Paper 11: Technology Foresight and Assessment in Future Use of Biotechnology
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Introduction

It is virtually certain that biotechnology, with its applications and challenges will develop further and increase in importance. Among its major challenges is the fact that a very large percentage of the world’s population lives in abject poverty, lacking food and suffering from deficiency of their diet in vital microelements or in vitamins. Another problem, which with time becomes even more evident, is the environmental damage caused by modern agricultural systems and their consequences.

These and other complex issues are being addressed by biotechnological research, which may offer solutions to several concrete problems. Golden Rice, for example, is supposed to provide an improvement in vitamin A deficiency which - according to the World Health Organization (WHO) - leads to between 250 000 to 500 000 children becoming blind each year. Golden Rice was, however, not met with much acceptance from the public, and became a point of criticism from NGOs. The same has happened with many others foods derived from modern biotechnology. Why is this?

Answering this question could provide better understanding of a more general problem; i.e. gaps in the framework in the introduction of biotechnology into the food sector. Public reactions to this new technology and its usage will very likely increase, as will fears associated with it. All indications point in this direction. However, there are clearly also problems related to our present political processes and institutions. These include contending theories about how to somehow ‘control’ or manage technology. Some of these claims strike us as being excessive. Whereas technology should not be stopped blindly, one should always try to stop blind technology. For several reasons, which we explore, these problems are often not easily solved. To the extent that they cannot be solved, the problems (or conflicts) must somehow be settled before any fruitful results of technological usage and applications are won.

A crucial issue of this type is the relevance of the applications of modern biotechnology to the peoples’ needs. It is often contested in the case of genetically modified (GM) food. How can this be changed? Should it be? The question of the ‘need’ in certain types of food cannot be decided without competent and independent scientific advice. Paralleling the forum for the discussion of need in GM food case-by-case should be provided. Another issue of importance is how to involve those populations who are supposed to be benefactors into the preliminary discussion.

We are concerned about the principal changes which are likely to take place in public and private organizations involved with biotechnology. We are also concerned with how these would, and should, be run in the future. How could and should public and private policy be organized in order to meet the new challenges and opportunities caused by the future breakthroughs in biotechnology and governance?

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Most governments, for example, remain in a short-term mode and – as such - may need scientific inputs to the decision-making process. How could this be achieved? Are new types of policy instruments required and, if so, what should they be? Or do we also need new types of joint decision-making processes in order to safeguard biotechnology and governance? Which changes are likely to take place and what consequences will these have on present and future decision-making?

How can technology foresight and assessment be useful? Can “think tanks”, for example, be of any help? How important are these and their methods for policy making? Do “think tanks” really matter, and if so in what capacity? Which typologies and issues exist and how can general criteria for evaluation become established? What should the foresight and forecasting agenda be for the field of biotechnology and biotechnological applications?

In this paper we attempt to answer some principal questions concerning the possible future role of technology foresight and assessment when dealing with modern biotechnology and its applications. Through this process we try to develop a preliminary model of how some of these major concerns may be met.

The paper, therefore, deals with the increasing importance of biotechnology, and some of its major applications and challenges. These are many and growing in importance. As should be known, some 80% of the world’s population lives in less developed countries (LDCs) or – perhaps better – “developing countries”. By the middle of this century this figure may grow to 88%. Almost one billion persons are said to be undernourished, and more than one billion lack clean water. Nearly half the world’s population lives on an income of less than $2 per day. A child born in an LDC has a 40% chance of growing up under extreme poverty. Biotechnology could be of some help, but how? There are enormous challenges but also opportunities facing mankind which must be understood and met.

In addition - and of particular interest to us - are principal changes which are likely to take place in public and private organizations, and how these will be run in the future. How could public and private policy be changed in order to meet new challenges caused by the breakthroughs in biotechnology and its governance?

As is now becoming increasingly clear, most governments remain in a short term-mode and (we think) may need scientific input to the decision-making process. How could this be achieved? Are new types of policy instruments required, and if so what should they be? Or do we need new types of joint decision making processes in order to safeguard biotechnology and governance? Which changes are likely to take place and which consequences will they have on present and future decision-making? Are “think tanks” (and their tools) of any help and if so how?

**Biotechnology Issues and Challenges**

Several significant issues are waiting to be properly addressed with respect to decision making within the field of modern biotechnology. This applies to the US as well as Europe. The controversies about insufficient risk assessments, inadequate risk management or ethical acceptability with respect to different applications of
biotechnology co-exist with controversies about their needs. One such case is the development and commercialization of recombinant bovine somatotropine (rBST), a hormone used to increase milk yields, which has become an issue of intense public discussion [IFST 1999; Kingsnorth 1998]. The “need” within this product was contested from the beginning, and the inadequacy of risk assessment as well as risk policy with respect to rBST have been discussed [Gaivoronskaia & Solem 2001]. RBST was developed by several biotech companies in the 80s, a period when milk surpluses represented a problem in the US. It was approved for commercialization in the US and some other countries. In Europe the cost/benefit analysis of rBST was performed with the conclusion that its introduction would cause some small milk producers to be driven out of business [Kluver 1998]. Hence, the “need” in rBGH was put in doubt and a moratorium was declared in Europe. This case highlighted, among other things, the importance of having a correct approach to the criterion of “need” when dealing with technology governance and particularly, a wide presentation of interests with this respect.

Many difficulties are mentioned, and other cases with respect to decision making on GM food happen, since the issues are addressed by means of a system which was developed long time ago to deal with problems different from the those of the present, and which arise now when dealing with biotechnology. Institutions, laws, responsibilities of the stakeholders in this older system may have been adapt to cope with scenarios that emerged in the past, but are unhelpful when dealing with the new technologies and their consequences [Weale 2002]. The same inadequacy in the decision making system may be observed in the case of GM food from the frequently occurring and easily observable dichotomy between governmental decisions and consumers’ needs and concerns about risks (that seems to be decreasing somewhat now); the low level of public trust in government and industry; a generally held public belief that large corporations are the main benefactors from GM food [Consumers’ Association 2002; Eurobarometer 2002].

Hence, we are interested in finding out what could be done in order to achieve progress in the case of the decision making process concerning for example GM food, in such a way that a consensus on the need of particular applications will better be reached. The case of GM food is of particular importance for such an analysis, among other reasons since it is here that the publicly held scepticism holds the highest profile. Consumers show very little or no support for this field of application of modern biotechnology, even if strong efforts were to be made to take into account the consumer’s concerns on the European level, as well as in individual countries [Eurobarometer 2002]. We shall begin our analysis by characterizing some important problems associated with the introduction of modern biotechnology.

The Concept of “Need” in Biotechnology

Data from focus groups, public conferences and other participatory exercises on GM foods in different European countries not infrequently arrive at the conclusion that there is no “need” for the application of biotechnology for food production. Such was for example an opinion expressed by the two Norwegian lay people conferences in 1996 and 2000 [Gaivoronskaia & Solem 2000]. The question arises then, how should this opinion be included in public policy? In the case of Norway it seemed quite easy; a “de facto” moratorium on GM food was already in existence at the time when these conferences took place, and the conclusions of the conferences proved the existence agreement of this
policy with public opinion. But what happens in more complicated cases, and of what importance is the concept of “need” for technology acceptance? How is this concept constructed with respect to food? These questions must be analyzed more carefully, as they have a potential to influence another important issue as well as risk policy.

“Need” is defined as a strong feeling that you want to have or do something. It has been noted that needs do not exist independently of the social environment and specific state of techniques in which they occur [Winner 1992]. Food suits perfectly the Maslowean pyramid of human needs, as it corresponds to all needs beginning from the physiological and ending in the self fulfilling one [Maslow 1954]. If GM food fails in peoples’ opinion to suit some of these needs, then it is felt as a ground for discontent.

Need was once a means of society’s coercion, but now we have moved from the “solidarity of need” to the “solidarity of anxiety” in the opinion of Ulrich Beck [Beck 1995]. However, has GM food again returned us, this time to the solidarity of “not-need”? When we act as consumers we normally make our choices and do not buy food products which we do not need. In this way a democratic society guarantees that “not-needed” products are not forced upon us against our will. However, if GM foods are not labelled, people have no chance to choose, which is why and how the concerns about risk or ethical objection get their ground.

Analyzing recent developments we clearly see that modern biotechnology has become one of the technologies that have divided scientific experts, stakeholders, population and even countries in blocks of proponents and opponents. The “no need” concept may play an important role in this respect. The public’s view on “need” in biotechnology in general can be understood from data of the latest Eurobarometers. One question asked was about people’s expectations in the life improvement from biotechnology within the next 20 years, and this question correlates in our opinion with the issue of ‘need’, although life improvement has a wider meaning.

The European population has been divided into two parts; those who associate biotechnology with better life and those who do not. 44% of persons interviewed in Eurobarometer 2002 thought that biotechnology had the potential to improve their way of life [Eurobarometer 2002]. The other part of the population considered that biotechnology would worsen things, that it would have no effect, or gave a “do not know answer” [Eurobarometer 2002]. There could be different and complex reasons for these findings, but it is almost sure that all these people feel that biotechnology is not needed. They may feel then that this technology is introduced against their will and we should count on the possibility that the mentioned part of the population may disapprove of the whole political and juridical mechanism, as well the corresponding decision making process that provided for it.

Association with “no-need” was important in our mind for the evaluation (with respect to life improvement) of another technology, space technology. In Eurobarometer 2000 it had the same low expectations to improve life as did biotechnology [Eurobarometer 2000]. In other words, the perceived improvements (or benefits) from both technologies for the public are almost equal. However biotechnology offers a wide choice of solutions to medical and societal problems, and from the technical point of view many of these solutions, such as human cloning, is achievable already. At the same time with respect to
space research it can be imagined that a difficulty may arise to correlate it with certain life improvements. Improvements of our life as a result of a space research are not yet a topic that has received much attention, since many technical problems remain unresolved. There are no direct associations with the applications of space technology. It is more related to the future than to the present and therefore provides often the subject of science fiction.

Another particularity emerging from a recent Eurobarometer is that about 25% of the persons give a “do not know” answer, which is the highest percent in comparison to all mentioned technologies [Eurobarometer 2002]. As many as 27% of Europeans said: “Do not know” when the same question was asked about GM foods. It may, of course, result from different considerations. There could, for example, be a possibility that people do not feel themselves sufficiently knowledgeable to arrive at correct conclusions. Another is a balance of positive and negative arguments. The last explanation of “do not know” could be the passivity linked to a feeling that it is impossible to influence events. If surveys are to be considered democratic instruments of public participation, then the answer “do not know” may mean that people are extracting themselves from this type of participation.

It appears that views about “not-needed” technology are strongly represented in public opinion with respect to modern biotechnology and GM food. Many people may consider that different types of GM food are created without asking for their opinion, and then fed to them without their consent. These arguments are often not only related to the generation of GM crops created to have herbicide and insecticide resistance, but as well with respect to Golden Rice (engineered to contain vitamin A), useful in opinion of many experts, [IIFPR 2000]. As is well known, the deficiency in vitamin A causes every year many child deaths in developing countries.

From the above mentioned it could be concluded that in decision making on GM foods, mechanisms should be provided for preliminary careful consideration of the “need” or “no need” in different types of GM food. This should be done with the increased possibilities of public input, particularly from localities where this food is expected to be grown or commercialized. But at the same time, scientific advice plays an important role in technology policy making, hence ways for integrating it should be developed.

**Science, Needs and Risks**

Science plays an important role in deciding what is needed and what is not in our daily food. In some cases it finds out that our diets are not healthy and may lead to the risk of developing premature diseases. It can be deducted therefore that such diets are not needed. We may better follow this advice without objections. In the case of GM food one group of scientists, usually working in industry, develop what they think is “needed” food. However, if consumers are opposed, they should have the possibility to choose. Another group of scientists are involved in risk assessment. Their results may lead to a decision that will change an opinion about “needed” food in the opposite direction. Scientifically based risk assessment provides an important input for the experts’ perception of risk. The existing strategies for the safety evaluation of food derived from genetically modified organisms were developed with the participation of such respected international groupings as the Organisation for Economic Cooperation and Development (OECD), the Food and Agriculture Organisation (FAO) and the World Health
Organisation (WHO). The central concept for such an evaluation is called “substantial equivalence”, and was developed by the OECD [OECD 1993]. Its main idea is to compare the characteristics of GM food with the appropriate counterpart, the safety of which is proven by the long practice of consumption. The differences are further explored afterwards. Among safety tests that can be required to be performed are toxicity testing of the nature and function of the new protein; the occurrence of unintended effects, gene transfer to gut micro flora [Kuiper et al 2001]. Another type of study can be made on the potential allergenicity of the newly inserted traits and the role of the new food in the diet (ibid).

Safety issues with regard to GM foods, according to [Kuiper et al 2001] are:
1. Genetic modification process.
2. Safety of new proteins
3. Occurrence and implications of unintended effects.
4. Gene transfer to gut micro flora.
5. Allergenicity of new proteins.
6. Role of the new food in the diet.
7. Influence of food processing.

It is often stated that scientific consensus exists about safety evaluation of the GM foods [IFT 2000]. A report from the U.S. National Biotechnology Policy Board emphasized that “the risks associated with biotechnology are not unique, and tend to be associated with particular products, not with the technology per se. In fact, biotechnology processes tend to reduce risks because they are more precise and predictable.” [NIH 1992]. A recent FAO/WHO consultation concluded, for example, that “A comparative approach focusing on the determination of similarities and differences between the GM food and its conventional counterpart aids the identification of potential safety and nutritional issues and is considered the most appropriate strategy”[FAO/WHO 2000].

Experts’ perception of risk is however different from the consumers’, and this may create many controversies especially connected with food. Psychometric research has shown that individuals' perception of risk depends on many variables, for example the degree to which a risk is considered new or dreaded [Rohrmann, Renn 2000]. Among other factors that influence the perception are characteristics of hazard outcomes and the potential to blame institutions or persons responsible for the creation of a risk situation. As we know, people’s perception and acceptance of risk is determined by the specific context in which they get exposed to this risk [Slovic 1990]. Furthermore, consumer risk perception may be affected by moral or ethical considerations, media exposure, the opinion of scientific experts and such factors as perceived control over risk [Starr C.1985; Pilisuk M. et. Al. 1987; Andman P. et al 1987].

**Biotechnology and Confidence.**

We turn now to another area of public concerns with respect to modern biotechnology – political reality. An important finding from a recent Eurobarometer is that people have the lowest confidence that national governments, the European Commission and industry are doing a good job with respect to biotechnology [Eurobarometer 2002]. The judgments of the Europeans about stakeholder as “doing a good job for society” were supposed to characterize a view that the stakeholder is both competent and behaves in a socially responsible way. From this point of view for example, only 46% have
confidence in their own governments in making regulations on biotechnology. Hence, the above mentioned data further support the view about a crisis of trust in the authorities and industry that is evident with respect to biotechnology policy-making.

A notable difference was observed in the confidence in scientists working in universities and those in industry. While 56% of the respondents expressed confidence in scientists working in industry, 76% had confidence in scientists from universities. This can be linked to the perception that scientists in industry are not completely independent in their research, and this can influence as well the specific risk assessments of biotechnological products. Such a situation has occurred for example with the risk assessment of the recombinant bovine somatotropine (rBST), a recombinant bovine growth hormone, produced by the Monsanto Corporation [Gaivoronskaia and Solem 2000]. Several issues in this assessment, for example the possible effects of the insulin like growth factor in milk produced with rBST were omitted. This fact was later revealed by the Canadian Health Agency and by the Scientific Body of the European Union, which was asked to approve rBST for commercialization (ibid).

Another factor that could have been of importance in order to understand the difference in confidence of the two categories of scientists is the opinion that multinational companies which develop and commercialize GM crops concentrate enormous power, as they are integrating the whole food chain and agrochemical production [Gaivoronskaia and Solem 1999]. Hence, it is of critical importance how the benefits from this new technology will be distributed, and whether or not farmers (particularly small farmers in the developing world) will be taken into consideration [Pretty 2002]. At the same time it was shown that 70% of Europeans have confidence in consumer and patients’ organizations (ibid). This sign of approval for these organizations may indicate that they were judged to have adequate characteristics for successful pursuit of the policy goals considered important by the majority of the European public. It would be important in this context to reflect on what these characteristics are, and in what kinds of policy the mentioned organizations are involved.

It is evident that besides the competence and responsibility that can be attributed to consumer and patients’ organizations by European opinion, these organizations have in common another important characteristics – independence. It was noted on several occasions that many organizations involved in decision making with respect to biotechnology were seen as “lacking independence”. However, “independence” is an important characteristic which becomes indispensable in dealing not only with technological but also with other issues, such as food and agriculture or health politics. Hence, when measures were developed to deal with the recent European food safety crisis and the creation of a new food safety agency was suggested, it was particularly underlined that the agency should be independent.

So what can be done to avoid the situation where people are worried about society moving towards being more risky, less moral and with decision making processes that ignores public concerns? A useful approach can be represented by looking -and providing for - policy advice on the issues in question that will have advantages from the point of view of the public and as well of the decision makers. The most significant characteristics with respect to this type of policy advice are that it should offer the possibility to come to a consensus in all these three major areas: risk, ethics and policy.
Can we look for appropriate models of such policy processes among available possibilities? Analyzing this issue we have concluded that the most helpful model for such purpose could be “think tanks” with their particular types of research tools and methods. To explain better our arguments we will first provide a working definition of think tanks and of their function.

**Roles and Functions of Think-tanks**

First and foremost we should know what is meant by this label, so as to ascertain how and in which ways such types of organizations could prove useful within the field of biotechnology and its applications. Much has been written about “think tanks”, some of it insightful or ambivalent, some of it inconclusive and possibly quite misleading. Defining “think tanks”, hence establishing clear conceptual boundaries as to what separates them from other types of organizations is not an easy task. McGann and Weaver (2000) argue that the commonly used - and admittedly easily accepted - definition of think tanks as “institutions which provide public policy and advice” is in fact much too broad. One could agree that this definition casts its net too widely, and in the process catches a variety of interest organizations and associations, university-based or other research groups, civil society organizations whose primary purpose is to carry out policy analysis and provide advice when needed. In addition, such a definition of necessity includes a great variety of governmental agencies which, according to their differing mandates simply “provide advice”. This is in fact not the type of organizations that interest us in the context of biotechnology.

Alternatively, a more stringent definition of “think tanks” exists, which is frequently used especially in US and British contexts. This is a type of organization that is independent of governments or universities and is of a non-profit nature. According to some critics, however, this definition seems too narrow and exclusively “Anglo-American”. Admittedly, the definition would certainly rule out a large number of organizations that provide useful policy advice and see themselves as belonging to the category of think tanks. Diane Stone and Mark Garnett, for example, have argued that, regarding the notion of think tanks to have independence or autonomy from the state and private interests in order to be “free-thinking”, is a “peculiarly Anglo-American predilection that does not travel well into other cultures” [Stone & Garnett 1998]. However, it seems that organizations that rely totally on government contracts for their revenues cannot and should not be considered completely autonomous. Hence, attaching the label of “thinks tanks” to such types of organizations – as is quite often done – may be both misleading and in-advisable.

As is known, the term “think tank” was first introduced within a military context. It helps if you have a clearly defined enemy. This was so as to be able to describe a secure environment where military as well as civilian experts could meet to analyse and deal with treats of invasion and attack, and to develop and employ their own planning. One of the first such examples is RAND, an abbreviation for Research and Development. This very special military establishment had carried out a mixture of deep thinking and program evaluation for the US Air Force and national defence. It was only later on that the term “think tank” was used to cover contract research by groups of experts who would formulate a variety of policy recommendations, including semi-academic research institutes concerned with the study of international relations and strategic questions [Smith 1991].
By the 1970s, however, the term “think tank” had been applied to institutions focusing not only on foreign policy and defence strategy, but also on current political, economic and social issues [Weaver and McGann 2000]. Not only has the information-providing function since then been of growing concern, think tanks were also seen as interesting phenomena from the point of view of civil society or the so-called “third sector” political processes. The latter concept was developed in order to distinguish non-profit, non-governmental institutions from the state sector, as well as from the private ‘for profit’ sector. The concept may be important for the future, since it covers that particular “political” space which, for various reasons, is neither the domain of government nor business exclusively, but an area where actions may be initiated and carried out either by Non-governmental organizations (NGOs) on behalf of peoples or by people themselves. The importance of these institutions to the civil society movement has of course already been recognized in the United Nations Universal Declaration of Human Rights (Articles 19, 20) where the right to freedom of assembly, freedom of expression, and freedom of forming associations has been clearly stipulated. Think tanks could therefore relatively easily fall in this particular grey area of the civil society concept. They are often organized, at least indirectly, to advise or assist governments whenever possible or desired.

Without doubt, the whole idea and the concept of “think tanks” have become increasingly relevant, especially during recent decades. Their importance may grow even more rapidly in the future, for several reasons. The first of these has to do the process of change. This applies to social, technological, cultural and political change. From now on, nothing will remain exactly the way it once was. Almost everything that can be produced will be faster, smaller and (possibly) cheaper, except life itself. Technological and social processes will intensify and pick up speed as is seen in the field of biotechnology and other mega-trends.

In the area of politics itself this is easy to see. Whereas political parties have only been with us for the past 200-300 years, political reality itself is thousands of years old. Already much of our present political “machinery” (including political parties) by now seems obsolete to some observers. They argue that our present political parties cannot really meet the many complex challenges that they are facing. Some politicians, of course, seem to be aware of this state of affairs; therefore they will increasingly want to look elsewhere for additional, critical advice. One direction in which several of these decision-makers may want to look will be towards think tanks.

**Technology, Politics and Risks**

Large questions loom over the horizon, many of which are directly related to the role of science and technology. And as we know, many of these questions are about change in national and international society. They are concerned about breakthroughs caused by technological innovation, health issues, food supply and security, biotechnology and – last but not least – partly as a function of all the above human survival on this planet.

The political system remains the central context for what happens along a number of separate axes and within many areas of technological and socio-economic activity. As far as the political system itself is concerned, it faces at least three major critical challenges; we might even call them crises. The first crisis has to do with whether or not
the political systems (with its subordinate processes) is sufficiently well equipped to deal with the complex future challenges which they face. We could call this the crisis of competence. Does the system contain enough competent practitioners or executors of the public will, which is essentially its sine qua non? By now this seems to be an open question. And even if the system does contain enough competence, can it deliver? Is it efficient enough? We may call this second crisis the crisis of deliverability. If the political system in question lacks both competence and ability to deliver, it will - at some stage - face a third, and ominous, crisis- namely the crisis of legitimacy. History has proven this to be the most sinister type of crisis, both in terms of its nature and manifestation.

We have previously argued for the need to anticipate risk and to properly integrate foresight into our political decision-making processes [Gaivoronskaia and Solem 2000]. These points have not gone unheeded, even if much remains to be done. To get advice on how to anticipate risk, establish foresight and, where it is required, how to develop precautionary research programs and processes, politicians at times turn to someone else, different from their own in-house group of advisors in order to get outside, perhaps – as they see it - more “objective” information than what (they think) they receive from their own bureaucrats. Such assumptions are of course often correct.

Risk is a principal component in much biotechnology. In general, government ministers very often see themselves as having a problem about managing risks. There have been plenty of cases in the past few years alone showing that events could have been handled better. To take Britain as an example, foot and mouth disease, asylum seekers, variant CJD, GMO, fuel tax protests, rail disasters are but a few such cases, which would seem to indicate that there are shortcomings in present decision-making. At the same time, national bureaucrats almost everywhere seem so obsessed with avoiding risks that they may be managing opportunity with even less skill. Why is this?

There are at least two major reasons for the current situation. First, there is the question of very rapid (“hyper”) change, already touched upon by several observers, including the present ones. Secondly, there is the onset of new, global type trends and issues occurring concurrently, and often with sudden strength. However, this “new” problem when examined more closely - is really related to an “old” fact, namely that in those in human affairs in general, proper allowance is seldom made for changing conditions outside our control. For example, while at the same time, researchers and bureaucrats within government agencies feel that they “know” their decision-maker, it is becoming increasingly clear that the respective “worlds” which these separate groups inhabit are often qualitatively very different from each other. Hence, their perception of inside “knowledge” may in fact be quite faulty. The bureaucrats’ world, for example, is to a large extent driven by the notion of efficiency. This somewhat poorly defined concept is often seen in purely quantitative terms. Why is this? The answer is that it seems easier to measure. A natural consequence of this widely held, bureaucratically based view is that - almost always – more rather than less information tends to be produced. Many bureaucrats, in order to increase their superiors’ impression of “efficiency” tend turn themselves into producers of data. Their ‘effectiveness’, measured largely by the quantity of information supplied, is - for that reason - high.

However, as is now evident at least for those of us seriously studying the problems of decision-making, the more information provided, the greater the delay in reaching a
decision; hence the greater the chance of postponing it indefinitely [Kaye and Solem 1992]. Whereas this particular problem seems related to information overload, it may also be its real cause. Newer, more complex and many-sided issues, such as those of biotechnology will not make this process easier, unless a deeper understanding of system (and process) is achieved by all parties involved and appropriate measures taken to sort out specific roles and functions.

Consider for a moment the role of the data-producing bureaucrats versus their decision-making bosses. Despite the fact that much of the above may be known by bureaucrats, the situation still remains difficult. It is very hard for him/her to provide information in a situation where the decision-makers’ goals and plans are as complex, unclear and uncertain as is often the case. The tendency could easily arise for scientific or other “knowledge-workers” in the many national, government run or controlled research laboratories to deliberately avoid treating particularly difficult, albeit important problems. Instead, research personnel may want to concentrate on the more easily understood and more easily solved problems. Whereas there may be nothing particularly wrong with this approach in general, when it comes to problems of decision-making it more often leads to the process known as “discounting the future”. This means bad planning and bad results.

The middle-level decision-maker (of which there are many), as contrasted to the government-lab type researcher, lives in very different world, hence has dissimilar preoccupations. Being inundated with “information” and finding himself/herself in a virtual vortex of change, with multiple levels of decision making to contend with, the temptation is to delay if possible or - failing that - to push the decision upwards towards superiors. The middle-level decision maker will then, as a general rule, tend to seek explanation from below – if she thinks this can be obtained in time – and decisions from above. The top-level decision makers (the CEOs or the elected politicians) have generally little or no time for longer-term problems which are presented in this way. Theirs is more often than not nowadays a world of relatively serene simplicity, interrupted by burst of spasmodic, frantic activity, which then tends to spread itself downwards in the hierarchical structures of public or private bureaucracy [Kaye and Solem 1992]. There is absolutely no reason to assume that, with the many new breakthroughs and future developments in biotechnology the decision-making processes of rule making and governance will be any easier; unless, of course, something is done to rectify the situation.

As may have been observed, politicians are for various reasons increasingly “shying” away from difficult problems, even when these are clearly political. By pushing particularly tough problems onto the bureaucracy, two effects are created, both of them clearly counterproductive and potentially damaging to the system. The politicians are abandoning their responsibility, hence - in time – adding to the growing disgust for politics and politicians. Simultaneously, the process seems unfair for the bureaucracy, which has not been created to make political choices. Mixing the roles will, in time de-professionalize the research and administrative parts of the public services in many countries, then subsequently politicize it, adding to a general decline in performance as well as expectations.

The politicians who sense this (and some have good noses) will therefore continue to make use of various “non-governmental organizations” (NGOs) for specific purposes,
some of which are clearly political in nature. Or they will turn to “think tanks”, rather than to rely solely on their own researchers. In either case it is safe to assume that politicians will bring their own agenda principles with them. They will also - where possible - try to make the NGO or the think tanks (as NGOs often are or can be) produce such results which they, the politicians find palatable for their own purposes. This process should call for some sort of quality control from the NGO or think tank’s points of view. How can this best be done? It is important for all new global trends and issues, including those of biotechnology.

**Integrating Technology and Politics**

A major goal for solving large problems of a global nature is to somehow integrate sound science and sound governance, so as to enhance the interface in a way which could make the system accountable, transparent and credible. Strengthening the integration of science and government is in many modern countries by now seen as essential in the face of change and complexity [Kobayashi 2003]. It may even be more important as far as the international dimension of governance is concerned. We are of course not here advocating a system of “government by science”. Rather, what we want to see implemented are scientific (or science based) facts and findings not as substitute for the political decision-making, but as an aid to that same process [Solem and Brattebø 2002].

Think tanks possess a variety of methods and techniques, which could be helpful in this process. How, in a general sense, would they measure up in terms of aiding decision-making and governance of biotechnology? Take prediction, forecasting, and/or modelling, for example. How helpful are these and their results for decision-makers and corporate and public policy planners? Clearly the answer will depend upon the reliability of individual forecasting methods and techniques, as well as on the models themselves. But it also depends upon the care with which forecasters have tried to incorporate the maximum elements of reality and all relevant components into their work. Last but not least, it depends upon the responsiveness shown towards forecasters from the policy maker(s). To the extent that the learning process has been incorporated as completely as possible, and that negative feedback loops exist, suspicions will generally tend to subside, and the entire exercise stand to benefit all concerned.

Returning for a moment to the techniques and research methods which could and perhaps should be used more frequently and deeply within the general process of decision-making we shall emphasize three. Of these, the most basic, easiest, hence most frequently used from all the futures methodologies toolbox is trends analysis. Whereas this technique may lack complexity and sophistication compared with many others, it is nevertheless about 1000 per cent better than not using futures methods at all. By examining and evaluating a trend thoroughly and closely we might be able to determine its origin, direction(s) and some possible consequence(s). This requires dedication, hard work and insight, qualities not always in ample supply. Trends analysis is the most frequently used – perhaps also misused – of all so-far available futures methods. We say “so-far” since new techniques, some of them possibly hybrid, will inevitable be developed and applied within think-tanks and applied outside. The only problem which we see with trends analysis is that its users, of which there are many types of decision-centres and decision-makers, could tend to ignore “trend-breaks” or “discontinuities”, to
use a more proper term. This would apply to research within the field of biotechnology as well as elsewhere.

Scenarios and scenario planning is of course not used as frequently, as these take time and efforts. They are much more creative since they take into account; in fact they may ideally incorporate and develop further, the ideas of “trend breaks” (discontinuities) and try to get to the bottom of what causes what to happen. Scenario planning is in fact a type of literary criticism, in which people dig down to understand the assumptions and perceptions that underpin the imagination in each scenario and evaluate their plausibility and credibility. It is methodical thinking of the “unthinkable”, which is easily understood, consisting of persuasive and credible stories on how the world might work. Another useful method which, based on technology foresight and assessment is ideal for think-tanks.

The third method, the Delphi technique, allows us a better us of experts. This technique, which was developed by Olaf Helmer and Norman Dalkey at the RAND Corporation in the late 1950s, may help leaders get better forecasts and advice from their advisors. The Delphi method recognizes unencumbered human judgement not only as legitimate but possibly superior as a necessary input to decision-making in multiple contexts. By using anonymity in the reaction process from the participants it bypasses or avoids the typical socio-psychological barriers and traps, created by the well-known phenomenon of dominating or domineering personalities. Since there are several “rounds” of a Delphi, the final results is often a consensus forecast or judgement, which is uncontaminated by “follow-the-leader” tendencies. The Delphi technique is a very useful method to obtain refined, hence better, results from expert opinions. Widely used to generate forecasts in technology, education and other fields it might be of good, practical use for the teaching and practical aspects of biotechnology.

**General Criteria for Evaluation**

Given the considerable potential of thinks tanks and their role as aids to decision-making, as well as their utility for “quality-control”, especially for new and emerging trends with associated issues of complexity, such as biotechnology, we now need a more rigorous definition of what a think tank is (and should be). Which roles and functions are their most appropriate? A clearer concept of what constitutes a think tank is, could make it more easily understood, analyzed and, if need be, comparable to other types policy-advice organizations and associations. As we see it, some of the major criteria for an organization to be labelled a “think tank”, and for it to be accepted as such, are that it should have (and generally be seen as having) several or most of the following characteristics:

- Credibility (on which much of the rest is based)
- Policy influence
  - Independence, sufficient to carry out the needed work
  - Public relations, in terms of access, use and understanding
  - Sustainability

These are general criteria for the understanding of what a “think tank” is, or tries to be. They also allow analysis and comparison to be carried out among think tank “candidates”. Some of these criteria may be easier to arrive at than others. The criteria
are, however, interrelated. As is the case with quality control, in general this is usually more easily achieved with quality present. Carrying on from the above, we will now perform a double task. First, we will examine more closely the above mentioned criteria. Secondly, we will try to determine which of these lend themselves most easily and most appropriately to the question of biotechnology.

Credibility is largely a function of quality achieved and developed further. If and when a sufficient number of scientists group themselves – or are grouped – together for the purpose of solving (or settling) importantly recognizable (global?) problems, results may likely be achieved which create credibility in the eyes of many. Yotaro Kobayashi observes that first and foremost a think tank needs to be able to implement scholarly research in its specialized fields. Its research results must also be highly recognized by the policymaking community [Kobayashi 2003]. In order to achieve this, a think tank “must hammer out quality and credible research output useful for policy making” [ibid]. This sequence of ideas reflects on more than one of our own characteristics of think-tanks. Some reservation may be raised concerning the need for (direct?) applicability to the policy making process. How is this different from commissioned research tasks and if not, who sets the stage and decides on content and/or direction? However, in both our cases the component of independence is stressed. Kobayashi states, for example, that for a think tank to be independent and strictly non-partisan it must be established on firm financial and personnel basis [Kobayashi 2003].

Policy influence may be harder to nail down in terms of quantification. This goes for trying to assess strength as well as direction. Our view is that think tanks are in fact in the “business” of developing, refining and (possibly most important for many of them) marketing ideas. In order to succeed they must of necessity employ a set of different strategies. Traditionally, think tanks have tried to influence parliamentary or other legislative or executive bodies by submitting briefs or – in the former case – testifying to specialist committees. However, think tanks can also invite elected officials or other major decision makers to participate in research seminars or other specialized gatherings by their own design. Think tanks can also influence policy-making (at least indirectly) by publishing articles or briefs to specialist journals or particularly influential newspapers. It may (but need not) be relatively easy to trace the various governmental or non-governmental channels on which think tanks rely in order to increase their visibility. But to assess or evaluate the strength of the actual policy influence is harder. Hence, to evaluate the direct influence of a particular think tank on the decision making process is methodically very challenging. However, this does not mean that it could or should not be attempted. This line of thought goes beyond the present context of biotechnology and governance but allows for some potentially innovative research ideas. By separating the policy influence criterion into shorter- vs. longer-term policy influence, interesting findings could be the results, and important hypotheses proven or - even better - discarded.

Turning to our third criterion: independence sufficient to carry out the needed work this is by most observers recognized as being of pivotal importance. If examined closely and in detail the criterion would in fact disqualify a number of organizations which pride themselves with the label of think tanks. To achieve the status of a genuine think tank some important strategies must be undertaken. First, assuming credibility has already been achieved by means of quality, it is then essential for the think-tank to build and strengthen its institutional network, preferably on a global basis. This means aiming at
the establishing of exchange programs, creating visiting research fellowships, and initiating integrated multi-dimensional projects and other collaborated scientific activities. In order to obtain this type of independence, the think tank “candidate” must avoid the most typical external pressures, temptation to be bought-into by donors who will want to determine content and direction of research. To build and strengthen its own research network the think-tank must establish contacts with scholars in the field and, ideally, aim at serving as a bridge between specific types of scholarship and policymaking. We are describing here an ideal think tank, being fully aware of the presence of multiple external pressures, temptations and constraints. For that reason alone, as well as several others, it is essential that the think tank gets its international research network on track and engage in research exchanges with relevant scholars, making use of these as well as their base organizations as external catalysts. Political scientists and other experts in associated fields could form such clusters as required.

Concerning the criterion of public relations in terms of access, use and understanding the following key mission is important: think tanks should start, as early as possible to collect and disseminate policy relevant to government officials and legislatures, in particular on issues and perspectives thereof that they are unable to involve directly due to diplomatic and bureaucratic constraints [Kobayashi 2003]. This idea parallels our notion of the think tank taking on the helping role as external catalyst [Solem 1982]. In addition to aiding the informational base of the decision-making process – no small matter in itself – think tanks could contribute to the development and promotion of a useful international debate on policy agendas (with possible consensus) on important trends and issues, such as biotechnology and governance.

In order to obtain sufficient independence as a policy research institution and to achieve sustainability, the think tank should be kept at arms-length from day-to-day politics. This is easier said than done, since there are many temptations and constraints. Until fully established as the somewhat idealized think tank which we have described, governments would often tend to ignore them. If the status of a fully-fledged genuine think tank is achieved, chances are that the tune from governmental throats would change. Now it becomes important for the think tank to speak with its own free voice. To fully realize this, the think tank should be independently well financed and able to maintain necessary research and support personnel.

Conclusions

Why are think tanks important in general, and which additional utility could they bring to trends and issues concerning biotechnology and governance? First, on the role of science vs. government operations and policy, some final observations are useful. Contrary to what some political or social theorists may claim, governments are normally not ahead of the people in terms of knowing what the public needs or wants. Nor should they be. At least this is so in democratic political systems. Should the opposite apply (as for totalitarian or heavily authoritarian states) governments would then hardly need the relatively large amount of scientific services in terms of advice, which they demonstratively require from the host of long term planning institutes and consultants existing and actively employed throughout the political system.

We have shown that a general theory about think tanks exists, although only in an embryonic state. However, the precise, meaningful definition in operational terms is yet
nowhere to be seen fully. Furthermore, establishing clear, conceptual boundaries so as to separate think tanks from similar types of organizations remains a tricky business. The present paper has attempted to provide a fuller, more precise definition of this type of an organization, and to say something about its role in the twin challenges of biotechnology and governance. We have briefly examined a set of general criteria for the assessment of think tanks and their results. By identifying which criteria exist and could be used we have proposed a tentative outline for how a think tank could be useful in the particular context of biotechnology.

Think tanks should be seen as very useful aids to decision-making. Their purpose was never to be a substitute for it. Think tanks must be close to, yet detached from day-to-day politics, in short they must be independent creatures. It would greatly help if they were independently financed. Think tanks possess a great variety of useful methods and techniques which could be used in this process. Technology Foresight and Assessment and other types of futures studies (prospective analysis) should be the central elements in their working agenda. Why were not used more frequently in the past is the subject of another study.

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