TECHNOLOGY ASSESSMENT

COMPARISON BETWEEN THE FINNISH PRACTICE AND THE PRACTICES OF THE FIVE EPTA INSTITUTIONS

COMMITTEE FOR THE FUTURE
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and the Practices of the Five EPTA Institutions

Osmo Kuusi

Contacts:

Committee for the Future, FI-00102 Parliament of Finland
Tel. +358 9 4321, fax +358 9 432 2140
E-mail: tuv@parliament.fi
www.parliament.fi/FutureCommittee

Osmo Kuusi
Tel. +358 50 372 0829
E-mail: osmo.kuusi@vatt.fi

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Technology Assessments and Parliament

Parliamentary work focuses on the politics of the day. Laws are passed to resolve apparent societal problems, while the State budget is used to analyse the future over an extremely short period of time. In general, most opportunities provided by and problems caused by technological development are realised too late, in a situation where any possibility to influence the current direction of development has been lost.

With the rapidly increasing rate of technological and societal change, it has become obvious that the existing legislative bodies cannot proactively react to future trends. For example, a bill concerning data security in electronic communication was not submitted to Parliament until quite recently, regardless of the fact that Finnish people have been using mobile phones and e-mail, on a daily basis, for more than 10 years. Due to the non-existence of pertinent legislation, it has been extremely difficult, if not impossible, for citizens and businesses to assess their concomitant rights and responsibilities. Among other things, there have been problems in organising efficient protection against e-mail transmitted viruses and spamming, due to the fact that teleoperators have not been entirely convinced about the lawfulness of the means and methods currently available.

To enable Parliament to steer the development of Finnish society, instead of merely reacting to problems, Members of Parliament need information on forthcoming technologies and their potential consequences. Such a phenomenon as globalisation, which shakes the very foundations of international economy, would have been impossible without the worldwide data communication networks that developed during the past few decades, which now enable the efficient management of global, distributed organisations. If this had been understood in time, the so-called “China phenomenon” would have come as no surprise to Finland, allowing us to prepare accordingly.

The effects of data communication networks on the structures of global economy are a prime example of a situation where Parliament must do more than just record the development trends detected by other players. TA activities require courage and ambition, and the preparedness to accept risks that are invariably involved in any analysis of uncertain future opportunities. This is the only way parliamentary TA projects can produce real added value, motivating the researchers and MPs involved.

The Committee for the Future is responsible for the TA activities carried out by the Parliament of Finland. Unlike several other countries, Finnish politicians actively participate in assessment activities, in co-operation with researchers, defining the assessment targets and drawing the conclusions. This means that ensuring the political neutrality of assessment work constitutes a special challenge. Can MPs select the themes and draw the conclusions objectively? The answer is no, and this is a particular strength of the Finnish assessment approach. On the other hand, political players are capable of identifying the political issues involved in the effects of various technologies and examine these from different points of view. However, this variety of thoughts must also be seen in the assessment results. Otherwise, there is the risk of presenting a single, politically biased, view as the only truth. In addition, care must be taken so as not to exclusively concentrate on personal pet schemes fostered by those decision-makers who select the assessment targets. There have been clear indications in this direction over the past few years. In terms of societal development, there is the risk of overlooking significant development trends, which deserve due attention. Among others, the effects of communication technology development on working life have been assessed to a limited degree in Finland, regardless of the fact that about 22% of our workforce is engaged in so-called eWork or telework, mobile work, or work independently from home.

At the beginning of the electoral period 2003–2007, the Committee for the Future will not only launch new activities but also carry on with the work initiated during the previous period. The TA projects conducted during the electoral period 1999-2003, generated a number of new questions, to which answers are currently being sought. Among others, the TA report called "Initial Social Capital and ICT" is to be supplemented by an analysis where the significance of social capital will be examined, especially in view of children's and young people's future-related risks. The assessment of regional innovation activities will also be continued. As for new TA projects, future development will be analysed with regards to the Finnish model of the information society, the provision of health care services, and people's security, in the long term. All three constitute major challenges that Finnish society must rise to, with Parliament taking a stand during the current electoral period.

People's inactivity in civic debate is the most significant drawback of the Finnish assessment system. Finland has failed to engage private citizens in TA activities, regardless of the fact that they constitute the ultimate targets for any effects imposed by new technologies. In addition, the TA results are poorly communicated, and not debated in the media. In this respect, the Committee for the Future has a great deal to learn from the participating TA practice assumed in Denmark. The politicians participating in TA activities must assume the central role as initiators of public debate on the effects of technological development.

In addition to activating civic debate, attention must be paid to securing the high scientific standard of TA activities. The scarcity of resources available to TA constitutes an obvious problem, especially in this respect. To reliably assess the impacts of technological development on society means, that the field of technology must be monitored, in it entirety. According to a recent report by the Institute for the Future (IFTF) in Silicon Valley, California, significant future innovation will be generated by interfaces between ICT, material technologies, bio technologies and energy technologies. This means that, over the next few decades, a major societal challenge would be the birth of a bio society, as an outcome of nanotechnology development that will combine the said four technologies.

We must provide a solid basis for TA activities in Finland, to secure their long-term development. With the Committee for the Future currently having a well-established position in our parliamentary organisation, and its work no longer being of a temporary nature, TA activities, which are among its central duties, can no longer be financed through temporary solutions or random funding. This means that the Committee for the Future must, during the current electoral period, create a permanent TA procedure that will guarantee the high quality of assessments, and find a way to obtain permanent funding for this arrangement.

Jyrki J.J. Kasvi
Member of Parliament, Member of the Committee for the Future, Person responsible for TA

To the Reader

Commissioned by Sitra (the Finnish National Fund for Research and Development) Dr. Osmo Kuusi undertook a survey on the development technology assessment and technology foresight activities, with a special emphasis on the tasks of the Finnish Parliament's Committee for the Future. During 2000–2003, Kuusi was employed by Sitra as an assessment expert assigned to support the Committee for the Future in its TA activities. He has participated in several TA projects, bearing the main responsibility in those concerning the human genome and stem cells, among others. As part of his responsibilities, he has also rendered advisory opinions concerning assessment targets proposed by the Committee for the Future.

The starting shot for parliamentary assessment activities may be seen in a working group that was commissioned in 1995, for the purpose of clarifying Parliament's technology assessment activities. Professor Reijo Miettinen was assigned to produce a report on the issue. The report proposed that a separate institute should be established to co-ordinate and implement assessment activities. However, Parliament decided otherwise and included TA activities in its own organisation. To obtain additional resources, Parliament turned to Sitra, and, as a result, Dr. Kuusi began his work in support of the Committee for the Future.

Sitra requested that Osmo Kuusi analyse the various assessment practices assumed in different countries, and propose how TA activities should be organised in Finland, based on the results obtained. Kuusi acquainted himself with various models of assessment work organisation. His report focuses on analysing the current practices in Germany, Austria, Switzerland, Denmark, and the UK, which considerably differ from one another, and from the Finnish practice. The strength of the Finnish practice is seen in active participation by MPs in TA activities. As a major drawback, Kuusi points out the absence of scientific quality assessments, including possible doubts concerning the assessments' political neutrality. With this as the basis, his view is that the country needs a specific technology assessment and foresight unit, one that is provided with a sufficient critical mass of technological and societal expertise, so as to meet the various criteria in terms of functions and criteria. Apart from parliamentary TA needs, the unit would also serve other sectors that require assessment and foresight knowledge (administration, businesses, the general public).

The report analyses alternative locations for the possible forthcoming assessment unit. Especially, the Finland Futures Research Centre of the Turku School of Economics and Business Administration, the Systems Analysis Laboratory of the Helsinki University of Technology, VTT Technology Studies – a unit of the VTT Technical Research Centre of Finland, and the Government Institute for Economic Research VATT, are likely candidates. According to Kuusi, other possible home bases include Tekes (the National Technology Agency of Finland) and Sitra. As Kuusi sees it, their strengths are found in their versatile knowledge of various technologies, and the establishment of the unit in question would comply with their mutual objectives. However, Sitra and Tekes are, primarily, research funding bodies by nature, not ones involved in practical research. This would make their activity as a research unit home base somewhat problematic.

Sitra's Finland 2015 Course Programme with its Summit seminar held in Tallinn, Estonia, in September 2003 also focused on technology assessment and technology foresight issues. Five working groups were assigned to prepare the Summit, with one concentrating on technology foresight and the societal and economic significance of technology. Experts and support groups were nominated for each working group. The working groups' theses were processed by the Summit. The working group concentrating on technology foresight will continue to work with its experts, to present its final report in early 2004. Section 5.1 of Kuusi's report deals with the work in question.

Sitra's strategy emphasises a pioneering role, plus research into and experimentation with new issues and phenomena. This role does not fit well with the funding of permanent organisations and tasks. Technology assessments and technology foresight have an important position in the Finnish innovation system in their own right. This means that we must seriously consider the organisation and co-ordination of assessment and foresight activities in Finland. Osmo Kuusi's report provides an excellent premise for this work and complements a previous Sitra report titled "Experiences with National Technology Foresight Studies" (Sitra reports 4, 2001).

Antti Hautamäki
Director
Sitra

1. Introduction

The purpose of this report is to open discussion on the future of the Finnish Parliament's technology assessment activities, in principle on a clean slate, analysing the experiences gained of TA activities in Finland and other European countries.

A parliamentary working group and its report published on 21st December 1995, led to the launch of TA activities in Parliament in 1997. The need for assessment activities was justified as follows:

> The need for parliamentary TA activities can be justified in two ways. The increasing rate of scientific and technological development exerts an essential influence on society, economic development, and the lives of private citizens. With the aid of technology assessments, Members of Parliament can more effectively perceive the impacts in question, and take them into account in political decision-making. The second justification is related to the Parliament's tasks and democracy. To be able to supervise the Government's activities, Parliament must have an existing, adequate knowledge base when assessing submitted bills and budget solutions of societal significance.

In practice, the Committee for the Future was made responsible for parliamentary TA activities and was granted the status of a permanent committee in 2000. As the working group had suggested, the implementation of TA activities was initiated in a manner resembling that assumed by the German Bundestag. However, a central, significant deviation was initially made from the German model. Unlike the German assessment unit TAB, the responsibility for conducting TA activities was not assumed by a non-parliamentary unit in Finland. As set out in this report, the Finnish assessment practice has also deviated from the German model in certain other respects. Apart from the two basic objectives quoted above, additional goals have been pursued.

It has been the experience of several European countries that connecting TA activities to parliamentary work is a feasible solution. This is indicated by the fact that, in addition to the EU's parliamentary TA unit STOA, 14 European countries operate a TA unit, and have all joined the European Parliamentary Technology Assessment (EPTA), either as regular members or as observers (www.eptanetwork.org). The exchange of experiences has been EPTA's central task. Two annual EPTA meetings are arranged and hosted by the presiding country, with the presidency changing each year.

An EPTA Directors' Meeting is arranged each spring, with 20–30 TA unit directors or persons responsible for international activities meeting to exchange experiences and plan the year's activities. In 2001, the meeting was held in Kuusamo, Finland, in 2002 in Belfast, Northern Ireland, and in 2003 in Geneva, Switzerland. A more extensive meeting is the Conference convened each autumn, focusing on a specific theme or themes, with a large number of MPs participating, hosted by the Parliament in the presiding country. The Council that has the highest decision-making power within the network has its annual meeting in conjunction with the Conference.

On the one hand, this report is based on my personal experience of producing TA reports to our Parliament, and on the discussions that I have had with people engaged in EPTA's activities, on the other. My point of view is very practical.

Report appendix 1 briefly sets out a brief history of TA activities conducted by the Finnish Parliament, mentioning the nine TA projects completed until now. During 1999–2003, I participated in seven of the projects, either as the person chiefly responsible for the assessment in question, and as the writer of the final report (the Gerontechnology TA project and the Human Genome and Stem Cell Research TA project), as the expert responsible for the TA procedure (Energy 2010), producing statements and draft texts, and actively participating in steering group work (Knowledge Management, Initial Social Capital and Regional Innovation Systems), or writing the statement concerning the implementation method (New and Renewable Energy Solutions).

I have participated in two EPTA Directors' Meetings, in 2001 and 2002, and EPTA council meetings in Finland and the UK. In practice, I was largely responsible for the thematic section of the meeting held in the Finnish Parliament in 2001. Based on the informal discussions held with key representatives of the said TA units at various stages, I have a fairly good view on the various countries' experiences concerning TA activities. I have systematically deepened this view through visiting the various national TA units during the summer and autumn of 2002.

It is important to stress that this report is the English translation of the Finnish report published in autumn 2003.

2. Summary of the Finnish Parliament's TA practice compared to those of other countries

In this section, the Finnish TA practice is compared to those assumed by other EPTA countries' TA units that I visited during the latter half of 2002. The visited units were the German TAB (Das Büro für Technikfolgen-Abschätzung beim Deutschen Bundestag), the UK POST (Parlamentary Office of Science and Technology), the Austrian ITA (Institut für Technikfolgen-Abschätzung), the Swiss TA (Zentrum für Technologiefolgen- Abschätzung) and the Danish Board of Technology (Teknologirådet). However, one must point out that, in addition to the said institutes, the Dutch Rathenau Institute especially has contributed significantly to the development of TA within EPTA. The constructive technology assessment method developed in Holland is analysed more closely in the methods section.

In general, it may be stated that the assessment practice of the compared institutes differ mutually to a significant degree. However, the various implementations may be seen to seek solutions to similar basic problems of a practical nature, regardless of their differing emphasis. In practice, the most significant contentual choices are related to the following 10 basic problems:

1) Are several specific themes assessed briefly or just a few wide themes extensively?
2) Are answers sought quickly to urgent questions, or to difficult ones with time?
3) Is the intention to acquire existing knowledge, or to develop new, alternative ways for perception and action?
4) Is the focus on analysing forthcoming threats imposed by technology development, or on new technology-related opportunities?
5) Do parliamentarians learn from assessments, and do they experience the insights and discoveries thus generated as their own?
6) What are the methods used to ensure the assessments' high scientific standard and political neutrality?
7) Is the quality of assessments improved by the experience gained from previous TA projects? Is there progress with regard to the assessment methods?
8) Is dialogue promoted between parliamentarians, scientists and technology experts?
9) Is dialogue promoted between parliamentarians and the administration personnel engaged in preparatory work?
10) Is dialogue promoted between parliamentarians, experts, and the general public, using Internet pages, citizen hearings and publicity in the media, for example?

In addition to the above contentual basic questions, and closely relating to them, there are essential issues pertaining to TA resource allocation, and to the degree to which the TA units' own personnel, and external experts, are responsible for the assessments in question.

The table below is a summary describing the TA practices assumed by the interviewed units. The characterisations are based on discussions held during my visits to the TA units in question, and comments received with regard to assessments made on the units in 2003. The key persons interviewed in the TA institutes, who contributed their comments to the summary, were Sergio Bellucci and Adrian Rüegsegger (the Swiss TA), David Cope (the UK POST), Leonhard Hennen (the German TAB), Lars Klüver (the Danish Teknologirådet) and Walter Peissl (the Austrian ITA). In certain respects, I could not concur with the comments expressed. Especially regarding the question whether the TA units primarily focused on threats arising from technology development, rather than opportunities, a difference of interpretation remained between me and some interviees. Apart from this criterion 4, the differences of interpretation were insignificant.

Table 1. An estimate of the various countries' TA practices compared to the Finnish practice

	Germany TAB	**Austria ITA**	**TA Swiss**	**Danish Board of Technology**	**UK POST**	**Finland Committee for the Future**
1. Short/long reports on specific/wide themes	Long reports on wide themes	Long reports on usually specific themes, met-hodological reports	Long reports on wide themes for studies, medium length reports on participatory methods	Wide or specific, medium length reports often focused on assessments by experts involved, stakeholders or citizens	Short or medium-length reports on specific or wider themes	Long reports on wide themes
2. Length of assessments and urgency of their themes	On average about 30 months; wide distribution, 10–66 months	On average about 18 months; projects lasting only 6 months beside long-lasting projects	On average about 24 months for studies; 6 to 18 months for participatory methods	Hearings are reported on average about 3 months after. Wider TA 4–18 months	Postnotes of 2–8 pages about urgent themes in 1–3 months; also longer assessments – up to a year	On average about 18 months. If only a preliminary assessment, 2–3 months
3. Collection of information for TA and its valuation	Information from expert statements. Experts are selected by TAB. The referee MPs (rapporteurs) only formally approve selected experts	Case studies or survey studies. Also expert interviews and increasingly workshops with experts and stakeholders	TA project managers collect information and make conclusions and suggestions based on it; relevant issues are discussed with stakeholders	Participative processes with experts, stakeholders and citizens as the source of information and its validation. Different groups make conclusions, depending on problem and method	Experts in POST collect from written sources and from key experts	TA project managers collect information or systematically use panels of 20-40 experts; Committee for the Future makes a final conclusion statement
4. Focus on threats or opportunities (Interpretation of Osmo Kuusi)	Predominantly on threats	Evenly on both	Predominantly on threats	Slightly more on threats	Evenly on both	Somewhat more on opportunities
4. Focus on threats or opportunities (interpretations of the heard institutes)	Threats as well as opportunities	Both threats and opportunities	Somewhat more on threats	Both threats and opportunities	Both threats and opportunities	Somewhat more on opportunities

5. MPs learn from assessments and commit to their conclusions	MPs select TA themes and function as reporters	Weak connections with Parliament	MPs participate as one stake-holder group	MPs participate as one stake-holder group	Board (mainly MPs) selects themes and discusses results	MPs select TA themes and participate actively in TA processes
6. Scientific quality and neutrality	Scientific director of the research institute (ITAS) responsible	Academicians of the Academy of Sciences beside ITA researchers responsible	Expert panels (accompanying groups) are organized for every project	Transparency, open discourse, counter-expertise	Independent assessment unit (POST) responsible, with external review of drafts	No clear practice
7. Experience gained from earlier assessments	Fairly permanent – at least 5-year period – assessment unit a part of the research institute	Permanent assessment institute	Permanent assessment institute; network of stakeholders (including MPs), restriction on three subject areas	Permanent assessment institute	Permanent assessment institute	Permanent secretary on MP advisory boards and same people often TA mana-gers
8. Dialogue between scientific community and MPs	As part of the scientific research institute, TAB belongs to the scientific community	As part of the Austrian Academy of Sciences, the ITA belongs to the scientific community	Direct contacts between researchers and MPs and the steering committee of TA Swiss. Information meetings organized for MPs, involving scientists in the discussions	Representatives of the scientific communities belong to the Board and the Board of Representatives	Personal contacts of POST scientific officers with the scientific community	Organised contact based on the Association of MPs and Researchers; (TUTKAS). Informal contacts
9. Dialogue between MPs and public administration preparing technology policy choices	Continuous interaction with the ad-ministration on a routine basis	Many institutions of the ad-ministration do partly TA-related studies; cooperation on specific themes	TA projects often support legislation, first during the draft phase (work on law projects by the administration), later in the work of parliamentary commissions	Formal connection with the Science Ministry, which is the main financier of the Institute. Formal link with parliamentary committees	Formal separation from but many informal contacts with the public administration	Permanent co-operation network with research units of the administration; network meetings usually twice a year

10. Internet pages and dialogue between MPs, experts and the general public	Rather good Internet pages. No public hearings. Not much visibility in media	Good Internet pages. Public hearings in preparation. Not much visibility in media	Good Internet pages. Public hearings. Quite a lot of visibility in media	Good Internet pages. Public hearings the basic working method. Much visibility in media	Good Internet pages. No public hearings (not POST's role). Quite a lot of visibility in media	Rather poor Internet pages and difficult to find. No public hearings. Not much visibility in media
11. Monetary resources of the assessment activities in comparison with the Finnish practice	Plenty	Sufficient	Plenty	Sufficient, but reduced in recent years	Moderate	Meagre
12. People who perform assessment activities	Outside experts contribute to the TA processes designed and steered by TAB staff. The reports are written by permanent staff	Mainly by permanent staff	Mainly by experts hired for projects	Mainly by permanent staff	Mainly by permanent staff, with occasional use of external experts	Half and half by permanent staff and by experts hired for projects

During the electoral period 1999—2003 the TA procedures in Finland had the following features in comparison to other countries.

All seven of the TA projects conducted during the electoral period have focused on fairly wide themes, regardless of the fact that their preliminary surveys have typically endeavoured to limit the themes. The assessments have been carried out with a tight schedule, compared to Switzerland, and especially Germany, which are countries operating with same kind of themes.

With regard to its primary TA procedure, the UK POST has chosen an operation model that clearly deviates from the rest of the units analysed in this report. POST's activities are directly equivalent to those of the House of Commons Library, with regard to POST notes consisting of 2-8 pages. This similarity is especially obvious with regard to the 2-page POST notes, which are defined to provide background information on scientific and technological issues as soon as possible, with immediate political relevance (The Future of Parliamentary Office…, 2000). The reports by the Danish Board of Technology also deviate from the others, due to the fact that they are chiefly descriptions of implemented hearing processes.

The division of labour between POST and the Library has occasionally been experienced as problematic in the UK. A UK parliamentary committee report from 1995 contained the following statement:

> The Library's research service relies mainly on published material (increasingly from online sources). POST's use of unpublished material and its contacts with scientists elsewhere about work in progress make it very up to date but they require that its papers are referred by outside experts. The Library produces various opinions on issues in the form of text quotations whereas POST endeavours to reach consensus in its assessments. There is room for both viewpoints.

When recommending a permanent status for POST, starting from 1st April 2001, the Information Committee particularly emphasised that POST should have an efficient division of labour with the Library.

In this regard, the Finnish Committee for the Future has expressed conflicting views, whether to exclusively collect existing knowledge and information, or to embark on new approaches and projects. In general, TA managers have also wanted to seek new solutions, especially through systematic expert hearings (such as argumentation-based Delphi processes). One may conclude that, at least, Germany and Denmark have assumed a systematic use of similar expert hearings, albeit using somewhat different methods than Finland. Especially in Austria, knowledge has been sought through carefully analysed case studies, in addition to expert hearings. The other TA units have used expert knowledge to a less systematic degree.

In the Finnish TA practice, opportunities have been emphasised more than threats, when compared to other countries. Innovation through new solutions has been highlighted in all the TA projects conducted. In Finland, TA activities have been implemented by the Committee for the Future that analyses future opportunities on a wide basis. Undoubtedly, this is one of the factors behind the emphasis on opportunities. More clearly than others, the Swiss and German TA practices focused on threats. The Swiss focus on threats, instead of potential benefits, manifests itself, for example in the following introduction text found on the TA-Swiss Internet web site.

> Hardly anyone today would like to do without all the benefits of modern technology. It is often requested, however, that possible consequences should be comprehensively examined in good time, in order to assess negative effects and reduce them as far as possible. The Centre for Technology Assessment TA-SWISS at the Swiss Science and Technology Council has taken on this task.

In Germany, such statements have not been expressed. Instead, when comparing the German and Finnish practice more closely, as indicated later in this report, the German Bundestag has even advised people to avoid them. In his comment on the English summary of this report the TAB representative denied the highlighting of threats, stating, however, that this is a matter of interpretation. When reading German reports, one cannot, however, escape the conclusion that threats were emphasised more than opportunities, especially in reports dealing with gene technology assessment. In my opinion, the viewpoints were more evenly balanced in the British and Austrian assessments. One indication of this is that the Austrian ITA also undertook a large national Technology Foresight project on opportunities provided by technology. Denmark’s slight emphasis on threats can be justified by the fact that, in a consensus panel, citizens are generally more worried about technology-related threats than interested in the potential opportunities provided. The Danish Board of Technology has also initiated a national Technology Foresight study.

Even if a number of MPs were not re-elected for the current period, which led to a new situation, I still consider MPs’ active personal participation in TA activities as a special strength of the Finnish practice. Consequently, MPs are in an excellent position to adopt TA generated insights and discoveries and experience them as their own. During the 4-year period 1999–2003, a number of MPs had TA projects very much at heart, especially those dealing with energy politics, knowledge management, regional innovation systems and initial social capital.

The downside of active MP participation is the aforesaid endangering of neutrality. The UK POST, in particular, has apparently succeeded in establishing excellent partnerships with parliamentarians, without compromising its critical approach and independence. The Austrian ITA is the opposite example, with a number of parliamentarians experiencing negative consequences from their party colleagues because of their active participation in TA. Austria uses the so-called long lists set by political parties in general elections. According to an interviewed ITA researcher, participation in TA projects was seen as an impediment when defining the order of listed candidates. Though ITA has worked quite actively within the EPTA-network, its weak connections with parliamentarians were explanation of its observer status at EPTA.

As I see it, the absence of scientific quality assessments, including possible doubts concerning the assessments' political neutrality, are major drawbacks in the Finnish Parliament's current TA activities. There is no established procedure applied to quality control or the ensuring of neutrality. This may be regarded as a moderate price to pay for parliamentarians' active participation in TA projects. On the other hand, it also constitutes a "time bomb" that can instantly ruin the activities' credibility in their entirety. My view is that, that in the autumn of 2001, we came close to a "credibility bomb detonation" in the Energy 2010 TA project, even if special caution had been followed and objectivity endeavoured for, due to the delicate nature of the issue in question. In Germany and Austria, the control of TA activities' high scientific quality has been considered to be extremely important. The Swiss, Danish and British TA units are independent of their national parliaments, and their close contacts with the scientific community have implied scientific quality control and neutrality. On its Internet home pages, the Austrian ITA analyses the quality requirements as follows:

> It is important to seek systematic and interdisciplinary empirical verification and to put the results into a highly transparent form. In addition, a pre-condition is a considerable amount of basic research and an effort to detect fields of future problems as early as possible.

If a TA unit operates, like the German TAB, as part of a national research institute, or if there is a sufficient number of scientifically qualified people, or people active in the field of science (distinctly the Austrian ITA, less distinctly the UK POST and the Danish Board of Technology), one may conclude that scientific quality is controlled, at least to a reasonable degree. The minimum quality control requirement is seen in the practice of the TA-Swiss where the researchers are personally responsible for their own assessments.

In terms of experience gained from earlier assessments, the Finnish practice is comparable to the Swiss. Learning is based on the fact that the same people participate in several consecutive TA projects. Up until now, this approach to TA has resulted in the type of learning that has improved the quality of completed projects in Finland. This has been promoted by the work of Researcher Ulrica Gabrielsson as the TA projects' steering group secretary, and by the same MPs' participation in several TA project steering groups. In addition, Sitra's active participation TA preparatory work and implementation, plus TA-funded, systematic experimentations with various assessment methods (and those based on my personal contribution) have all promoted learning. However, participation by the same people in TA activities constitutes a more unstable situation in terms of learning, compared to a unit provided with sufficient personnel and permanent preconditions for operations. An independent unit with relatively stable resources may assume the important task of continuously improving TA and foresight quality, and that of related methods, as is the case with TAB, ITA and the Danish Board of Technology. This provides the required preconditions for learning on a long-term basis.

Intensive dialogue with the scientific community is a must for up-to-date TA activities. In parliamentary debate on the future of POST conducted on 3rd June 2000, Lord Flowers stated the issue as follows (The Future of Parliamentary Office…, 2000):

> POST's activities largely consist of co-operation with the scientific community. This is their source of information. Knowledge is not acquired from books or magazines in the first place. It is generated through discourse between people, and by making people in laboratories and elsewhere in the country think what they could give, and what kind of answers they could give to our questions, etc..

All the TA units included in this comparison regarded direct, personal, confidential contacts with the scientific community as extremely important. Without contacts of this type, tacit knowledge, or the weak signs of potential opportunities and threats relating to technology development, cannot be identified. Relying merely on the type of knowledge that is supplied by libraries' information services through their document search operations, early insights on future developments will remain undone. Scientists' direct participation in TA unit administration constitutes one opportunity to acquire this type of knowledge. In fact, scientists participate, in one way or another, in the decision making of all national TA units, with the exception of Finland. However, interaction has been in progress from the early days of TA activities through the Association of Members of Parliament and Scientists (TUTKAS). A Finnish tradition is to hear scientists in all parliamentary committees as experts. There have also been connections through Sitra and the TA project secretaries' personal contacts.

In the Human Genome and Stem Cells TA project, the Argument Delphi technique was used to establish systematic interaction between representatives of the scientific community through interviews and written expert comments. The statements made were recorded verbatim in the basic TA report but MPs did not personally participate in the interaction process with scientists. In the Energy 2010 TA project, MPs also participated in written dialogue with scientific experts. However, some MPs experienced the chosen type of interaction, which was based on anonymously expressed points of view between MPs and experts, as manipulative, and preferred the conventional expert hearings by the parliamentary committees.

During the electoral period 1999–2003, a better premise for dialogue between MPs and the administration has been created in the Finnish TA practice. A new, promoting step in this direction was the establishment of a TA contact persons' network between research institutes and the central administration units. In the Knowledge Management and Regional Innovation Systems TA projects, interaction with the administration was promoted through steering group visits to regional meetings and dialogue on the Internet. Regarding the analysed TA units, Switzerland and Denmark have arranged their contacts with the administration in the clearest fashion. The TA-Swiss management are nominated by the Swiss Science and Technology Council, and the Danish Board of Technology is funded by the Ministry of Science. In its introduction text, the Board defines Parliament's and the science administration's contribution to its management as follows:

> The Ministry of Research is the supervising authority for the Board and the Parliament's Research Committee is the Board's steady liaison with Parliament.

Based on the report approved by the German Bundestag in 2002, TAB has permanent connections with the administration. Unambiguously, POST exclusively serves Parliament, being separated from administrative law-drafting work. One may conclude that the UK POST has done high-quality work with success, in spite of having abstained from contacts with non-parliamentary organisations. Naturally, however, its employees have informal personal contacts with the administration and non-governmental organisations.

In 2003 Finnish citizens were not informed on Parliament's TA activities by means of well-edited Internet pages, unlike all the other countries involved. The only negative comment one could make concerning TAB's pages is that they need updating. Nevertheless, compared to the existing Finnish pages, with inadequate descriptions of our current TA activities, they were superior. Still, the status of the Finnish Internet pages in 2003 can be explained, at least partly, by the scarcity of resources available to the TA activities. An additional explanation is that Parliament's information systems practice was rather rigid.

Finnish TA activities have clearly focused on interaction with scientists, instead of citizens (through consensus conferences, for example). Direct dialogue between citizens and MPs has remained in the background in completed TA projects, with the exception of Parliament's Knowledge Management project. In this regard, the Finnish practice clearly deviates from that of the Danish Board of Technology and TA-Swiss. Whereas in TAB and POST direct interaction with citizens has never been a standard practice.

In recent scientific discussion, the so-called participatory TA has been quite favourably observed. For the Danish Board of Technology, this has been the central procedure for a long time. The institute describes its research theme selection method on its web site as follows:

> Every year, the Danish Board of Technology calls upon members of Parliament, various authorities, organizations, business enterprises and individuals to come up with suggestions for topics for the coming year's efforts. Some of these ideas evolve into projects; others are treated in articles in both "Teknologidebat" and our newsletter, "From the Board to the Parliament".
>
> The Danish Board of Technology's collection of topics for the year 2002 has now come to a close. We gathered 172 topic suggestions for the Board's 2002 work schedule. The proposals align themselves in certain categories: IT, culture/media, agriculture, environment/energy, health care, traffic, technology policy, etc.
>
> Our secretariat has reviewed all the proposals and has written theme descriptions about them. On this basis, the Board's directorate selected eight projects with which the secretariat will be working this year.

On its web site, TA-Swiss expresses its interest in promoting interaction between parliamentarians and citizens as follows:

> The creation of a constructive dialogue between the public and the scientific community is also one of the tasks which the Centre for Technology Assessment has taken on through the implementation and development of participative methods.

The visibility of TA results in the media – concerning which I had not much other than the interviewees' statements as the data – would appear to correlate with the emphasis of participatory working methods. The extensive publicity gained by a number of well-edited POST reports are a clear exception to this rule. Regardless of the fact that certain TA reports completed by the Finnish Parliament have made prominent news in the media – most recently the Human Genome and Stems Cells TA project on the scientific pages of Helsingin Sanomat in November 2002 – on the whole, TA has gained little interest in the press.

Compared to other countries, the Parliament of Finland has had meagre resources at its disposal for this purpose. Without Sitra's resources, above all, but also taking into account the investments made by other parties (VTT and universities) current, rather high quality TA activities would not have been possible in Finland. The meagre resources is easy to perceive when one compares the German TAB's costs to Finland's total TA costs.

The German Parliament granted an annual 2045 000 euros for TA activities in 2002. Half of this sum consisted of TAB's own expenses, and the other half of external expert costs. A rough estimate is that the Parliament of Finland has spent about 130 000 euros per year on TA activities. In addition, Sitra has supported this work by providing expert assistance. Sitra's financial support amounted to about 290 000 euros during 1999–2003, which translates to an annual equivalent of 73 000 euros. This means that Finland's annual TA costs are about 10 % of Germany's corresponding costs.

The Danish Board of Technology says on its web site it receives about DKK 13 million, i.e. about 1.7 million euros. The costs of the Austrian and Swiss TA units are probably of the same order. In 2000, POST was closer to the Finnish level, in terms of costs and personnel resources among the compared institutes. Its annual costs in the said year were about 300 000 euros (The Future of Parliamentary Office…, 2000). Compared to all others, the low costs were explained by focusing on the publication of brief POST Notes, mainly produced by its own personnel. From 2000 to 2003, however, POST's resources increased considerably and its personnel from the initial five to nine.

The Finnish TA unit's practice of focusing on external and internal workforce most closely resembles the practice of the German TAB. As for Finland, however, the proportion is decisively determined on how Sitra's contribution (in other words my personal contribution during the electoral period 1999–2003) is calculated. TA-Swiss is the unit that has based its activities most clearly on orders received from clients. ITA, the Danish Board of Technology and POST have mainly conducted their TA activities with permanent staff, with external expert knowledge playing a central role.

3. Comparing German TA activities

As stated above, the preliminary point of comparison for Finnish TA activities initially consisted of those pursued by the German Bundestag. To open a more comprehensive point of view on the premise for TA, in addition to individual characteristics, it is useful to compare the practices implemented in Finland and Germany more closely. An excellent opportunity for this (conserning the period 1999—2003) was provided by the German Bundestag's survey report titled "Assessing the Impact of Technology. Technology Assessment Activities as a Political Advisory System in the German Bundestag" (Technikfolgenabschätzung, 2002).

The premise for launching TA activities in Germany is quite similar to that expressed in Finland in 1995:

1) Recognising the need for impartial knowledge on the development of science and technology.
2) Within Parliament, generating the type of assessment resource that exclusively operates on parliamentary conditions, forming a counterweight for the executive administration and expertise provided by various interest groups.
3) Winning the public trust through increasing participation in civic debate on technology and the impact of technology development, to strengthen Parliament's position as the forum for debate on central issues of national importance.
4) Controlling the Government's activities and defining a framework for technology development, preparing to process forthcoming conflicts.

The above constituted the point of departure for German TA activities that are independent of parliamentary electoral periods. A separate TA office, TAB (Das Büro für Technikfolgen-Abschätzung beim Deutschen Bundestag), was established with the following tasks defined:

1) To survey potential developments in the field of science and technology, plus related economic and environmental risks and opportunities.
2) To study the judicial, economic and societal preconditions for changing the course of scientific and technological development.
3) To analyse potential effects focusing on the future, in a comprehensive fashion, clarifying the opportunities for benefiting from strategic investment for the exploitation of technology, or for minimising related risks.
4) To develop alternative ways of action and approaches for political decision-makers.

The group of parliamentarians, that defined TAB's principle of operation, stressed a point that has not realizes very well:

> The objective is not to issue early warnings on technology-related risks. Instead, the primary task is to identify the opportunities and risks, and to develop the preconditions for new technologies.

In practice, the analysis of technology-related risks has played the central role in Germany. Taking into account promising opportunities provided by genetic tests, TAB TA project conclusions concerning genetic testing are illuminating (Hennen et al., 2001). It is stated, in italics, that "special care must be taken regarding the possibility of increasing, uncontrolled misuse of genetic tests".

Formally, German TA activities have resembled the Finnish ones in many respects, with a number of significant exceptions, however.

Identical features are as follows:

- Like the Finnish Committee for the Future, the German Parliament's Research, Science and Technology Assessment Committee has been ultimately responsible for conducting the TA projects.

- Finland has had TA project steering groups and Germany groups of reporting MPs with corresponding responsibilities.

Somewhat deviating features are as follows:

- In Germany, all parliamentary committees and political groups may submit TA initiatives, with the Research Committee making the choice after negotiations with TAB. In Finland TA initiatives have mainly come from the members of the Committee for the Future, with the Committee deciding the projects' implementation, even if initiatives have also been requested from other committees.

- Between 1992 and 2001, TAB produced about three assessments per year. The average time consumed for a TA project was about 32 months. During the electoral period 1999–2003 Finland produced about two assessments per year. On average, TA projects were completed in about 18 months, with a considerable variation, however.

- The German and Finnish assessment themes have been somewhat similar, both in terms of their themes and scope, with a number of differences. Germany has made seven assessments on gene technology, and Finland two. Like Germany, Finland has conducted TA projects on plant gene technology and genetic testing. Germany has made seven assessments on environmental and energy technology, and Finland two. Finland's assessment targets, i.e. health effects relating to energy production, plus new and renewable energy sources, have also been assessed by Germany. The German TA project focusing on the effects of multimedia was somewhat similar to the Finnish project launched to clarify the relation between social initial capital and ICT. A special Finnish characteristic was constituted by three TA projects dealing with knowledge management and innovation, to which no counterpart was found in Germany. Furthermore, Germany has not assessed gerontechnology, unlike several other countries. Germany has completed three assessments on traffic and tourism. The theme was under consideration in Finland but did not lead to a TA project. In addition, the German projects conducted on new plastic types and military build-up politics have no Finnish counterparts.

First of all, the most significant deviating characteristics are found with TA project funding:

- There has been a great variation in TA costs in Germany. As such, the average costs from the use of external experts have been approximately 250 000 euros per project. The total costs per TA project have been much higher as the projects have mainly been carried out by the TAB personnel. Based on the annual grant of 2 045 000 euros from the German Parliament in 2002, and 3–4 assessments being completed per year, the total costs for full-scale TA projects have been in the order of 500 000 euros. Considering a single full-scale project, the economic resources spent by the Finnish Parliament on external expert fees, have been about 75 000 euros. However, the economic contribution and employee salaries paid by Sitra must be added to this sum. Sitra's financial support amounted to about 290 000 euros during 1999–2003, which roughly translates to an annual equivalent of 50 000 euros in support for an individual full-scale TA project (preliminary survey/actual implementation). Taken as a whole, as a rough estimate, Finland has spent about 25% of the German equivalent per TA project.

Another deviation is closely connected with the German TAB's task definition:

- TA projects are implemented by TAB, which is a unit not directly supervised by Parliament. The German Bundestag Committee on Science, Research and Technology receives TA proposals and requests related statements from TAB. TAB then carries out a preliminary survey to establish whether previous results exist on the issue and provides a statement concerning the necessity of the research in question. It is estimated that the Committee approves about every third proposal made.

- Responsibility for TAB's activities rests with a research institute of high scientific esteem, based on a 5-year agreement period, selected through a bidding contest. In practice, three successive agreements have been made with the Karlsruhe-based ITAS institute. However, the most recent agreement signed for 2003–2008 includes a stipulation that ITAS is to collaborate, on specific issues, with the ISI institute, another Karlsruhe-based applicant.

- Some distance from the Parliament is considered to be important for TAB to retain its neutrality towards people with parliamentary power, and to prevent party politics from affecting TAB's personnel recruitment.

- An objective is to exploit the scientific capacity of ITAS for TA activities.

- The scientific responsibility for TAB's activities rests with the TAB Director who reports to Parliament.

4. Technology assessment and foresight methods

4.1. Method comparison framework

The sections above contain a comparison between the Finnish practice and those of other European countries in TA projects launched to serve parliamentary purposes. Especially during 1999–2003, the Finnish parliamentary TA practice has increasingly focused on anticipation of future developments, in addition to assessing existing technologies. This is a natural development, due to the fact that the Committee for the Future is responsible for TA activities in our Parliament. The final section of the memorandum also proposes organisational solutions based on combining TA with technology foresight activities.

The following sets out a number of central methods that have been or could be used in parliamentary TA and technology foresight activities in Finland. The central challenges to rise to in assessment work have been analysed in various ways. The web site of the Austrian TA unit ITA (http://www.oeaw.ac.at/ita/e1-1.htm) mentions that TA research typically adheres to a procedure containing the following components:

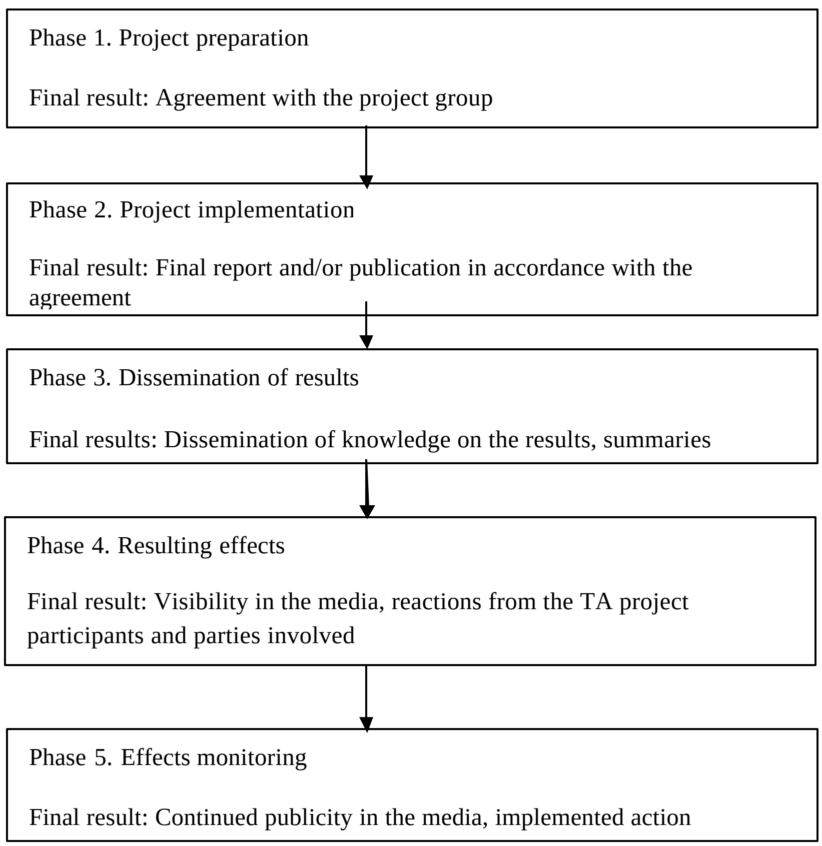
1. problem definition
2. technology description
3. technology development prediction
4. description of the society or people affected by the technology in question
5. societal development prediction
6. identification, analysis and assessment of the impact of technology
7. analysis of alternatives for political action
8. result reports presented in a generally understandable forms.

The above component list is a fairly good description of the challenges to rise to, in cases where the assessment problem is of the type: “Assess how technology XX might affect society.” Such TA problems are of the so-called “technology push” type and clearly based on a specific technology. They have been fairly common but are, naturally, not the only type possible. Another central assessment point of view is based on societal challenges (“demand pull”). In general it is of the following type: “Assess the possibilities of solving societal problem XX developing technologies.” For example, the Gerontechnology TA project conducted by the Finnish Parliament can be seen to have answered the following question: “What type of technological solutions can especially promote elderly people’s independent living at home?” Consequently, the assessment in question does not focus on a single technology. Instead, solving the problem requires versatile clarification and comparison of current and forthcoming technologies, in addition to versatile analysis of the societal challenges in question.

Switzerland’s assessment unit TA-Swiss has published a set of instructions for its TA project orders. Unlike the ITA assessment framework, the TA-Swiss framework strongly emphasises the assessments’ effectiveness aspects.

Consequently, a central question relating to the definition of TA work is how to emphasise the generation of valid information and knowledge on the assessment object, and its dissemination, so as to influence political decision-making. Referring to the TA unit comparison table in section 2 above, it may be sated that items 1–4 and 6 deal with the knowledge being generated, and the quality of this knowledge, with items 5 and 7–10 focusing on the knowledge dissemination problem. In the set of instructions, projects are divided into five phases (Interne Richtlinien…, 2001):

Diagram 1. TA project phases required by TA-Swiss



The following may be identified as the central challenges for universally applicable (parliamentary) technology assessment/foresight methods:

A. Definition of the general assessment problem and its division into essential partial problems.
B. Analysis of relevant features (technologies, social aspects) of previous developments and the present situation for the assessment problem
C. Identification and description of essential development possibilities (technologies, societal factors).
D. Identifying potential opportunities for action, assessing their feasibility, effects and desirability.

E. Dissemination of results in an understandable, effective form to stakeholders that are relevant to the TA problem (politicians, people and organisations mostly affected by the TA problem). In parliamentary TA projects, MPs constitute the most important stakeholders. They should receive information in an understandable, effective form.

The sections below analyse the various assessment methods used or planned to be in use in Finland to meet the five requirements. Here, one must especially emphasise that the five requirements are not identical to the phasing of TA projects. Instead, they generally describe important problems in all future-oriented TA activities, regardless of the means and methods available, and the various stakeholders involved.

Historically, parliamentary TA activities, and the methods used in European countries for this purpose, have largely developed from the experiences gained by the US Congressional Office of Technology Assessment (OTA), the first significant parliamentary TA unit. Josie van Eijndhoven who was the Rathenau Institute Director at that time (1997) has divided existing TA practices into classic TA activities, those with the OTA practice, Public Technology Assessments, and constructive TA. He considers that the OTA practice is the closest to the classic idea of TA to provide scientific basis for politics. When terminating its activities in 1995, good TA was interpreted by OTA as impartial research concerning the positive and negative effects of a specific technology, carried out by neutral scientists (assessors) according to the principles of science. The questions and answers were formulated from extensive hearings of technology developers, or those affected by the said technology.

Detailed descriptions of the projects implemented by OTA are found on the web site: http://www.wws.princeton.edu/~ota/ns20/hman_f.html. The site also contains personal comments from a number of people who participated in OTA's activities. In his final assessment on the institute, Roger Herdman, the last OTA Director, stated as follows:

> In 1972 the U.S. Congress, recognizing the importance for responsible legislating of unbiased expert information and analysis of major science and technology issues, established, by the enactment of Public Law 92-484, the Office of Technology Assessment (OTA), an agency of the Legislative Branch. In the 23 years that followed, OTA developed an experienced and knowledgeable professional scientific staff and, with the help of thousands of national and international experts and stakeholders, created a process, a culture, and a body of work in response to requests from Congressional Committees and OTA's bipartisan, bicameral Board of 12 Senators and Representatives.

Separation of technology evaluation from its users' values has frequently been seen as the basic problem in OTA's approach – a view that is somewhat unjustified considering the TA projects carried out in OTA. As a typical example of citizens' participation in TA, van Eijndhoven mentions the consensus conference developed in Denmark. Admittedly, by taking citizens' values and beliefs into account, the consensus conference clearly deviates from the OTA tradition. Constructive TA especially emphasises that technology assessments are part of the development and implementation of various technologies ("construction"). Surely also experts in OTA realized this role of TA activities

The central characteristic of the Finnish TA practice during the electoral period 1999–2003 was its connections to the frame of reference and methods of futures studies and innovation research. This is natural taking into account the fact that TA activities are closely connected to the work of the Committee for the Future.

The following is an analysis of TA methods used in Finland. The TA methods being analysed are divided into three main groups: futures research methods, decision-model-assisted TA, and participatory TA.

The main methods in the first group in the Parliament of Finland were the Argument Delphi method (cf. Kuusi, 1999a) and the Futures Table or Morphological Matrix method (e.g. Kamppinen et. al., 2002). The other group includes especially the multicriteria-based decision-making models applied by the Systems Analysis Laboratory of the Helsinki University of Technology (Salo, et al., 2003b). In the third group I will discuss, beside the consensus panel method, methods used for "rooting of technologies", (Rask et al., 1999; Väyrynen et al., 2002, Kuusi 2001). The above group division is no way mutually exclusive. It is possible to use methods from each of the three main groups in any single TA project.

In a sense, all below discussed methods may be seen as constructive TA methods, due to the fact that they all interpret technologies as objects of continual development. However, assuming that the methods' developers must be aware of their "constructive approach", then only the method for "rooting of technologies" clearly fills the requirement (Väyrynen et al., 2002). The other methods have been generated in other research paradigms, such as futures studies and systems analysis.

4.2. Futures mapping methods

The futures research is just now intensively looking for the status of science. Traditionally, its identity is very much built on its characteristic methods. In particular, these "identity methods" include various scenario building methods (e.g. Kahn and Wiener 1967, Godet 1994), the Delphi technique (e.g. Linstone and Turoff, 1975; Kuusi 1999), the futures table or morphological matrix technique (e.g. Julien et al., 1975; Kamppinen et al., 2002), cross-impact analysis (e.g. Honton et al., 1984, Seppälä and Kuusi, 1993) and soft systems analysis (e.g. Checkland, 1981; Rubin, 2002). The futures workshop is an important background method for the consensus panel method. It was developed in the beginning of 1970s by Robert Jungk, a prominent futures researcher.

The research tradition of futures studies has largely developed on its own, outside TA activities. The approaches have, however, some common methods. TA has adopted from the futures studies the scenario and the futures workshop methods (e.g. Klüver, 2002). Regardless of their partly identical methods, the Argument Delphi method, for example, has been largely ignored in European TA practices. Still closer the futures studies are to the "technology foresight", which, alongside TA, emphasises the opportunity to influence forthcoming technologies. The Delphi method is an extensively used method in the foresight.

Futures researchers have used their methods in very different ways and emphases. All futures research methods assist, however, in various ways, in the drafting of a set of "futures paths", "scenarios" or "futures map" that can be used for navigating from the present moment to a future target or vision.

The developing technologies play a central role in the looking for feasible routes in the "futures terrain". Assuming that a technology, based on its previous development, will exert a strong influence on the future, we can call it a strong driver or a megatrend (Naisbitt 1984, Kamppinen et al., 2002). A more specific concept which might in the future replace these concepts is the "strong prospective trend" (Toivonen, 2004). First, the strong prospective trend has a strong historical trend giving strong statistical support to its possible continuation. But in reality this statistical evidence is not enough for its continuation in the future because it might happen that the historical trend is just in its breaking point. According to the definition of the "strong prospective trend" a strong trend becomes "prospective" or future-oriented when stakeholders (or experts) relevant for its continuation consider that it will continue in the future. It means that the continuation is based beside statistical information on a common expert evaluation.

Separation of "strong prospective trend" from historical "strong trend" is in particular important in TA, because technological development produces changes that are impossible to realize analysing statistically significant time series of the past. What is needed is "tacit knowledge" of experts. Unlike statistical methods such as regression analysis, futures studies are characterised by methods specifically developed for the critical use of experts' tacit knowledge in turbulent environments.

In addition to the strong prospective trends, futurists have endeavoured to identify weak signals (e.g. Ansoff, 1984, Kuusi et. al, 2000, recently COST A22 project of EU). The critical analysis of the tacit knowledge of experts is especially important in the scientific analysis of weak signals. Like in the decision-model-assisted TA and participatory TA, the central issue in the study of weak signals is the sense making of stakeholders related to the developments related to weak signals.

4.2.1. The Argument Delphi technique

The Argument Delphi technique was the main method in two TA projects during the parliamentary period 1999–2003: The Energy 2010, which discussed the health effects of the possible building of new nuclear power (Technology Assessment 10, 2001) and the Social Challenges of Human Genome and Stem Cell Research (Technology Assessment 16, 2003). The latter study resulted e.g. in still continuing discussion concerning the Finnish Gene Information Centre (Kuusi 2004). In addition, the Argument Delphi technique was applied on a small scale in the Gerontechnology TA project (Kuusi 2001). In the beginning of 2005, started an especially challenging assessment process which was based on the method. After one year's preparatory work the Committee for the Future started the Argument Delphi process concerning the future of the Finnish health care system.

The Argument Delphi technique is based on the Policy Delphi approach (e.g. Turoff, 1975). It is developed in anticipation projects concerning social impacts of new technologies (Kuusi, 1987, 1991, 1994). In the conventional Delphi technique experts are contacted in repeated mail surveys. In the Argument Delphi method, the first mail round is replaced by expert interviews. The long interviews (2-4 hours) are focused typically on broad questions concerning specific themes. They result in anonymous evaluations and arguments expressed by stakeholders or experts. The interviews may be replaced by a panellist-provided text where the author analyses the research problem. For example, in an Argument Delphi process launched to establish a definition for the weak futures related signals, material of this type consisted of definitions of weak future-related signals and the justifications of definitions (Kuusi et al., 2000).

For the second round of the Argument Delphi process, Delphi managers elaborate the first round material. The results of the first round are presented in theses or scenarios and their anonymously expressed justifications (arguments). The second round is implemented through mail or e-mail. Beside numerical evaluations or simple yes/no answers to theses, especially further written arguments are wanted. In the TA projects implemented by the Finnish Parliament, the second round mainly consisted of e-mail use. However, the key panellists also had the opportunity to submit their comments in handwriting to the first round report. There is also available in Finland a dedicated Internet-based software package for this purpose called *Professional Delphi Scan* (www.internetix.fi). A number of other corresponding methods are also available, for the analysis of weak signals (www.fountainpark.org).

The third round of the Argument Delphi process is an expert meeting. It includes the face-to-face discussion of the panellists concerning the results of the second round. The social dynamics of the face-to-face discussion differs fundamentally from the social dynamics of the anonymous argumentation. That is why the third round is used just for the interpretation of the results of the second round. The reporting of the Delphi process is mostly based on the second round.

How the main aims of the TA mentioned in section 4.1. are possible to meet in Argument Delphi processes? I illustrate this with two projects.

Energy 2010 project

A) Definition of the assessment problem and dividing it into partial problems.

Formulation of the assessment problem and dividing it into partial problems was done by the TA Project Steering Group. The specification of partial problems was made in collaboration with MPs participating in the Steering Group, and with the project researchers. Prior to making the specifications, the Steering Group orally heard a number of national key experts representing the energy sector, radiation, and combustion-generated micro particles.

B) Analysis of essential features of past developments and the current situation.

In the project, the first interview round of the Argument Delphi process was divided in two parts. Especially, the first part was used for the identification of essential features of past developments and the current situation. The three radiation specialists and three combustion specialists gave short written answers to theses concerning radiation related to energy production and combustion-generated micro particles.

The experts who were selected by the Steering Group were requested to take a stand on 19 theses. For example, one of these theses stated that "the final disposal of consumed nuclear fuel have not been solved, which means that the most significant health effects of nuclear power are those relating the final disposal of consumed fuel". Five experts made comments on the argument, and one refrained. The answers were as follows:

Expert 1: "*Technically, they* (i.e. the problems of final nuclear fuel disposal) *are already solved, and a not very expensive solution would be perfectly sufficient in terms of the environment and population. The problem must be solved by politicians, and cannot be shifted onto any others." (Disagreement)*

Expert 2: *" I disagree"*

Expert 3: "*Nuclear power is the only form of energy production which has the waste disposal problems solved at the outset. The fossil fuel waste problem has not been solved at all, regarding nitric oxides and CO_2, for example." (Disagreement)*

Expert 4: *"It is difficult to take a stand. Technical solutions, which appear to be extremely reliable, have been developed, but, however, it has not been possible to test them over a realistic period of*

time. The risks are extremely small, but a time span exceeding the human perspective, on which this is based, is problematic from an ethical point of view, at the very least." (No comment)
Expert 5: "Consumed fuel can be safely disposed of by placing it in the bedrock." (Disagreement)

C) Future development options

Expert statements concerning the 19 theses were the starting point of the second part of interview round. Beside 16 Members of the Parliament, 20 other experts or stakeholders participated in it. They were selected by the Steering Group based on the Delphi managers' suggestions. They were divided into three sub-panels: Independent researchers from the administration and universities (6), energy production & distribution experts, and those involved in large-scale energy consumption (9) plus representatives of interested stakeholders influencing public opinion (5).

The panellists took a stand on the future oriented theses with anonymous expert views as the background. They also expressed further points of view that were conveyed as anonymous to all other panellists. As far as the MPs were concerned, the first TA round was carried out by means of interviews, and by e-mail concerning all others. The answers were compiled in accordance with Table 2 below, for the comment round (2nd round). The third column in the original table, consisting of those who did not take a clear stand on the issue, is left out of the table.

Any box of the table 2 is the synthesis of all arguments presented by those belonging to the box. It is of course possible that all in the box do not share the synthesis. During the second round of the Argument Delphi process, the panellists were requested to primarily check their "own box". For example, the independent researchers who opposed the issue primarily checked the box in the upper right-hand corner. Beside that, the panellists have also an opportunity to comment any other argument in the table.

D) Identifying and assessing potential action option

Considering the politically very controversial nature of the assessment object, the Delphi managers did not make any suggestions concerning future action. This also complies with the TA practice where the Committee for the Future makes its own statement based on any conducted assessment. The political statement of the Committee is in the final report of the project. Of course, the statement took into account the results of the Argument Delphi process. With regards to Table 2, for example, it was taken into account that among the different expert groups only a minority group of MPs considered that the final disposal of nuclear fuel belongs to the most difficult problems. In its final statement, the Committee for the Future did not specifically mention the final disposal among the most significant nuclear power problems.

Especially, the third round of the Delphi process was important for conclusions. A seminar was arranged where panellists, MPs from different parties and other stakeholders discussed about the results of the project.

E) Dissemination of results in an understandable, effective form.

The TA project primarily focused on promoting Parliament's internal debate concerning the decision about the new nuclear power station. The TA project was not discussed in the media, except in professional futures studies journals.

Table 2. Delphi panel evaluations and arguments concerning a future-related thesis. Final evaluations from the Argument Delphi round 2.

Thesis: The problems relating to the final disposal of nuclear fuel have not been solved. The most significant health effects of nuclear power are related to the final disposal of consumed fuel.				
Respondent group	I agree		I disagree	
Independent researchers	0		5	The problems relating to the final disposal have been solved as efficiently as, or more efficiently than by several other industries, through several successive protection systems. However, the final disposal constitutes a major ethical problem.
Energy production and distribution, industrial use of energy	1	International development work is required related to the final disposal of consumed fuel.	6	Technically, the storage of consumed nuclear fuel has been solved, even exceeding the security requirements.
Parliament	3	It is safer to store permanently now than use open storage. Permanent storage is not the final solution, however. Transportation from Loviisa to Olkiluoto constitutes a major threat. Changes in the bedrock, earthquakes, groundwater flows, glacial periods, and man's ill will or stupidity constitute threats. Due to bedrock movement, there is no certainty concerning the durability of waste containers. Since the existing natural radiation levels are high in Finland, they should not be elevated through waste disposal.	12	Compared to other power installations, the accident risk is lower. The Posiva Company's nuclear waste management ensures that Finland has no problem but Sosnovyi Bor and Russia are highly problematic. Storage-based radiation doses are insignificant. After a single glacial period (~110 000 years) waste-generated radiation will not significantly deviate from that of uranium ore. The Finnish bedrock does not constitute a risk for final waste disposal. Even in the worst case, where nuclear waste is released onto the ground or into ground water, the risk will not be very high, compared to the existing ground radiation risk. In the long term, a useful application may be developed for nuclear waste. The burden passed on to future generations will be greater from fossil fuels than that of nuclear waste.
Interested stakeholders influencing public opinion	0		4	The most significant health effects of nuclear power are not related to the final disposal of consumed fuel.
Total	4		27	

Social Challenges of Human Genome and Stem Cell Research

A) Definition of the assessment problem and dividing it into partial problems.

The role of the TA Project Steering Group of MPs was rather limited in the definition of the research problem. The definition was based on a preliminary introductory study including the second assessor's (Professor Martti Parvinen) lectures to the Steering Group concerning problems of stem cell research. The formulation of problems concerning the human genome research was especially influenced by the German Parliament's previous TA project (Hennen et al., 2001), and by my interviews in the National Institute for Health in the US.

B) Analysis of the essential features of past developments and the current situation.

The analysis of the present situation and historical trends started in the preliminary research stage (e.g. my interviews in the US). Analysis continued during the first Argument Delphi round.

Discussion concerning future impacts of human genome and stem cells research needs special scientific expertise. Based on that fact, it was reasonable not to use MPs as Delphi panellists, unlike in Energy 2010 project. Another reason for this choice was the MP criticism received in the Energy 2010 project for using MPs in Delphi interviews.

The core of Delphi panellists consisted of four sub-panels. The sub-panels were nominated by four people each representing a highly esteemed national or international TA point of view. The viewpoints were human genome research, stem cell research, ethical questions, as well as economics and business related to these fields of research. For example, the representatives of human genome research were selected by Professor Leena Palotie-Peltonen, a researcher of high international esteem, the current leader of the EU's central research programme in the field. Each selector was requested to nominate five experts, in addition to themselves, for their respective sub-panels. An additional request was to nominate experts whose views most comprehensively cover the various opinions currently prevailing in Finland concerning the future development of their own special fields. It was also desired that one of the nominees should disagree with his or her selector on a maximum number of issues. All the selectors and nominees – a total of 26 persons – were interviewed for 2–3 hours. The Delphi panel was complemented by 5 new members not selected by nominators.

C) Future development options

Identification of future-related development options constituted the main themes of the interviews. Typically, 3–4 issue areas were dealt with, from the total of six issue areas. Some of the interviewees, or those who otherwise commented the first round questionnaire, were prepared to comment on all the areas. The issue areas were as follows:

1. Is there need for extensive analysis of genomes of Finnish people?
2. Capabilities of Finnish experts to exploit knowledge about genomes.
3. General ethical principles and other principles for genetic testing.
4. Opportunities provided by stem cell research.
5. Ethical problems relating to stem cell research
6. Will Finland get economic or social benefit from the investments made in the human genome and stem cells research?

Each of the issue areas was further divided into 5–7 specific issues, the total number of which was 33. In addition to standpoints, the experts were requested to provide estimates of the issue's importance in general, and in terms of parliamentary work in particular.

D) Identifying and assessing potential action options

In the second Argument Delphi round, the experts mainly answered using e-mail. The second round comments were provided by 27 panellists. In order to intensify the commenting, differing opinions or contradictory arguments were sharpened. Concealing the people's identity behind the opinions and arguments enabled this. The resulted critic was directed to the Delphi managers. As the result of the second-round hearing the original 60-page "questionnaire" or report was complemented by written comments, amounting to a total of about 50 pages, beside "tick in the box" answers.

The second round of the Delphi process clearly focused on the action to be taken by Parliament. Future-oriented arguments centred on issues in which the Parliament would play a significant role. The special focus of the second round was the establishment of the National Genome Information Centre. On the other hand, it was realized that it is reasonable to wait important applications of stem cell research just after 2015. What is needed in this field is resource allocation to basic research.

The stands taken on future issues and related actions were presented in the final report as per panellist group. The presenters of judgments and arguments were divided into the following groups:

1) Gene generalists, who are, based on their comprehensive, high-standard professional expertise, in a fairly prominent position in the Finnish debate on the generation and exploitation of gene-related knowledge.
2) Gene specialists with high-standard professional expertise but without as significant a position in the field's general debate as the generalists.
3) The NIH researchers, who have worked in the National Institute for Health in the USA, consisting of a young professor of international esteem plus two junior researchers.
4) Stem cell researchers conducting versatile research into stem cells.
5) Philosophers consisting of university researchers from philosophy and theology departments, well-acquainted with gene ethics.
6) Financial experts, especially those with special knowledge on financial exploitation of gene technology.

E) Dissemination of results in an understandable, effective form.

In accordance with the wish expressed by the Committee for the Future in its final statement, Sitra (Finnish Foundation for Research and Development) decided to finance a book in order to promote general discussion concerning the Finnish gene bank or the Gene Information Centre. The book "Geenitieto kuuluu kaikille" ("Gene Information Belongs to Everybody") (Kuusi 2004) was very well noticed by media (television, radio and press). The initiatives presented in the book resulted in preparation work in the public administration.

The realized assessment projects have shown that the Argument Delphi method is suitable for parliamentary technology assessment. Special features which have made its applications suitable seem to be:

- The special weight given to the selection process of Delphi panellists. Like in the selection of a special committee members, the selection of every single person of the panel of 25-40 persons has to be well motivated from the point of view of the whole panel. Different expertises of panellists should complement each others.

- Long interviews have had two important advantages. They motivate panellists for detailed and serious argumentation. In long interviews it is possible to identify the sense-making approach of a panellist. This promotes the identification of relevant weak signals.

- Anonymous argumentation resulting in social interaction without the problems related to the face-to-face interaction.

- Unlike the traditional Delphi method looking for alternative possible futures instead of expert consensus.

In the final stage of the Energy 2010 TA project, the Committee for the Future discussed the reasonability of expressing judgements and arguments anonymously. In the Parliament of Finland, as in other parliaments, the standard practice is for the Committees to hear experts in person, or by means of written statements confirmed by signatures.

Why is it, then, that the Argument Delphi technique emphasises anonymity in the expression of views? Working face-to-face, and other types of interaction, where those who are expressing opinions are easily identified, involves the following problems (cf. Turoff, 1975):

- A dominant person of high esteem often dictates matters, and others dare not oppose him or her.
- People are reluctant to take a stand before massively acquiring confirmed factual information, or before the majority's stand is clear.
- It is difficult to abandon a stand assumed in public.
- People are shy to express ideas that may prove to be idiotic and lead to loss of face.
- Representing the wrong school of thought makes the idea incredible.
- People get punished for disclosing "confidential" information.

On the other hand, concealing the identity also involves major problems that may be crucial in parliamentary work:

- Other panellists, or the audience, do not know what the debater expressing a view really stands for. It is possible to express conflicting views, or support, in cases where confidential decisions are involved, solutions that contradict those the person in question has expressed previously in public.
- As there is no fear of getting caught, people may propagate groundless and/or purposeful views.
- Doubts concerning the "wrong" opinions may be traced to the wrong person who may get into trouble.
- A person who has disclosed confidential information does not get punished.

In political debate, it is extremely important that voters know what ideas decision-makers stand for, and what type of action they are supporting. One may interpret that this also applies to the experts heard by Parliament. Since it is frequently impossible for MPs to verify expert statements, they are compelled, to a substantial degree, to base their personal assessment on experts' otherwise verifiable reliability. With regards to political activities, identity-based public debate and oral expert hearings by Parliament can be regarded as justified, for the said reasons.

On the other hand, above views in defence of anonymity are really important especially when new ideas are launched or weak signals discussed. Also in cases where strong emotions are involved, the experts can easily be divided into opposing camps, thus preventing fruitful exchange of opinions. This means that research of the Argument Delphi type may be helpful in these situations. However, it may be advisable not to rely on anonymity in cases of undisputed experts, such as the Energy

2010 TA project where six experts were heard initially. Regarding any other expert involved, it might be sometimes a good idea to retain his or her anonymity only during the commenting rounds. Especially if the expert does not see problems in that.

The Committee for the Future took a stand on the issue when dealing with the Energy 2010 TA project on 24th November 2001 as follows:

> *The Committee for the Future considers it necessary to develop parliamentary expert hearing methods. Oral expert hearings must be preserved as the primary hearing method. However, it would be advisable to develop additional, supportive hearing methods, such as expert hearings in writing. The advantages and disadvantages of the various methods available must be clarified.*

4.2.2. Using the Futures Table method in TA

The Futures Table or the Morphological Matrix is a basic tool for futures researchers. However, it has not been widely used for TA purposes, perhaps the reason being that its basic strength – the opportunity to outline several alternative futures – has not been regarded as an essential element. Evaluating alternatives has been seen as more important than their outlining.

Especially when endeavouring to establish the relation between technology development and other societal developments, the Futures Table does offer very interesting tool, however. During the 4-year period 1999–2003, an assessment problem of this type was constituted by the independent living of old people at home, which is with the aid of the so-called gerontechnology (Technology Assessment 9, 2001).

As indicated by the following main section, among others, the Gerontechnology TA project also used a simple decision model. Consequently, the Futures Table may be best applied as an auxiliary to other TA methods. Scenarios formulated using a Futures Table can be used to outline the dimensions that deserve particular attention when evaluating various technologies. The method can also be used to distinguish which issues gain importance when weighting a specific criterion. In fact, this was the method applied in the Gerontechnology TA project. The scenarios based on a Futures Table specified a number of mutually different worlds, where the assessment criterion regarded as the most important by the Committee for the Future will manifest itself in various ways: *"A technology-based solution will promote positive communication and interaction between elderly people and between the elderly and other age groups."*

Since the Futures Table only constituted a single phase in the TA Gerontechnology TA project, it is not advisable to examine it through all the phases set out in section 4.1. The method in question is particularly connected to one of the phases alone that is to outlining potential forthcoming opportunities.

The Gerontechnology Futures Table (Table 3) was used with the column rows indicating the factors expected to have greatest effect on how the old people can cope at home assisted by their families and friends in the future. Each factor may be referred to by means of its numeric code. The factors interpreted as the most important may develop in various ways in the future. Three development alternatives were presented for each factor. These are indicated as A, B, or C. In cases where the factor lacks the year indication it is assumed to be 15 years. The future development alternatives may be debated simply by connecting a future development factor's numeric code to its corresponding alphabetical code. For example, code 1B refers to alternative B (economic growth) for the first factor, which means that the economic growth will be 2–3% over a period of 15 years. Whereas 8C refers to a situation, where immigrants will arrive from all over the world, including the developing countries.

With the table's futures map as the basis, five alternative future paths or scenarios were outlined. The first scenario referred to an idea that is especially general among gerontechnology developers, according to which the post-retirement period would represent a transitory period in life where people leave a painful phase for a period of much-awaited free self-realisation. In other words, the "senior period" in question, which precedes the final dependence on others, in fact, constitutes the "crown of life" as Professor Peter Laslett puts it. A very different future that is based on the increasingly rewarding aspects of work can also be outlined by means of the same table. A third scenario that is essentially based on xenophobia is a fairly probable threat scene that nobody really wants but which is also possible, however. The last two scenarios that were drafted in conjunction with the Gerontechnology TA project outline threat-related futures that are less probable but still possible.

Table 3. The Business as usual or "Proceeding in the current direction" scenario in the Gerontechnology TA project (Kuusi, 2001). The scenario-related development is indicated with a grey background.

Development is examined over a 15-year period, unless indicated otherwise.	**Various development options for the relevant variables, referred to using letter codes (A, B or C) within the text.**		
Relevant variables, referred to using a row number within the text.	**A**	**B**	**C**
1. Economic growth	1% or less	2–3%	4% or more
2. Baby Boomers retire	Early	Late	Inconsistently
3. How do Baby Boomers seek welfare and well-being?	Through improving employment-time quality and converting work into a hobby.	By abandoning the chains of gainful employment for "irresponsible freedom".	Some seek quality of life in employment, others improve their old-age pension through extra income.
4. Participation in voluntary care for the elderly (including assistance provided by the family)	More than currently	As much as currently	Less than currently
5. Baby Boomers' physical and mental preparedness to active life when retiring.	Typically, exhaustion and frustration	Good	Inconsistent
6. Number of Finnish people aged over 60 living abroad in the next 30 years.	Low	High	Very high
7. Number of immigrants	Low	Relatively high	High
8. Where do immigrants come from?	A steady flow from the EU area, including the new member countries	Mainly from the new EU member countries, plus in part from Russia	From all over the world, including developing countries
9. Immigrants' basic education	High	Mainly low	Both educated and uneducated people
10. Use of technology to support independent coping	Restricted	Extensive	Very extensive
11. Use of care workforce	Increases significantly more than is required by the demographic change	Increases in accordance with the demographic change	Increases significantly less than is required by the demographic change

Since the intention in this connection is only to briefly introduce the opportunities provided by the Futures Table for TA, I will only describe the first scenario outlined. In 2001, it was the direction towards which the trends were going 2001. The scenario-related choices are indicated with grey background in the Futures Table. The scenario can be presented in a coded form as follows: 1B, 2A, 3B, 4C, 5A, 6B, 7B, 8B, 9B, 10C, 11B.

Since 2001, progress has been made, which has made the development depicted by the scenario questionable, at least to a certain degree. The comprehensive old age pension scheme that Finland has embarked upon has created major incentives for people to continue their careers in working life. In several central respects, the scenario can still be seen to represent the direction in which Finland is currently drifting.

The storyline of the business as usual scenario:

> In the scenario, the annual economic growth will be 2–3 %. Baby Boomers will retire early. This could refer to an average age of 60 years, which will slightly increase the retirement age from the current approximate age of 59 years. The perceived pressures of work, especially in the public sector's care, health care and other jobs will continue to be high, as the recruitment of young employees becomes more difficult. Regardless of the fact that working capacity maintenance courses and rehabilitation courses are provided for aging employees, the basic problems, that is the underrating of the aging and perceived scarcity of the labour force, still remain. The fear of continual reductions will make people less eager to discuss the development of their own work, even in less stressful jobs within the public care and health care sector, with no will to assume new care-related duties that are becoming increasingly stressful and overburdened. Retiring Baby Boomers may be physically fit but their mental fitness is poor, on average. Being tired when retiring, they want to distance themselves from everything they have done before. They want to relax "free and irresponsible" with no desire to assume the central responsibility for the care of their next of kin or any other elderly people. They set high requirements for their own services, considering that they have already done enough for the common good.
>
> The number of immigrants will continue to rise, despite the opposing trade unions. Immigrants will mainly come from near-by areas that are from the new EU countries such as Estonia, and in part from Russia. Initially, the majority will be young people seeking experience abroad. Gradually, however, somewhat older groups and people with families will join them. Immigrants will have a varying level of education but, in the main, lower than the Finnish standard. They will be invited by private care and health care businesses starting to provide alternative services alongside the services rendered by tired, frustrated and aging employees in the public sector. Public services will also lose some of their best employees to private service providers, rather because of their currently declining work conditions than their currently modest economic benefits.
>
> With economic growth being reasonable, the elderly and their families will also be able afford high-quality care. As a consequence of wanting to distance themselves from their previous lives, declining public services, and the strained atmosphere in their home country in general, retired Baby Boomers will start spending a great deal of their time abroad. Many will also end up living out their final years in a foreign country.

> Especially in public care and health care provision, major investment will be made in technological solutions that promote independent coping. This means that the problems relating to the scarcity of the labour force and employee exhaustion can be alleviated in care and heath care jobs. Elderly people's families can also relieve their own care-related responsibilities, seeing the use of technical aids as a very positive development. Private service providers will become interested in investing in new technology, primarily for competition-related reasons. On the other hand, care providing businesses will also be able to retain a reasonable level for personal services, by using foreign employees, for example. Extensive use of new technology in support of independent coping will enable a lower level of care and health care related work, compared to the actual requirement based on the demographic change.

An important conclusion relating to gerontechnology, which was taken into account by the Committee for the Future, was that the extensive application of a new technology will not invariably be the best solution. In fact, the best technology policy, regarding the elderly, would be to promote Baby Boomers' endurance at work.

4.3. Decision-model-assisted TA[1]

Decision-model-assisted TA presents the various viewpoints (such as economy, health, environment) as a decision model providing a systematic setting for the identification and comparison of impacts. Various methodological approaches can be adopted when constructing the decision models. Especially interesting are multi-objective decision-making models that are well suited for analysing the type of decision problems that involve diverse and mutually conflicting objectives.

Decision-model-assisted TA has been applied quite frequently in Finland. Examples of Finnish applications are the preparation and assessment of research and technology programmes receiving public funding (Salo et al., 2003a, b), a research of MPs' energy policy views (Hämäläinen, 1991; Hämäläinen and Leikola, 1995), a comparison of crisis management actions (Hämäläinen et al., 2000) and the preparation of environment-related decision making (Hämäläinen et al., 2001). The experiences gained from the decision-model-based approach in TA projects by the Committee for the Future have also been positive: for example, in conjunction with the Gerontechnology TA project, MPs gave weights to assessment criteria. The criteria described various objectives important for independent living of old people (Technology Assessment 9, 2001; Salo and Kuusi, 2001).

The decision models are well suited for supporting group decision making. Action can also be made more effective by means of ICT-based support systems for decision-making: for example, each group member can put forward numeric assessment opinions and free-form comments via a computer connected to the information network (Salo et al., 2003b). Assessment data thus collected can be processed into result compilations to enable discussion without revealing the identity of those presenting the views.

The decision-model-assisted assessment provides particular support to the TA problem definition. When applied to group work, however, it requires the participants' will to approach the TA object with an open mind and constructive spirit, which is not necessarily the case with controversial technologies (Salo, 2001). Also, the amount of background work preceding group work sessions

[1] My thanks to Ahti Salo for the background texts and material for this section. The conclusions drawn are, however, my own.

can be considerable, as the required background material needs to be carefully prepared (including descriptions of the technologies in question and their development prospects).

Several types of procedures are applied to decision-model-assisted TA. One simple possibility is to weight the decision criteria by means of a six-step Likert scale, in which 0 indicates that the criterion is totally unnecessary and 5 that the criterion is of central importance. This was done in the Gerontechnology TA project (Technology Assessment 9, 2001) where the members of the Committee for the Future assessed fifteen criteria relating to independent living of old people. The highest average value of 4.5 was given to the following criterion: "A technological solution promotes positive communication and interaction between the elderly and between the elderly and other age groups." However, the criterion "A technological solution is profitable with regards to the municipal economy" received an average importance value of just 3.2. The differences in importance were taken into consideration in the scenarios related to the independent living of old people. In particular, the scenarios focused on examining interaction between younger generations and the elderly, but little attention was paid to the municipal economy.

The Helsinki University of Technology's System Analysis Laboratory has been developing procedures for decision-model-assisted TA since the 1980s. The first major method experiment was connected to researching MPs' energy policy views (Hämäläinen 1991). A recent challenging project undertaken by the System Analysis Laboratory was the assessment the WoodWisdom cluster programme, which has received funding from several public organisations and industries (Salo et al., 2003a). The target of the TA project launched in 2001 was a research programme, which commenced in 1996 with a total funding of about 40 million euros. It had 130 subprojects and 400 researchers and 70 research organisations participating. Three objectives were emphasised in the assessment task: compiling results from the subprojects, assessing the subprojects from the point of view of future challenges, and producing information supporting the funders' decision-making process from the point of view of future research and development activities. The following examines how the general assessment problems were approached in the assessment task.

A) Definition of the assessment problem and dividing it into partial problems.

The above mentioned three objectives of the assessment task formed the general starting point for the assessment. The assessment problem was specified so as to make it appropriate for decision-model-assisted assessment, mainly through discussions held with the WoodWisdom programme manager and leading Tekes' [1] technology experts. These resulted in the decision to examine the issues relating to the subprojects, and programme-level issues, as separate entities. The central justification for the solution was that the various stakeholders carrying out the subprojects could not be assumed to have an overview of the programme. It was concluded, at both levels, to use the multi-criteria model presented in Table 4. The model was used with the purpose of clarifying the objectives, of assessing the programme and its subprojects in regard to these objectives, and to start discussion on which objectives to emphasise when promoting research and development activities.

The model is used to weight criteria specifying guidelines for the future. These are implemented by weighting the alternatives at each of the three levels so that their sum totals 100. For example, at the third level, the three alternatives of techno-scientific research – basic research, applied research and product development - are weighted so that their sum is 100. At the second level, the weighting is on the alternatives of goal-oriented research, techno-scientific research and other research (with the total sum of weightings being 100). At the first level, the weighting on 100 focuses on strengthening goal-oriented research and developing research co-operation. For example: if basic

[1] The Technology Agency of Finland

research for level 3 is given a weighting of 30, techno-scientific research a weighting of 70, and goal-oriented research a weighting of 50, then the general importance of basic research is 30x70x50/100x100x100, which is 0.105. This means that the total weight of basic research is 10.5%. Decision-making support systems calculate total weights of this type automatically. In practice, weighting started from level 1 and proceeded to level 3 (from general to specific). Occasionally, proceeding in the opposite direction may be justified (from specific to general) in order to clarify the general concepts' content.

Table 4. Multi-criteria model for assessing the WoodWisdom Programme.

Principal goal	1. Level 1	2. Level 2	3. Level 3
Long-term industrial competitiveness	To strengthen goal-oriented research	Techno-scientific research	Basic research
			Applied research
			Product development
		Other research	Economic research
			Environmental and scientific research
			Social scientific research
	Development of research co-operation	Co-operation between research units	Promotion of research co-operation
			Creation of new co-operation networks
		Co-operation between research units and industry	Promotion of research co-operation
			Creation of new co-operation networks
		International research co-operation	

B) Identifying the essential features of past development and the current situation

In the assessment task, the identification of future challenges was clearly emphasised more than the assessment of past development. However, the situation can be interpreted so that past development was in the background when the WoodWisdom Programmes objectives were set in the mid-1990s. The objectives set for the programme were: customer orientation, ecological efficiency, high-quality products, integration of forestry and the forest industry, interdisciplinary networking and co-operation (Salo et al., 2003a).

C) Future development options

The central challenge in the assessment project was to collect the subprojects' results in a future-oriented manner. A good starting point for this was provided by a WoodWisdom subproject, which involved constructing the scenarios up to the year 2015. The subprojects' representatives were requested, on the one hand, to assess their expertise in regard to the 10 scenarios built in the subproject and, on the other hand, to indicate to what extent they believed in the actualisation of each scenario. The scenarios were examined prior to a more detailed specification of future challenges using the multi-criteria model.

D) Identifying and assessing potential options for action

Researchers involved in the programme's 15 subprojects, or experts belonging to the project steering groups, assessed the future research needs using the multi-criteria model of Table 4. In practice, the assessment took place in 15 workshops held at the System Analysis Laboratory. Most of the workshops included the facilitator and his technical assistance plus the representatives of about 7 subprojects and the programme manager. The workshops' programme began with the introduction of the people present and the introduction of the projects. This was followed by the assessment made using the multi-criteria model pertaining to the development challenges encountered in the research area in question. The weighting took place within a semicircular space using 11 portable computers connected to the same local area network. The participants evaluated the results of the weighting. The results (the average values and deviations) concealing the identity of the assessment providers. Moreover, the decision-making support system made up of portable computers and software also enabled the presenting of anonymous verbal comments.

In addition to the participants assessing the general importance of the various objectives using the multi-criteria model, the projects' steering group members were also requested to assess the project's success in reaching the three objectives using the five-stepped Likert scale.

E) Dissemination of results in an understandable, effective form

In addition to the project-specific realisation of the objectives, the participants were also requested to assess the workshop itself: Were the results useful and well-grounded? Had the workshops been successful in general? Should similar workshops be arranged in the future? About 75% of the respondents concurred with the claim that the workshop results were useful and well-grounded, with 78% considering that similar arranging similar workshops in the future would be useful.

The parallel objectives in the above multi-criteria model were interpreted to be separate, which meant that the assessed projects were examined separately in regard to each criterion. Project-specific profiles were obtained as the result of this examination. However, numerical results concerning the projects' "overall quality" not derived from the profiles. In other words, the external assessors did not state their opinions in a numerical form regarding the importance of the various criteria. Instead, interdependencies between the criteria were discussed.

Implicit assumption of the separate criteria is that they are additive. Yet, the decision models suitable for TA can also be based on other assumptions. I have suggested the so called epistemic utility for the evaluation of technological initiatives (Kuusi, 1999). It is based on multiplication instead of addition. In order to be promising, an innovation initiative has to produce some measurable changes (I = impacts) that can be achieved applying it. These changes to be achieved are important from points of view of relevant actors (R = relevance) and sufficient resources should exist for the proposed innovation (F = feasibility) to be implemented. And finally: the impact/relevance/feasibility claims should be true (V = validity). If any of the factors mentioned above is zeroed, it will make the drafted innovation useless, i.e. usefulness can be roughly described using the product ratio IRFV.

In practice, it is advisable to use multi-criteria models that are relatively simple. In the practical assessment work, perhaps the most important property of multi-criteria models is their so-called transparency. In the case of a transparent model, the stakeholders involved in the analysis can easily trace the origin of the results obtained. The transparency requirement is especially important in cases where the decision-makers'/citizens' value-related judgments can affect the final result. However, when anticipating development in natural phenomena – e.g. the greenhouse effect's future impacts – there is certainly good reason to apply models which simulate the real behaviour of natural phenomena. However, it is often useful to make illustrative models, even from models of this type, which also help "laymen" understand how a certain final result had evolved.

4.4. Participatory TA and consensus conferences

4.4.1. What is Participatory TA?

Participatory Technology Assessment (Participatory TA) as a special approached came into being in the late 1980s. In Finnish, the approach is described meritoriously in a report titled Teknologian arviointi, arvot ja osallistuminen ("Technology Assessment, Values and Participation") (Rask et al, 1999). Often, Participatory TA is seen as synonymous with Constructive TA. This seems to be the interpretation of Tarja Cronberg (1996) who characterised the Constructive TA as being the latest stage in TA. Both approaches consider that technology and society are not separate entities; instead, technology evolves ("is construed") in constant interaction between the developers of technological products and their users or potential users.

Participatory TA has challenged many key features of the "conventional TA practice". Rask et al. (1999) compared the "conventional practice" the Office of Technology Assessment (OTA) of the United States Congress and Participatory TA as follows:

Theme	Conventional TA	Participatory TA
Nature of assessment	Non-political	Political
Object of assessment	Efficient decision making	Genuine democracy and learning
Subject of assessment	Expert	Citizen/layman/ consumer/customer
Focus of assessment	Facts, evidence	Value given by subject to facts
Relation to information	Production of information important	Processing of information important
Relation of facts and values in process	Intention to keep issues technical	Values and value systems included in assessment
Location of politics	After assessment	Included in assessment, made public
Becomes emphasised in final results	Matters in which consensus prevails	Matters in which differences of opinion prevail
Relation to publicity	Results are public	Assessment is public

Along with the Participatory TA and the Constructive TA the interaction between stakeholders is also the essential feature of the above discussed methods of futures studies and modelling. The characterization of Rask et al. (1999) of the participatory TA includes, however, some aspects where these methods seem to be closer to "conventional TA". Subjects of assessments are typically experts or "delighted" representatives of important stakeholders (e.g. MPs). Processes are not only focussed on the processing of information but also on the production of new information or new options. They also suppose that the decisions should be based on facts even if the facts (e.g. related genetic engineering) are not popular.

The limit between questionable relativism concerning facts and the democratic right to give subjective values to facts is not easy to maintain. How to avoid the uncritical following of new ideas and at the same time not to believe prejudices of laggards?

The EU Commission's TSER-programme-funded EUROPTA Research Programme was in operation during the years 1998-2000. The study compared 16 projects of participative technology assessment in various EPTA countries, presenting the methods of implementation and the results achieved. The results of the project were presented in a book published in 2002 (Joss & Bellucci, 2002) with many of EPTA's most active participants as contributing authors.

In fact, the practices employed in many of the assessments described, with their interviews and workshops, bear a close resemblance with many assessments implemented in Finland during the period 1999-2003. In particular, similar features are seen in the seven TA projects in which only experts or persons (stakeholders) directly impacted by the examined technologies were heard. Methods described in earlier sections would have been useful in many described projects.

However, some of the assessment practices compared in EUROEPTA differ substantially from those used as examples in sections 4.2 and 4.3. In particular, the forms of Participatory TA used widely in Denmark differ from them. In emphasising the face-to-face interaction, applied with fairly large groups between decision-makers, experts and ordinary people, they resemble the Knowledge Management project (Technology Assessment 6, 2001) and the Regional Innovation Systems project (Technology Assessment 15, 2003). There is, however, a clear difference concerning the role of ordinary people. In regard to the picture presented in connection with Knowledge Management project, and subsequently often used in many connections, the core issue in TA activities is to combine the power of decision-making and expertise. Politicians and experts should meet each others on the arenas of learning. MPs participating in the TA steering group defined this type of knowledge management as follows:

- Knowledge management is discovery learning.
- Knowledge management is a matter of the wise upkeep and development of knowledge, skills and communication based on a desired vision of the future.
- Knowledge management is based on jointly defined values.
- Knowledge management presupposes creative and responsible leadership.

The way of thinking developed in connection with the Knowledge Management TA project was applied in the Regional Innovation Systems project. The project aim was to achieve direct encounter and learning together between MPs and regional agents of influence while applying the frame of reference developed by the assessors, analysing regional strengths and weaknesses (Technology Assessment 15, 2003).

Surely the Finnish TA practice could learn a lot from the Danish practice. The participatory and dialogue-based approach in Denmark has long traditions. They extend back to Pastor N.F.S. Grundtvig, who in the early 1800s founded a rural co-operative movement. It has profoundly influenced development in Denmark. The general view held in Denmark is that freedom of speech, freedom of association, right to vote, and participation in local decision-making are empty vessels if enlightenment through dialogue is missing (Klüver, 2002). Consequently, it is of no surprise that the 1995 act concerning the institute activities defined citizens' participatory processes as the Board's central task.

The following sections take a closer look at three methods of Participatory TA. The "Rooting of Technologies" and the GLEN strategy clearly focus on interaction between decision-makers and experts. However, the Danish Consensus Conference practice examined in section 4.4.3 primarily aims at promoting participation by ordinary citizen representatives. Naturally, MPs are far more justifiably representatives of the people than those participating in the consensus conferences. However, they seldom have the time to participate in processes of the consensus conference type.

4.4.2 Rooting of Technologies and the GLEN Strategy

Considering Parliament's role as a legislator and general decision-maker, it is clear that TA projects launched for parliamentary purposes assess relatively broad fields of technology. Analysis of individual technologies can, however, help to understand a larger field. Parliament is also in a position to use its authority in contributing to the launching of pilot projects relating to a new technology. Based on this, the Gerontechnology TA project decided to examine Internet-based support systems for self-care in common diseases (Technology Assessment 8, 2001) and security alarm systems promoting independent living of old people (Technology Assessment 7, 2001).

Participatory TA is especially useful as an approach in the assessment of individual innovations or innovation initiatives. This section takes a brief look at two forms of Constructive TA: the rooting of technologies and a model used to identify and support innovation developer networks (the so-called GLEN model).

The rooting approach was first developed mainly in the well-being sector. Pilots were focused on projects serving new business start-ups, in which the building up of partnership relationships was considered to be important (Väyrynen et al., 1998). A more recent application of the method concerns energy sector (Väyrynen et al., 2002).

The central idea in rooting is to bring about interaction between stakeholders influencing the development and the success of an innovation. It is aimed at deepening the developers' understanding of the users' needs and the demands. Moreover, the rooting disseminates information about the possibilities offered by the technology (Väyrynen et al., 2002).

The rooting process is described as a spiral where the product is developed gradually by responding to the following questions while proceeding in many "increasingly larger rounds":

1. What kind of a product or service are we developing?
2. Whose expertise or commitment do we need for development?
3. What interests do the various stakeholders have to participate in development?

The first round results in the first draft of the idea and appropriate persons to process it. Their roles are defined and their commitment is secured. During the second round, the object of development is specified. This results in a more detailed concept of the product and how it connects to the application environment and established practices. Based on this, new stakeholders are asked to take part in the development work, generating a need to ensure their commitment. During the third round, the product attains an even clearer format, which makes it necessary again to have new stakeholders commit themselves to the process. The required number of rounds depends on the special characteristics of each development process.

The central challenge in rooting is to identify and then gain the commitment of the stakeholders playing the crucial role in the innovation's success in the marketplace. The central actors within the market network are divided into producers, users and societal actors (Väyrynen et al., 2002). The producer stakeholders may include, for example, hardware and software suppliers in the particular field, and the stakeholders responsible for transport, distribution and maintenance. The users can be also orderers, payers and those benefiting from the innovation. Social actors in this review include various professional and citizens' organisations and the media as well as public decision-makers and authorities. The choice of stakeholder groups varies, strictly speaking, from one case to the next. Thematic interviews and arranging dialogues and polyphonic working seminars are commonly used work methods in rooting. (Väyrynen et al., 2002).

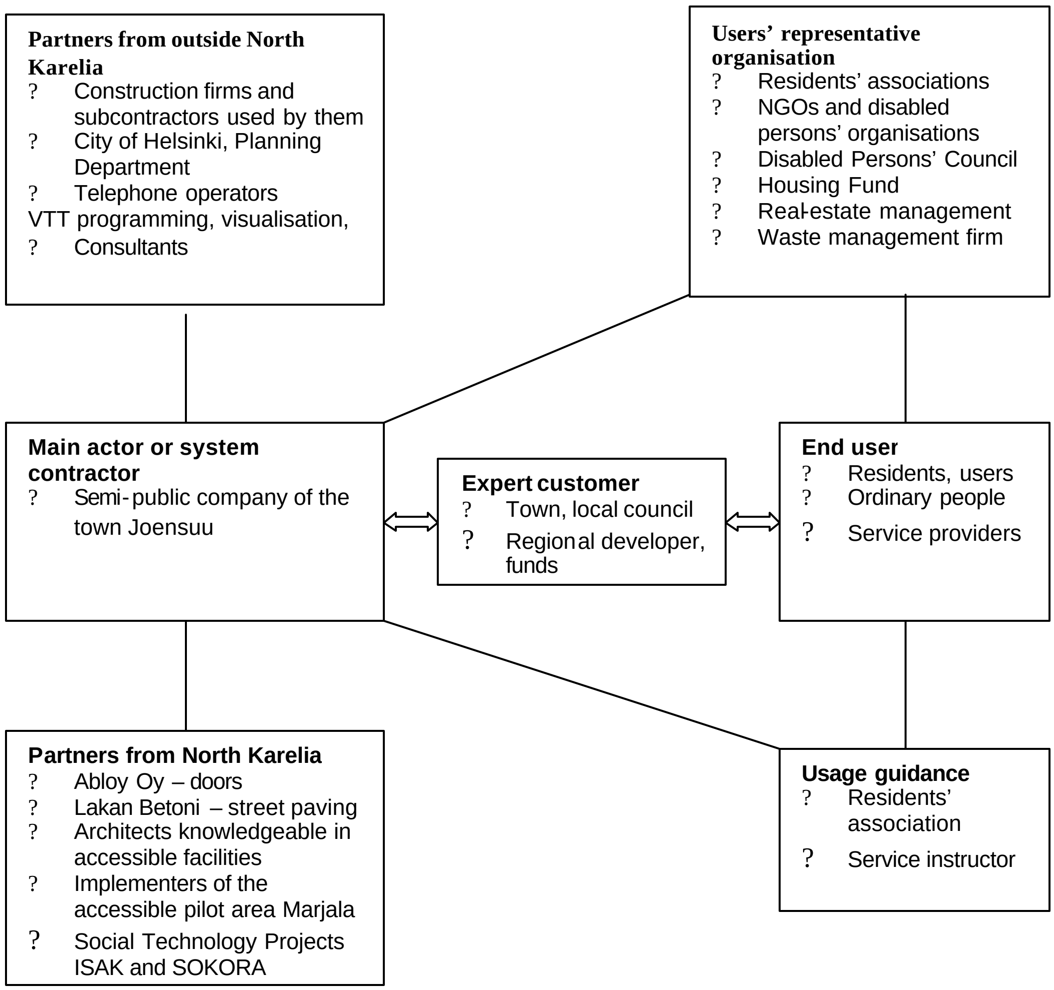
The GLEN (Growing and Learning Entrepreneurial Networks) strategy resembles the rooting method. It was proposed in the connection of Sitra's[1] Innovation Programme (Kuusi, 1999b). A fundamental difference between the approaches is that in the GLEN strategy one actor or a few actors, at the most, are appointed to bear particular responsibility for the process. The aim of the process is to develop a supplier network integrating several subcontractors and a leading system contractor who represents the network in negotiations with customers. This approach has been successful for the supply of cabins for ships, for example. It was proposed in the strategy that the work was to proceed in the following stages:

1. Facilitators identify potential system contractor networks
2. Selection of one or more core actors or a potential system contractor and the identification of the core competencies and the basic networks of core actor(s)
3. Monitoring of the business environment
4. Strengthening of the network
5. Education system capable of educating the needed experts
6. How to meet future regulations and standards
7. How the network can mobilise the workforce and fulfil the individual needs of employees

The GLEN strategy has been used e.g. in a well-being cluster development project (Savela & Hakulinen, 2001). This project served largely as the starting point for the Gerontechnology TA project carried out by the Finnish Parliament. The well-being cluster project looked into the potential progress of several product concepts/social innovations developed in North Karelia, a less developed area of Finland. The project was carried out in the form of seminars and as Argument Delphi processes. An important innovation in the project was the description of the developer network of a typical innovation in the well-being cluster. The framework was used for the analysis of many innovation networks in the field. An example is presented in figure 2.

[1] Finnish National Fund for Research and Development

Figure 2. A GLEN – network for the building of accessible living environment for elderly people *(compare Savela & Hakulinen, 2001).*



4.4.2. Consensus Conference – Danish model

Denmark's TA activities have become widely known, especially for their consensus conferences developed in the 1980s. This procedure has been described in detail in Finnish in the report by Rask, et al. (1999). As far the Parliament of Finland has not arranged any consensus conference but there are plans to organise one in the near future related to the future of the Finnish health care system. This section differs from other methodological sections because the Finnish experience of the method is very limited. I describe the method, however, because I think that it is important that it will be used in the future also in Finland in proper connections. The other reason is that I like to compare the method with the most used method in Finland: the Argument Delphi method.

The health care sector's consensus conferences arranged by the NIH (National Institute for Health) in the USA formed the special background for Denmark's Consensus Conferences. However, Denmark's practice differs from these in two ways: firstly, the assessment objects can be any socially controversial applications of science or technology. Secondly, the assessment panel consists of laymen (instead of experts), who have no special advance knowledge of the field being assessed. The lay panel draws up the plan of action for the conference, selects the questions to be dealt with in the conference and the experts to be heard, carries out the assessment, and draws up the assessment report.

The first consensus conference conducted by the Danish Board of Technology was held in 1987. It was carried out in co-operation with the Danish Biologists' Association. Its theme was genetic engineering in industry and agriculture. Subsequently, this became the most popular theme for consensus conferences held in various countries. If we now look at the European Union regulation practice of GM plants in ten past years or so, there are good reasons to evaluate that it has not been optimal. It is interesting for the evaluation of the method if many consensus conferences organised in Europe concerning the issue have had some impact on the optimality.

The Danish consensus conference practice developed step by step since the first exercise, Two general targets had been set for the consensus conference: firstly, the stimulation of public debate on new technologies, and secondly the production of information reflecting laymen's ideas and attitudes to meet the politicians' needs. A lay panel consisting of interested citizens is usually the foremost factor of consensus conferences. Participants for the panels are sought by means of announcements placed in newspapers with large regional coverage. The applicants are asked to submit a brief, one page description of themselves also indicating their advance knowledge about the subject matter and the reasons why the applicant is interested in participating. With the applications as the basis, the steering committee of the conference then chooses 10-16 laymen for the panel.

Two central criteria are involved in the appointment of laymen: on the one hand, socio-demographic factors and, on the other hand, the person's knowledge about the technology to be assessed. The socio-demographic criteria include the person's age, gender, education, profession and place of residence. One aim is to appoint a panel whose members form a heterogeneous group in regard to their background, one that represents as wide a range of viewpoints as possible with regards to the technology being assessed. The panel's task is not to represent the citizens' views in a democratic sense, neither does the panel strive to produce a description of the nation's conceptions comparable to the results of opinion polls. Its task is to produce viewpoints related to controversial issues, and to clarify how close to consensus people can get when setting out from differing points of departure, based on expert-provided information.

Ignorance regarding the technology being assessed has been the foremost criterion applied in order to ensure the panel's lay viewpoint. The panellists must not be experts in the field being assessed, or have any special knowledge relating to the theme. As such, specific personal interest in the field is not considered to be a restricting factor. For example, two members, who themselves suffered from childlessness, were appointed to a panel in a conference held in Denmark in 1993 on infertility treatment. Even though the technology being assessed touched upon them as laymen, they were not considered to represent any special interest group. One aim is to avoid including interest groups because obtaining consensus through joint efforts is more important, as a conference goal, than hammering through panellists' fixed ideas, or winning debates.

Thus, even though appointing people to the panel is based on favouring "ignorance", a central element in panel work is connected to reducing this ignorance. All panellists are initiated into the assessment target, well in advance of the consensus conference, by providing them with material concerning the subject matter, and by arranging training meetings, which usually cover two weekends. In this way, the panel members are provided with an impartial knowledge base.

As was mentioned above, the heard experts are appointed based on the lay panel's wishes, The final choice will be made by the steering committee. Expertise is understood in a very broad sense of the word: an expert is a person considered, on the one hand, to be a scientific expert of the technology in question or, on the other hand, a central opinion-forming expert in the field. An opinion-forming expert can, for example, be a representative of an interest group or even a famous scientist or artist. In any case, an expert is assumed to possess above-average knowledge in the field being assessed. In principle, an expert is also required to possess the most recent knowledge available in the field, good general understanding of the target being assessed, good communication skills, and willingness to participate in discussions. In practice, compromises are often required in the fulfilling of criteria, but the expert panel should, at least as a whole, fulfil them all. In addition, the experts need to represent sufficiently differing points of view, so that any fundamental disputes and scientific conflicts prevailing in the field are exposed and addressed during the conference.

Two or three months before the conference, the lay panel assistant will arrange the first training weekend in collaboration with the project manager. During the weekend, the lay panel will decide the main conference issues, which is usually 8-10 in number. Following the training weekend, the lay panellists are asked to refrain from commenting on the subject in the media before the conference is held. This is to keep individual panellists from becoming too strongly committed in advance to their earlier statements, thus ensuring that the theme may be freely and openly addressed in the conference.

During the first day of the conference, the experts will respond to the main questions presented by the lay panel in the form of short presentations lasting about 20–30 minutes. At the end of the day, the lay panel will assemble to consider which questions have been sufficiently answered and which need further treatment.

On the second day of the conference, the lay panel will present additional questions to the experts, the questions having been drawn up by the panel based on the previous day's proceedings. The conference is chaired by the lay panel assistant. His or her task is to supervise that the experts actually provide answers to the questions put to them.

On the third day of the conference, the lay panel reads aloud the final report to the participants of the conference. Copies of the report are also distributed to the participants. Following this, the experts proceed to correct any factual errors in the report, but they may not interfere with the report in any other form. Finally, both the audience and the experts can put questions to and discuss the report's conclusions with the panel. However, these have no effect on the report content. In general, a press conference is organised once the official programme has ended, to provide representatives of the media the opportunity to interact with the experts, lay panellists and the conference organisers.

In summary, the consensus panel method can be characterised from the point of view of parliamentary TA as follows:

A. Definition of the general assessment problem and dividing it into partial problems.

   The assessment unit or, for example, the project steering group (formed of parliamentarians in the case of Finland) formulates the general problem, and the consensus panel, supported by the project manager and the assistant, defines the partial problems.

B. Identifying the essential features of past developments and the current situation, with regards to TA problems (technologies, societal factors).

   The consensus panel suggests and the steering committee chooses experts deemed to be competent and the experts provide introductions to discussion on the subject.

C. Identifying and assessing potential opportunities for action, considering their effectiveness, impact and desirability.

   The consensus panel formulates a statement that is jointly approved. With the approval of the panel, the experts correct any errors, such as errors based on misunderstanding matters pertaining to the natural sciences.

D. Dissemination of results in an understandable, effective form.

   Special attention is paid to the results dissemination. In general, a press conference is organised once the consensus panel's official programme has ended, to provide representatives of the media the opportunity to interact with, the experts, lay panellists, and the conference organisers.

The Danish consensus panel procedure resembles the Argument Delphi technique examined in section 4.1. The panel of an Argument Delphi process includes typically, however, experts or representatives of different – also lay – stakeholder groups. Another evident difference is that argumentation in consensus conferences places more emphasis on processing citizens' prejudices based on their inadequate knowledge. A surely good idea of the identification and processing of prejudices is that they correspond to ideas held by people in general. The panel's small size simplifies the simultaneous adoption of information conveyed by experts and enables participation by all the panellists in the discussion, like in an Argument Delphi process. Perhaps the most questionable idea of the consensus conference is just the idea of consensus. Consensus typically produces conservatism: dangers and well-known present practices are stressed more than opportunities. The idea of consensus is definitely rejected in an Argument Delphi process. The idea of the Argument Delphi process is more to sharpen the different scenarios concerning possible futures than to find one "most reasonable" scenario or action plan.

5. Conclusions

Based on the discussed international comparison, successful parliamentary TA activities should meet the following challenges:

1) As its background, TA work requires comprehensive monitoring of developments in the field of technology, personal acquaintance with the most prominent developers of central technologies, and constant interaction with these people.
2) Contacts with Parliament should be natural and non-formal, thus enabling MPs to flexibly obtain well-grounded, valid information on issues which they find interesting.
3) TA procedures should evolve based on the experiences gained. Implemented TA projects should include clearly defined scientific quality control.
4) TA activities should, in addition to serving parliamentary purposes, interact with technology-related administrative preparation, public debate and the aims of enterprises, while taking the societal impact of technological development into consideration.

The four challenges cannot be placed in an undisputed order of importance. However, the first viewpoint would appear to be continuously increasing its weight, because technology development appears to progress towards integration. The first challenge is especially important, provided that the aim is to anticipate future development, in addition to assessing the present-day technologies. Recent trends in technology development – ICT, material technology, biotechnology and energy technology – adopt more and more influences from each other, and actually resolve identical nano-technical problems.

According to a report submitted to Sitra by the IFTF (Institute for the Future) operating in California's Silicon Valley, forthcoming important technological innovations will be generated by the interfaces between ICT, material technology, biotechnology and energy technology. A challenge of exceptional magnitude is the integration of ICT, which basically explains the recent years' extremely fast developments in bio and genetic engineering. However, from the point of view of sustainable development, new materials and the breakthroughs related to energy technology are also very important.

In addition, techno-scientific development is increasingly and crucially related with any socio-economic change. This means that the TA unit should possess such a "critical mass of know-how" as would enable it to alertly follow technology development and all of its main trends, enabling it to anticipate, not technology development alone, but also its societal impact.

In 2000, the staff employed by POST, the UK Parliament's TA unit, could be seen as the absolute long-term minimum, in terms of high-quality work. POST employed three full-time scientific advisers, in addition to its director. Each of the three advisers was responsible for one broad field of science and technology. In addition to them, the unit had a secretary. It should be noted that, in 2003, the unit was considerably larger, with six scientific advisers and two secretaries in addition to its director.

When conducted under favourable circumstances, parliamentary TA could evolve into a forum bringing together all TA activities, possibly including our national Technology Foresight activities. Without appropriate resources, parliamentary TA will mainly remain comparable to the work of an informatician employed by a Parliament Library. Regardless of the fact that information services are definitely useful for MPs, reports thus produced will hardly be appreciated by the scientific community, the media and the public at large. Neither does this type of work really motivate people with a more serious interest in assessment work.

It is, of course, very important that the MPs regard the TA targets and results as personally significant. However, high-quality TA should constitute functional dialogue between the best experts in technology development, MPs, other political decision-makers, and interested citizens. In particular, we should be able to distance ourselves from current daily issues and ponder issues and matters, the significance of which is not thoroughly grasped in the current situation, neither by politicians nor in civic debate.

The Committee for the Future of the Finnish parliament took the future of Finland's health system its main TA target for the years 2004–2007. This can be considered to be a very astute choice, when considering the more distant views of technology development. The greatest individual challenge in terms of technology over the next few decades would be seen in the forthcoming bio-society, where development will be determined by nanotechnology integrating the four principle trends of technological development.

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Appendix 1

Central phases in Parliament's TA activities and implemented TA projects in Finland

In September 1995, Chancellery Commission of the Parliament of Finland appointed a team to clarify the implementation of Parliament's technology assessment activities. The team ordered a report from VTT Technology Studies (Reijo Miettinen: Proposal for the implementation of Parliament's technology assessment activities, Report 21 December 1995), which largely served as the basis for the proposals made by the team. The assessment targets set out in the memorandum were limited to the development and societal impacts of emerging technologies (e.g. genetic engineering, information technology, particle research) or to activities making use of evolving technology (treatment of diabetes, traffic system).

The team proposed a model for TA activities, where the Committee for the Future would be responsible for the assessments, by co-ordinating the order of priority for parliamentary technology assessment proposals submitted by different committees. Commissioned by Parliament, and under its control, an external research institution would prepare and implement assessment reports, conduct technology research, and co-ordinate and promote technology assessment activities in Finland. The team proposed that the Committee for the Future should select the said research institution. In the report submitted by VTT, the potential choices were: Sitra (Finnish Foundation for Research and Development), the Finnish Academy of Technology, VATT and VTT Technology Studies. The report recommended that the one mentioned last be chosen.

Sitra gave a statement on the team's proposal on 12th April 1996. The statement pointed out that the proposed model safeguards the reaching of the set objectives, and that it would be feasible, provided that the institution's task was not, on its own, to perform assessments commissioned by Parliament, using its existing researcher resources or by recruiting more staff. The statement deems it more appropriate to define the selected institution's task as being that of bringing together the best experts for performing the given task as a project. The statement goes on to say that Sitra could, if so proposed by Parliament, function as this co-ordinating institution following a decision taken by Sitra's board of directors. The task would be well suited for Sitra's statutory functions. Sitra is directly controlled by Parliament.

The operations model proposed by Sitra was approved, but neither Sitra, nor any other stakeholder was selected to function as the co-ordinating institution. In practice, the secretariat of the Committee for the Future, and especially Researcher Ulrica Gabrielsson and (from the end of 1999) also Docent Osmo Kuusi, have participated in steering group work as a secretary and a permanent expert, and thereby co-ordinated assessment projects. On Parliament's request, Sitra initially employed Dr. Kuusi for the year 2000 as a scientific expert in assessment work. Thereafter, his employment was extended to cover the year 2001, and subsequently until the end of April 2003. Since the end of 2003, Dr. Kuusi has been responsible for the parliamentary assessment project concerning the future of the Finnish health care system.

In the period 1999-2003, Dr. Kuusi's task was defined to involve producing statements on appropriate methods and persons for the implementation of assessments, and other participation in the implementation of assessment projects, by participating in steering group work, for example. Dr. Kuusi has issued written statements on all the assessment projects carried out since 1999. He has participated actively in the implementation of most projects and has also prepared statements issued by the Committee on the assessment projects.

Below is a list of the assessment projects implemented in the period 1996-2003, and the main reports produced by them. In the recent parliamentary period since 2003, the Parliament has continued with the themes of the Social Capital and ICT (see report 7 below) and Regional Innovation Systems (see report 8 below). Clearly the most important TA project in the period has, however been the assessment project concerning the future of the Finnish health care system. Since now, it has resulted in the preliminary Finnish report Olli-Pekka Ryynänen, Juha Kinnunen, Markku Myllykangas, Johanna Lammintakanen and Osmo Kuusi "Suomen terveydenhuollon tulevaisuudet" (The Futures of the Finnish Health Care System), Technology Assessment 20, Publications of the Finnish Parliament 8/2004.

The list of documents from the period 1998-2003 sets out ten projects, although, in terms of themes, there would only be nine. The preliminary study on gerontechnology and the actual assessment of gerontechnology have been separated because they were carried out in different parliamentary electoral periods. Besides the names of the documents, the assessment projects are also briefly examined, especially from the point of view of MPs' participation.

The TA projects implemented by Parliament in the period 1996-2003 can be grouped into three generations.

The first generation of projects was carried out during electoral period 1995–1999. It included the following:

1) **GM Plants and Their Impacts in Food Production.** The organisation responsible for this project was VTT Technology Studies. Preliminary report 7th November 1997. Final report Ahti Salo, Veli Kauppinen and Mikko Rask: GM Plants in Food Production (in Finnish). Publication by Parliament of Finland 2/1998.

2) **ICT in Finnish Education and Learning.** The organisation responsible for this project was Sitra. Interim report on 15th March 1998 and final report 21st September 1998. Plus six partial reports in Sitra's publication series. Final report by Matti Sinko and Erno Lehtinen: ICT in Finnish Education and Learning. Publication by Parliament of Finland 5/1998.

3) **Preliminary Study on Gerontechnology.** Publication by Juha Kaakinen and Sinikka Törmä: Preliminary Study on Gerontechnology – Ageing Population and the Opportunities Offered by Technology. Publication by Parliament of Finland 5/1998. Publication was completed on 10th February 1999 by Sosiaalikehitys Oy.

The first generation of assessment projects was implemented in the form of projects ordered from research institutions and supervised by the Committee for the Future's Technology Section and steering groups composed of MPs appointed by the Committee for the Future. The ICT in the Finnish Education and Learning project also included a steering group composed of experts in these fields.

The assessment projects implemented during the 1999–2003 electoral period can be grouped into the two generations. *The second generation* of assessment projects was decided on by the Committee for the Future at the end of 1999 and completed in 2001. They are as follows:

4) **Knowledge Management.** The Project Manager was Riitta Suurla from Helsinki University of Technology's Dipoli Training Centre. Final report by Riitta Suurla: Developing and Implementing Knowledge Management in the Parliament of Finland. Publication by Parliament of Finland 1/2001. In English also a publication by Riitta Suurla, Markku Markkula, Olli Mustajärvi: Developing and Implementing Knowledge Management in the Parliament of Finland. Statement of the Committee for the Future, Edita Prima 2002.

5) **Main Assessment of Gerontechnology.** Two partial reports on safety alarm systems and self-care support systems. These reports were produced by Sosiaalikehitys Oy and VTT Technology Studies. Sinikka Törmä, Jarmo Nieminen and Arja Hietikko: Technology Supporting Independent Living of Old People: User's Viewpoint, Safety Alarm Systems. Publication by Parliament of Finland 4/2001. Annele Eerola, Sirkku Kivisaari, Riikka Eela and Mikko Rask: Technology Supporting Independent Coping by the Elderly: Assessment of Internet-based Self-care Support Systems. Publication by Parliament of Finland 5/2001. Final report by Osmo Kuusi: Future Policy and Gerontechnology Supporting Independent Living of Old People. Publication by Parliament of Finland 7/2001.

6) **Energy 2010.** Assessment focusing on the health impacts of energy generation. The consultant in this case was VTT Chemicals Technology. Final report by Osmo Kuusi, Torsti Loikkanen and Tarja Turkulainen: Energy 2001 Delphi Study concerning Future Energy Choices. Publication by Parliament of Finland 8/2001.

In the case of second-generation assessment projects the entire Committee for the Future, instead of its Technology Section, served as the steering group. However, the actual control responsibility was borne by the steering groups' of Members of Parliament belonging to various committees. The steering groups' chairpersons came from the Committee for the Future. The participation by Members of Parliament in the assessment work was clearly closer in the second-generation assessment projects than in the first-generation projects. It was particularly close in the Knowledge Management project in which the assessment material was collected mainly in connection with visits made by the assessment project's steering group. The most important visit was the one made to the leading universities in the United States (MIT, Harvard, Stanford and Berkeley) and important research institutions in Boston, Washington and Silicon Valley in California. As well as engaging in the keen work of the steering groups in the assessment of gerontechnology, the Members of Parliament also participated in the weighting of the criteria used in assessment. In the Energy 2010 project, the Members of Parliament formed one argument Delphi panellist group, in addition to those of representatives of the scientific community, leading energy producers and users, and public opinion formers (NGOs, journalists).

In the autumn of 2001, the Committee for the Future took a decision on launching the *third generation* of assessment projects. Except for the project concerning new and renewable sources of energy, which went no further than its preliminary study, the final reports of these projects were published in the spring of 2003.

7) Social Capital and ICT. This assessment was commissioned from the University of Jyväskylä's Agora Centre. The assessment produced an exceptionally comprehensive preliminary study by Osmo Pekonen and Lea Pulkkinen: Social Capital and the Development of Information and Communication Technology. Publication by Parliament of Finland 5/2002. Final report by Anu Mustonen and Lea Pulkkinen: Initial Social Initial Capital and ICT. Publication by Parliament of Finland 1/2003. As was mentioned above, this project has continued also in the new parliament selected in 2003.

8) Regional Innovation Systems. Professors Pirjo Ståhle and Markku Sotarauta were responsible for this assessment project as external experts. The state of innovation systems and their development potential were assessed in four regions using the reference frame of regional innovation systems developed by them in the preliminary study stage: the regions of Jyväskylä, Kemi-Tornio, south of Oulu, and some municipalities in Uusimaa. Final report by Pirjo Ståhle and Markku Sotarauta: The Status, Significance and Development Challenges of Regional Innovation Activities in Finland. Publication by Parliament of Finland 3/2003. As was mentioned above, this project has continued also in the new parliament selected in 2003.

9) Human Genome and Stem Cells. The external expert in this assessment was Professor Martti Parvinen from the University of Turku. He bore the main responsibility for the preliminary study of this assessment completed in the spring of 2002. The main responsibility for the assessment proper was borne by Osmo Kuusi assisted by Martti Parvinen. Final report by Osmo Kuusi and Martti Parvinen: Social and Legal Challenges of Human Genome and Stem Cell Research. Publication by Parliament of Finland 4/2003. The project resulted later in a book that was extensively discussed in media in autumn 2004: Osmo Kuusi (2004) Geenitieto kuuluu kaikille (Gene information belongs to everybody), Edita, Helsinki.

10) Renewable and New Sources of Energy. VTT Processes was responsible for the assessment carried out as a preliminary study. Publication by Satu Helynen, Kai Sipilä, Esa Peltola and Hannele Holttinen: Renewable Energy Sources in Finland to the Year 2030. Publication by Parliament of Finland 6/2003.

As regards third-generation projects, Members of Parliament were particularly active in participating in the project on regional innovation systems; e.g. they organised enterprise meetings and discussions with the authorities and Members of Parliament in four areas. They also participated by contributing texts to the final report. In other projects, participation was manifested as active participation in steering groups' work. In the Human Genome and Stem Cells project, Members of Parliament visited research institutions in this field at Heidelberg, but unlike in the Energy 2010 project, they did not participate in the work of the Delphi expert panels.