

# **Scenarios and Foresight— towards a constructive integration**

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Draft Paper**

**Foresight to Scenarios - Landscaping Methodology and Tools**

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<sup>1</sup> Many people have contributed to the ideas developed in this paper, but I would like to especially acknowledge James Gavigan's inputs as to the threefold nature of Foresight, and Clem Bezold's inputs as to the conduct and various kinds of scenario workshop.

## **1. Introduction**

The emergence of Foresight approaches as important policy instruments at the turn of the millennium represents more than just the rediscovery of futures studies. Foresight is much more closely linked to decision making, and to the building of action-oriented networks, than was the case for traditional futures studies. Given this, it is more than a matter of merely academic interest as to how Foresight processes adopt some of the major elements of futures studies – especially the stress on developing visions of alternative futures. Scenario methods are among the main tools used here, and their use in Foresight is thus especially interesting. For these methods can be used to advance the goals of Foresight concerned with informing decisions and enhancing networks, as well as helping to elaborate visions of the long term future.

This paper addresses these issues, in particular looking at the experience of utilising “success scenario” methodologies to inform technology related decisions in recent UK activities. Further use and development of such methodologies could be an important contribution to future Foresight activities. This could be especially useful not just for implementation activities, but also for the renewal and revitalisation of Foresight.

## **2. Foresight**

'Foresight' has long been used as an alternative term for forecasting and futures studies, with visionaries from H G Wells to Joseph Coates occasionally using the term to describe their activities. But the term acquired a specific meaning from the 1980s on, especially after the publication of Irvine and Martin's Foresight in Science (198\*, London: Pinter) Their study described a range of approaches to developing (especially) research policies with long-term perspectives to the fore, and such approaches were widely applied to improving national government decision-making (especially in the area of S&T) from the mid-1990s on. These approaches differed from the majority of traditional futures studies in two ways (as we have described in the second edition of the FOREN Practical Guide to Regional Foresight (available from [www.forenc.jrc.es](http://www.forenc.jrc.es)), on which the following account draws, and from which Figure 1 derives).

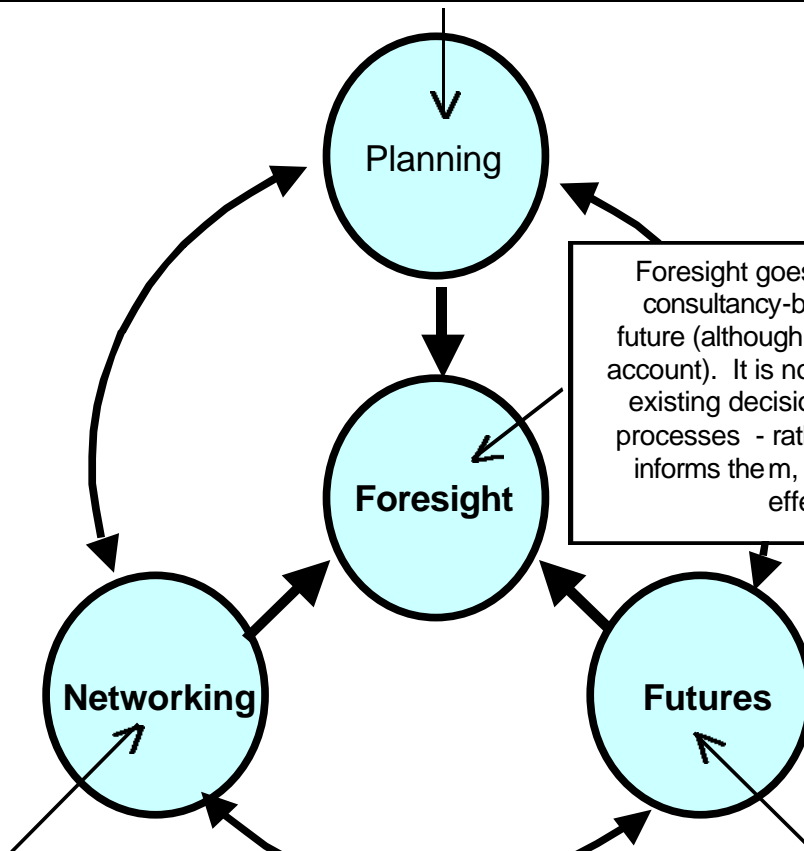
In common with familiar futures studies, Foresight does involve thinking about emerging opportunities and challenges, trends and breaks in trends, and such factors – indeed, not just speculating about such things in an undisciplined way, but using systematic methods to develop better insights and visions concerning future possibilities. But the aim is not just to produce better futures studies with more insight, more compelling visions. The first distinctive feature of Foresight is that it is highly related to decision-making. It brings together key agents of change and sources of knowledge, in order to develop *anticipatory strategic*

*intelligence*. Beyond the preparation of specific plans and lists of priorities, guiding strategic visions are elaborated. These can enable a shared sense of commitment (achieved, in part, through the networking processes described below), and should be more robust to changing circumstances than are particular plans or priorities. This strategic vision is not a utopia: it must combine feasibility and desirability, and to be explicitly related to present day decisions and actions.

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

Figure 1 The Threefold nature of Foresight

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



Foresight goes beyond academic or consultancy-based forecasts of the future (although it should take these into account). It is not, and does not displace existing decision-making and planning processes - rather, it complements and informs them, so as to increase their effectiveness.

*Policy development has seen a shift from an elite-driven / top-down to a broader, more participatory approach. This reflects pressures for greater democratisation and legitimacy in political processes. Also, it builds on the increasing awareness that no single body (especially not a government agency!) can know everything that needs to be known in order to effect desired changes. Decision-makers have to live with the fact that knowledge is distributed widely. This is becoming ever more apparent as the world grows more complex (through advances in science and technology, through greater social*

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 policymaking in systematic and ongoing ways.

The recent popularity of Foresight has meant that a large number of more conventional futures activities have been renamed as Foresight activities – for example the “Technology Watch” pages of a major futures consultancy was renamed “Technology Foresight” in the past year. Sometimes we have used the term “Fully-Fledged Foresight” to distinguish activities which combine long-term orientations with networking activities and strong links to planning and decision-making.

Scenario methods – especially the well-known scenario workshop approaches – can be highly relevant to these networking goals. It is thus quite remarkable that such approaches were hardly used at all in the glory years of the UK Foresight Programme in the mid and late 1990s. Though the panels set up in this period were asked to develop scenarios, the burden of work on them, and the other outputs they were supposed to achieve – together with the lack of guidance as to how they should do this – meant that their scenario development was rudimentary, typically just a few paragraphs in their main reports. They had been provided with a stimulating paper presenting some scenarios (authored by Oliver Sparrow), but this was not tailored to their particular requirements, and was not particularly influential. The question of scenarios was raised intermittently – for example when it was pointed out that the structure of some Delphi reports suggested that there were actually quite distinct scenarios being used to guide the responses of different respondents.

Strangely enough, scenario workshop methods were promoted to business users of Foresight in documentation produced for the national programme – a quite useful guidebook on conducting such a workshop was produced for consultants and industry associations. And the second round of UK Foresight invested substantial resources into developing, and displaying on its website and video resources, a set of alternative future scenarios. Just how far these have been used to inform decision-making – or even the activities of Foresight panels – is a moot point.

### **3. Scenarios**

In the context of Foresight and futures studies, scenarios are visions of future possibilities. They go beyond simply profiling the future in terms of one or two key variables, to present a more fleshed out picture, in which many details are linked together. These may be details of a future history or of a state of affairs. A “future history” will present a sequence of events or developments of trends. An “image of the future” will elaborate the circumstances at a particular point in future time. Typically either approach will present us with a mixture of quantifiable and non-quantifiable components. Often both will be combined.

In **presentational** terms, scenarios may be presented in discursive, narrative ways, and illustrated with snippets of fiction and imitation newspaper stories, etc. For **analytic** purposes and for examining implications for action, it is very helpful to prepare scenarios in the form of tables and similar systematic frameworks. This is also useful for the scenario **development process**, where it makes it easier to compare scenarios, check their consistency and comprehensiveness, by reference to the same structure of elements. But the scenario development process is itself an important vehicle for learning, and the sharing of knowledge too, and the methodology of scenario workshops is particularly important here.

To think about the range of scenario methods used in practice, we draw below on material prepared in TAP-ASSESS, a study of the current and potential impacts of the Telematics Application Programme. (Report available at [www.databank.it/dbc](http://www.databank.it/dbc))

#### **4. Varieties of Scenario Analysis**

There are numerous technical methods for generating scenarios, with diverse underlying philosophies. There are also often numerous approaches to implementing most methods, as different (sometimes proprietary) versions of the method are developed, and as different rules of thumb and ideas of best practice are put into play with respect to any particular method.

Table 1 maps different approaches to generating alternative scenarios, and suggests illustrative methods corresponding to these. Vertically, this table portrays what is often called the exploratory-normative dimension. (Because all scenarios are full of normative content, I prefer to term these “outward bound” and “inner-directed” orientations.) The former methods essentially involve starting from the present and posing “what if” questions: what if the growth rate is x% or y%? what if events W or Z happen? What if we pursue one or other strategy? In contrast, the latter methods can be seen as starting from a point in the future, and asking “how” questions: what would it have taken to have reached a future where the parameter of interest is x% greater than its current value? What would have led us to situation Y?

The second, horizontal dimension distinguishes those approaches in which the scenarios are very largely constructed and analysed by specialist forecasters, from those that are more “bottom-up”, where experts in the specific field are the source of the knowledge and frameworks used in the scenario analysis.

The point of this mapping is not to argue that one method is inherently better than another. The purpose is severalfold. First, to make it clear that there are many different approaches that can be taken, the field is not solely a matter of “genius” forecasts or scenario workshops. Second, displaying material in this way actually prompts us to look for examples of some of the lesser-known approaches. For example, there have been studies that elaborated on different

scenarios by dividing up a population of survey respondents into different groups according to their answers to questions about future issues, and then using these groupings as a basis for elaborating alternative scenarios. Third, the mapping brings to the fore the point that different scenario approaches are bound to meet particular objectives to different extents. Some methods are well –adapted to ascertaining different views of the future from within a large population; some are more readily used than others to construct compelling and rich visions of the future; some are better-equipped for mobilising small groups behind shared visions. Any of these objectives may feature in a Foresight exercise.

### **5. *The Functions of Scenario Workshops***

The focus of the remainder of this paper is on scenario workshop methods, and especially those in cell 9 (and also 6 and to some extent 3) of [Table 1](#). The reason for this is that these methods are particularly relevant for all three elements of Foresight.

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

Scenario workshops are frequently used to build or to elaborate on scenarios. The aim is usually not just to achieve a finished scenario as a product. There are also benefits from involving members of an organisation or community in futures exercises or more specifically in a Foresight process. Such workshops bring together a range of knowledgeable and experienced participants, usually stakeholders of one kind or another, within a structured framework of activities.

Table 1 Varieties of Scenario Methodology

		Top-Down Approaches	Mixed Approaches	Bottom-Up Approaches
		1. Analysts define "what-if" scenarios	2. Analysts heavily structure group discussion or survey instruments to focus on a few predefined exploratory scenarios	3. Experts involved in free-form exploratory scenario workshop, or provide survey responses (e.g. conventional forecast Delphi) which are grouped by statistical methods to yield scenarios.
		4. Analysts define scenarios based on different theories/ perspectives	5. Analysts define normative profiles, these are elaborated by experts	6. Experts grouped according to worldviews and expectations by statistical methods or discussion, and then elaborate scenarios as distinct groups.
		7. Analysts define normative end-state scenarios	8. Analysts define normative scenarios, experts comment on them, identify key issues.	9. Experts involved in free-form normative scenario workshop, or provide survey responses (e.g. goals Delphi) which are grouped by statistical methods to yield scenarios.



This framework allows the participants to:

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

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

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

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

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

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

## **6. Before the Workshop: Design and Background Material**

Before the scenario workshop is implemented, it has to be designed - in more than a rudimentary fashion. For example, an earlier **scenario design**

**workshop**, drawing on a range of expert and interested parties, may be constituted to help:

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

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

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

## **7. Case Studies**

The discussion below will largely draw upon a set of recent applications of scenario workshops 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 ESRC again, but responding to a request from the DGRC (Director General of Research Councils), commissioned CRIC and PREST to organise a pair of scenario workshops on the themes of biotechnology and ICT prospects for the

UK, with the aim of informing decisions about public expenditure on these areas – and not least to justify expenditure to the Treasury.

- ◆ The Office of Science and Technology (again working effectively for the DGRC) commissioned CRIC, together with the national Physics Laboratory and the Institute of Nanotechnology, to run a similar workshop on UK prospects and potentials in the field of nanotechnology, in the autumn of 2001.

The discussion below also draws on experience in scenario analysis for corporate clients and as part of programme evaluation efforts. The three recent experiences in using scenarios in the UK proceeded as follows, however:

- ◆ In the ESRC Genomics exercise, a set of four scenarios were presented to the workshop participants, with each one having been outlined in a couple of pages of text. One of the scenarios was a first attempt at an “aspirational” scenario. Participants formed separate groups to focus on each scenario as one phase in the workshop process.
- ◆ In the DGRC Biotechnology and ICT exercises, a set of scenarios were sketched in one of the kick-off presentations, but the workshop participants then proceeded to elaborate their own “success scenario” with little reference to these. The break-out groups were here constituted around subdomains of the technology field.
- ◆ In the OST Nanotechnology exercise, there was no overall effort to sketch out scenarios in advance of the workshop, and break-out groups were again constituted around subdomains of the technology field. There was some background information constituting a scenario of the most probable technology path.

## **8. Genomics: elaborating and exploring scenarios**

In the Genomics workshop, the organisers used an approach developed by the IAF, which features four archetypal scenarios. Generically, these are: a “best guess” extrapolation, or “official future” scenario; a hard times scenario; and two “structurally different” scenarios (at least one of these is to be visionary, marking a paradigm change or an aspirational future). . In the workshop, the four scenarios – featuring the application of genomics achieving very different degrees and patterns of success – were:

- ◆ **Genomics, Inc.** in which benefits primarily accrue for the developed countries, the affluent, and corporations
- ◆ **Genomics for All** in which genomics applications are developed to increase equity and sustainability
- ◆ **Broken Promises** in which genomics applications work poorly in general, failing for a variety of reasons
- ◆ **Out of Control** in which genomics is an international and environmental destabilising force.

Each was described in a document of several pages, which was one element of a package of documents supplied to participants (others included, for example, discussions of drivers” of genomics applications and explication of the nature of the genomics revolution. See Box 1). A set of break out groups focused on one or other of these scenarios. In line with the workshop objectives, these small groups considered the key contributions that social research might make in the event of the given future occurring. What would the critical demands for knowledge be? What sorts of pressure might social science be under?

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

- A. Assuming this scenario will occur, What is the optimal contribution of social science research can make (your 3 to 5 top priorities)?
- B. Signposts: What would indicate movement toward this particular scenario, expressed, for example, as headlines in the media?

This process yielded a large number of specifications of opportunities for research. It was one of a number of approaches to the question of research priorities that were employed in the workshop.<sup>2</sup> .

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

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

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<sup>2</sup> Full reports of the workshop are provided on the CRIC ([les1.man.ac.uk/cric](http://les1.man.ac.uk/cric)) and IAF ([www.altfutures.com](http://www.altfutures.com)) websites. The discussion here draws on text produced by Clem Bezold and colleagues.

## **Box 2 Background Inputs for the Genomics Scenario Workshop**

An earlier “design workshop” including representatives of the sponsor, stakeholders in genomics, and a number of leading UK futurists, approved the development of a set of background inputs for the scenario workshop. These background documents provided “homework” for workshop participants before they met, and implicitly carried the message that a serious effort was underway, to which a good deal of work had already been committed. It meant that participants were exposed to a common body of information, both about the area and the methodology that was being employed. In addition to the scenario document described in the main text, these inputs included:

- ◆ **Overview and Forecasts of the Applications of Genomics.** An account of genomics science and technology and applications, the promises and the problems identified by some commentators, was prepared (particularly for those less familiar with genomics). This identified, and provided forecasts for, agricultural, human health and other applications of genomics. The design workshop discussed what points needed to be made here.
- ◆ **Key Drivers of Genomics: Forecasts to 2015.** A first specification and grouping of major factors driving and shaping genomics and its applications: One major activity in the design workshop was an exercise at listing and categorising such factors. Ten drivers affecting the development of genomics and its applications and modes of application were eventually chosen. *Three forecasts were developed for each of these:* an extrapolative forecast, a challenging or “hard times” forecast, and a “successful” visionary forecast.
- ◆ **Genomics and Social Science.** This paper provided a series of questions and forecasts related to genomics in terms of the issues that this raised for social science. This report took a set of generic “thematic priorities” already developed within the ESRC and familiar to its staff as well as to UK social researchers. (These were: 1. Economic Performance and Development; 2. Environment and Human Behaviour; 3. Governance and Citizenship; 4. Knowledge, Communication and Learning; 5. Lifecourse, Lifestyles and Health; 6. Social Stability and Exclusion; and 7. Work and Organisation.) For each of these priority areas, examples were generated of the ways in which the evolution of genomics could influence social research requirements, by generating some speculative forecasts about relevant applications of genomics and indicating social research challenges that would follow. As well as providing a useful tool for the workshop, it subsequently transpired that this approach proved very useful in achieving recognition of the importance of genomics and of the scenario exercise within the ESRC, since it brought the relevance of the topic to the attention of specialists in all areas of work.

Full documentation on this study can be downloaded from <http://www.altfutures.com> and <http://les1.man.ac.uk/cric> and a set of papers deriving from it are due to be published in the journal *Foresight* in 2002.

## BOX 2 Some Outputs of Genomics Scenario Workshop

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

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

## 9. *Three Technological Revolutions – IT, Biotechnology and Nanotechnology*

The “success scenario” method has been applied to issues of science and technology policy in the UK,<sup>3</sup> though the underlying principles can be applied in many other domains. The workshops described here focused on a more short-term future than usual for such approaches – 5 to 10 years – on account of sponsor requirements, though inevitably longer-term prospects were also discussed.

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

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

Each of these elements is informed by background research that provides a common information base for the experts to work with in workshop and other settings. The scenario is described in terms of a set of goals that can be achieved, and indicators that can measure and monitor its achievement; together with specification of actions that need to be taken to help realise the scenario.

Developing success scenarios has a number of functions:

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

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<sup>3</sup> The ICT and biotechnology scenario reports are reported on the CRIC (<http://les1.man.ac.uk/cric>) and DTI (<http://www.ost.gov.uk/policy/futures/ict/intro.htm> [www.ost.gov.uk/policy/futures/biotechnology/scenario.htm](http://www.ost.gov.uk/policy/futures/biotechnology/scenario.htm)) websites as *ICT in the UK a scenario for success in 2005*. and *Biotechnology in the UK a scenario for success in 2005*. CRIC also presents the background analyses for these studies. The nanotechnology scenario report has just been placed on the DTI website, under the title: *New Dimensions for Manufacturing: A UK Strategy for Nanotechnology*, at <http://www.dti.gov.uk/innovation/nanotechnologyreport.pdf>

((you have not yet distinguished between scenario focus on the macro, operating environment, and the organization – aspirations and stretch targets are developed by the organization/community, even though they may be targets for the organization, the operating environment, or the macroenvironment ))

### *The Success Scenarios Workshop*

The heart of the process is a scenario workshop. As outlined above the design of the workshop has to be carefully prepared, members recruited, and background research prepared with which to inform the participants. In none of these cases was there a design workshop as such – the design process extended over time, with a series of meetings between the sponsor and the scenario team. These were extremely important for “tuning” the design and making sure that the sponsor was fully behind the approaches being used in the workshop.

The background material prepared for these studies included SWOT-type and or benchmarking analyses concerning subdomains of the field studied. For example, in the ICT and Biotechnology cases, a study team produced statistical and other material on the state of play in the area; there was also a special study of the academic-industry links in the two areas, and the results of modelling exercises in which efforts were made to assess the economic implications of development of the technologies. Additionally, a series of papers were commissioned from leading social scientists reviewing the implications of the two technologies to their fields (again the thematic priorities were used as an organising principle), and a summary of these studies was made available. At the beginning of the workshops, presentations were made of this material, and a number of rudimentary scenarios for development of the field were outlined very briefly. Box 3 outlines these scenarios as presented in the ICT workshop.

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

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



### **Box 3 Scenarios used to kick off ICT scenario workshop**

Each of the sets of notes below is the content of one page of a PowerPoint presentation on scenarios.

#### **Scenario I: (That's) The Way We Were"**

- ◆ Current Trends - *Scattered Successes?*
- ◆ Surprise-free - except for private investors?
- ◆ Slow take up of new services by consumers & SMEs (*eCommerce mainly a tool of big business supply chains – with a few successful consumer niches*)
- ◆ Little really innovative use except in a few advanced companies. *In UK or of UK?*
- ◆ Standards and applications increasingly externally driven

#### **Scenario II: "Things Get Better"**

- ◆ Where? - *Should we abandon hope in hardware?*
- ◆ Therefore, a Diffusion/Content Led Scenario?
- ◆ Rapid take up of new services by consumers & SMEs (*via the Internet, digital TV & mobiles – although most SMEs remain passive users*)
- ◆ Stimulates widespread efficiency savings, content leadership ... *Is this enough?*
- ◆ (*overseas earnings through efficiency savings !?!*)

#### **Scenario III: "Things Can Be Marvellous .. Soon"**

More radical change: Any Number of Possibilities ... BUT ..

- ◆ Production – requires change in Standards? Agility in new application markets (mobile, dTV, etc.)?
- ◆ Large Users – achieve advanced network integration *new AI techniques, groupwork, advanced CAD, data mining apps., m-commerce, etc*
- ◆ Small Users catch up – *service providers as well as users*
- ◆ End Users – mass take up of ecommerce ...
- ◆ **Marvellous for Whom?** *Economic, Commercial or Social Success*

#### **What would Constitute Success?**

##### Economic

Effective and creative use, not necessarily production, but complete dissociation unsustainable?

##### Social

An ICT literate society, more equal and informed, avoiding "information feudalism"...

##### Geographic

Success for London? or for the UK?

##### Other?

*How much change can we expect by 2005?*

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

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

### *Drivers and Shapers*

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

In many scenario workshops the STEEPV approach – in which people are asked to identify factors and issues under the headings Social, Technological, Economic, Environmental, Political, and Value-Based factors – is used. This can be a useful prompt and way of ensuring that a broad range of issues is considered; it is also a helpful classification framework. But in our cases the workshop itself may be asked to come up with a grouping of “shaping” factors at an early stage of its work., and the background material indicated some broad ideas about drivers (nothing like as elaborate as in the Genomics workshop),

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

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

In these three workshops, we relied on paper-based rather than computer-supported methods (though some participants were spontaneously making use of laptops and even digital cameras in the most recent workshop). Thus here, as

later in the workshop, the groups are provided with written instructions. A facilitator/note-taker for each group was even given suggested timings for each task. The discussions were captured on posters which are attached to the walls to provide a record of development and material for other groups to inspect at intervals. The key technique is crystallising the thinking about factors, within different subgroups (and for them to communicate among themselves) in the form of lists.

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

The procedures of the workshop thus provide a platform for the elaboration and explication of knowledge. The background information, participants' knowledge, and their conceptual frameworks are brought together in ways that challenge them to develop shared understandings.

The success scenario methodology provides another impetus for these processes. It does so by asking the workshop, and working groups within it dealing with specific subtopics, to consider what might be *realistically achieved* if the UK (in these studies<sup>0</sup> is to be *successful* in the technology and its application areas. This means, of course, asking just what success in each area might constitute. This is another topic where views may differ. There may be quite different views of relations between means and ends, causes and effects; and also very different emphases on such values as efficiency, equity, sustainability, etc.

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

### *Indicators for success*

In this session the working groups further characterise the success scenario by specifying concrete ideas about how to recognise that the success scenario was becoming a reality. Again, some preliminary ideas of the sorts of indicator that might be developed are provided to kick off the work. The groups are challenged to suggest plausible quantitative estimates of such indicators - to clarify points of agreement and disagreement, to provide tools for monitoring progress, and to suggest alternatives to the narrow set of indicators that are

typically used to drive policies. Box 4 reproduces the introduction to this task as provided in the nanotechnology workshop.

Box 5 reproduces instructions drafted for the facilitators and chairs of the subgroups, to guide them in the tasks they were to undertake.

#### *Critical Success Factors and Actions*

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

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

In the carousel method, each group proceeds round the posters in turn (but starting at a separate point). It is free to read and comment on other groups' suggestions when visiting a station that another group has previously visited.

An alternative approach is to form new working groups, dedicated to specific action areas. It is possible to envisage other ways in which this task may be organised.

As well as specifying actions, participants are asked to indicate **who** might be responsible for seeing them through. The outputs of this phase of work need to be synthesised and prioritised, and plenary sessions are typically used to achieve this.

### **Box 4 Task of developing Success Scenario**

Text of three PowerPoint pages used in nanotechnology workshop.

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

##### *Indicators*

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

How much change by 2006?

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

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

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

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

## **Box 5 Guidance Material Used in a Success Scenario Workshop**

### **SESSION 2A**

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

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

Here is a list of potential drivers:

#### **Drivers**

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

#### **QUESTION 1**

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

#### **For each driver :**

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

#### **QUESTION 2**

When discussing these issues, please:

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

Continued

## **Box 5 continued: SESSION 2b**

### **Further Building the Success Scenario**

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

#### **Shapers**

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

#### **QUESTION 1**

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

*For each shaper :*

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

#### **QUESTION 2**

When discussing these issues, please:

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

Continued

## Box 5 continued SESSION 2c

### Summarising the scenario

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

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

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

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

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

Continued



## Box 5 continued SESSION 5

### Indicators for success

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

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

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

Continued

**Box 5 concluded**

### **SESSION 6 Critical Success Factors and Actions**

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

## ***10. The Output of Scenario Workshops***

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

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

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

## ***11. Scenario Workshops as Knowledge Platforms for Organisational Learning***

It may be helpful to examine scenario workshops as knowledge platforms, as opportunities for learning in organisations and social networks. One of the most influential approaches to organisational learning in recent years is the model developed by Nonaka and Takeuchi (1995);. The version we use here ([Table 2](#)) is based on one elaborated by Dawson (2000) who – rightly in our view- distinguishes

between “knowledge” and “information” rather than between tacit and explicit knowledge in this analysis.<sup>4</sup>

Table 2 A View of Knowledge and Organisational Learning

TO: →	Knowledge	Information
FROM: ↓		
<b>Knowledge</b>	Socialisation: <i>Transfer of knowledge between people (through interaction rather than mediated through captured information)</i>	Externalisation: <i>Capturing people’s knowledge by rendering it as documents or structured processes</i>
<b>Information</b>	Internalisation: <i>“Knowledge acquisition” – learning how to use models, formulae, equipment, methods etc.</i>	Combination: <i>Systematising and/or translating formalised concepts into new frameworks, procedures, etc.</i>

The idea that knowledge development takes place through a (typically clockwise) movement through these different categories is a powerful heuristic. Perhaps this can help us understand what takes place in scenario workshops, even though it was designed for examining other settings.

For example, the workshops begin by being provided by background documents (result of a process of externalisation), they work through this material in advance to gain a view of the problem area (combination), they apply the scenarios in a group discussion (internalisation), developing improved scenarios which they present to other members of the workshop (socialisation). Typically these procedures are reiterated several times – for drivers, scenarios, policy priorities, etc – until a final process of externalisation results in a report of the scenario workshop being delivered.

Whether or not this particular way of looking at scenario workshops is completely effective remains an open question. However, the point that they have proved valuable contexts for people to bring together their knowledge and develop better understandings of how knows what, etc., is evidently a valid one. One piece of

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<sup>4</sup> Nonaka I. and Takeuchi H. (1995). The Knowledge-creating Company, Oxford: Oxford University Press; Ross Dawson: 2000, Developing Knowledge-Based Client Relationships Butterworth-Heinemann

feedback from the sponsor of the Genomics workshop echoes this point: the use of scenario approaches had enhanced dialogue across disciplinary boundaries. It had forced a confrontation between knowledge bases and the perspectives based on them, as a result of which participants were not only better-informed, but had also developed strategic orientations with a firmer and wider grasp of the wider context within which decisions were being made.

## **12. Use of the Material**

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

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

Formally, we know that the studies described above have been utilised in funding decisions. They have helped provided intelligence, too, that can be used in debates between different decision makers. (Thus the genomics exercise could be used within the sponsoring organisation to raise awareness of the relevance of the topic more widely than just among those centrally concerned with the decision. The other exercises provided those responsible with science expenditure not just with a case to take to the Treasury, but also with suggestions as to how financial authorities might be able to assess whether the investment was worthwhile – staving off the threat that indicators of success might be imposed from outside.)

In all of these cases, client involvement proved vital, in the design and conduct of the scenario workshops. Without such involvement, the exercises would not have been adequately tailored to the decision-making needs of the sponsors. And participation in the activities helped ensure, as suggested above, that there were “champions” for the scenario work within the sponsoring organisation, who could take the messages of the study further. This could be seen as a matter of disseminating the *products* of the exercise further. Equally, it can be viewed as a matter of extending the *process* of the exercise.. Design to allow both of these dimensions to be maximised is needed to make sure that the use of scenarios effectively contributes to decision making.