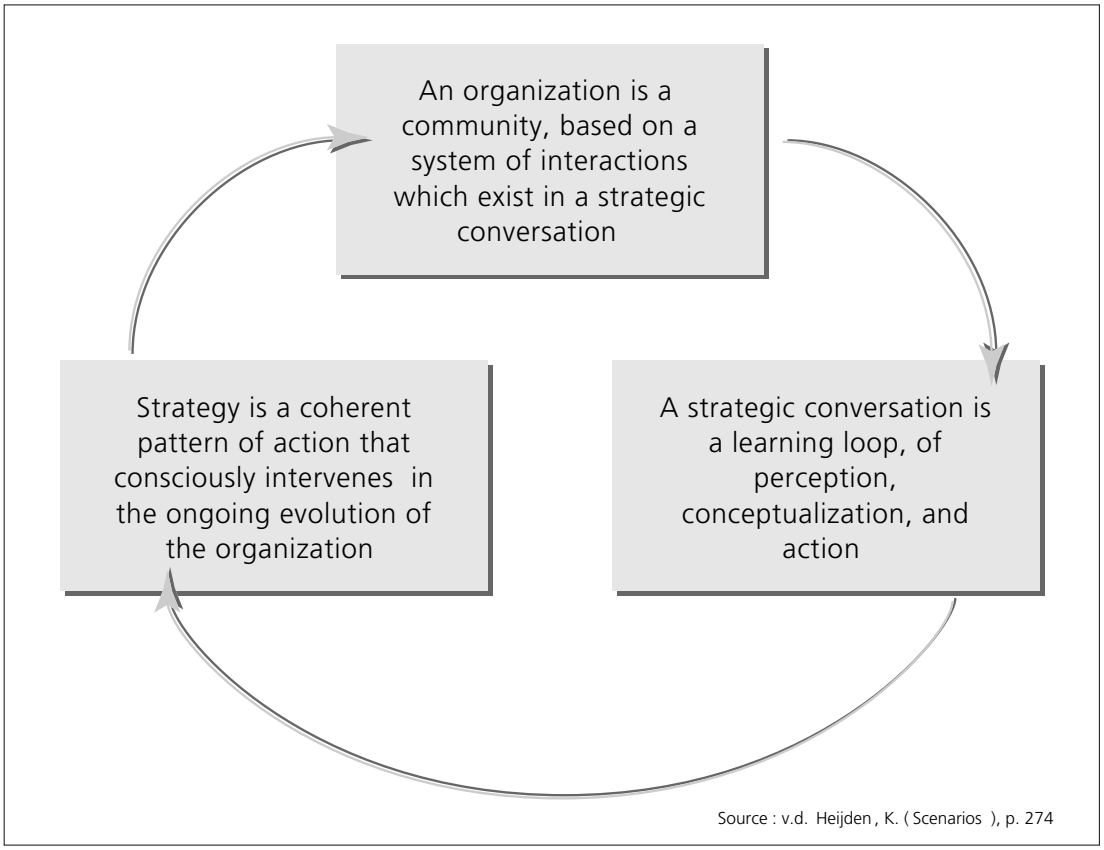
Source: Graf, (2003).

Operational recommendations

When developing scenarios for a company the following points are strongly recommended (Graf, 2003):

- There must be a clearly set decision focus to guide the work of the team charged with the development of corporate scenarios. At the same time the scenario work should closely fit into the normal planning process in order to involve all relevant hierarchical levels of a company.
- Developing scenarios for a company is a learning process that best takes place in the form of a strategic conversation (see figure XIX). The working team should not only consist of people in the planning department but also should include persons from marketing, finance, research, and—above all—include top management to underscore the importance of such an endeavour.

Figure XIX. The art of strategic conversation



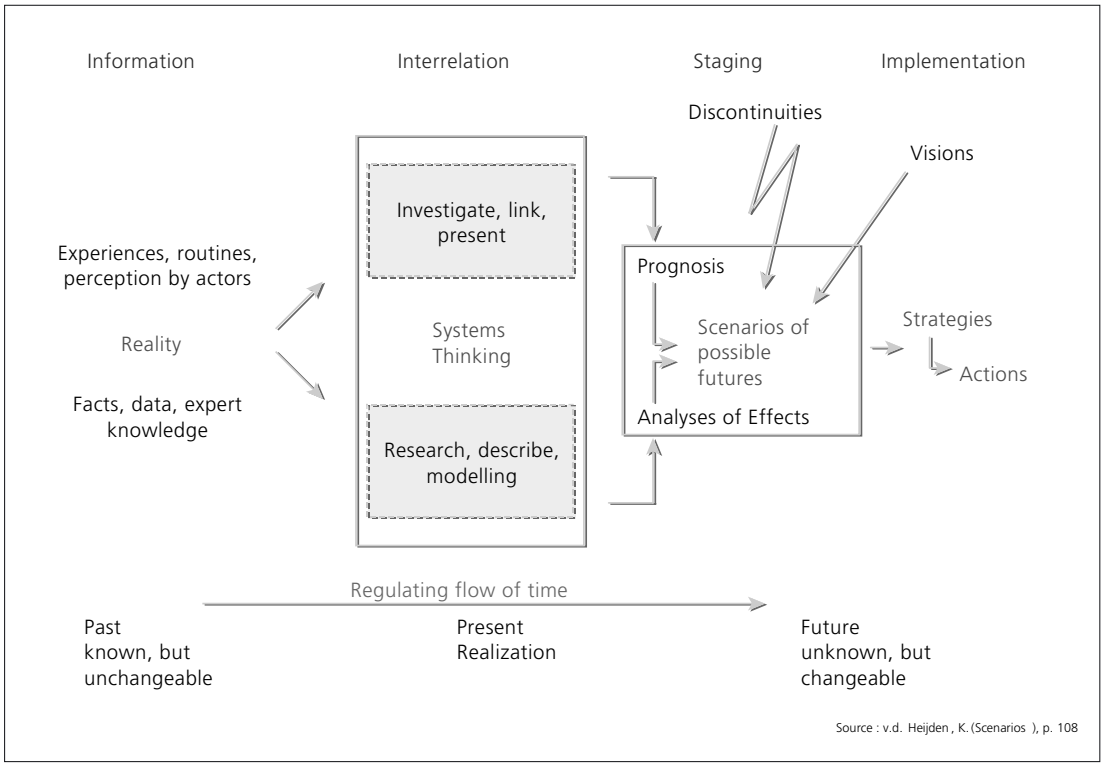
Source: Graf, (2003).

- Often, the process starts with a workshop of a minimum of two days, following a path as depicted in figure XX. It will have to be very well organized and include in-depth preparatory development of information necessary for an adequate basis of teamwork in the workshop. Software tools will support workshop activity that in the end leads to the preparation of different scenarios relevant to the company under consideration as a basis for strategic decisions with regard to products, markets, investment, research and development, and personnel. The ensuing steps as well as the responsibilities of different actors are decided upon also with regard to ongoing work, including a clearly set agenda.

- Scenarios thus understood are working tools for a company in the preparation of decisions. They therefore have to be developed in an efficient manner and clearly directed by the decision focus set at the outset of the whole process.

- In conclusion: a decision has to be understood as a choice from among several possibilities. In order to be able to decide it is a prerequisite that these possibilities are outlined clearly with regard to causes and effects. In highly dynamic and complex frameworks, guidance by scenarios in the decision process is the only means to navigate a company securely through uncharted waters.

Figure XX. Futures dialogue



Source: Graf, (2003).

9. THE SOCIETY AND TECHNOLOGY GROUP OF DaimlerChrysler

The Society and Technology Group of DaimlerChrysler (STRG) started with two basic premises. Firstly, before focusing on technology, a broader view of the external business environment, including societal factors, has to be taken if a company is looking into the future. Second, to accept and learn about complex and dynamic environments, foresight within a company has to concentrate on an "outside-in" perspective. Thus the mission of STRG is social science-based futures and business environment research to support strategy and product development processes for DaimlerChrysler and its business divisions. The key question of this mission is: what business environment trends shape future markets and contexts for the automotive industry and the mobility business, and what key questions do these pose for DaimlerChrysler?

To accomplish this mission, STRG has five main fields of activities:

(a) Strategic futures research: Development of scenarios for future products, services and business processes.
(b) Future-oriented monitoring: International and future-oriented analysis of the company's business environment.

(c) Automotive business and decision processes: Identification of opportunities and risks for existing and new products, services and processes.

(d) Future based innovation assessment: Development and deployment of methods to generate and evaluate innovative ideas in the context of futures analysis and innovation management.

(e) Markets and customers of tomorrow: Analysis of future customer needs and the derivation of requirements for future products and services.

(f) The research group unites about 40 research scientists from a diversity of disciplinary and regional backgrounds. The headquarters are in Berlin, and there are branch offices in Palo Alto (United States of America) and Kyoto (Japan). For its international projects, STRG maintains an international network of partners in Europe, the United States, Japan, Eastern Europe and parts of Asia.

An example of foresight in a business context: Mobile communications in the vehicle of the future

The continuous development of information and communication technologies (ICT) and the swift growth of mobile communications is a field that has been qualified as a current focal topic for foresight on account of its dynamism, complexity, uncertainty and the diverging assessments regarding the diffusion of new technologies and their impact on markets and societies.

Forecasts by future researchers and industrial analysts indicate continued, swift growth perspectives for mobile communications with mobile telephones, portable devices and for the use of telematics in vehicles in the coming 5 to 10 years. Since the collapse of the "dot.com" boom in mid-2000, this optimism has been corrected to some degree but the basically optimistic tenets regarding mobile communications have survived.

For the automotive industry the focal question is whether these revolutionary developments will continue and how vehicle-bound mobile communications will look in the future.

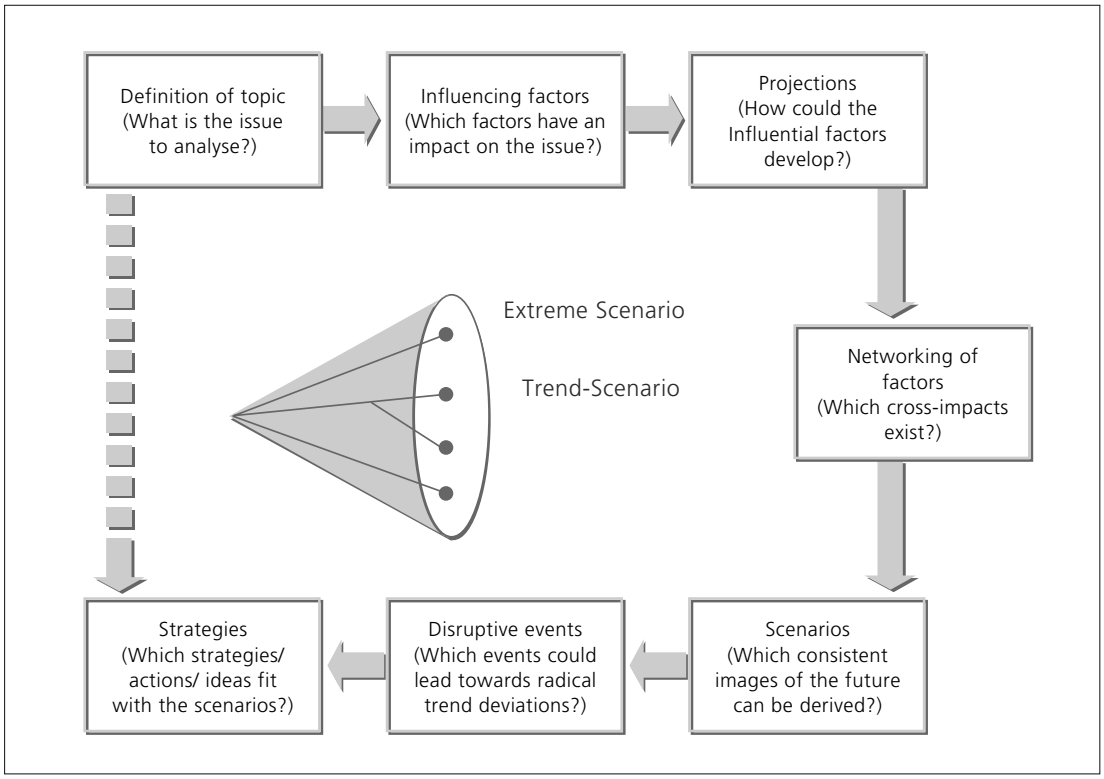
To research this topic the Society and Technology Research Group of DaimlerChrysler conducted a series of foresight studies (for a broader coverage of this topic see Ruff and Järisch, 2000). A core component of these foresight studies is the scenario method, which compensates for some insufficiencies of traditional quantitative forecasts.

A scenario process is typically organized as a structured and focused communication process between experts from different disciplinary backgrounds and from different corporate functions about potential future developments, their driving forces and the interactions between them. The process involves seven steps (see figure XXI), which are briefly described here:

(a) Definition of topic: what is the issue to analyse?

This first step is a crucial one because it creates a convergence between the various involved experts on the core question, the time frame and the regional scope of the

Figure XXI. Scenario process



Source: Ruff, (2003).

foresight study. In the case study described here the core question was: How would vehicle-bound mobile communication look in Europe in 2010?

(b) Influencing factors: what factors have an impact on the issue?

In this step a broad array of influencing factors from the economic, political and societal business environments are gathered. To reduce complexity, a structured evaluation of influencing factors on the basis of their impact on the issue and their uncertainty is a helpful tool.

(c) Projections: how might the influencing factors develop?

In this step the scenario team formulates alternative projections regarding the future developments of the identified influencing factors. For each factor, likely and less likely developments should be considered.

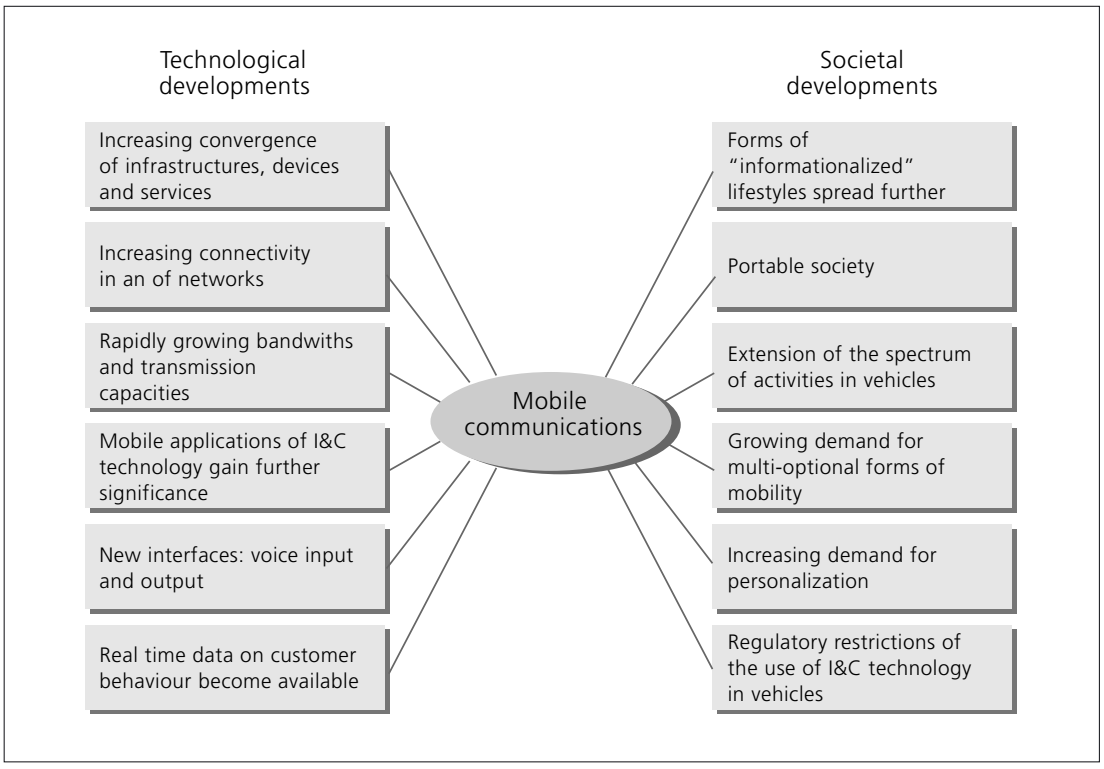
An example in the area of societal developments is “the portable society": today we can observe the increasing use of portable information and communications technology equipment (mobile telephones, palmtops, etc.). “Portable intelligence” is especially popular in technophile metropolitan social milieus and with young people. The professional nomads of modern society, who move in individually configured, heavily communications-oriented life and working conditions tacitly introduce a new quality

of interpersonal communication and social bonding through the use of portable and networked devices. Thus portable society is not just the use of new technologies but the subsequent change in social and communications behaviour.

Less likely but potential alternatives to the continuation and diffusion of this observable development are the stagnation of today's level of portable society (limited to only a small group of people), or even the rejection of portable intelligence and the retreat from portable lifestyles. Although considered less likely from today's commonsense view, a rejection of portable devices could occur. What if epidemiological studies prove a significant negative health effect of high-frequency transmissions? Such unlikely but high-impact developments are systematically considered in a separate step of the scenario method, which is described below.

In this case study, a core set of 12 projections, including technological and societal developments, which were rated as very likely by the involved experts, was identified (see figure XXII.

Figure XXII. Mobile communications—projections of developments



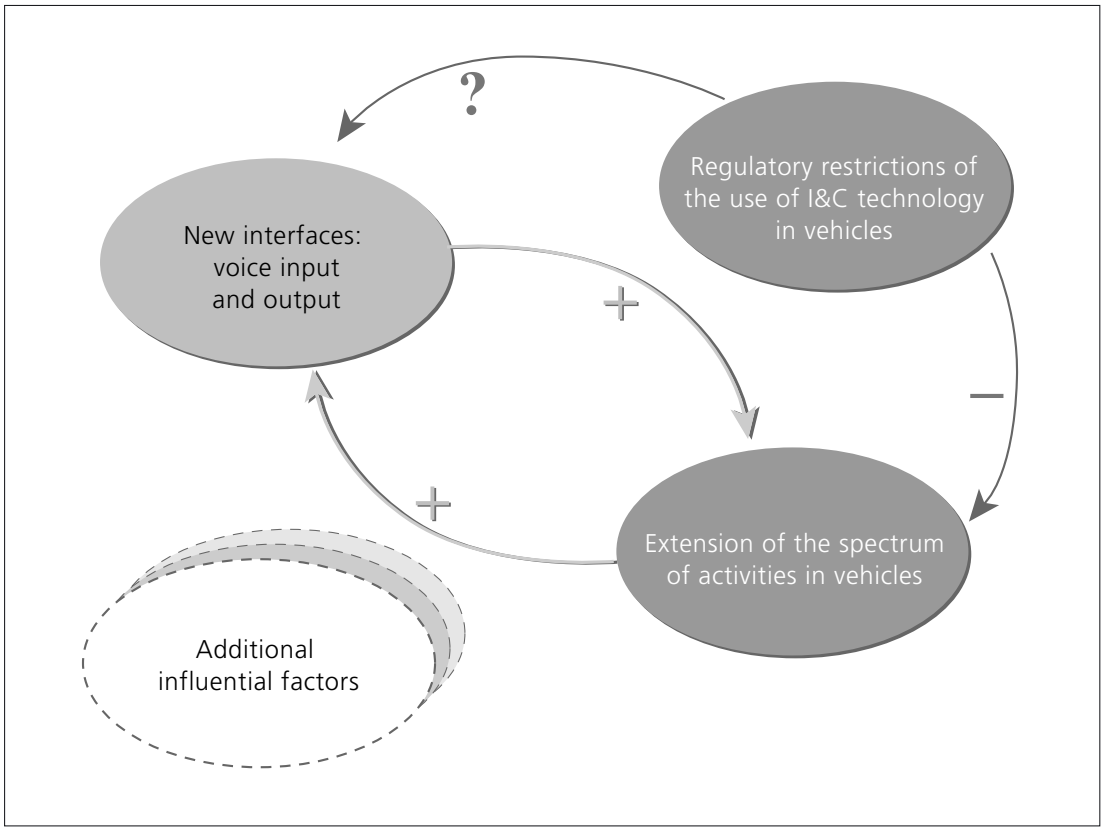
Source: Ruff, (2003).

(d) Networking of factors: what cross-impacts exist?

This step is at the systemic core of the scenario method and calls for a thorough and systematic look at the interactions between the influencing factors and their projections.

Figure XXIII shows part of the cross-impact analysis in this foresight study. In this example the technological availability of new interfaces with voice input and output has a positive effect on the extension of the spectrum of activities in vehicles. If information (e.g. e-mails) can be more easily accessed in the car by voice input and output, people would be inclined to extend their range of activities in vehicles. Conversely, this change of behaviour influences the supply side of developing new interfaces. A third factor, potential regulatory restrictions on the use of information and communications technology in vehicles, is related in a different way. If it turns out that the extension of the spectrum of activities in vehicles has a negative effect on driver concentration, safety regulators will be likely to restrict the legally approved activities in vehicles (e.g. information displayed on screens). On the other hand, legislation could also directly regulate technological standards.

Figure XXIII. Mobile communications—networking of influencing factors



Source: Ruff, (2003).

This detailed look at interactions has to be conducted for all influencing factors and their projections so that counterintuitive or latent feedback loops can be distinguished.

(e) Scenarios: what consistent images of the future can be inferred?

On the basis of the cross-impact analysis, a diverse range of scenarios is generated. From this basic pool of potential future situations two scenarios are selected as extreme

scenarios at either end of the field of potential developments. Usually a trend scenario—as an evolutionary extrapolation of current developments—is also considered.

From this case study two scenarios are described below.

Extreme scenario 2010: the vehicle as a permanently online multi-media environment

One extreme scenario envisages the vehicle as a permanently online multi-media environment.

Main features:

- Vehicles will have high-speed connections to the Internet and act as a permanent mobile network node.
- The willingness of customers to pay for new services is high.
- Customer acceptance will thus follow a revolutionary path (steep learning curve).
- Drivers and passengers will frequently use new services (e.g. navigation/traffic information, location-based services, customer assistance, mobile office services, personalized portals in the vehicle).
- A diversity of multi-media and information and communication devices will be plugged into the car.

Trend scenario 2010: the selectively connected vehicle

One trend scenario is illustrated by a more evolutionary development path, in which vehicles will be connected to the Internet but drivers and passengers will only very selectively use new devices and services in the car (e.g. navigation, location-based services or customer assistance).

Main features:

- Vehicles will be connected to the Internet.
- Customer acceptance will follow an evolutionary path (flat learning curve).
- The willingness to pay for new services is limited.
- Drivers and passengers will use new services selectively (e.g. navigation, location-based services, customer assistance).
- Voice input/output and information filtering will slowly diffuse into the market.

(f) Disruptive events: what events could lead to radical trend deviations?

This step is introduced to probe the sensitivity of the identified scenarios in the face of extreme external disruptive events or "wild cards". To analyse their impact, a diversity of potential disruptive events are gathered in a brainstorming session. They are

sorted according to their uncertainty and their impact on the focal topic. Usually, wild cards with high uncertainty and high impact are selected for further analysis (see figure XXIV).

One example of a wild card in the case study is the accumulation of strong evidence for serious negative health impact from the electromagnetic fields used for wireless transmissions. Such an event would have dramatic consequences for the whole field of mobile communications. If consequences were serious enough (e.g. evidence of higher rates of cancer from the emissions of mobile communications devices), this could be the end for most applications of wireless communications. Alternative technologies (infrared or ultrasound transmission) are very limited in reach.

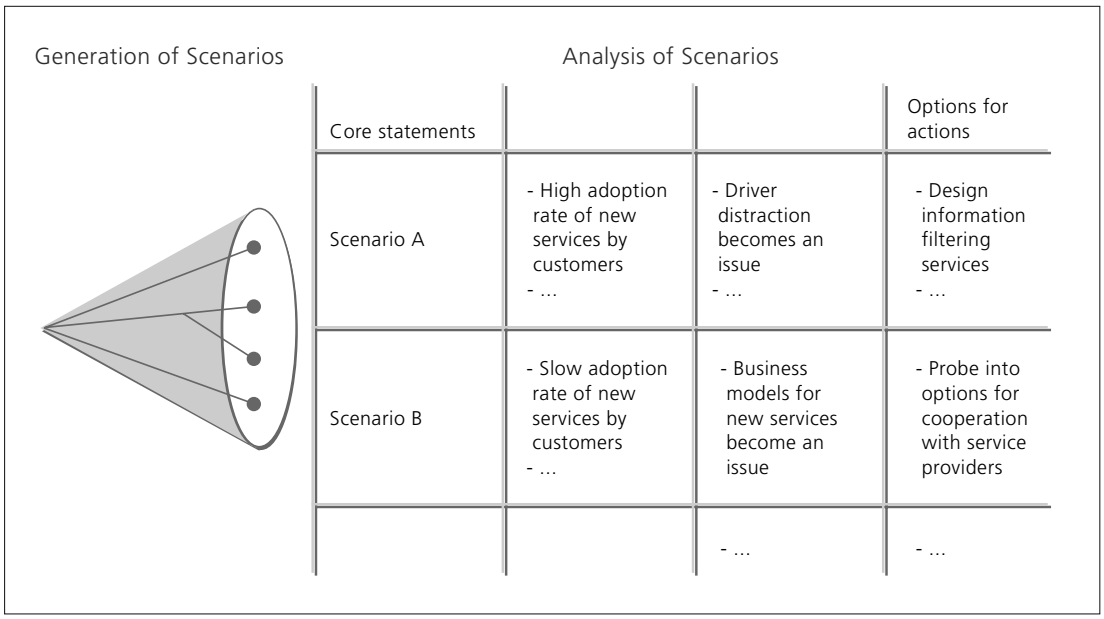
Another wild card in this area could be frequent and regular violations of privacy and data protection by the intrusion of hackers, spies and cyber-terrorists into wireless communication networks.

(g) Strategies: what strategies/actions/ideas fit with the scenarios?

The last step of the scenario method, which is the bridge to the strategy process, deals with the identification and evaluation of options for action. In this step a host of methodological procedures are again available, depending on the focus and target of the strategy process. A frequently used method is to focus on the opportunities and risks (or threats) that emerge in the scenarios.

After options for action for each scenario have been generated, the next step focuses on identifying common options for action. In this case study a couple of options, that match a broad range of scenarios and can thus be seen as "robust" strategies, were

Figure XXIV. Analysis of scenarios



Source: Ruff, (2003).

identified. One evident result from the scenarios is that in the area of mobile communications the whole market is and will be dominated by the business logic of the telecommunications industry and service providers. Thus, automotive applications of mobile communications such as telematics and advanced communication services will be embedded in the broader and more rapidly evolving telecommunications markets and will not be a stand-alone or even a trend-setting force in itself. Another "robust" conclusion is that voice input and output technologies with a high degree of individual adaptive capabilities are crucial to the success of extended in-car services.

10. CONCLUSIONS

A variety of foresight concepts and approaches are of relevance to long-term strategy processes within companies. Because of the focus in companies on risks and opportunities for business and on innovations, markets, branches and competitors, foresight studies in a business context have some specific features, which distinguish them from public foresight activities.

Beyond these specific characteristics and differences there is a lot of consensus in the basic principles and objectives. The major shared premises are that foresight:

(a) Is a process and not a (forecasting) technique.
(b) Is an interdisciplinary endeavour.
(c) Takes a long-term perspective.
(d) Integrates various perspectives, including developments in technology, economy, politics and society.
(e) Is a supporting tool for decision-making, but does not deliver ready-made corporate or political strategies.
(f) Is an attempt to promote technological and social innovations in the public and private sector.
(g) Is best implemented as a participatory process with the promoters who have to implement the decisions later.

The frequently suggested and demanded collaboration of public and private entities in the field of foresight is still in its early stages and should be further encouraged. As the interaction of public and private sectors and players strongly depends on the specific political, economic and cultural context itself and is highly diversified internationally, no general recipes are available. It is important to be aware of the basic differences in the focal perspectives and interests of public and private players, respectively. It is evident that focus on the process design of public foresight projects and an acceleration of the funding allocation process would have a positive effect on future public-private collaboration.

REFERENCES

This module is based on:

Corporate Foresight and Company Future Strategies, Dr. Frank Ruff—Society and Technology Research Group—DaimlerChrysler AG, Berlin, Palo Alto and Kyoto, TF Retreat, Moscow, 17-18 November 2003.

Experiences with foresight methods at the corporate level, Prof. Dr. H. G. Graf: Director, Centre for Future Research, St Gallen, Switzerland, TF Summit, Budapest, 27-19 March 2003.

and extracts from:

Corporate Foresight in Europe: A First Overview. Patrick Becker: European Communities 2003, available at
ftp://ftp.cordis.lu/pub/foresight/doc/st_corporate_foresight_040109.pdf

Bibliography

Amsden, A.H.: *The Rise of "The Rest"*, Oxford University Press, New York 2001 Baron, W., Häußler, S., Luther, W., and Zweck, A.: *Innovations und Technikanalyse. Chancen und Barrieren betrieblicher Integration*, Frankfurt/New York, 2003.

Bleicher, K. (Konzept): *Das Konzept integriertes Management*, 5. Aufl., Campus Verlag, Frankfurt, 1999.

Büllingen, F. Technikfolgenabschätzung. In: Schütz, H. and Wiedemann, H. (eds.): *Technik kontrovers. Aktuelle Schlüsselbegriffe für die öffentliche Diskussion. Ein Handbuch*. Frankfurt/Main, Institut für Medienentwicklung und Kommunikation, 1993.

Bröchler, S., Simonis, G. and Sundermann, K. (eds.): *Handbuch Technikfolgenabschätzung*. Berlin, 1999.

Cuhls, K., Blind, K. and Grupp, H. Delphi "98: *Umfrage. Studie zur globalen Entwicklung von Wissenschaft und Technik*. Karlsruhe, 1998.

Cuhls, K.: *Wie kann ein Foresight-Prozess in Deutschland organiziert werden*? Gutachten für die Friedrich-Ebert-Stiftung. Bonn, 2000.

Fahey, L., Randall, R.M.: *Learning from the Future*, Wiley & Sons, New York 1998.

Glenn, J. C. and Gordon, T. J.: *Futures Research Methodologies*. American Council for The United Nations University, the Millennium Project, Washington, D.C., 1999.

Glenn, J. C. and Gordon, T. J.: *State of the Future at The Millennium*. American Council for the United Nations University, the Millennium Project. Washington, D.C., 2000.

Graf, H.G.: *Economic Forecasting for Management. Possibilities and Limitations*, Quorum Publishers, Westport CT., 2002.

Graf, H.G.: *Global Scenarios. Megatrends in Worldwide Dynamics*, Ruegger Verlag, Zürich, 2002.

Graf, H.G., Klein, G.: *Der Zukunftsgipfel. Strategieentwicklung mit Szenarien*, under preparation v.d. Heijden, K. Scenarios, Wiley & Sons, New York, 1997.

Martin, B.: Technology Foresight in a rapidly globalizing economy. In: United Nations Industrial Development Organization (ed.): *Technology Foresight—International Practice in Technology Foresight*. Vienna, 2002.

Minx, E. and Meyer, H.: Umsetzung von TA in der Wirtschaft. In: Bröchler, S., Simonis, G. and Sundermann, K. (eds.): *Handbuch Technikfolgenabschätzung*, Berlin, 1999, edition Sigma.

Minx, E. and Meyer, H. Produktfolgenabschätzung. In: Bröchler, S., Simonis, G. and Sundermann, K. (eds.): *Handbuch Technikfolgenabschätzung*, Berlin, 1999, edition Sigma.

Perrottet, C.M. (Strategies): *Testing your Strategies in Scenarios*, in: Fahey/Randall, op.cit., pp. 122ff .

Rotmans, J., Van Asselt, M.B.A., Anastasi, C. et al. Visions for a sustainable Europe, *Futures* 32 (2000), 809-831.

Ruff, F.: *Produktfolgenabschätzung im Innovationsmanagement*. Forschungsbericht, Daimler-Benz AG: Forschung Gesellschaft und Technik, 1995.

Ruff, F. and Järisch, B.: *How much Communication does Mobile Society need*? Perspectives of Studies into the Future, DaimlerChrysler AG, Research and Technology, Research report by the Society and Technology Research Group, 2000.

Senge, P.M.: *The fifth Descipline. The Art and Practice of the Learning Organization*, Random House, London, 1993.

Taylor, C.W. (World Scenarios): *Alternative World Scenarios for Strategic Planning*, Strategic Studies Institute, US Army War College, Carlisle Barracks, Pa, 1988

Thomas, C.W. (Planning): *Scenario-Based Planning for Technology Investment*, in: Fahey/Randall, op.cit., pp. 246ff .

Wilson, I. (Implementation): *The Effective Implementation of Scenario Planning*, in: Fahey/Randall, op.cit., pp. 352 ff .

Additional sources

A number of companies post information about their foresight activities on their websites. They include:

BT (British Telecom) publishes technology predictions prepared by their futurologist http://www.btexact.com/publication/futurology

Royal Dutch Shell, who publish their scenarios and advice on preparing scenarios http://www.shell.com

Siemens publishes a Webzine, "Pictures of the Future" http://w4.siemens.de/FuI/en/archiv/pof/index.html

Ericsson http://www.ericsson.com/foresight/

REVIEW QUESTIONS

1. Why have companies become interested in foresight? What uses do they make of it?
2. What are the common pitfalls that foresight in companies can encounter?
3. What are the main differences between foresight in the public and private sectors? How might they be brought closer together?
4. What lessons can be drawn from this experience to assist the development of foresight?
5. What are the benefits of the scenario method?
6. Review the case study and conclusion. What lessons do you draw?

Review question 1

Because of

- Change.
- Globalization.

- Technology.
- Institutional change.

Which lead to the need for a new approach to cope with change and increasing complexity.

"To prepare for the uncertain future".

Internal and external reasons.

- Internal
  - — Long lead times.
  - — The need to innovate.
- External
  - — To reduce surprise.
  - — To increase understanding of the context of business.

Seven steps in the foresight process

(a) Definition of topic.
(b) Influencing factors.
(c) Projections.
(d) Networking of factors.
(e) Scenarios.
(f) Disruptive events.
(g) Strategies.

Objectives of foresight

(a) Anticipatory intelligence.
(b) Direction setting.
(c) Determining priorities.
(d) Strategy formulation.
(e) Innovation catalysing.

Review question 2

- — Linear extrapolation of trends.
- — Underestimation of basic innovations in the early stages.
- — Incremental innovations: overestimation of speed of change.
- — Technical feasibility is often equated with market demand.
- — Abandonment of continuous monitoring.
- — Inclination towards quantification where qualification is sufficient.

Review question 3

- The main differences relate to:
- Specific objectives.
- The "players" involved.
- The time-frame or horizon of the study.
- The duration of the project.

They are generally similar in:

- General objectives.
- Methods used.

Review question 4

The main shortcomings which need to be addressed relate to:

- Methodology.
- Organization and management.
- Integration of foresight into companies.

Areas for potential improvement include:

- Better communication.
- Clearer strategic relevance to companies.
- Methodological development.

Review question 5

Number of reasons include:

- They can provide early warning of problems.
- Dealing with uncertainty particularly in relation to investment decisions.
- They can widen the perception of the external environment.
- Enable contingency planning.

Review question 6

The foresight:

(a) Is a process and not a (forecasting) technique.
(b) Is an interdisciplinary endeavour.

(c) Takes a long-term perspective.
(d) Integrates various perspectives, including developments in technology, economy, politics and society.
(e) Is a supporting tool for decision-making, but does not deliver ready-made corporate or political strategies.
(f) Is an attempt to promote technological and social innovations in the public and private sector.
(g) Is best implemented as a participatory process with the promoters who have to implement the decisions later.

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