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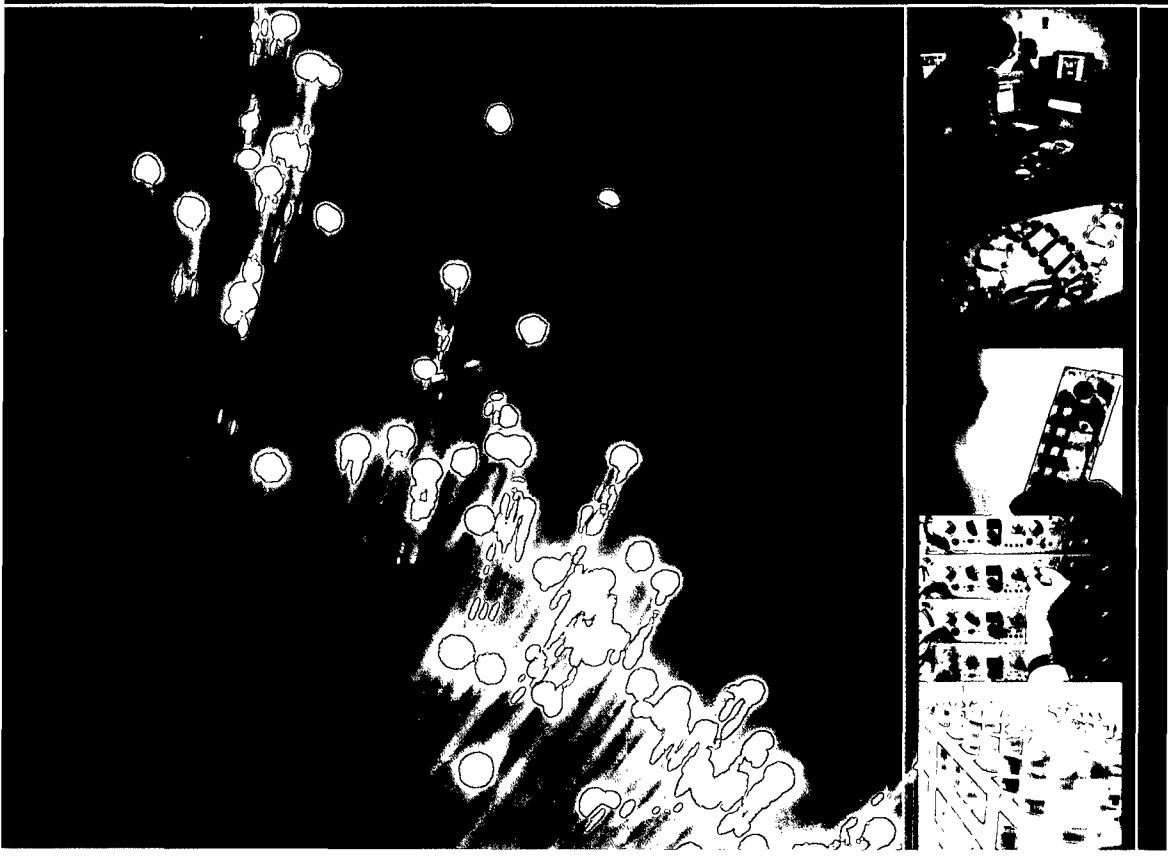
# EXPERT GROUP MEETING ON TECHNOLOGY FORESIGHT

## for Central and Eastern Europe and the Newly Independent States

Organized by UNIDO in cooperation with the Government of Hungary
Vienna, Austria, 18 and 19 June 2001

**REPORT**



UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION

**economy environment employment**

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Vienna, 2002

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# INTRODUCTION

This high-level expert group meeting was organized jointly by the United Nations Industrial Development Organization (UNIDO) and the Permanent Mission of Hungary to the United Nations (Vienna), following the Regional Conference on Technology Foresight for Central and Eastern Europe and the Newly Independent States, held in Vienna on 4 and 5 April 2001.

The main objective of the meeting was, on the basis of the conclusions and recommendations of the Regional Conference, to contribute to the formulation of a regional technology foresight initiative for Central and Eastern Europe (CEE) and the newly independent States (NIS).

The high-level expert group meeting worked on two issues: firstly, it identified highlights for the preparation of the regional programme; secondly, taking the biotechnological area as a case study, it defined an appropriate approach for regional technology foresight initiatives. The reason for the selection of the biotechnological area was the potential of the region for the creation of a new industry based on innovations emerging in the life sciences and the possible synergies with information and telecommunication technology, nano-technology and new materials. The pervasive character of biotechnology could contribute to the definition of region-wide technology foresight initiatives.

The one-and-a-half-day meeting was divided into three sessions. The first was devoted to the discussion of technology foresight for biotechnology sectors as a paradigm for strategic decision-making on policy and strategies to support knowledge-based industry. That session addressed selected clusters regarding the emerging biotechnology economy, such as biomedicine, agro-industry, environment and cross-cutting issues, including challenges and opportunities. The second session focused on special considerations to be taken into account when promoting technology foresight in the region. The two sessions were conducted as a round-table discussion with the aim of answering the following questions:

> Why are countries and regions using technology foresight methods better placed to establish competitive knowledge-based industry?
>
> What should be done in terms of policies and strategies to upgrade the innovation capabilities of industry?

The third session was devoted to drafting an outline for the planned regional programme using a methodology for programme preparation and addressed the

question as to how the region should develop its activities and initiatives on technology foresight.

The meeting was opened at 9 a.m. on 18 June 2001 by Ambassador Tibor Toth, Permanent Representative of Hungary to the United Nations (Vienna). His opening speech appears in the next section of the present report, followed by summaries of presentations and floor discussions. The conclusions and recommendations of the meeting are presented in the final section of the report. The agenda and list of participants of the meeting appear in annexes I and II, respectively.

# SESSION I

## Challenges and opportunities for a new industrial economy in strengthening the economies in transition: contribution of the biodigital economy to Central and Eastern Europe and the newly independent States

# Opening address

*Tibor Toth, Ambassador, Permanent Representative of Hungary to the United Nations (Vienna)*

I welcome you to this meeting on behalf of the Permanent Mission of Hungary to the United Nations (Vienna). This is an event jointly organized by UNIDO and the Permanent Mission of Hungary and I am really delighted to see present such an excellent array of experts and representatives of different communities, administrations, the scientific community and the business community. I would like to make some introductory points, but will try not to take away precious time from the substantial discussions, which we will be involved in afterwards.

First of all, I would like to call your attention to the fact that exactly 10 weeks ago we had a conference on technology foresight in this building, the first event addressing the launching of a technology foresight programme for the CEE/NIS region. This is the second meeting devoted to the same issue. The next event will be a training programme on technology foresight.

Probably there is no need to explain the topicality of the issue. The Regional Conference of 4 and 5 April on technology foresight identified the need for UNIDO to promote technology foresight programmes in the CEE/NIS region. That Conference identified possible avenues for action by UNIDO and the proceedings show the ideas that emerged.

The purpose of the present expert group meeting is to be more precise and identify practically, on the basis of three questions, a possible programme of action for UNIDO. The leaflet you have received makes clear what those three questions are: we would like to focus your attention on the question of *why* technology foresight is relevant for the countries of the region. The second question is *what* kind of niche might exist for UNIDO, that is, exactly what UNIDO could do in the area of promoting technology foresight programmes. The third question is *how* UNIDO could do so, with the cooperation of the countries of the region, which could take the form of implementation, support for the implementation or assisting in implementing the programme elements.

A layered approach will be taken to these issues. For the first morning, the area of biotechnology and life sciences has been identified as a point of reference, since that area is very much in the forefront of technology foresight programmes,

and could offer excellent opportunities for countries of this region. In taking this approach, the intention was not to try to examine in detail what biotechnology might offer for the years or decades to come, but to use this as a point of reference and, on the basis of a broad approach, to identify possible answers to the why, what and how questions. I realize that it will not be easy, because there is a natural inclination to go deeply into the scientific details of those issues, but I would like to request the participants to avoid doing so and to concentrate on the potential answers to these questions.

In the afternoon there will be a multisectoral and cross-cutting type of discussion, giving a wider perspective to technology foresight. From the point of view of different industrial branches, from the point of view of different sectors of the economic area, we will be able to articulate potential answers to the three questions of why, what and how. Again, my request to the experts is not to get lost in the myriads of potentially interesting issues, but to try to define a specific agenda. Keynote presentations will be followed by discussion sessions, to which all are encouraged to contribute. Please consider it as an interaction between all the participants: there are practically no observers here—everyone will have direct participant status.

I would like to request speakers to keep to the time limits prescribed, because it is extremely important to have a cross-fertilization of ideas and to return the feedback to the three basic questions. The cross-cutting approach will also apply to the lunch break, during which representatives from different constituencies will be brought together. Representatives of the administration and the academic, scientific and business communities will sit around the same table to encourage an exchange of ideas from the point of view of experts representing discrete areas who have an intimate knowledge of the expectations and the possible outcome from their particular point of view.

With these words of welcome and introduction, I would like, with your permission, to open session I. Challenges and opportunities for a new industrial economy in strengthening the economies in transition: contribution of the biodigital economy to Central and Eastern Europe and the newly independent States.

I would like to introduce Ferenc Kovats, who will be coordinator for the discussion in the course of session I. I would also like to cordially welcome Dan Liang, who is responsible, among many other issues in UNIDO, for issues related to technology foresight and biotechnology. I would like to start by giving Mr. Kovats an opportunity to make some introductory points and then we will continue our discussion in a clustered way, with some 10 to 15 minutes allocated to each speaker.

# Technology foresight initiative: Why, what and how?

## *Cluster 1. Technology foresight for the health industry*

*Ferenc Kovats*
*Chairman, Steering Committee, Hungarian Technology Foresight Programme, Hungary*

Firstly, I would like to present a figure, prepared by Policy Research in Engineering, Science and Technology, University of Manchester, on biotechnology in the United Kingdom of Great Britain and Northern Ireland: a scenario for success in 2005. This symbolizes a big problem for small and Eastern European countries, because in the middle of the figure is shown the relationship between biotechnology, agriculture and industry. For Western Europe and for the United States of America, certainly, biotechnology is a huge challenge in research and development (R&D) and for future industrial applications, primarily for the pharmaceutical industry and maybe more importantly for agriculture. For the CEE/NIS countries, agriculture is extremely important. Possibly countries will not be in the forefront in all areas of R&D. However, concerning the wide agricultural possibilities of this region, it would be difficult to find a better way to start with a future foresight exercise than the relationship between biotechnology and agriculture.

Concerning the relationship between biotechnology and pharmaceuticals, I will quote some items from the United Kingdom scenario where this issue is very important as regards the human aspect. Therapeutic proteins, gene therapy, medical devices, antibody-based and other diagnostics and pharmacogenetics constitute the top priority, bio-informatic technology the second priority and the regulatory aspects of biotechnology are also very important. This is important not only for the United Kingdom, but also for CEE/NIS countries.

Secondly, I would like to present the results of opinion research carried out by electronic mail (e-mail) with the expert group meeting participants over the last two weeks. For Cluster 1, technology foresight for the health industry, deoxyribonucleic acid (DNA)-based diagnostic tools (drug development, diagnosis and treatment of partially genetic and multi-genetic diseases) received eight votes. During the discussion comments should relate either to the competitiveness of a certain country or region or to quality of life. When a country is conducting

a foresight project, the first priority is usually the quality of life of the population. In Eastern Europe there are a number of small countries that are less developed and are in a transitional period. These should be borne in mind as important criteria for selecting specific areas of study.

## Discussion

As regards the position of the pharmaceutical industry in the CEE/NIS countries, as far as drug development is concerned, factors such as funding, the time necessary for development and penetration of the market probably make development impossible for these countries. Their future thus lies in cooperation with large companies that are able to provide funding for development and also have a market network. In this case what is very important is intellectual property rights, an area in which there is little capacity in these countries. Collaboration with large pharmaceutical companies would necessitate support in intellectual property rights; the CEE/NIS States have more experience in producing diagnostic tools.

It is important to emphasize that "biotechnology" is not only "bio". The word is truly a combination of two parts, that is, "bio" and "technology". What has just been addressed is medical technology in addition to diagnostic tools. The countries of Eastern Europe that are on the verge of entering the European Community are probably in a far better situation than the others in the region. However, even their R&D investment is around between 0.7 and 0.9 or 1.0 per cent of gross domestic product (GDP). This is very low and it will be very hard for CEE/NIS countries to break into the biotechnology market.

Drug development is more or less out of the reach of the CEE/NIS countries, but with knowledge of the whole structure of the human genome, the age of functional genomics, or finding the function of individual genes, is opening up. In that respect, research and applications can again be rather more individualized than for large structural projects. There is therefore room for small and medium-sized companies and smaller research teams to find new drug targets and help in the development of drugs, which is at present entirely the job of the large pharmaceutical companies.

Another important issue for the CEE/NIS countries is that practically all of them have general health insurance, free of charge for practically everybody. An entirely unresolved issue and one that should be answered in the future is who will pay for DNA diagnostics, genetic diagnostics, and how will they pay? This is a very wide field and the need for such testing is very doubtful in many cases, so in a foresight project it is essential to determine how it should be done.

In relation to new drugs and the pharmaceutical industry, two issues must be stressed: cooperation and patent protection. It is almost impossible to carry out drug development alone: only a very few companies can now do this. The only way for the smaller countries is to cooperate. The second issue related to the pharmaceutical industry is patent protection. There is no way for big companies to come to these countries if the latter do not have full patent protection: without it cooperation will not take place. Those two points are very important factors for the future.

The best and probably the only way to cooperate in biotechnology would be for the CEE/NIS countries to have a good patenting strategy. One of the outcomes of this meeting might be a recommendation to Governments emphasizing that it is necessary to have a common standpoint on this issue and that patenting strategy needs to be coordinated in the region. In fact, this is a problem for the whole of Europe, given the competition between the European Union and the United States, where it is much easier to obtain patents. It would be very important to appeal to Governments to take action on patents.

The protection of health is a matter of the highest importance for the CEE/NIS countries, some of whom are facing deterioration of the environment. It is a cross-cutting issue, because health would depend in some regions of these countries more on the environment than on various preventive medical measures. Perhaps we should consider discussing how to improve the environment, taking into account the possibility of overcoming pollution by using genetically modified organisms (GMOs) to clean the soil, water and air.

Another issue that could be raised is how far technology foresight programmes can be depicted as an element to attract high-technology industry to the CEE/NIS region and the support necessary from Governments, industry and individual firms. In that sense, for example, Vienna is an emerging showcase in terms of attracting high-technology industry to the city.

The ethical preparation of society for new inventions to come is a very interesting issue. The question here is whether the CEE/NIS region has a specificity or not, whether the whole cluster of legal regulations, that is, the overall safety network that underpins new developments, is strong enough to prevent misuse of those new developments. Is it a characteristic feature that in these countries it is necessary to pay more attention to prepare people for a new era to come?

The expert group should avoid generalization regarding roles of countries. That role should be discussed and created by the countries themselves. In Turkey, the situation is being examined with the focus on four levels of capability: scientific capability, innovative capability, manufacturing and service delivery capability

and finally commercial vision capability. It can happen that a country can be strong in certain areas, even in biotechnology in certain fields, maybe strong in three, but then needs cooperation for the fourth, or the country may decide on a joint discussion of the subject—this is a matter of choice. It is probably true to say that the CEE/NIS countries do not suffer from a lack of funds. It is possible that all the countries do have funds, but the problem is how to allocate them. In order to reach a conclusion that has an impact on creation of wealth and the quality of life, technology foresight would help tremendously.

Technology foresight is particularly important in this area. To introduce a new development without foresight it is not impossible, but really very difficult. Resources are limited and even if you have all the necessary resources, there are many different ways of doing the same thing. In the last case technology foresight is a very important tool—for Governments or for companies, or even for academia—to define what to do.

As regards ethical issues concerning the health industry and the environment, it seems that this subject probably will not seriously influence developments in the medical and health fields, because they are not so controversial for the general public. All the possible GMO developments have a more or less general acceptance and although there are serious ethical issues connected with this, they are not of such a divisive nature that society will present strong resistance. These are questions that will probably be resolved at a high level and accepted by society in general. It is expected that the region will not have to face particular problems in this field. It is usually believed that a society or nation is more sensitive to issues the higher the living standard is, so the stage of development of these countries makes it not too sensitive an issue. On the other hand, if living standards are too low, as in parts of the developing world, there may be a serious issue of misuse of technology. This will probably not be the case in our region.

The biotechnology industry is really a new industry, which creates an opportunity for the CEE countries to fit in and benefit from this. As regards cooperation with large pharmaceutical companies, it is clear that the latter will take whatever measures they can in terms of protection. We should not expect the large companies to come and try to help in this area. Basically, the CEE countries must create a structure like that in parts of the United States. Innovations are converted into intellectual property within the universities themselves and there is a structure that will communicate or mediate this intellectual property to industry. UNIDO can help in this area by making the CEE countries aware of how to create structures that convert scientific discoveries into intellectual properties and channel and mediate them and convert them into industry. The large companies are not innovative: they take whatever is created in academia, and this is where the strength of the CEE countries lies. The case is very

different in developing countries that do not have a scientific tradition. What is entirely lacking is an understanding of the value of intellectual property and of its structure, such as offices within public institutions, and also the structure to achieve the goals of the biotechnology industry by creating venture capital and actually teaching investors how to become capitalists. Then at that point the big pharmaceutical companies will step in and buy it. That is how the local scientific community and the local communities, which are like small countries here, become beneficiaries in the larger picture.

High technology in general, and biotechnology in particular, is a component of the culture of an individual country, meaning that it is like a ground, a new space, for individual development. It is necessary to think about the new people who enter this field. Where they will go? Where do they come from? Will they stay in the country if they join the arena of biotechnology? In most cases they will not and this is what countries should really think about. Whenever a new technology is decided on, whether biotechnology or any other high technology, it is necessary to consider the possibility that this high technology should keep the educated workforce within the country and how this will evolve, and this is where the country's actual responsibility comes in. Countries should create infrastructures that will actually help some of the players like the big pharmaceutical companies to enter the country, but they should also find a way to keep the educated workforce within the country.

It is very important to achieve broad consensus among the different stakeholders, which includes the important knowledge centres in industry, the Government, academia and other areas such as finance, non-governmental organizations and the educational system. UNIDO can play a significant role in supporting building such a broad consensus, which can motivate Governments and help them to accept the international legislation on standards.

It must be absolutely clear that there is a big difference between research and innovation. The term "research" means more or less that money is transformed into basic knowledge, whereas "innovation" refers to the transfer of knowledge into money. The large companies really know what innovation is and they are very innovative in that respect. However, to invent a product and then to transform it into a marketable one, the companies are not in the forefront and the research groups are very important in that respect. There is thus a difference between innovation and research and it is important to take that into account.

Concerning the structure of the discussion, which is centred on trying to formulate an answer to the questions why, what and how, we could address the following: why should medical biotechnology be involved in preventive medicine? To answer that question we must compare issues such as life expectancy,

mortality and morbidity in our countries with rates in Western countries. Some countries are even at a very dangerous phase as regards increasing mortality. One project could be to provide data and bases for reasons to support medical biotechniques. But how and what? Maybe the "what" question could be answered in biotechnology, first of all, genetic screening, not only for genetic diseases, but also for genetic infrastructures. Of course, this is only one issue, however, and other things have to be taken into consideration for prevention as well. And for the question "how", the answer should be "differently in the different countries, according to what there is the most important disease or danger".

## Summary of the discussion by the Chairman

Now is the time to digest the ideas brought up in the course of the discussion. First of all, reference was made to the specific features of this region. At the same time, the point was made that one should not overestimate the importance of such specificities. It is clear that priorities would have to be set on the basis of the different contributions. We need a "game plan" and an overall strategy to identify where to put the resources, which may be limited, or to make effective use of those resources. In that respect participants identified a number of methods. One reference was to smaller companies, smaller research teams, which could be quite competitive, even at a time when large pharmaceutical companies dominate the market, and such small teams could work together. There was also reference to investing in promotion at the university level in the transformation of innovations into intellectual property, and creating the necessary link between universities and the business community. An opportunity was identified for the CEE/NIS countries in biotechnology as an area where they could make very good use of investment. In general, an important point was made that, when one is dealing with some of the newly emerging industries, the difficulty countries normally face of being to a certain degree latecomers might not be as problematic. One question is the level of investment that would be needed to try to reduce the distance between them and countries that are in a more advanced position. Probably the newness of this high-technology industry might offer a good investment opportunity for countries, on condition we identify the best investment strategy, the right priorities and the right game plan. It is clear that there is a need for awareness-raising and creation of the necessary structures and mechanisms to identify priorities and to implement some of those priorities.

## *Cluster 2. Technology foresight for the agro-food industry*

*Pal Venetianer*
*Research Professor, Biological Research Centre, Hungary*

As an introduction, let me say a few words about my credentials in this area. First of all, I am a research scientist in the fields of genetic engineering and gene technology; secondly, I am a member of the Steering Committee of the Hungarian Technology Foresight Programme; and, thirdly, I am chairman of the Hungarian national committee responsible for evaluating GMOs.

In order to start off the discussion, I would like to act as devil's advocate about what the difficulties are in making reasonable foresight in this field. Technological foresight is normally based on objective evaluation of scientific, technological, demographic and economic trends and situations. If we took into account only those factors, it would be easy to conduct foresight in the field of the agro-food industry, but there are many more unpredictable factors that make foresight either difficult or impossible. Nobody, when GMOs were first invented and produced, could have guessed at the very violent opposition that arose among parts of the public, especially in Europe. Therefore one could not really say what would happen if one took into account that resistance, which for most experts is quite unreasonable, but it does exist and strongly influences the policy of practically all the European States and many States in the third world. So this is one of the difficulties.

The second difficulty concerns the CEE/NIS region, because even if the public in those countries is not strongly opposed to such innovations, we are more or less bound by the political decisions of our Governments, who want to join the European Union. We are bound to accept the opinion and policy of the Union, which is sometimes against our best interests or our best judgement. That is the second difficulty.

There are also many other complicating factors connected with this. For instance, here all of us are aware of the panic all over the world and especially in Europe about bovine spongiform encephalopathy (BSE). We all know that it has nothing to do with genetic engineering and GMOs, but in the public mind it is entirely connected. This again leads to a very controversial situation. The rational response to the BSE crisis is, and probably will be, a complete ban on

using bone meal as animal fodder. A ban on bone meal would naturally mean an increased need for soybean, which is not produced in Europe: it must be imported. The main producer of soybean is the United States, which is not willing to separate GMOs from non-GMOs. Therefore as their reaction to the BSE crisis, Europe will probably be forced to allow GMOs, which the public opposes.

These are some of the examples of the difficulties in making reasonable foresights. Another example is the dilemma of the developing countries. Most experts believe that the real importance of GMOs for agriculture lies in feeding the developing countries. Most experts in the developing countries are very eager to accept the technology. On the other hand, the development is connected so closely with the increasing power of multinational companies and globalization that there is very strong political resistance in those countries to such technological innovations. These are some of the difficulties making technology-related predictions very hard.

## Discussion

It is reasonable to address and elaborate on the problem of the public's concern on the effects of genetic engineering and the environment. A few points perhaps should be considered, because the concern really exists and the scientists should be ready to answer some of the questions that are raised by the public. Firstly, there are the environmental risks involved in the release of transgenic organisms—these environmental risks may be from either intentional or accidental releases. The intentional or deliberate releases are genetically modified (GM) crops, for instance GM bacteria for bioremediation. Then there are accidental releases, for example, the waste from factories using GM micro-organisms, from laboratories conducting research with GMOs. Of course there are intentional releases, that is, by terrorist groups or as acts of war. It has to be addressed and it must be explained that some of these questions are irrelevant. And then eventually to answer the public about the risks of intentional release: that is how the genes can flow, what could be the flow of genes among organisms or among various species of the organisms. Again it has to be explained whether this is realistic or not. Concerning accidental releases, there are several types of questions that are asked, especially by members of Greenpeace, who are not completely lay people. One has to be ready and prepared to discuss this not only with good arguments, but also especially with arguments that the public would understand.

Concerning the foresight part, this is quite a controversy. In a few years' time GMOs will be generally accepted and widely used. It should be the foundation

for the foresight or the projections already made here. There are many reasons for the foresight controversy, which are all scientific reasons. For example, genetic engineering technology is not any different from conventional breeding. If there is no fear of a hybrid of beet and oats, no one will be worried that they will get into the environment and actually there is no knowledge about what kind of genes have been mixed with each other. Genetic engineering is an entirely scientific and well-defined controlled introduction of new chains. It is also environmentally friendly. There are overwhelming scientific reasons to use GMOs and there is an obvious discrepancy between the perception of the public of the technology and the dangers associated with it. This will have to be resolved in some way. Basically, people make their points and disregard the opposition's arguments. What Greenpeace was actually doing was planting fear in the public for no good reason. What should be done is to educate the public as to why the technology is good. It is naive to believe that large companies could force people into slavery and buy round-up ready crops. In Brazil, where the growing of round-up ready soybean, for example, is not legally possible, the farmers import the seed illegally from Argentina and grow it. Why do they do it? Because it is good for them. This is the reason for saying that GMOs will be generally accepted, because at some point reason will prevail. People will realize, for example, that genetically engineered corn is a lot healthier for babies than the non-genetically engineered corn. For a food company to say that they are not going to use GMOs for baby food would deny babies access to a healthier source of diet. Plants, co-plants or non-co-plants will also be used as a non-food source. There will be entirely new uses for plants developed simply because to grow plants is cheap while to build factories is expensive. To make antibodies in factories you have to build a huge factory; if you make antibodies in plants, you only hoe them in the fields. You can cut out costly investment there. One can also think about entirely new uses. Some of them you find in the public domain and there are actually many more new ones that will come up through the creativity of the people. This is where there is an opportunity for countries that enter the biotechnology field relatively late. They can participate, especially because the biotechnology industry did not grow out of the big companies—it came from universities where the real innovation is. This is why Vienna could be successful, because it had a strong programme in one particular area. The weakness is that the conversion of scientific novelty into intellectual property is missing. Basically there is scientific novelty and it becomes intellectual property through the patenting process when it legally stakes out certain uses. This is actually where the strength of the United States system comes from, which is basically just a few years ahead of the rest of the world. The United States has institutionalized and created a process by which scientific innovation receives a patent. They produced the structure for the transfer or commercialization of that patent. The state agencies and the Federal Government also had the resources to create opportunities for conversion of new scientific information

into patents and start-up companies. For example, all Federal agencies have small business innovative research plants, which provide an opportunity for somebody coming from academia to prove that a concept is commercially viable, and at various state or Federal levels there are basically interest-free funds to match the arrangements that provide funds for a start-up company to prove the validity of such a concept. Of course, in the end, most of these small companies are bought up by large companies, which want to complement their portfolio of technologies. For many of these small companies, especially in the agricultural field, it is very complicated to make money. If you make a telephone you can still make money on it, but if you are trying to commercialize genetically engineered crops, somebody already owns the breeding rights and it can be a very complicated process. Somehow it has to be tied to the general process of working with multinationals and certainly several East European countries have a strong tradition of research. There has to be a way in the CEE/NIS countries to create a structure to convert scientific discoveries into intellectual property, which stakes out the uses. There is also a need to create venture funds and institutional organizations, which would help the formation of small companies. Most of these will not survive as independent entities but will become part of the larger industrial process.

It is quite clear that the issue of the agro-food cluster is a political and not a technological concern. This political issue was imported to the CEE/NIS countries from Western Europe, in particular the European Union, so it is necessary to analyse what the roots of this political issue are. The roots lie primarily in the wrong politics of companies in the United States that developed the modified varieties. The situation in Europe, in the United States and in developing countries is quite different. It is not possible to apply the strategy developed in the United States or in Canada to Europe. First of all, in Europe people care about the countryside. They care about the structure of rural society. In many countries, agriculture is part of the national identity, which is not true in the United States. Europe is not interested in increasing the effectiveness of agriculture and of manpower in agriculture, because Europe has enough food: Europe has unemployment, and therefore the increase of the effectiveness of manpower would increase unemployment. That means the strategy in Europe is quite different to the strategy in the United States. In Europe second-generation crops are needed, crops that will be friendly to the environment. As regards public psychology, it was again the mistake of the companies: they fought with their attention for their immediate customer and that was the farmer. They fought with all the explanations and so forth to the farmer and they neglected to consider that the final customer is the consumer, because the consumer must eat what the farmers are producing. If the consumer refuses to do so, the farmer will not grow those crops. This opened the field to the propaganda of the non-governmental organizations and the propaganda is also fuelled by the economic

interests of the European Union. The European Union was interested in reducing the import of overseas agricultural imports and the resistance of the non-governmental organizations was a very good non-tariff barrier, which cannot be attacked by the General Agreement on Tariffs and Trade and the World Trade Organization.

## Summary of the discussion by the Chairman

It is important in the summary of this discussion to recall the limitations of technology foresight. A significant point that was mentioned was how rapid the pace of development is in this area and how difficult it is to make projections within the time frame of technology foresight, which is practically 15 to 20 years ahead.

One issue underlying the discussion was the pace of scientific and technological developments and the pace of developments in other areas, such as rules and regulations. Of course, the rules and regulations are trying to catch up with whatever science and technology are doing. There is another dimension to this race between development in the technological area and corresponding regulations, that is, some new developments within the CEE/NIS region itself. Some countries will be joining EU, where stricter regulations exist.

There was an important point about images created, about how important it is to generate the right image, and, especially in the light of the experience, to pre-empt negative scenarios. GMOs were cited as a really negative public image precedent. What is important, however, is the question of pre-empting the need for creating the right image for some developments that might be inevitable. There is a need for education in the widest sense. An important element that appeared is the need to make a sustained effort in terms of education, which might not require a large investment of resources, but at the same time might require identification of the overall interest from the point of view of the country or from the point of view of the public, which will have to accept those new technologies. There is again a recurring phenomenon, because of rapid development and emerging new technologies. The strength of CEE/NIS countries in education and scientific research might find a niche. That niche will have to be supported and promoted by Governments, however, by creating the right structures and mechanisms for channelling knowledge from practical innovation to intellectual property and to further on along the pipeline.

## *Cluster 3. Technology foresight for environmental protection*

*Rodolfo Quintero-Ramirez*
*Coordinator, Petroleum Biotechnology Programme, Mexican Petroleum Institute*

Firstly, let me give some information about my background. I work in cleaner environmental biotechnology for an oil company in Mexico and I have been a professor of biotechnology for the last 25 years.

We recently carried out a foresight study on biotechnology in Mexico for the National Council of Science and Technology entitled "Modern biotechnology for the development of Mexico in the twenty-first century". Twenty Mexican experts took part over a period of eight months. At the outset, the objective was to select priority areas, where in Mexico to do the research—paid for by the Government—and how to promote the biotechnology industry in the country. The final goal was to establish a national biotechnology policy.

Modern biotechnology started as an academic field in 1973 and the first commercial product in the health area appeared in 1981, human insulin. The first transgenic product emerged in 1994, in the United States. In 2000, the human genome project was finished. This means that the applications of biotechnology now affect many fields. This provides a rough framework of the timing of what is happening in this field.

The concerns about the risks and benefits of transgenic crops in the agricultural sector of biotechnology will end when people understand that they offer more benefits than risks.

In some ways biotechnology is very old: it has been used to clean up water for many years. With regard to environmental biotechnology, as we call it today, however, it really started only in the last 10 years or so. Most of it has been used in water waste management systems and more recently as a remediation for contaminated soils. A new area in environmental biotechnology is related to oil management in particular. In Alaska, the *Exxon-Valdez* disaster in 1989 started this entire field. There are two important points. Firstly, no countries or companies control the technology. That is a big difference with the health or agricultural sector. In the environmental area there is no big company like Monsanto,

Merck or Du Pont, and that is an important issue. Secondly, in many cases environmental problems cannot be solved in a general way. Local aspects need to be considered, which in itself creates opportunities.

A new area of environmental biotechnology known as "clean technology" aims at reducing the pollution produced by manufacture. We believe that biotechnology can provide tools to achieve clean technology, for all products, so that they consume less energy, produce less pollution, that is, are environmentally friendly in general. It is believed that biological methods for production can be applied to clean up, for instance, sulphur produced from oil by using bacteria. This is something new. No one is using this commercially as yet, but there is a possibility of doing it instead of using chemical processes. These are the options for environmental biotechnology.

For us, in Mexico, being so close to the United States, we know that the technical part—science, innovation—of biotechnology is, of course, important. The social and political aspects are also very important, however. For instance, Mexico has the legal framework in biotechnology for patents, for planting plants or for the use of bacteria in the fields. The other aspect concerns the public perception of biotechnology: it has already been mentioned that television programmes, newspaper articles, radio talks and so on are needed as people are sometimes afraid of it.

With regard to industrial biotechnology, for many years it was thought in Mexico that the country would do as the United States had done. Twenty years later we know that this will not be the case. The United States economy or venture capital is very American. It is almost impossible to replicate it in a country like Mexico and cooperation is therefore important. For instance, one pharmaceutical company in Mexico produces recombinant proteins, using technology from the CEE/NIS countries, which is a sort of cooperation. In the case of Mexican environmental biotechnology, our technology has been exported for some particular products.

The environment is a field that is going to become stronger in the future. Climate change and all the international guidelines will make us ever more aware of the environment. In that sense, biotechnology can play a role, especially for companies that want to be internationally known.

## Discussion

Concerning regulation of environmental biotechnology the CEE/NIS region and actually in an even wider sense concerning GMOs, because they are also related to food production it is interesting to mention that in January 2000 the

final version of the Cartagena Protocol on Biosafety was adopted. It is now in the process of ratification by countries that are party to the Convention on Biodiversity, and Hungary, Slovakia and others are already progressing in this field. It is actually one tool that could help achieve some uniformity in this region as regards the preparation of legislative issues in various countries. The last European Union directive is not completely harmonized with the protocol: unfortunately, there is a paragraph in the directive saying that it will perhaps not be harmonized until June or July 2002. The position of countries like Slovakia and others, which are candidates for European Union membership, is to harmonize their legislature with the European Union legislation in this field as well. It is therefore difficult to proceed because if something is adopted that is not completely finished, then it is difficult for small countries to draft their own legislation. The Protocol on Biosafety is a good tool for harmonizing all societies in the world, because it gives the possibility of adopting some strict conditions that will encourage progress in this field, and allow for cooperation with society and even with people who are sometimes against this topic. It would be very important to use GMOs in the regeneration of the environment. As it is such an important task, also in connection with the protection of health, biosafety should be given very high priority in this region as well. Unfortunately, the Cartagena Protocol on Biosafety is not really aimed at the pharmaceutical industry—it is outside of it. Again, it will be difficult to know how to proceed because GMOs are relevant in both areas, but perhaps two different international procedures should be adopted for working with GMOs: one for industrially produced food and environmental protection and the other for the pharmaceutical industry.

The so-called "clean technology" is particularly important in Europe since it is an essential part of the agricultural strategy. There are a lot of possibilities of using agriculture for this clean technology. One classic example used in some countries of the region even before the Second World War is the production of ethanol to be added to fuel for cars. This is very environmentally friendly. Now biotechnology provides new possibilities: a biodegradable lubricant, biodegradable oil and also biodegradable plastics. To introduce this technology in practice is difficult, however, because of the opposition of the petrochemical industry. The latter is strictly against this, for obvious reasons, and it also requires the support of the Government in the form of lower taxes for the biodegradable material and so on. This could cover a large portion of agriculture, without producing more food—which is not really necessary in Europe—and clean technology should therefore be supported at all levels, starting from UNIDO and going on to Governments and individual companies.

Three clusters were identified for discussion at this meeting. Which of these three will bring the most reward for those countries with a forecast? If there is a comparison with the forecast of the Battelle Institute in 2000 and if product

technologies and challenges are assigned priorities, this is the right way towards a human genome mapping, but it is less the way towards what is being addressed at this meeting concerning the environment. However, the environment issue really involves technology to be applied locally and each country has an opportunity to resolve these problems, though bioremediation would not have been a problem if care had been taken previously. That is another point. However, agreement could be reached here about what one can still make money out of or can these regions only make money if the Government supports these environmental issues? Who is paying for that?

It was pointed out how far some of the clusters under discussion are interrelated. For example, the health cluster and the environmental cluster, how much the interrelationship exists between health, environment and the state of affairs in the public health of the population. For very practical reasons an attempt was made to cluster the discussions, but in terms of the challenges involved it might be misleading just to think in terms of clearly separate boxes. To a certain degree the agricultural area could be very closely linked to the other two. A more holistic approach is needed in these areas and here again the reference to both UNIDO and Governments as different layers of future action is the right one, because at such a level the holistic approach is more feasible. As was rightly pointed out in the context of the environment, it is necessary to be aware about what the interest of firms would be, which is a more profit-oriented interest, and what would be the interest of the Government. We must look beyond profits and take into account the state of the environment and its impact on public health and as a consequence there might be additional investment efforts promoted by Governments.

GMOs are not any different from any other crop and gene flow has been going on from sugar beet into wild beets for hundreds of years. If scientists wanted to study this gene flow there would be very little interest. What would be the point of such a study? and now, surprisingly, GMOs have created an interest in this problem, which has already been there for many years. The outcome of these studies is that basically there is no danger of weeds becoming serious pests just because there is a gene flow from crops into the wild species. Obviously, however, this form of addressing the real problem of genes from farm crops into cultivated species has to be taken into account.

Thinking about the country or the region, one important point about environmental technology in general is that it is driven by law and depends on how a country sets up rules or standards. Business related to the environment depends on what the law says. For instance, "clean" water in a particular country would mean something else in another country. If the region—this could be part of UNIDO's work for the future—is going to set up one standard or if that is

going to be done country by country, it will have an impact on the results and the possibilities for the environmental industry.

**Summary of the discussion by the Chairman**

At the conclusion of the discussion about environmental protection there are a number of main points to flag. First of all, attention was called to the fact that the environmental aspects of biotechnology are a new field even in the biotechnology area. Some of the earlier points, which were made in the context of other aspects, are even more valid, namely, that this is a niche opportunity for countries that would like to join in the biotechnology "race". There was reference to some of the international regulations, including the Cartagena Protocol, and to the possibilities of promoting and assisting the harmonization that will have to take place both at the national level and at the international level in the European context. Of course, here again the sharing of best practices in terms of harmonization with international standards might be an interesting goal: reference was made to ongoing regional efforts that would provide an opportunity, for example, in annual conferences, to foster better understanding of the importance of technology for science. There is no need to create new frameworks and new mechanisms in all cases, but rather to use and rely on existing ones to promote technology for science issues.

The importance of laws and regulations was also mentioned. This area is rapidly changing, since regulations and laws are trying to deal with a situation that is developing continuously. Reference was also made to sharing experience on best practices in terms of how to apply regulations and laws and to determining what kind of standards already exist. Of course, in the area of environmental protection, countries will have to take into account the lessons of the past. Their environment became a victim or hostage of development in some areas. In the context of certain agricultural and other applications, these lessons will have to be kept in mind.

Governments need to pay more attention to the wider public and to create incentives that serve the interests of this area, not just promoting the profitability of small or medium-sized industries in activities related to environmental protection.

## *Cluster 4. Cross-cutting issues*

*Ferenc Kovats*
*Chairman, Steering Committee, Hungarian Technology Foresight Programme*

The last cluster is a so-called cross-cutting issue, as are in fact nearly all the issues. The forerunner was the patenting of intellectual property rights, which has been mentioned several times. To mention just one point: the major pharmaceutical companies have a considerable advantage over all others during preclinical and clinical tests. The biggest problem seems to be how to regulate access by the scientific community and humankind to information generated in the laboratories of those pharmaceutical companies.

The second aspect was the convergence between the life sciences and information and communication technology. Telling the future is always difficult, but with the convergence of those two disciplines, information and communication technology and biotechnology, the whole future will be revolutionized. The only problem is that we do not know how. That is why different countries carry out foresight exercises. This consists not of speculating on the future, but creating scenarios and starting to make decisions for the country and the major companies.

Probably none of us have sacrificed or dedicated ourselves enough to bioinformatics and information-processing or knowledge-management tools. For small countries, these can be a niche, a means to be at the forefront of the R&D global future. There is no guarantee that large profits will ensue, but a good position as regards informatics and information-processing and management tools can help us keep our place or even improve it.

Regulatory infrastructure and globalization have been discussed. I only wish to mention that there are both good and bad sides to globalization. It has a phase in which the poorer the country, the bigger was the danger of losses. Extremist parties can use the dangers of globalization and this can be a disaster for a country in the long run.

The last remark concerns the agricultural cluster. If the NIS countries, first of all the Russian Federation and Ukraine, do not follow the American way in the agricultural sector, they will lose 10 to 20 years, because their agriculture is extensive. They are potential competitors in grains, soya and other crops. For

the small countries this is not so important. The reluctance or conservative attitude of Western Europe is valid, even for Eastern and Central Europe, but not for the extensive arid lands in the Russian Federation and Ukraine. They need a different approach from Hungary, for instance. If you sit on a tractor in Hungary and you drive ahead, immediately you come to a border. There are no big fertile lands—the land is fertile, but it is very small. What can be done in Eastern Europe in order not to lose this competition to the United States? I have the feeling that in Central Europe we must not be as conservative as they are in the western parts of the continent.

Finally, I would kindly ask you if you could prepare for tomorrow inputs on what we could do. It would perhaps be the most important contribution of our two days here.

**Address by the Director-General of the United Nations Industrial Development Organization**

I would like to express my gratitude to Ambassador Toth and the Permanent Mission of Hungary to the United Nations (Vienna) for all the dedication you have shown in handling our initiative on technology foresight for the region. I would also like to express my gratitude to my colleague Dan Liang for her good handling of the topic of technology foresight. I am not planning to give a speech, but merely to express my gratitude to all of you. I will commit myself to being here this afternoon, to listen to the summary of the discussions and the comments of your deliberations today.

May I add that we attach great importance to your deliberations here concerning our regional initiative for Central and Eastern Europe. We would like this initiative on technology and foresight to be very concrete and precise. We know that this is a very important exercise and analysis. We are developing a similar approach for Latin America, but in this particular case we are pressed for time. We would like to draft a very concrete set of priority services to be supplied by UNIDO as part of our support for Central and Eastern European countries in their bid for the development of this sort of exercise.

Thank you all. I shall be pleased to attend this afternoon's session and to hear the conclusions of session II, on industrial innovation and competitiveness. I will discuss with my colleagues the summary of those discussions and the summary of the discussions you have in the morning.

# SESSION II

## Industrial innovation and competitiveness: highlights for technology foresight initiatives for Central and Eastern Europe and the newly independent States (What type of foresight?)

## Report on the working lunch discussions by the Chairman

A number of issues were raised by the high-level representatives of administrations with whom I worked at lunchtime. There was an interesting discussion about the link to be created between the universities, as the natural place for research, and the business community. There was confirmation that in quite a number of countries there is no "disconnection" between the universities and the business community. It was mentioned in the discussion, however, that sometimes there was a problem with the universities as regards technology foresight programmes, because some of the universities did not want to see a change in the present allocation of resources. A number of Governments in the region were trying to raise awareness in the universities as regards the technology foresight programme requirements. There were also efforts to create research centres, some of which might rely on the intellectual and research capacity of the universities, and to involve expertise available at the universities in launching small-scale enterprises.

There was an interesting discussion about where to place the technological foresight initiative nationally, with agreement that there were many possible solutions. It is very difficult to identify a few characteristics, but the main question was whether specialized institutions should be dealing with it, as R&D centres, or whether there should be a user framework created for the specific needs of the technology foresight programmes.

On the one hand there was a need to build awareness from the bottom upwards, but simultaneously on the other hand it was important to expose political decision makers to the need to undertake and to promote technology foresight programmes. Sometimes in the course of the allocation of resources, in the annual ritual of budgeting, the priorities of technology foresight were being diluted or even totally lost. There were strong lobbying forces in the budgeting process that could better defend their budget interests and quite frequently technology and science-related allocations were becoming the hostage of that situation.

The other element that was mentioned was a certain distortion. If there were no holistic programme on technology foresight, distortions might occur where again it was a question of personal or lobbyist influence, what the final mix of the priorities between areas would be, where the money would be spent and

priority given. It was stressed how important the availability of resources from Governments was, not just for technology foresight, but also for innovations in a wider sense. It was realized that the resources available might not be sufficient in the light of R&D investment expectations and requirements. Some of the resources available from Governments might be meagre compared with what industry could invest and was normally investing at the level of multinational corporations. Based on that, the idea was put forward of trying to build a strategic partnership between companies carrying out their activities in the same areas, companies of neighbouring countries or of subregions.

In a discussion of the brain drain, an excellent best practice was cited. It was mentioned that, in Slovenia, the brain drain was causing problems in that the Government was attracting the outstanding people. The reason was that the salaries paid by the Government were higher than those in industry.

Another interesting issue raised was why technology foresight was focusing in a holistic way on sectors that would be a driving force within 15 to 20 years. It was a specific feature of the CEE/NIS countries that the more traditional industries were playing a very important role in terms of providing jobs for a large portion of the population. The point was made that technology foresight could not be created in a vacuum for some of those countries, neglecting and ignoring totally that sort of situation. There should be a sort of parallel exit strategy identified for those industries. Government incentives should be provided to try to move in that direction those industrial sectors which were considered as not being in the forefront of technology foresight strategies or programmes.

### Discussion

The history of the establishment of the International Centre for Medical Biotechnology in Moscow is that it was started late in August 2000, when government officials approached UNIDO with a request for help in the commercialization of research results in the area. One of the state research centres—a huge centre in a most precarious position—was selected for this, the centre dealing with medical biotechnology. UNIDO proposed the concept of an international centre to mediate between research and industry and to promote international cooperation. UNIDO signed an agreement in November 2000 and the first partnership meeting with top-level officials from Governments and the private sector, from Brazil, China, India and the Russian Federation took place in Moscow in December 2000. A pharmaceutical company from Brazil, BIOBRAS, participated in the event. So far programmes on technology transfer partnership and agreements between India and the Russian Federation, China and the Russian Federation and between China and India have already been initiated. A mission from UNIDO is going soon to Brazil to promote the process. There

are already investments in technology transfer of some $8 million to $10 million, for example, in new medicine biotechnology products in India and a number of investment groups in China that have decided to join the project and invest in the joint ventures to be established in China. Investment levels are encouraging. UNIDO is now establishing focal points in different countries. One will probably also be set up in Europe in the near future to liaise with the business community. It will assist in a very interactive way, using information and communication technology, to bridge the gap between research and industry and to connect different small groups with a mobile production and research network.

The next step after a technology foresight activity in Austria is the creation of centres of competence, involving the implementation of R&D activities and of cooperation. This programme, known as K-Plus (competence plus), started in Austria about two years ago and it is perceived as a platform of cooperation between industry and the universities. The Government funds it in part and the procedure is that every year or every second year—not at regular intervals—a call for proposals is issued and then groups from all over Austria apply for funding for a research centre, which is a cooperation between university and industry for a certain subject and which runs up to seven years and then is finished. After seven years it has to close down or finance itself. One example was in telecommunications research, where all the major players in such research from the industry side—Siemens, Nokia, local Austrian companies and Alcatel—all the competitors agreed to cooperate with a specific university institute. They developed a common working programme and the Government paid 50 per cent of the budget. The individual actors had to put their own money into the enterprise and the results were shared later on. An important feature of the whole process is that it is not fully financed: participants have to put their own money in. This mechanism makes sure that they care about the results, because the people cooperating in the centre are not the directors of the companies but are their research people. They have to justify their expenditure and get an extension the next year only if something meaningful comes out. There is thus always control over the quality of the whole enterprise. The conclusion is that if you give something to people at no cost to them, it is not as effective as if you make them pay for at least part of it. The procedure is the following: each year there is a call for proposals, 5 centres of competence are finally funded and in the next few years Austria will have about 20 or 30 centres in various fields. It is a complete bottom-up approach, the subjects are not imposed from somewhere else, it is left to the market in which field companies and universities want and feel strong enough to cooperate and share experience. This is market-driven and it is very reasonable not to impose something from the outside but to let the country or region decide on its own. This might also be a possible solution later on for UNIDO activities.

## Summary of the discussion by the Chairman

Basically, more questions have risen than we could answer. One of the topics was knowledge and information technology in connection with patents, which was addressed briefly because of shortage of time. One point is that universities have the knowledge base, they have the patents and can join in cooperation with small and medium-sized industries. They should also participate in start-up companies. Apparently this is an American method that is rather successful. It raises the question of venture capital to promote the creation of start-ups. With respect to centres of competence, the question is how it was possible for Austria to have gained a "foot in the door" of the biotechnology area in Vienna. Basically there are two approaches. One is the personal approach between a university researcher who, at the same time, might have a firm or the family or partners might have a small or medium-sized company, and it takes 25 years for an industry to grow. As an example, one of the most successful industries in biotechnology in Austria is a company that produces a popular implant and now is a world market leader in that technology. They took 25 years of sponsoring from both the industrial side and the university side. That period is probably too long for our forecast and therefore we have to find a different way. One of the approaches now being tested in Austria that is rather in advance of the centres of competence is a programme by the Austrian Ministry for Innovation and Technology whereby universities and small and medium enterprises make proposals for the development of a product, which should be applicable. Basically the first approach is for older people, that is, a project that is socially accepted. One receives the money, but only if a company and a university are involved and the funding procedures are in accordance with European Union regulations. Perhaps that could stimulate small and medium enterprises to join in if a university comes up with a good idea. Finally, the movement of people is addressed because the knowledge base would not be removed from the Eastern European countries just by "buying" people who have the expertise and then they just freely move to another location. The movement of people or the movement of knowledge should also be addressed so that our countries do not lose this kind of knowledge base.

# Experiences and perspectives of selected technology foresight in the region

*Karel Klusacek*
*Director, Technology Centre, Academy of Sciences of the Czech Republic, Prague*

The Government of the Czech Republic instituted a foresight technology project through the Ministry of Education. The Ministry organized a public tender, as a result of which a consortium consisting of a technology centre and the Engineering Academy of the Czech Republic managed the project. In January 2000 the Government approved the national R&D policy. This is the background to the project. As usual, we have to add some provisos, as the project does not aim to produce decisions, but detailed and credible data on which to base decision-making. We had about one year to complete the project.

The project has several objectives, but there are two main ones. The first is to propose a set of national priorities for applied research and the second is to propose a system for management of the national programme of applied research and rules for programme implementation. That means rules on how all programmes should be transferred into the new programme, which is supposed to start in 2003.

Our first task was to choose panels for each sector. We have 13 application sector panels, some of which are technically oriented or natural-science-oriented. There is also a panel related to social grants and three infrastructural or cross-cutting panels: human resources, extension of rural development and integrated R&D. The last systemic panel should produce a proposal for management and implementation of the programme. Panels are not equal to priorities, but they should propose them.

Work started in December 2000. The management group was appointed and seminars and other awareness activities were organized. A database of about 800 national experts was created for different areas. Several interviews have been carried out in the industrial and applications sectors. Some 250 interviews will be conducted with industry, hospitals and different organizations. They will be asked what they expect from applied research, what their needs are and what sector they work in. We will also determine overall needs for the sectors, not just for the individual company. Of course some risk research will be performed and

external experts will be asked to perform "swab" analyses. Then the panels start to work: this is the point we are at now.

The main task of a panel is to identify key technologies for components of our national programme of applied research. The panel also should design programme management and implementation, as already mentioned. In September 2001, after the holidays, preliminary results should be available and public seminars will be organized. The preliminary results will be discussed with experts and everything should be completed and the final report delivered to the Ministry of Education by the end of November 2001.

The thematic programmes, the so-called priorities of applied R&D, are defined by national R&D policy, but these thematic programmes are rather like empty boxes, because the components have to be suggested. The panels will suggest significant technologies, after scrutinization panels. It is assumed that each panel will generate some 50 significant technologies. Of course, if there are 13 panels producing significant technologies, that will make a total of more than 600 significant technologies and a selection will have to be made of key technologies. This will be done by a scoring procedure in the panels and also by feasibility analysis. From the key technologies selected the components of our national programme of applied research will be formulated.

The scoring procedure is obviously very important and there is also a prioritization procedure aimed at selecting key technologies from signatory company technologies. We are using a modified version of an approach used in Australia and the United Kingdom, performed in panels and based on two criteria, importance versus feasibility. When we discussed the selection procedure with Denis Loveridge, he made just one recommendation: keep it simple. Finally we have 35 selection criteria in five categories. This is because politicians became involved and they were already watching closely what criteria would be used. There is no hope of reducing the number. The 35 selection criteria involve the economic sphere, environment and sustainable development, the feasibility of applications and the production strength of our R&D. Because there are 13 panels, with 50 important technologies each, and 35 selection criteria, one can talk about thousands of basic data that will be generated by the panels during the selection procedures.

For each panel there will be an "open window" on the Internet for two weeks and panel members will be able to vote on individual important technologies for a period of two weeks. After that the selection procedure will be closed and the panel voting procedure will be summarized and evaluated.

After the results are submitted to the Ministry of Education in November, we will have about three months to prepare the proposal for the Government,

which it is hoped will approve the national programme of applied research in April 2002.

*Gyõzõ Petrányi*
*Director and Scientific Advisor, Research Coordinating and Information Centre, Semmelweis University, Budapest*

I would like to share with you how one foresight programme was established in Hungary. The programme was prepared by more than 30 people in two and a half years and after many exercises and discussions was submitted to the Government. The main structure of the study is the first part, which analyses what could be the forecast or vision and then comes the selection of the best vision and some recommendations.

Based on this historical background our starting-point was to study demographics, to see if the country's population was growing or shrinking. If the latter were true, it would be necessary to focus on two very dangerous possibilities: either the birth rate is falling or the mortality and morbidity rate is rising. There was a quite good natural increase in the Hungarian population in the 1940s, 1950s, 1960s, and 1970s, but this changed in the 1980s, which was very dangerous for the population.

Our programme is very much interested in the fertility rate and how to increase the birth rate, but, I would like to focus on the mortality rate, because our expectation was that by decreasing mortality we could help the community more than by increasing the birth rate. The first thing was to analyse which are the most dangerous diseases. The conclusion is that in almost 30 years you could have a significant decrease in mortality and an improvement in health care.

For Hungary, malignant diseases were the main reason for the high rate of mortality. Of course, in other countries cardiovascular diseases might be the main factor. Many data are available on Europe and the rest of the world on the World Health Organization's home page. Every country can analyse each different health criterion as the parameters of health care. This is the basis for health expenditure, which is of the highest importance and is reflected in the general population's health and in the effectiveness of health care.

It is also possible to calculate for any given country how many physicians and nurses are available. As regards nurses, for example, Hungary is in a poor position, which means that one has to deal not only with the finances of health care but also with the number of people available to work in that area.

Another topic of our research was to determine what factors were responsible for the level of health of the population. Lifestyle is clearly the most important factor for having a healthy population. Genetic factors and environmental effects are also important. Our conclusion was that we have to deal with a broad framework of issues: if you look at what factors are influencing health, you see that social and community networks, individual lifestyles, employment and many other factors have to be taken into consideration.

Therefore, in our programme we have focused on, first of all, economic considerations. What is the input of the Government, financial factors, GDP per person—this is also a very important factor, and in Hungary it is very low, almost 5.3 per cent, in comparison with other countries, which have about 8 per cent. Social polarization strongly influences the health of the population. Education is very important at the social and scientific levels and, of course, among the most important variables are risk factors such as smoking, alcohol, drugs and so on.

The initiative to create a scenario for health care and quality of life aims, first of all, to establish a long-term programme that could help in lowering the mortality rate. It has to be a broad and new public health system for all the country and it needs support from the highest levels of government, giving absolute priority to health and quality of life. Mass communication is important as well, because without that it is impossible for society to move forward.

The last recommendation is that everything done in the country, economically or culturally, has to keep in mind health priorities, multisectorally, and knowledge about the health of the population has to be improved. This means teaching small children, families and the mass media, and of course what we are interested in is major support for R&D in the life sciences. That is how biotechnology can help us.

We have already demonstrated the consequences in the Parliament, in the mass media and in the universities. One positive result was an immediate demand for lower mortality rates. For example, in the research programme the first project was on life sciences and the quality of life, and another dealt with the protection of life and biotechnology. This has had a very positive influence on recent governmental policies.

## Discussion

The CEE/NIS countries should start to conduct pilot studies and to find out what it is necessary to do. It is important to examine the innovation systems in each country, especially as regards new biotechnologies and other new technologies. What is their status, how do the different players interact, what is lacking

and what is going on in the political system? This is something UNIDO could really help with, making a methodology to assist those countries in doing this.

It would be good to change the name of the programme from "technology foresight" study to "national foresight" study. It is also important to assign no role to the Government in conducting the study. If it is going to be on a nationwide scale, it should be done by a non-governmental organization appointed by private industry. UNIDO's role would actually be to help obtain funds to finance Master's and Ph.D. projects in CEE countries.

In Slovakia the transformation of the science and technology sector started nearly two years ago. Up to that time, practically all the old rules were followed, which were very much influenced by the socialist period. So two years ago an analysis was begun of the state of science and technology and development in this field, and the results of the analysis were very interesting. On the basis of these results a new technology policy started to be built. First a science and technology information system was created. Evaluation was conducted of research institutions and of the infrastructure for science and technology and priorities were defined for R&D.

The very important issue in national technology foresight programmes is who will be the end-user of the results of the exercise. Results should certainly be aimed at the Government, even if the Government does not support the exercise at all. For example, in the case of the Russian Federation, a special evaluation of critical technologies was carried out. Five years ago a list of 70 such technologies was drawn up and after expert evaluation it was found that many critical technologies were important but underdeveloped in the Russian Federation, or they were very well developed but not important. The first user of this technological foresight exercise would be the Government, at least in the case of the Russian Federation. The second user would be small and medium enterprises. The multinational corporations have their own capacity to organize their own investigations as to what will be going on in a given area of technology in the future. In the case of small and medium enterprises, a technology foresight exercise would be very useful. UNIDO might be helpful in the dissemination of foresight in Europe and all over the world in this area, and also considerable success might be achieved with meetings like this or training courses for individual countries, also with some feasibility studies or private surveys included in the national systems. The facilities offered by UNIDO are very important for this exercise.

## Summary of the discussion by the Chairman

The main points in this section were: *(a)* reference was made to the need to prepare technology foresight studies and to different approaches, such as pilot projects, as a possible method, or a narrower approach, that is, a sectoral view.

Sharing expertise might be important, because that might assist countries in seeing more clearly exactly what was being done and what tasks they are facing; *(b)* reference was made to the right balance in the roles that private industry, non-governmental organizations and the Government should play. There was a wide scale of expectations, ranging from no participation by the Government to a very significant role for the Government, depending of course on the specificities of the situation in each country; *(c)* there were suggestions that it would be good to assist countries who are about to undertake technology foresight projects, to provide methodological tools for them, for example. It is clear that the whole process is about that express requirement, that is, to offer methodological and other assistance tools to countries facing technology foresight problems; and *(d)* there were some other useful ideas, like funding and financing Master's and Ph.D. projects.

# Capacity-building considerations

*Denis Loveridge*
*Policy Research in Engineering, Science and Technology, University of Manchester, United Kingdom of Great Britain and Northern Ireland*

I have been involved in foresight activity since the 1960s. I have seen it go through several cycles, and its growth again from the early 1990s past the end of the millennium really came as no great surprise. It is a phenomenon that comes and goes. At the moment it is probably about as strong as it will get.

I would classify myself as far as foresight goes with two or three people present here who have already had a lot to do with foresight programmes, some of which have been influenced by the course that we run. This is not intended to be a sales pitch for the course: it is simply that I must draw upon it to try and use it for what UNIDO might be involved in. As regards that particular course, it always seems to me that, having gone through it, people do go away and do the most amazing things afterwards, some of which we recommended and some of which we did not.

In the same way—to give you just a few examples of the value of foresight where it is not often recognized—it is probably now 30 years or thereabouts since people first began to speculate about the possibility of the bench-top chemical production plant. That is now becoming a practicality. In 50 years' time, maybe less, we may find that many of the conventional chemical plants for producing drugs, for producing many fine chemicals, are just no longer there. The effects will be immense on capital, on employment and many other features. Equally, I believe very few people would have expected the almost devastating effect that the advent of combinatorial chemistry had on the employment opportunities for organic synthetic chemists. This does not mean to say that they are extinct, but there are certainly not as many of them as there used to be.

Those are just a few examples. In the English language the word "foresight" has a very simple meaning, it just means "looking forward", "anticipation". In the foresight world it has become much more complicated. In fact, I would say that what has happened has been, not a mutation, but a transmutation, from the simple act of looking forward to one which is that of trying to understand the future, which is really the realm of scenario planning. I think people forget that. They do so at their peril, because anybody who has been involved in scenario

planning of the kind practised by many large companies—for example, Shell International—will know that it is a very exhaustive task. I say that simply because I want to warn people against the possibility of sliding into what is a very different kind of activity to the one that started in Japan in 1971, which was called technology foresight and was built upon the many methods of control that were developed from the 1950s onwards in a community that was known for its technology forecasters, who later mutated themselves into social forecasters, where they were much less successful.

Nevertheless, I wanted to raise that possibility because there has been a change in the outlook for foresight over the last 10 years. It has come about through what has happened in countries like the Netherlands and now in the United Kingdom and some other countries as well, where elements have crept in that have much more to do with social research and the social aspects of science and technology. That is a major shift, and I believe if you do not appreciate it within UNIDO, you will find that you are effectively running behind what is happening in the world of foresight and of course you will be open to all kinds of criticism. People who think only about technology do not always appreciate the kind of society into which technology is going, however, and whether that society actually wants technology, even if it understands it and, even more so, when it does not understand it.

I think you need to realize that you cannot assume that while foresight is something that each of us practises every day—perhaps knowing that we have to go somewhere, we anticipate how we are going to get there—it is not necessarily right to assume that people understand what, in the context of developing human society, foresight is all about. There are many people who do, and they do not come from the area that you call foresight. They come from all kinds of areas and walks of life, from historians to bishops, to literary critics and so on. They are very perceptive people. Any of you who have read Arthur C. Clarke's books, in particular his latest series called the Rama series, might in fact wonder whether the last one of that series is Arthur C. Clarke's view of the future of human society. It is a view that if you look at what is happening in the world right now, is one that has a lot to say about what is happening, and it requires a great deal of thought from all democratic societies.

Do not assume that people will understand you when you are talking about foresight. I believe that part of UNIDO's job is to make sure that people do, and I think it is not an easy task when developing any kind of foresight programme. People tend to get locked into what is going on in a foresight programme and give far too much of their time to it, even if they were told that it should not take up much of their time to start with. Nevertheless, once you do get locked into this and a proper programme of work: do not underestimate how much

time and effort is involved. If a course is given for sponsors, organizers and practitioners, do not believe the sponsor or organizer when he tells you that it will not take much of your time, because it will take a lot of your time. The amount of resources that go into this sort of programme are also enormous.

There are three aspects that UNIDO will need to bear in mind. In any kind of foresight activity there needs to be a sponsor, an organizer and practitioners, all of whom need to be involved in creating and designing the programme and in deciding what is to be done with the outcome at the end. That is probably the most difficult part and the one that receives the least attention when foresight studies begin.

We always stress in our course that prioritization is in fact a bridge between the formal world of organizing a foresight programme, with all its methodologies and processes involved, and the world of politicians, and that point requires enormous care. Scientific and technical knowledge is quite different from political knowledge and political expectations. Building that bridge between what is done in a very logical, careful methodological way in a foresight programme and the political world, where other forces come into play and where people have got far less patience with what goes on in the more methodological part of the world requires the greatest of care.

Underlining the whole of the foresight saga is the need to understand and know something about the people who are involved and, above all, to understand the nature of the information you are getting. It is all subjective opinion, and you need to understand a great deal about the nature of subjective opinion in order to be able to understand fully what people are telling you in the foresight process, and that I think is another role for UNIDO.

**Discussion**

The last sentence of Mr. Loveridge's talk about prioritizing being a bridge is very important. It is right that the foresight process should end up with priorities.

When the sponsor, the organizers and the practitioners of a foresight programme are together, somebody has to decide what to do, what the point of the programme is. There are two extremes: there is the extreme that goes for "hard" prioritization, as happened in the United Kingdom study, as in quite a number of other studies. The opposite to that, which could be called the "open book" method, is typified by what happened in the Netherlands in their last study. They produced reports, they laid them on the table and it is for anybody to pick up. It is really up to the sponsors to make up their minds what they want, and if the sponsors cannot make up their minds what they want, then really the programme is headed for trouble. You will find that people will do all kinds of

things according to their own personal predilection and that is a recipe for disaster. There is actually a hidden recipe for disaster in the "open book" that has not yet surfaced, and it is that, while it is theoretically possible for somebody to go along and pick up an idea from the "open book", it is still expected that somebody who is involved in the panel will say "Wait a minute—that was discussed in the panel. What right have you to take that away and turn it into a product for your personal gain?" There is a hidden intellectual property problem that has never surfaced so far, but it is possible that it could.

If UNIDO is going to design a programme, it should be for at least 10 years. National foresight looks 10, 20, 25 years into the future, and the UNIDO programme should last for at least 10 years, because behavioural changes do not take place so quickly. The programme must follow up on developments so that self-sustaining capacity-building in those countries can be achieved.

There are basically two different sorts of foresight. The first, the French one-for-one type, started to select certain technologies, and the fact is that there are 105, 110 key technologies. It is not holistic; it concerns only the industrial or agricultural sectors. The other one starts from a holistic approach and may end in prioritized subjects or recommendations. The Hungarian foresight ends in recommendations, which is very good, but it has been criticized very strongly at the end. Why did it not give clearer information on certain departments or sectors of industry—which is not, and which was not, the aim?

# Geopolitical considerations

*Gianfranco Cicognani*
*Expert on Science and Technology, Central European Initiative*

This opportunity allows me to develop further a few considerations that I presented on the occasion of the technological foresight conference organized in Vienna in April 2001. Let me start again with the three questions I put to the floor at that conference, where time was not sufficient to formulate proper replies. Then I would like to propose a parallel line of development to classic technological foresight, which I call technology implementation for the benefit of small and medium-sized enterprises.

I am a nuclear engineer, but as in Italy we have ceased work in that area, I have since spent my time trying to transfer technology to small enterprises. I am therefore speaking on the basis of personal experience. The question that I put to myself first of all was: Can a classic technological foresight approach that was initially implemented for the most advanced countries be properly adapted more generally to an economically less advanced environment? Should that be the case, how far can that technological foresight tailored to a specific country be used to promote a more comprehensive and general regional development? Should the replies to these vital questions be not negative but simply doubtful, how real is the risk that this approach alone cannot fully cope with the real needs?

On the basis of my personal experience, a risk, even if small, does exist, and cannot be underestimated, because the risk is the product of probability and consequences. We must not forget it, even if the probability is low, because the consequences could be very negative in terms of loss of both time and opportunities. This region of Europe needs to close the technological and economic gaps that still exist in the shortest possible time. It should be possible to take a short cut in this direction, that is, to foster the adaptation of new technologies to the productive sectors on the basis of actual market requirements and forecasts of market trends, especially in the short term. There is no doubt that small and medium-sized enterprises will play a major role in the implementation of such an industrial strategy.

Would this be accepted? Let me develop very briefly some considerations on the basis of our experience in the Italian context. Small and medium-sized enterprises play a primary role in the European industrial system, in particular in

Italy, where we have 4 million enterprises working in the country, a number of which are clustered in so-called industrial zones. In creating both wealth and employment, it is enough to say that more than two thirds of the total employed manpower in the European Union work in small and medium-sized enterprises, to fully understand their importance in most of the sectors producing goods and services. I want to make reference to the small and medium-sized enterprises in the so-called traditional sectors—textiles, ceramics, shoes, furniture, wood, machinery, leather and so on—and also in agriculture-related activities. This is not only because of the huge economic impact of those sectors, but also considering the unique performances of the small and medium-sized enterprise system in facing the challenge of the national and international market and obtaining good results.

A full understanding of the reasons for this performance appears to be important for two main reasons: on the one hand, for promoting future activities along the most favourable path and, on the other, for giving an answer to the following question: How far and under what kind of conditions could this model be exported outside the country, thus offering a similar economic potential to economical development in other contexts?

In order to describe the frame of reference properly, we can start by considering a few typical characteristics of the Italian picture. Small and medium enterprises committed to the different productive sectors show a clear concentration at the territory level. This is a very important point: territory-related development. A small enterprise belongs to the territory; the developed territory goes through the small and medium-sized enterprise development. The expression "industrial zones" underlines very clearly this specificity, which takes full advantage of the typical industrial culture and tradition recognized at the local level, developed and implemented step by step through a typical bottom-up process counting on a very specific organization of work, at the same time focusing on both cooperation and competition. These are the three key concepts: cooperation and competition on the one side and territory-related development on the other.

There are more than 200, maybe 250, industrial zones in Italy at present. It is immediately clear that their distribution over the national territory is far from uniform. A high density is visible in the north of the country, more in the north-east than in the north-west, where major industries are prevalent. In central Italy their presence is mainly in the Marches and Tuscany, while a strong reduction is evident in the south of Italy. In our major islands, Sicily and Sardinia, no significant presence of industrial areas is shown. Two first lessons can be drawn immediately from this evidence. This form of association can be proposed and properly implemented where an industrial environment is already well established, also because it needs to count on an effective network of

services and infrastructures. The presence of the major industries does not necessarily help the establishment of the industrial zones. A comprehensive socio-economic analysis is, therefore, necessary.

The reconstruction of the Italian economy, destroyed completely during the Second World War, started in practical terms at the beginning of the 1950s, to be completed in the following 20 to 25 years. At that time there was a rapid decline in the number of farm employees in the larger agricultural areas of the Po valley. Among the factors that caused this decline was a sharp increase in the amount of agricultural machinery, determined by the implementation of the so-called Piano Verde—the Green Plan—launched by the Government to encourage food-feed production.

During the same period, many big factories were closed in the region because of their inefficient performance. A typical example was Officini Caproni, a company well known for its capability in aircraft construction before and during the Second World War. As a result, a huge number of skilled people lost their jobs, thus increasing the supply of qualified manpower, especially in the mechanical field. Ideal conditions were thus created for starting an aggregation process of small entrepreneurs, ready to take full advantage of the availability of qualified manpower, as well as of the benefits offered by the Government and local institutions in terms of reduced taxes and low-rate financing grants. Help was also given by the cooperative culture traditionally developed in the region, which made it easier to arrange for the establishment of complementary agreements among the small and medium-sized enterprises, not only on a legal basis, but also on the basis of mutual trust in the cooperative approach. Gradually, industrial zones producing agricultural machinery became more and more important. Today they total some 600 enterprises and represent one of the most interesting industrial realities in the Emilia Romagna region. The amount of new technology being introduced into the system is unbelievable.

Everywhere for the other 200 to 250 industrial zones, the mechanism was the same: a bottom-up driving force, great attention to the real opportunities, a network of inter-company relationships aiming at optimizing the production cycles, with specific attention to the owner-real time; interaction between producer and sub-producers; special care in logistic and quality-related aspects; and continuous efforts in the field of technological innovation and trust. All of this does not mean that periods of crisis are automatically avoided. As with all the market-oriented industrial activities, such periods are unavoidable, but they can be overcome in a shorter time counting on both flexibility and innovation.

It is important to underline how the industrial zones operate in order to achieve those results with the highest efficiency possible. A number of structures have

been created for that. There are the so-called service centres and the "technological observer". Service centres can help small enterprises in many activities, making market evaluation, providing financing, helping with maintenance problems, renting cost-effective machinery and so on. The technological observer function refers mainly to the promotional side, monitoring of internal and international markets, partner research, investment evaluation and opportunities, risk-factor analysis and so on.

Within the organization of the industrial zone, many activities are performed with the aim of helping the proper development of the associated enterprises. One of them deserves to be emphasized here, considering its growing importance in the short- to medium-term, because action was taken in line with an innovation that represents a widely recognized tool of major importance for the level of competitiveness demanded by the global market challenge.

Here, this morning, attention was placed on a very important question. How could some of these countries help in the establishment of a new strategy for UNIDO? I think that not only in technological foresight or national foresight, but also in the implementation of actual technology to help small enterprises, driven by market requirements, UNIDO taking full responsibility according to its name—United Nations Industrial Development Organization—can help a lot. It can help in fostering the conditions for which these territory-related industrial systems can grow in the smallest countries of the Central European region, for instance. I am from the Central European Initiative, which works with 17 countries. We are prepared to make an effort, which means to establish cooperation with UNIDO along these lines.

It is interesting to try to work together in a direction in which some help is to be given to these countries, together with the local authorities. I do not know if the central Government is to be involved, but the local authorities certainly have to be involved, because small enterprises are connected with the territories. The creation of agencies for small and medium-sized enterprises could be tried in order to help build up service centres of technological observers in a kind of structure that can help industries to progress. Last but not least, it is important to take good advantage of this bottom-up approach that adapts to the culture, attitude and competence of the small entrepreneurs who are a part of the individual countries, in a different way from country to country, but following the same logic.

Another important task that UNIDO could consider undertaking would be to launch a number of audits among these different countries. I am a nuclear engineer and I know very well how terrible the fight was against public opinion, driving in such a way, not very scientifically but in any case very strongly,

against nuclear energy. Now, because GM technology is an opportunity that we cannot miss, it is necessary for independent authorities to make an effort in this area by trying to convince people about risks. I think that an independent organization has a duty to do this. It is impossible for this to be done by entrepreneurs, because people will say that they have only their own interest at heart. An international institution has the important duty to make people aware about the real situation on a scientific basis.

# Industrial promotion considerations

*Fredy Jäger*
*Research and Development Manager, Corporate Development,*
*Siemens AG Österreich*

I have been participating in foresight activity for 15 years now. I started in Germany with a research institute, where we conducted the German Delphi study. At that time I was involved in the formulation of questions and in developing procedures. Later on, when I joined industry, a big electro-technical company, I received the questionnaires from the research institute. I tried to apply them in the company and to push people to reply, and later, when the results came in, I examined in our corporate research centre in Munich how we could make use of the results, which was an experience in itself.

I think if we undertake technological foresight, we need a vision at the beginning. This is how the planning process in industry in bigger companies works. We have heard this from Daimler-Chrysler at the April conference, and it is the same in our company (Siemens). We start with a vision, and we want to know in what fields we want to be active in 10, 15 or 20 years later. Then we approach the problem from two sides: we look at how the technologies will develop from the present to this goal, to this vision, and then we go backwards from the vision and ask what technologies we would need to arrive there. Usually, there is no connected roadmap between the present and the vision. We try to create the path, the technology path that leads to the future. We expect that foresight will help us in this process.

I think that whenever you start a technological foresight process, there must also be a vision of the future. What is the technology for, which socio-economic problems do we want to solve it with, where do we want to position the country as a whole, what are the political goals? And then we can talk about the technologies—that is the first step. The experience in industry with participation in Delphi inquiries or in panel studies is the following. With the Delphi studies we participated in these studies and answered all the questions that were asked in various stages. The result—what we got back was a 300-page report, with 500 excellent ideas, but when we gave it to the researchers in our companies, it was very hard to get something out of that. It turned out that for each of these 500 interesting fields you need a champion within the company. You need somebody to promote each of the interesting ideas and somebody who can command resources—people, money and so on.

Consequently, not very much happened with the Delphi result from this point of view because it was just too much at a particular time. Another problem was that the suggested interesting ideas did not fit the industrial schedule. Industry, and not only my company, was at various stages of development and had other plans, and an idea that came from the outside did not fit the previous commitment and did not fit the plans of the company. It was very difficult to incorporate the suggestion. This is why we now have a policy in industry to try to participate in these planning processes as early as possible, and because it is technology, it is not only industry that will and should participate, but also research institutions, universities and government organizations. These three parties should participate from the very beginning and then, if the results are developed jointly, it is much easier to implement them later on.

One of the problems that arises is that if you participate on a regional or a country level in such a process, many competitors are participating, and this is not something that is usually happening in the real world. Competitors do not participate easily and this is a very simple answer: they participate if there is some compensation at the end of the process, as in the European Union programmes. This is, by the way, the biggest foresight process that is going on at present in Europe, with the development of the six framework programmes, in which industry is participating because at the end of the whole procedure they can expect some funding for joint research projects, and money is very important. This is why I really think that Governments should not be excluded, because we need them to provide seed money. This is also the role of UNIDO. If there is money or some other advantage at the end of the process, you will get all the interested parties who are usually not cooperating in one exercise.

The next thing is that when you have the results, you need people inside industry who will transfer the results into product services. We do not yet have enough people to do this. This is a suggestion for UNIDO: there are not enough people capable of participating in planning processes, and the more people are trained in foresight processes the better it will be. This is especially true in less developed countries, where it would be most beneficial.

This leads me to a final comment on the technological foresight process. As Mr. Loveridge said earlier, some people overestimate the immediate effects of the foresight procedure. It is a very lengthy procedure and you do not always get real results in the foresight process only in one big step. This happens only rarely, but every unit of money that is spent on the foresight process is valuable, because it raises the capabilities and it achieves one very important process: the actors are talking to each other on a regular basis. This is my comment from the industrial side: we cooperate where we have some benefit, but this is also the case for universities. There must be a joint procedure and some reward at the end that makes it a beneficial process.

## Discussion

The issue of industrial participation is very important within the CEE/NIS community as well and it is very hard to generate enthusiasm. UNIDO could provide some assistance in helping to translate the longer-term foresight vision into more short-term business issues and make them relevant to industry, that is bringing the issues closer to the marketplace.

One remark should be added to this session. It is about the missing word from the title of the session, which is "competitiveness". UNIDO should change its strategy because industrial policy is not profession-mounted. Industrial policy is not known, either in the European Union or in the United States. However, there is a great technique for mapping out the future, technology foresight. The question is, how this technique, this methodology and those experiences can be employed in those countries. Who would need them? That is why the definition of national economic competitiveness should be shown in some element and it is very important because nothing comes free in economics. Sooner or later the taxpayer has to pay.

It is widely accepted all over the world that national economic competitiveness is the ability of a nation to produce the goods and services that it needs. The test of international markets and globalization is very important in economic competitiveness. The point of every foresight action should take into account a standard of living that both continues to rise and is sustainable over the long run. This definition came because most of the topics that were discussed in the two sessions aim at this approach and, regardless of political considerations, this is the ultimate goal of economics and foresight action. The European competitiveness pyramid shows that there are two sides to standards of living—employment rates and productivity. The employment rate is composed of participation rate and job creation. What is important is that biotechnology can support this side and that productivity in most cases is the business of companies. However, what is significant is that the smaller and less developed the country, the more effort and resources are expected from national Governments.

I would like to draw the attention of UNIDO to the integrated management model developed by Professor Cerchi in Zurich, Switzerland, which assumes three management levels, normative, strategic and operational, and at each level the model includes structures, goals and behaviours. That creates a 3 x 3 matrix, or nine units, and any project that UNIDO develops and supports or any programme should take into consideration changes in all those nine units. Without a balanced interrelated change between the levels and the components of the levels, one cannot achieve success.

Concerning the statement made earlier that the ideas that came from outside could not fit into the companies' concept, it depends on the company and what the concept is, because, for small and medium companies that have no money for strategic thinking or to conduct research for the future, foresight may give great support. The big companies and big multinationals are not interested at all. They have their own ideas, which are top secret, and they are interested in the next 10 to 20 years. For example, a company dealing with fashion for the next year or the year after is not interested in foresight, but pharmaceutical, agricultural and biotechnological companies are very much interested in the next 10 to 20 years. They are interested, they are listening to us but they are not saying a single word, because everything is confidential because of competition.

The actors—scientific institutions and industrial enterprises, large and small—should be involved from the very beginning and a foresight study should not be imposed from the outside or from the top down. Small and medium-sized companies and large companies complement each other as well, because they have different roles in the innovation business.

There was a point raised in Mr. Jäger's presentation concerning how to encourage the participation of industry and business in these exercises. It is important to emphasize that whenever a technology foresight programme is undertaken there is a need to have some ideas about the implementation side as well. Exactly what kind of resources, what kind of mechanism might be used to assist in implementation? This is the "how" question. There was already a useful exchange of ideas on the "why" and "what" questions, and also some ideas about the "how" question, which is more a question of methodology. The challenge is on the one hand to find opportunities that are in accordance with the mandate and the size of UNIDO, not too ambitious, but at the same time meaningful. It is known that there are national efforts and other organizations that are quite active in this area, but there should be no overlap. All these elements, of course, narrow the possibilities of what UNIDO can and should do in the future.

There is active competition, there is cooperation and the institutions of cooperation are the organizations of different sectors in industry. They work to obtain a bigger cake and not to have to slice up the cake. They should plan for the longer term and that is why they can be great partners in technology foresight programmes.

UNIDO could push the universities to introduce undergraduate-level courses on the techniques of foresight. If you do not have that manpower you will have only industrial engineering departments, which hold courses on total quality and benchmarking. Undergraduate-level courses would help and UNIDO is in a perfect position to suggest to universities that they introduce courses on foresight techniques.

Education should not stop at the undergraduate level. We should find a way of educating management within industry on a continuous basis. Coming into a company from university it is not long before the ways of the business become ingrained. The university education quite quickly gets lost and there are no opportunities even to consider foresight, so some vocational qualification is important.

### Summary of the discussion by the Chairman

Now it is time to highlight some of the points identified as important elements. First of all, there is a need to have different dimensions while contemplating the technology foresight programme, these have been called visions and they could be of different types. One vision was promoting the development of small and medium-sized enterprises; another was the vision of promoting competitiveness. We need to think about the users of the technology foresight programme and this is where industry is extremely important.

There was a strong point about making technology foresight a real joint venture, where from the beginning there is close involvement of the different constituencies—business, administration, the Government and the scientific community—and there should be an incentive for participation by the different constituencies.

There was a strong point also about how to make the outcome of technology foresight "digestible" and that in general this was a problem for industry. There were concrete suggestions for UNIDO, where UNIDO could try to translate longer-term ideas into short-term implementation ideas, which is quite significant in making such programmes meaningful for end-users, who are the actors in the business field.

There was a sustained emphasis on training and education, and in general the feeling is that the more people are trained in technology foresight, the better it is. There were points that this whole educational cycle should be started at the graduate level. And also, some ideas about the postgraduate level as well. There is a need for UNIDO to think about the opportunities we have both at the undergraduate level and at the postgraduate level.

There is a separate element, which is related to implementation. This is more about the "how" question and marketing of the results is extremely important, probably the involvement of political decision makers in the process is crucial, at least from some of the earlier cluster discussions this was an element that came up. The personal factor was stressed and the significance of the dedication

of the participants to the process is very important. It is not just the quality of the participants, but how far they are dedicated to that process and surely this is valid for the implementation as well. Technology foresight should be made user-friendly. We heard the very wise historical perspective from Mr. Loveridge, indicating that there are ups and downs to this issue of becoming user-friendly, and there might be an interest slowly fading away and then coming back again.

*Dan Liang*
*Director, Quality, Technology and Investment Branch,*
*United Nations Industrial Development Organization*

We have kept silent because we wanted to listen to the experts' comments and recommendations. I think these are very useful and instrumental for our future work. I still have one remaining question to ask you all, perhaps for tomorrow's discussion. Because UNIDO is an international organization, with the advantage of international organizations to be able to organize something that single countries maybe cannot do. Our question is what kind of a programme you expect UNIDO to organize and should it be regional or national? I would also like to feel that tomorrow you will look at the whole programme, to give us some suggestions and recommendations on that. We have to decide whether we need the regional approach or not, and what the common interests and common programmes are that we have to deal with collectively.

# Summary of the discussions and comments of the representatives of the Central and Eastern European countries and the newly independent States

*Vladimir Kozharnovich*
*Programme Manager, Investment Promotion and Institutional Capacity-Building Division/Quality, Technology and Investment Branch, United Nations Industrial Development Organization*

First of all, I would like to thank all the experts for their excellent presentations and very productive discussions. I would kindly request you also to help us by providing additional inputs by tomorrow, so that we could really generate and develop a good programme that will be beneficial for member States and recipients of UNIDO services.

Today we had a very hard task: an analysis of the biotechnology sector. Biotechnology is a high technology, a very competitive sector, a technology of the twenty-first century that will define the technological prowess of any country. This requires high investment in research and production; there is no doubt that it is a highly competitive area where a few multinationals are ahead in R&D but, at the same time, many countries also have their ongoing activities in research, development and production.

What are the problems? It is a fact that the CEE/NIS countries are in a very peculiar situation. They are entering, for example, the European Union, where the regulations are stricter than those they now have; this is also an additional problem that will arise. It is clear that the countries in the region have different capacities and capabilities, which would be required for going into this area and succeeding in research, production and so on. These capacities and capabilities can be characterized by what types of capacity there are in science and research, whatever innovation capacity there is in the country, manufacturing capacity and capabilities, and also commercialization efforts of the country.

It was clear in the discussions that the countries should have a real strategy for development. However, that strategy will vary from country to country, depending on the country's specific context, capacity and capability, and also its interest in and strategy for overall economic development. The situation, for example, in the United States, in the European Union and also in developing countries and

in the CEE countries is different. That means that one cannot apply a strategy applied in the United States or transfer that strategy to countries in the region.

There was also discussion as to which three main areas could be tackled in medical biotechnology: drug development, DNA-based diagnosis and treatment. The point was also made that countries should have a share in spite of the fact that multinationals dominate the market. Research groups and individual scientists can be linked in research and marketing to the multinationals, which have huge research capacity and also marketing networks. More room and more options in cooperation and benefits for the CEE countries can be found in the diagnostics area and production of diagnostic schemes.

A very strong point was made that there is an interrelationship between health and the environment. Importance should also be attached to prevention of disease through improvements in overall pollution control. These are areas where biotechnology can play a great role.

It was clear that technology foresight was a missing element for Governments and industry in many cases. It was difficult to decide what type of investment was needed in R&D and where to put that investment. This was very important specifically because biotechnology is an area that has a cross-sectoral impact and considerable social impact on the health of the nation, that means the demographic security of the nation, but at the same time there are ethical problems and safety issues that should be tackled during the development of research and production.

A number of recommendations were made during the discussions. I would really very much like to ask you not to be too critical, because this is an ad hoc draft. I will try with my colleagues to put together the main ideas, which are really of great importance, and with your help tomorrow we can polish them and put them into the report.

Since technology foresight is a useful mechanism for Governments—combinatorial, technological and regulatory changes in emerging technologies—in identifying shares for industry, recommendations will be aimed mainly at Governments. However, there are also structured recommendations in terms of education and regulatory organs, but these are cross-cutting and we will need to work more in order to put the government policy in each block. The Government should also have a special policy to ensure the enhancement of research into biotechnology, since biotechnology is one of the key technologies that typifies technological progress in social and economic development.

There are also other issues. Governments should take the lead in providing financial incentives for launching and implementation of technology programmes, commercialization of new technologies and creation of small industries in this

specific area. Special policies should also be drawn up to help create venture and start-up capital and different funds, which would facilitate research and commercialization, in particular the commercialization of research results, since there is much intellectual capacity in the region and individual scientists, and groups in the universities and the pharmaceutical industry working in this area. There are also technologies that can be commercialized and incorporated into new products for the benefit of all, specifically in medicinal biotechnology, which is very cost-effective. With the development of such medicines, the population in the lower income strata can have access to new types of treatment.

It was also argued that a special policy should be adopted concerning education, since there is a lack of public acceptance of new products, especially in the biotechnology area, which is a controversial one. Public acceptance in different countries is different, so special programmes to promote such innovations and technological advances should be set up. In that context, scientists in the universities and research institutes should play a key role as the providers and carriers of knowledge in educating the public and in enhancing public acceptance of the new products. All this public education and psychology should also be oriented to consumer needs, since the consumers are the driving force in any development, and so this should be taken into account.

There are a lot of problems as regards patenting and regulations. It is therefore recommended that Governments strengthen and enforce patenting strategies and systems. To create such structures as patenting offices to patent the intellectual property of individual scientists and research groups constitutes a bridge between research and industry. In this case the role of universities is also gaining importance.

There was a question to which we did not find a solution, but I think it should be addressed somehow. The large companies and pharmaceutical companies have a lot of data on pre-clinical and clinical tests and have great advantages in commercialization and putting new products on the market. There is no access for other countries to such data, which would really facilitate access to new markets. That issue should be addressed.

There is a strong need for establishing harmonization of different laws and regulations in this area. Especially now that several countries are entering the European Union, there should be a harmonization of national regulations with the European Union protocols on biosafety and other biotechnology issues. In that context it is recommended that a permanent mechanism be developed and funded to support internationally based harmonization of regulations, laws, biosafety requirements and so on, especially because the technological pace is changing rapidly, as are also the regulations in force, and countries should be aware of what is happening in this area.

It was observed that new technologies were an engine for socio-economic development. Using biotechnology, new clean technologies without any harmful impact on the environment and health should be an important part of national and industrial strategy. For example, in biotechnology, biodegradable plastics, biodegradable lubricants and oils already exist, but, they need to be especially promoted because there is resistance from petrochemical companies, since they want to keep this to themselves and not to have other alternative products on the market. In that respect, data management tools for bio-informatics and information and communication technologies could constitute a niche for countries to monitor technological advances and regulations and to help them be prepared for changes in markets in the area of biotechnology. In that context, regional cooperation will be very important in those specific areas in the harmonization of laws, in interactions between different companies on research results, in monitoring technological advances and also in pooling limited human and financial resources in order to have the greatest impact.

With globalization and modern information communication technologies, there is a possibility for individual scientists and small research groups to enter the global research and production networks and cooperate with other countries, companies and so on. Biotechnology companies, especially small ones, should take into consideration and make serious decisions regarding the creation of alliances, and business alliances should be a target for them to compete in the market and to survive.

*Emilio Vento*
*Liaison Officer, International Centre for Science and High Technology,*
*Quality, Technology and Investment Branch,*
*United Nations Industrial Development Organization*

I will go through the points that I noted during this afternoon's discussion. I am sure that some will be a repetition of what Mr. Kozharnovich has already reported from the morning and I am sure that some points will be missing, so I invite everybody who made a contribution to provide additional ideas to what I identify as the key points to put on the record.

Concerning the relevance of biotechnology in Eastern Europe, it seems that actually there is general agreement that a specific subject of relevance to national priorities and competencies should be carefully identified. Each country should identify its key core competencies where R&D activities should focus. The example of health in Hungary was mentioned: health is a priority issue for Hungary from the point of view of quality of life. Of course, the issue is also relevant to other countries in the region. Foresight technology applied to health and life sciences could be a key priority to be supported and promoted at the

regional level. As for some consideration concerning preliminary steps to be undertaken before entering a technology foresight exercise, there were comments that an appropriate preliminary step in starting a national technology foresight exercise was to conduct pilot studies. This could be very relevant for whatever initiative we propose for the future development of Eastern Europe.

There were some other comments on preparing preliminary study assessments of national innovation systems in order to understand and have a clear picture of how all the relevant international actors work or should work together in the technology foresight effort. There were some other comments also concerning this preparatory effort from Mr. Loveridge, especially the need for full commitment of the parties involved in the technology foresight exercise for substantial and practical results to be assured. Another relevant recommendation was that technology foresight exercises and programmes should benefit all the different actors involved, Governments, R&D, innovation systems and the private sector. Public opinion and awareness-building is a key step towards building consensus about the results to be achieved and utilized broadly for the benefit of society.

There were recommendations concerning learning from other experiences: studies at the national and regional levels should take advantage of the experiences and studies of other countries.

Education was mentioned in connection with building expertise in the medium and long term. It was recommended that UNIDO promote Master's and postgraduate programmes—I do not know if this is really the role of UNIDO or of the United Nations Educational, Scientific and Cultural Organization. However, in any case it is important to educate and train in technology foresight young experts who at a later stage will become decision makers.

It was also commented on that there was a strong need in Eastern Europe for support and guidance on how to initiate, establish and activate national or regional technology foresight exercises.

There were also a number of recommendations concerning the holistic approach to technology foresight. Technology foresight exercises should look at the different priorities of relevance to the particular society. This will give a comprehensive view of the expectations of the specific society. In a way this is linked to the previous comment that everybody should be involved in the technology foresight process. A second recommendation is that the gap between science and industry could be bridged through joint technology foresight activities that result in public R&D and innovation programmes. This is quite interesting in that there is insistence on the need not only to have a technology foresight exercise per se, but to reach practical results, that is, to utilize the results of the technology foresight studies.

As the last set of recommendations, I noted some points concerning the role of UNIDO. UNIDO could play a relevant role focusing on activities related to awareness-building and developing methodologies for programme design and implementation. As an independent and neutral body, UNIDO could be instrumental at the end of a technology foresight exercise in connecting the technical results with the political expectations, and this is also very relevant, to obtain something very practical at the end of this kind of study. The last recommendation was that UNIDO be instrumental in disseminating best practices on technology foresight and undertaken capacity-building through training courses and seminars.

## Discussion

It is also important to discuss cooperation with other international organizations: health subjects, the World Health Organization; agro-food, the Food and Agriculture Organization of the United Nations; R&D, the European research area of the Institute for Prospective Technological Studies, in Brussels; environment, the Environment Protection Agency. In order to avoid parallel activities and to avert problems with other organizations, we should put in some remarks on that.

Discussion about cooperation with other international organizations is more related to the third category of questions, that is the "who" question. We have had just a preliminary exchange of ideas regarding the "how" question and it is important to identify very clearly the "what" question before trying to speculate how much UNIDO or others might do. The main thrust of the point of Mr. Öner is that we must keep flexibility in mind in terms of what could be done before we address exactly how it should be done. Of course it is important that we remain within the scope of the mandate of UNIDO and within its limited financial and manpower resources. A major part of the UNIDO team is here now, with some important components still around, so there is a limitation in terms of both manpower and resources.

The health-care sector was identified as one of the major driving forces for the biotechnology industry. A forecast for it is necessary to the development of health-care financing in those countries, and if you look at the European countries, they are cutting costs. As an example, one of the most fashionable prostheses for walking costs 500,000 Austrian schillings and the Austrian social security system will not pay for it any longer. It does not help to develop such costly devices if you do not have some kind of figures in the future on how to finance the health-care system.

GM crops and the concept of GM crops are going to be very important for everybody, including people in this area. There is obviously some controversy

at this point. The scientific benefits are clear; the social problems are also obviously there in terms of their acceptance. What is UNIDO planning to do for the benefit of the people in this area when it comes to GM crops? This issue was indeed taken up in the discussion from the point of view of shaping the right reception by the public, which is part of awareness-raising, namely, the preparation of the public to absorb new developments.

The question was raised as to whether UNIDO should focus on regional or national activities. It was suggested that UNIDO could supply some kind of Internet supplier service for all the countries, whatever work is being done. Actually there is no need in the twenty-first century for regional or national centres. I do not think that UNIDO needs to think about establishing centres as such, but could just give Internet support on all the work done, which could be shared by everybody.

With reference to one of the last questions raised by Ms. Liang, as to where UNIDO should place the main emphasis in its future activities, whether they should focus on national efforts or regional efforts? What emerged in the course of the discussion is the expectation among institutions to get some assistance from UNIDO. When countries and experts contemplate a technology foresight programme, they face real challenges as to how to carry it out and how to make good use of the experience already gained. There is expectation that UNIDO will make relevant expertise available to member States in the future and of course it might be interesting to see how far new information technologies can be used. For a cutting-edge criterion like technology foresight one should rely on cutting-edge possibilities like information technology, the Internet and so on.

UNIDO has been very active in Latin America and has already established a quite interesting network. UNIDO is also trying to establish this kind of facility for Eastern Europe, to bring on line information about what is going on at the country level. To make this available it is important to decide on which language to use, because there are so many languages in Eastern Europe. In Latin America it was much easier, because Spanish is the language of most of the countries of the region. It is possible that English will be the language for Eastern Europe. This could be very relevant and could reply to a lot of inquiries coming from beneficiaries in Eastern Europe.

Mr. Loveridge confirmed that it should be made very clear what the goal of the foresight process would be. It is up to the initiators of the process what they want to have—whether to set priorities or have an "open-book" approach. We did not touch upon this in the recommendations. What is the result of the foresight process and will it serve for setting priorities? This question has still not been answered.

There was an additional component, which was how to transfer the results and the outcome of the technology foresight to the decision-making level and how to make politicians and decision makers interested in implementation.

There are countries that are entering the European Union, or are in the process of joining. One of the many reasons why these counties should do regional foresight with the support of UNIDO is that they must also prepare themselves to negotiate properly with the European Union on entering. This will strengthen them and in entering they will probably achieve much more.

# SESSION III

## Regional programme on technology foresight

## Elaboration on highlights for the regional programme

### *Introduction by the Chairman*

I would like to suggest that we start our proceedings by making an adjustment in the programme. The idea is to keep the biotechnology experts with us and to conduct the round-table discussion afterwards, as suggested in the programme. The idea would be to devote closer attention to what is contained in annex II, on pages 7 to 9 of the aide-memoire, and to double-check whether one might improve, enhance and enrich this document. Before we proceed to that, however, I just wanted to check whether there are any ideas that should have been raised before we proceed to taking a closer look at annex II.

European Union activities were touched on only very briefly. As many of you are aware, there is a planning process for the European research programme. Some of the countries represented here are accession countries for European Union membership and there are two important things in European Union planning right now that might be considered by UNIDO for these regional exercises. The first is that national programmes of technology foresight and European Union research programmes will be much more coordinated and harmonized in the future. This is something to consider and it might be useful for this activity to look at the plans for the framework programme, at what is happening at the European Union level. The second thing is that a new instrument in the European Union framework programme is the exploitation of article 169, which allows a group of member countries to come together and suggest joint research projects or programmes that might then be funded by the European Union. This is totally new and might also be applied in the future to a group of countries that is trying to do something. This is a very interesting policy, which it might be worth considering.

# CONCLUSIONS AND RECOMMENDATIONS

# Session I. Challenges and opportunities for a new industrial economy in strengthening the economies in transition: contribution of the biodigital economy to Central and Eastern Europe and the newly independent States

## Conclusions

1. Biotechnology is a highly competitive sector and requires high investment in R&D.

2. Countries in the region are bound by the decisions of their Governments to join the European Union and Governments must prepare public opinion for more strict regulations.

3. CEE/NIS countries have different capacity and capabilities in:

   Science and research

   Innovations

   Manufacturing

   Commercialization.

4. Technology foresight programmes should be adjusted to the country-specific context and interests.

5. Three main areas in biotechnology are:

   Drug development

   DNA-based diagnosis

   Treatment.

6. Large companies put a lot of money into research and have networks for marketing.

   CEE countries should be linked to multinationals in research and marketing.

   There are more options in diagnostics, but cooperation with large companies would be beneficial.

There are opportunities for small and medium enterprises and small research groups.

Interrelations exist between health and the environment.

More importance should be given to prevention of diseases by reducing pollution.

7. Technology foresight is a missing element that will help Governments and industry decide what level of investment is enough and where to invest.

   Safety networks

   Ethical issues

   Special problems.

**Recommendations**

1. Governments

   Technology foresight is a useful mechanism for Governments to monitor rapid technological and regulatory change in emerging technologies and to identify niches for industry.

   Governments should ensure the enhancement of research.

   Governments should help create venture and start-up capital and provide funds for new companies.

   Governments should take the leading role in providing incentives for technology foresight programmes and the commercialization of new technologies.

   Investment in education should be increased.

   Governments should introduce a special policy to keep educated people in the country.

2. Education

   People should be educated about the advantages of high technology.

   Public education and psychology should be oriented towards consumer needs. The consumer is a driving force.

   Scientists should play an important role as knowledge carriers in the education of the public and the enhancement of public acceptance of new products by implementing attractive programmes.

3. Patenting

   Governments should enforce a patenting strategy.

   Governments should create/strengthen the structure offices for patents.

Governments should provide a framework for the commercialization of intellectual property in order to connect research with industry (role of the universities).

Large pharmaceutical companies have a lot of data from preclinical and clinical tests and thus have a great advantage, but they do not allow access to those data to others.

4. Regulatory

Laws and regulations in the rapidly changing technological environment and economic areas need to be monitored.

National regulations need to be harmonized with European Union protocols on biosafety.

Best practices in the harmonization of a country's laws and regulations need to be shared.

5. Promotion and new technologies

Clean technologies are an important part of strategy.

Biotechnologies: biodegradable plastics, lubricants and oils.

The role of UNIDO is to support the promotion of new technologies and innovations and to strengthen the position of the CEE/NIS countries vis-à-vis the large petrochemical companies.

Bioinformatics, information and knowledge management tools are niches for these countries to monitor technological change and regulations.

6. International/regional cooperation

With globalization, individual scientists and small research groups can cooperate.

Biotechnology companies should make alliances a target.

7. Capacity-building

Mechanisms should be developed to encourage transformation of innovations into new products and processes.

Investors need to be trained to become competitors.

UNIDO should assist in the creation of structures and mechanisms to start up businesses.

The role of UNIDO is to support commercialization.

The existing regional cooperation mechanism in biosafety should be utilized.

# Session II. Industrial innovation and competitiveness: highlights for technology foresight initiatives for Central and Eastern Europe and the newly independent States (What type of foresight?)

## Recommendations

*Relevance of biotechnology in Eastern Europe*

Biotechnology is a very broad technical area and it could prove too ambitious for some Eastern European countries to cover all the different subjects related to it. Specific subjects relevant to national priorities and key core competencies where R&D activities should be focused should therefore be carefully identified.

As an example, public health is a priority for Hungary from the point of view of quality of life. This issue is certainly also relevant to other countries of the region. Therefore, biotechnology applied to health and life sciences could be a key priority to be supported and promoted by national authorities at the regional level.

The importance of a proper development of biotechnology applied to the protection of health and the environment was recognized and biotechnology should be regarded as a reference technology for agriculture and the food-feed business. In that respect, specific attention was given to GMO-related R&D. Public acceptance of GMOs required a considerable effort on the part of all committed institutions to clarify the scientific background against which the different aspects of GMO production and use need to be considered and fully clarified. UNIDO, as an international and independent institution, could play an important role in promoting the sound information basis needed for a proper understanding of the benefits to be derived from GMOs through a number of specific promotional activities to be organized in the different countries.

*Preliminary steps to a technology foresight exercise*

As a preliminary step to start any national technology foresight exercise correctly, pilot studies should be carried out to get acquainted with all the boundary conditions of the technical and implementation aspects.

Preparatory assessment studies on the national innovation system should also be made to understand and clarify how all the relevant national actors work or should work together.

The full commitment of all parties involved in the technology foresight exercise to viable, relevant and practical results must be ensured.

Technology foresight exercises should benefit all the different actors (Government, R&D/innovation systems and the private sector). Public awareness-building is a key step in obtaining consensus and securing support and acceptance for the results that will be derived from the technology foresight studies.

*Learning from others*

Studies at the national and regional levels should take advantage of the experiences of other regions, countries and companies.

*Building expertise over the medium term*

UNIDO should promote Master's and postgraduate programmes to educate and train young experts in technology foresight who will become the decision makers of tomorrow.

*Capacity-building, advisory services and networking on technology foresight*

There is a strong need in Eastern Europe for support and guidance on how to initiate, establish and activate national technology foresight exercises.

In order to implement a regional technology foresight initiative for the CEE/NIS countries, cooperation between UNIDO and the Central European Initiative is recommended. The Central European Initiative Economic Forum in Trieste from 21 to 24 November 2001, on the occasion of the summit meeting of the Prime Ministers of the 17 member countries, could provide an important opportunity to present to policy decision makers of the region the highlights of a comprehensive programme aimed at promoting the economic and industrial development of Eastern Europe.

*Holistic approach to technology foresight*

Technology foresight exercises should look at the different aspects of relevance to the needs and expectations of the national society.

The gap between science and industry can be bridged through technology foresight activities, which will result in public R&D and innovation programmes.

*Role of the United Nations Industrial Development Organization*

UNIDO could play a relevant role in activities related to:

- Awareness-building and dissemination of methodologies and know-how
- Design of technology foresight programmes
- Implementation of technology foresight programmes.

As an independent and neutral body, UNIDO could be instrumental at the end of technology foresight exercises in linking the technical results with the political expectations.

UNIDO should be instrumental in:

- Disseminating best technology foresight practices
- Providing technology foresight capacity-building through training courses and seminars
- Building up technology foresight regional and national capacity (experts and institutions).

# Session III. Regional programme on technology foresight

## Background

On the basis of the conclusions and recommendations of the Regional Conference on Technology Foresight for Central and Eastern Europe and the Newly Independent States, held in Vienna on 4 and 5 April 2001, UNIDO was encouraged by Governments of the region to establish technology foresight programmes for it. The Conference requested UNIDO to support such an initiative at the national and regional levels. A regional initiative would be instrumental in providing assistance to countries with economies in transition aimed at more sustainable and innovative development by enhancing economic, environmental and social benefits at the national and regional levels.

## Objectives

The objectives of a regional initiative would be to raise awareness of the critical importance of foresight as an instrument for improving the competitiveness of enterprises and institutions, to establish permanent capability to apply and develop foresight as an innovation policy instrument, to undertake regional pilot studies for specific sectors or on specific themes, and to support national and regional capabilities in using techniques of foresight and related activities. The end result would be knowledge and capability to use technology foresight as a practical tool in designing policies and long-term strategies to exploit emerging technologies. Governments and industry will share those capabilities at the national, subregional and regional levels. The ultimate objective of the proposed programme would be to provide solutions to relevant problems in the region, which could be addressed through the proper application of technology.

## Regional initiative

The core idea of the regional initiative is to use the foresight process as a tool for regional development programmes in emerging countries.

A regional initiative on technology foresight would involve promotion of the concept, training of practitioners, hands-on experience with different methodologies and some kind of regional resource to develop and promote a foresight culture and all its components.

Organization of regional foresight studies would need to be promoted as part of the continuing role of the State as the enabler of technological and industrial development. At the same time, determined and well-focused efforts would be needed to mobilize industry for foresight exercises in which they would risk neither their firms' time nor other resources, nor their operational independence. A prominent role for industry would be necessary at all stages, for example, in the detailed design and implementation of the programme and each of its components.

As a basic framework, UNIDO would propose a three-component strategy as the basis for a region-wide programme. This initiative would aim at the awareness of the country and set up a regional database of foresight specialists. Regional and subregional steering groups and institutions would be established to coordinate and implement regionally conceived foresight projects. Educational courses would give the subject an academic footing and build the foresight culture into the thinking of future generations of scientists and engineers. Foresight work in other countries would have to be examined, summarized, evaluated and adapted to CEE perspectives. Promotional materials and events would need to be organized to familiarize stakeholders with the concept, the practice and the results of regional foresight activities. Hands-on experience would show how well different approaches to foresight work, demonstrating the value of the results to stakeholders. A regional centre would function as a repository of foresight knowledge and experience to ensure long-term sustainability.

**Project components**

The project would include the following components:

*(a) Awareness-building and creation of a foresight culture in the region.* On the basis of a technology foresight network, the project would contribute to the preparation of promotional and information material to demonstrate the utility of foresight approaches in the Central and Eastern European context to policy makers, companies, R&D institutions and the general public, as well as promote foresight concepts in industry through working meetings, publications, electronic networks and media-related activities;

*(b) Development of national and regional capabilities.* Activities would include development of a roster of regional and international experts on relevant areas of knowledge, creation of national and regional centres of excellence on the foresight process, which could be mobilized for the preparation of foresight exercises; enhancing human skills through training of foresight practitioners by courses, workshops, seminars, fellowships and study tours; and development of exchange programmes between regional centres and institutions in other regions;

*(c) Coordination and foresight implementation.* Development and promotion of regional counterparts to coordinate and harmonize regional foresight activities with a view to motivating national actors to adopt common foresight objectives, methodologies, infrastructure and management teams and to use foresight in the design of regional innovative technology policy; and implementation of selected foresight studies as "base" cases to demonstrate the applicability of foresight approaches to the definition of regional policies related to common issues or themes.

**Programme preparation and implementation**

The following steps and activities are recommended for the preparation of a programme for the development of a regional initiative on foresight:

*(a) Selection of a regional facilitator and counterpart.* UNIDO would support the constitution of a regional centre for facilitating the implementation of the regional initiative. The institutional building for the regional centre would follow the experience of UNIDO in establishing international technology centres;

*(b) Identification of coordination and financing mechanisms for the programme preparation.* A detailed strategy for funding the initiative will be developed, using both UNIDO funding, emerging donors and other sources;

*(c) Creation of a regional steering party.* In order to create ownership at the regional level, a strategic steering party would be set up, involving Government, research communities and industry;

*(d) Establishment of an electronic information exchange facility.* A special communication mechanism would be set up for the initiative, with a view to creating a live knowledge-sharing process;

*(e) Expert group meetings.* Expert group meetings would be organized to determine the scope, methodology, cost, time frame and other related details of studies for the preparation of the programme document;

*(f) Development of studies.* To provide an immediate contribution to strategic decision-making in the region, special foresight studies would be promoted, with a focus on areas of critical interest to the local industry.

## ANNEX I

## Agenda

**Monday, 18 June 2001**

9.00-9.30 a.m. Opening by Ambassador Tibor Toth, Permanent Representative of Hungary to the United Nations (Vienna)

Address by the Director-General of the United Nations Industrial Development Organization

### Session 1. Challenges and opportunities for a new industrial economy in strengthening the economies in transition: contribution of the biodigital economy to Central and Eastern Europe and the newly independent States

Chairperson: Ambassador Toth

Coordinator: Ferenc Kovats, Chairman, Steering Committee, Hungarian Technology Foresight Programme

9.30-9.50 a.m. Technology foresight initiative: why, what and how?
*Discussion leaders: T. Toth and F. Kovats*

9.50-10.20 a.m. Cluster 1. Technology foresight for the health industry
*Discussion leader: F. Kovats*

10.20-10.50 a.m. Cluster 2. Technology foresight for the agro-food industry
*Discussion leader: P. Venetianer*

11.10-11.40 a.m. Cluster 3. Technology foresight for environmental protection
*Discussion leader: R. Quintero-Ramirez*

11.40-12.10 p.m. Cluster 4. Cross-cutting issues
*Discussion leader: F. Kovats*

12.10-12.20 p.m. Summary discussions: Technology foresight: why, what and how?

12.20-1.30 p.m. Working lunch

## Session II. Industrial innovation and competitiveness: highlights for technology foresight initiatives for Central and Eastern Europe and the newly independent States (What type of foresight?)

Chairperson: Ambassador Toth

Coordinator: Ferenc Kovats

1.30-2.00 p.m. Report on the working lunch discussions by the Chairman

2.00-3.00 p.m. Experiences and perspectives of selected technology foresight in the region
*Discussion leaders: K. Klusacek and G. Petrányi*

3.00-3.30 p.m. Capacity-building considerations
*Discussion leader: D. Loveridge*

3.50-4.20 p.m. Geopolitical considerations
*Discussion leader: G. Chicognani*

4.20-5.00 p.m. Industrial promotion considerations
*Discussion leader: F. Jäger*

5.00-6.00 p.m. Summary of the discussions and comments of the representatives by the Central and Eastern European countries and newly independent States
*Rapporteur: V. Kozharnovich and E. Vento*

Tuesday, 19 June 2001

## Session III. Regional programme on technology foresight

Chairperson: Ambassador Toth

Coordinator: UNIDO expert

9.00-11.45 a.m. Elaboration on highlights for the regional programme
*Discussion leaders: F. Kovats and K. Klusacek*
*Rapporteur: R. Seidl da Fonseca*

Round table on promotion of innovations in biotechnology
*Chairperson: Dan Liang, Director, Quality, Technology and Investment Branch, UNIDO*
*Coordinator: J. Caldas Lima, UNIDO*

Identification of main issues for definition of policies and strategies for technology development in the biotechnology industry
*Discussion leaders: D. Durmanov, S. Pongor and P. Venetianer*
*Rapporteur: M. Misra*

12.00-1.15 p.m. Working lunch

1.15-1.30 p.m. Closing of the meeting

## ANNEX II

### List of participants

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