Swedish Technology Foresight
- a successful project, with many lessons learned

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Introduction

The American futurologist Peter Schwarz is among the world's leading designers of future scenarios about how we live, communicate, work, consume or amuse ourselves. A very optimistic image is apparent in his most recent scenarios. Among other things, they assert that large portions of the world will experience 25 very good years, characterised by greater freedom, better environment and increased material welfare.

New technological advances are the most important driving force behind growth and renewal in such fields as information technology, energy supply and genetic engineering that are predicted to provide increasing quality of life. According to these scenarios, in 2020 we will experience "quantum computing," buy the first commercial nanoproducts and be able to treat one third of humanity's 4,000 genetic diseases. The point of these technological predictions is that they draw attention to the potential for improving the quality of life that new technology can deliver.

A number of elements of development work reinforce the need for long-term technology assessments. To an increasing extent, new technology is selectable and adaptable - in other words, there is no optimal solution. This applies, for example, to IT, which has the paradoxical characteristic of simultaneously becoming more complex, robust and generally adaptable - something that, for traditional technology, sounds like an impossible combination. One consequence is that technology implies substantial freedom of choice. That freedom of choice provides major opportunities for companies and organisations capable of spotting new opportunities, embracing new technology and integrating technology into the other competencies of their operations.

Technological advances are behind much of the world's growth and renewal, but globalisation is perhaps the most important driving force. During the foreseeable future it will dominate the changes in our living conditions. Meanwhile, changes in attitudes and values are essential for social and technological development. It is also becoming increasingly important for all technologic development to take ethical issues into account.

In a way, Sweden faces greater challenges than many of our large trading partners. Countries and regions with small populations and an open economy are always heavily dependent on foreign trade. This gives them strength, flexibility and major opportunities to identify new markets and achieve good economic growth, but it also creates

vulnerability.

One way to increase the chances of maximising one's advantages and minimising one's vulnerability is to predict the future as accurately as possible. This has always been the case. Princes have surrounded themselves with fortune-tellers and astrologers. Modern companies and governments engage the services of global analysts, think tanks and forecasting institutes.

Ordinary people, too, have always speculated about the future. A large proportion of science fiction deals with how technological and scientific development may conceivably affect our future. Science fiction has often also been used to elucidate the consequences of contemporary trends. Examples of this are H.G. Wells´ The Time Machine, George Orwell´s 1984 and Harry Martinsson´s Aniara.

More systematic future studies have existed since the 1950s. Various institutes have been founded in order to study future scenarios. Governments, organisations and companies have continuously conducted a large number of studies of the future in order to elucidate developments in various sectors.

In recent years, a number of countries have carried out national studies of the future. Japan publishes a study with a 30-year horizon that it updates every five years. Great Britain published its Technology Foresight in 1995. Germany, Australia, New Zealand, the Netherlands, Hungary and Ireland are among the other countries that have carried out this type of studies.

A Swedish preliminary study completed in 1997 stated that a Sweden Technology Foresight could be expected to provide valuable contributions to long-term planning for companies and organizations.

During the spring of 1998, a decision was thus made to carry out Teknisk Framsyn (Swedish Technology Foresight) as a national project. Its purpose would be to engage many of the players in Sweden’s "knowledge society" in a discussion of the best ways to promote a long-term interplay between technological, economic, institutional and social processes.

The project has been run by the Royal Swedish Academy of Engineering Sciences (IVA), the Swedish National Board for Industrial and Technical Development: (NUTEK), the Swedish Foundation for Strategic Research and the Federation of Swedish Industries. It has been implemented with support from the Swedish government and in close collaboration with companies, public agencies and other interested parties.

The objective of Swedish Technology Foresight has been to strengthen a futures-oriented approach in companies and organisations and to identify and prioritise areas of expertise with potential for growth and renewal in Sweden.

Technology Foresight has therefore attempted to convey insights and credible images of the future that may form the basis for a discussion of trends in Swedish society and in the business sector, and on how Sweden can use technology in the service of humanity.

Hindsight

"The telephone is a fantastic invention - I am sure that every city will get one.
This quotation illustrates the difficulty of foreseeing the full use and consequences of new technology and new ideas.

Swedish Technology Foresight carried out a separate study of earlier attempts at predicting the future, Teknisk baksyn (Technology Hindsight).

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

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

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

But the difficulties of foreseeing the basic outlines of the future should not be exaggerated either. Every generation perceives itself as living in an age of major changes. Perhaps the generation of August Strindberg (1849-1912) experienced larger actual changes than today's Swedes. It is quite certain that the Sweden of 2020 will not have changed to the point of being unrecognisable. A large proportion of the infrastructure - such as buildings and roads - are renewed over longer periods than 20 years. The same

is true of many technological systems. Most of the Swedes who will be alive in 2020 are already adults, and many developments over the next 20 years will be based on technological advances that are already known.

Swedish Technology Foresight has deliberately chosen to ignore pure disaster scenarios. We cannot rule out that over the next 20 years, our society may be subjected to wars and blockades. Nor can we predict terrorist actions, devastating epidemics, the collapse of the food or energy supply system or large-scale disruptions in the world economy. The mere act of worrying about the possibility of such events may be of great significance to national development, for example in the form of military build-ups or trade barriers of various kinds. In this respect, Swedish Technology Foresight is optimistic - perhaps excessively coloured by its own Zeitgeist.

In this context, it is important to be aware that Swedish Technology Foresight has been based on different assumptions and has had a different objective from other comparable studies. The project is uniquely Swedish. Instead of saying, "This is how it will be!" Swedish Technology Foresight has assumed that there is no need to be familiar with the minutiae of the future in order to prepare for it. We can go a long way by analysing the main features of likely developments. The important thing is to have enough knowledge to dare realise that we cannot know how it will turn out, to dare to act without being completely sure of the direction of the journey and, based on the right knowledge, to constantly be prepared to reassess our decisions.

Organisation of Technology Foresight

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

There were several conceivable foreign models for Sweden's Technology Foresight project. The British version of Technology Foresight, which was presented at IVA in April 1996, was an important source of inspiration. The Federation of Swedish Industries analysed the effect of relevant European studies and decided to initiate a Swedish study. IVA and NUTEK carried out a joint preliminary study about international experiences and on the preconditions and interest in Sweden for carrying out a corresponding project. This initiative evoked interest in many quarters.

After further preparation in 1997, the four organisations behind the study - IVA, NUTEK, the Federation of Industries and the Foundation for Strategic Research-formed a committee to evaluate the possibility of carrying out a Technology Foresight project. Unlike most studies in other countries, Swedish Technology Foresight was not carried out on behalf of the government, although it has enjoyed strong government interest and support.

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

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

The Steering Committee chose to create a limited number of panels, each with a broad based composition and a broadly defined field, well aware that because of this, no complete coverage of the technology would be possible either. The division into panel subject areas was made on the basis of need and user perspectives, not fields of technology.

No.	**Panel**
1	Health, medicine and care
2	Biological natural resources
3	Society's infrastructure
4	Production systems
5	Information and Communications systems
6	Materials and material flows in the community
7	Service industries
8	Education and learning

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

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

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

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

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

The eight panel reports were completed in draft form late in November 1999, and in final form in January 2000. A number of highly qualified referees were asked to read the panel reports and provide overall opinions as background material for a synthesis report. This synthesis report was written on behalf of the Steering Committee, and under its supervision, by independent consultants.

The Swedish Technology Foresight project was implemented in a very open way. Among other things, the drafts of the panel reports were successively posted on the Technology Foresight web site (www. tekniskframsyn.nu) and all interested individuals were invited to comment on the drafts.

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

Results and users

The results of Technology Foresight were presented at a final conference in presence of the Swedish Prime Minister in March 2000. During the two following years, Technology Foresight has also been presented at a great number of meetings, including a series of regional conferences around Sweden.

As to users, it can now be said that it is doubtful whether there was from the outset a clear picture of who the primary users of the results were, except that the four main sponsors of the project were assumed to have an obvious interest. Moreover, the government which had demonstrated its support financially and otherwise was hoped to be a user in view of the fact that a bill on R&D policy and funding to the Swedish Parliament was to be submitted in the autumn of 2000. Consequently the four

organisations behind the project were more or less continuously involved throughout the project, including its implementation phase, and the government was kept informed also on the ministerial level.

The four organisations also established an Advisory Committee in order to broaden the range of organisations involved in the Technology Foresight process. Some 30 organisations have been represented in this committee. The task of the Advisory Committee was to ensure that important interested parties in Sweden were integrated into the process, as well as initially to suggest names of possible panel participants. Another task of the Committee was to create involvement and generate support for the Technology Foresight project in their respective organisations, disseminate its findings and advice the expert panels on their work. In addition, an Evaluation Committee was established and entrusted with the work to continuously follow up and evaluate the implementation of the project.

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

In general, the reaction in Sweden to the Technology Foresight project was very favourable. This is not to say that there were no voices of criticism, in particular relating to the absence of surprises in the panel reports and to the observation that many panels had chosen to deal with issues of a societal rather than technical nature, issues where the competence of the panels could be questioned.

So the reaction was fine but what about the actions? When looking at the first objective, to strengthen a futures-oriented approach in companies and organisations we have noted a wide acceptance of foresight as a powerful process. Examples of this is that "The Ericsson Foresight" started on 1 September 2000; that "The West Sweden Foresight" was carried out during 2001, sponsored by 18 companies and organisations; that the "Wireless Foresight" sponsored by Telia and the Royal Institute of Technology started on 1 September 2001; that the IVA project "Energy Foresight" has been carried out during 2002 and that VINNOVA, the new Swedish Agency for Innovation Systems has been instructed by the government to integrate Foresight into its strategic development process.

With respect to the second objective, to identify areas of expertise with potential for growth and renewal in Sweden, the achievement was rather overwhelming in the sense that in the bill to Parliament in 2000 the government almost entirely accepted the recommendations and priorities of Technology Foresight. It can be argued that this was to be expected since the conclusions of the project were very much in line with current thinking in the field of R&D policy, priorities being given to the areas of IT, biotechnology and materials technology.

Many lessons were learned

The lessons from the implementation of the first Swedish Technology Foresight were followed up on a continuous basis by an Evaluation Committee, which reported its observations and conclusions to the four organisations that ran the project. This evaluation focused on the actual process, not the findings of the project's work. In addition the project management team conducted an internal "failure investigation" based on interviews with all persons involved in the project on the working level, altogether some 25 persons. A wealth of information now exists on all practical issues relating to the management of a foresight project in Sweden. This information will be very beneficial now that the second Swedish Technology Foresight is about to start, but it could also be of help to other countries which are in the process of undertaking a foresight project.

The overall judgement in Sweden – internal and external – on the practical aspects was very benevolent, but many detailed and some major lessons were learned. The following critical points are worth mentioning:

- The mission definition was too vague
- The time given to the panels was too short (no time for analysis)
- No "scientific guidance" of the process took place
- Societal problems were defined under way, and were not professionally treated
- No mechanism was established to prevent dominance by eloquent participants
- The risk analysis, which was conducted, should have been more extensive.
- The interchange between panels was too limited
- Some practical problems in the production of reports (guidance, logistics)
- The panel recruitment procedure was not very transparent
- The internal project management structure should have been more strict

All of these points are worth considering in any foresight exercise, but are not intended to give the impression that the Swedish project was not a success. On the contrary, it was generally regarded as genuinely successful, and in particular the following features were emphasised:

- Wide acceptance in the Swedish society of Foresight as a powerful process
- The "mind setting" and networking among participants was highly appreciated
- The industrial participation in the project was very satisfactory
- The reaction was good
- The action was better than expected, in particular regarding the R&D priorities set by government - and many lessons were learned

There is one particular aspect of the above where the Swedish experience has proven to be of particular importance. That is what has been named above as "the mission definition". It can not be too much stressed that any organisation starting a foresight must find out beforehand:

Who are the most important users?
Which are the questions to which they really need the answers?
Which process can find these answers?

This mission definition is also the major argument for undertaking a Foresight effort in an individual country or a specific region, rather than relying on what is being done elsewhere.

It goes without saying that an additional lesson is that, once the important users have been defined, it is very beneficial to have them involved in the Foresight, in order to facilitate the dissemination and implementation process. It is well known, and it is also the Swedish experience, that the difficulties of this process are often underestimated.

One more lesson which relates to the quality of the actual results which are produced by a Technology Foresight process is that it is useful to examine the Foresight results bearing in mind mistakes which have been made by futurists of the past. In Sweden we tried to achieve this objective by producing the special report on earlier attempts at predicting the future, Teknisk baksyn (Technology Hindsight) mentioned above.

The next Swedish Technology Foresight

A measure of the success of the Technology Foresight project is the general acceptance of the conclusion expressly stated by the project that this process is not something that can be done on a single occasion and then be regarded as finished. The Technology Foresight project must be carried forward in various ways and in various forms and it was recently decided to start a second Technology Foresight in Sweden, which will include an update of the previous results but also include new dimensions.

The purpose of this second foresight project is similar to the first one, i.e. to create the basis for priority setting for technology-related R&D and educational issues central to Swedish sustainable growth and to economic, social and ecological sustainability. In addition to creating a broad basis for other in-depth foresight studies to be done by many separate actors in their respective domains (regional, industrial sectors, research areas, corporations, organisations etc.), there are also ambitions to increase understanding about the role of technology for Swedish prosperity and to identify improvement areas in the Swedish innovation system, and to increase long-term thinking and pro-activity. And the obvious general objective from the first Foresight remains, to provide an arena for a broad discussion about technology-related issues about the future.

The intention is to carry out the project in a few sub-projects running their own processes, with a concluding sub-project for integration, synthesis and recommendations. The methods will be based on experience from the first foresight with openness and transparency, in dialogue during the course of the project. A large number of groups will be invited and many people will be involved in the sub-processes.

There will be five sub-projects:

- Other national Foresights – an international perspective
- Updating the first Swedish Technology Foresight
- Technology's context
- Paradigm-shaping innovations
- Integration, synthesis and recommendations

Many countries have made *national foresights* and thus we intend to identify the most important studies and analyse them with respect to target problem /needs, priority issues and recommended actions. How do they differ from current Swedish understanding? To apply judgement to decide what may be relevant for Sweden and identify what we can learn.

In the *Updating* we intend to use the old panel structure and ask eight panels to make an update of each report, each panel to consist of those from the old panels who would like to participate and a few new members. In order to create exiting input to each panel we will employ young researchers and entrepreneurs who will be asked to comment and update the reports.

In the sub-project *Technology's context* we will address subjects such as:

- The enlargement of the European Union
- The demographic development
- Globalisation
- The effects of "September 11"
- The role of technology in society
- Developments within the university system
- Value changes in society

This will be a process of its own with a reference group for management and priorities and participation from experts in the subject areas.

The *Paradigm-shaping innovations* sub-project will describe and assess the frontiers of science and research and identify potential break-throughs and their possible paradigm-shaping implications.

This will also be a process of its own with an assessment group for many-facetted analysis and a large network for broad participation.

When it comes to *Integration, synthesis and recommendations*, the plan calls for a creation of an integrated understanding from the results of the sub-projects, to describe how technology can increase quality of life in Sweden and to discuss essential driving forces for the future. Finally the recommendations should give advice on how to improve the Swedish innovation system and identify priority areas for R&D and education and for the application of technology as set out in the primary objective. And

as in all Foresights there should be an answer to the question of how to improve long-term thinking and pro-activeness in the Swedish society.

A most encouraging feature of this second Swedish Technology Foresight is the fact that we have been able to attract even more sponsors, thus maintaining the benefit of having a true bottoms-up process. The sponsors are:

- IVA – The Royal Swedish Academy of Engineering Sciences
- KK-Stiftelsen - The Knowledge Foundation
- LO – The Swedish Trade Union Confederation
- Svenskt Näringsliv - The Confederation of Swedish Enterprise
- Vetenskapsrådet – the Swedish Research Council
- VINNOVA – Swedish Agency for Innovation Systems