

Horizon Scan Report 2007

Towards a Future Oriented Policy
and Knowledge Agenda

Colofon

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Preface

You have before you the final report of the COS Horizon Scan Project 2007. Taking a long term perspective, the scan provides a view of the problems and opportunity-filled developments that lie on the horizon. Within this context, short term strategic policy and knowledge questions are posed that promise to contribute to sustainable policy and a knowledge agenda that is directed toward the long term. The report does not offer solutions but is meant to stimulate future-oriented thinking. The approach transcends domains and disciplines. The Horizon Scan is a snapshot and this report offers insight into the steps leading up to the scanning process, the analysis of data and establishment of a strategic knowledge agenda. With this report we want to introduce a new method that, we believe, will help improve the development of the right knowledge questions for future-directed policy making.

The Hague, 2007

Editorial Board:

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"There is no likelihood man can ever tap the power of the atom."

Dr. Robert Andrews Millikan (Nobel Prize winner for physics, 1923)

1. Introduction

Who commissioned the project?

The Horizon Scan is a project of the COS. The COS, established under article 12 of the 1987 Sector Councils Framework Act, is the collaboration platform of the sector councils and the Netherlands Study Center for Technology Trends (STT). COS members are knowledge network organizations that develop societal directed foresights upon which strategic knowledge questions are formulated that contribute to the programming of research and policy. Sector councils are made up of representatives of government, society, the business community and science. They bring government, knowledge producers and society closer together.

The COS Horizon Scan was carried out by a specially established team that operated under the communal responsibility of the COS membership. The team's work was supported by a number of sounding board groups. (See appendix 1.)

What led to the Horizon Scan?

An evaluation of the COS in 2004 indicated that, in addition to the usual societal foresight studies regarding the organization of sector councils that transcend domain and disciplinary boundaries, there was need for foresights studies of a broader nature. By constructing links between domains and being sensitive to weak signs of divergence from what we might expect about future developments, a broad-based foresight can serve as the source for new foresight topics. It can thereby catalyze cooperation with other organizations.

This last point is important for foresighting in domains that fall outside the purview of the sector councils' organization. More important, however, was the idea that a Horizon Scan might offer a good basis for the work and foresighting agenda of COS members.

Based on a discussion held within the COS following preliminary (concept) studies done by the British Foresight organization and COS members, and inspired by Horizon Scans that are already being carried out in various countries, it was decided to start a Dutch Horizon Scan. These scans promise to chart the most complete map possible of future problems, threats and opportunity-filled developments that can influence governmental policies that are to be implemented, as well as businesses, institutions and organizations. Ideally, they lead to focused questions regarding what needs to be known or researched further in order to construct sustainable and future-directed policies. Horizon Scans thereby do more than deliver source material for trans-domain foresights. They also lead to knowledge questions that can be used for shaping a knowledge and research agenda.

2. Methods and approach

Definition

For a clear and workable definition of Horizon Scanning, we rely on the approach of the British Chief Scientific Adviser's Committee (2004):

Horizon Scanning is defined as the systematic examination of potential threats, opportunities and likely future developments, including (but not restricted to) those at the margins of current thinking and planning. Horizons scanning, may explore novel and unexpected issues as well as persistent problems or trends.

This means that a Horizon Scan can see past usual (policy) terms and beyond the boundaries of disciplines and departments. It entails a rapid, systematic process of pattern recognition that apprehends both positive and negative signals. All signals that can have a future impact, including weak signals, are noticed, whereby possible interactions between signals can also be researched.

Goal of the Horizon Scan

The goal of the COS Horizon Scan is to help decision- and agenda-makers, researchers and developers think about future societal problems, threats and opportunities. By charting and communicating future developments and their relations in a timely manner, we can be better prepared for 'surprises'. We have tried to meet this goal with the help of the Horizon Scan in the following ways:

- » By identifying and prioritizing the topics of foresight studies and other sector councils' activities;
- » By identifying topics that need further study or foresighting, but fall outside the domain of current COS members;
- » By feeding discussions with other parties, such as the major research organizations (KNAW, NWO)¹, ministries, societal organizations and the business world.

¹ NWO: Netherlands Organisation for Scientific Research
KNAW: Royal Netherlands Academy of Arts and Sciences

Outline of steps in the Horizon Scan

This report is the result of a process that extended over two years. Drawing on the international literature, COS designed a protocol upon which the first Dutch Horizon Scan is structured. Figure 2.1 lists the steps that were followed in the Horizon Scan project.

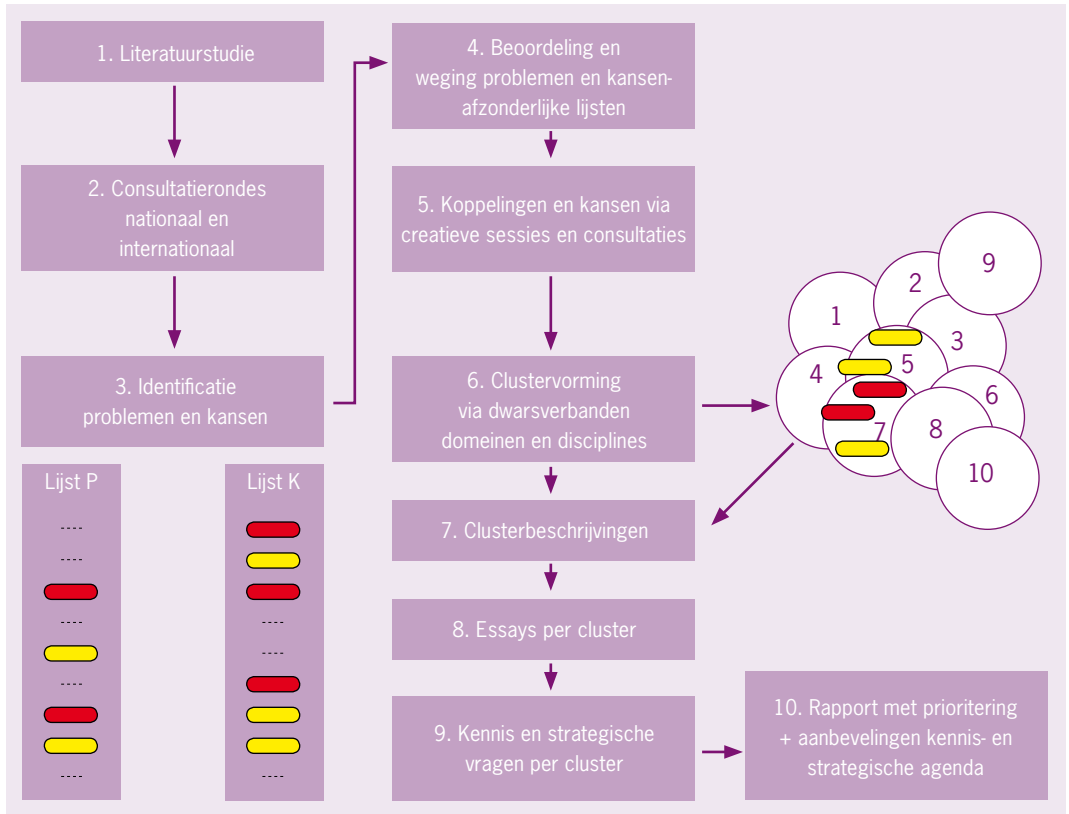


Figure 2.1 Schematic presentation of Horizon Scan process (For translation see page 11).

For your convenience the texts were translated:

Translation of figure nr 2.1.:

1. Literature study
2. National and international consultations
3. Identification of problems and opportunities
4. Evaluation and weighing of problems and opportunities – individual lists
5. 'Coupling and opportunities' through creative sessions and consultations
6. Formation of clusters by drawing connections between domains and disciplines
7. Description of clusters
8. Essays per cluster
9. Knowledge and strategic questions per cluster
10. Report with prioritizing and recommendations for knowledge and strategic agenda

Steps 1-3: Identifying problems and opportunities

The first phase of the Horizon Scan included an extended study of general future literature – such as the top 100 books from the World Future Society, the key-technology studies from the European Commission's DG Research, the British Ministry of Defence Joint Doctrine and Concept Center (JDCC)'s Sigma Scan and literature found on the major websites that deal with the problematics of future studies. This study produced an extended bibliography.(See appendix 3.)

Based on this literature search, a two-part draft list with problems (threats) and opportunities was constructed according to a set of selection criteria (see box 2.1). These lists of problems and opportunities were divided according to previously determined categories (see box 2.2). The categories were drawn from the JDCC Sigma Scan and supplemented with categories used by the World Future Society to organize future literature. The advantage of working with pre-determined categories is that no areas are skipped in the search for problems and opportunities.

Problems and opportunities are separately handled in this phase of the Horizon Scan in order to make new combinations of problems and opportunities possible. On the one hand, new opportunities and developments bring new problems. On the other hand, problems are often seen as presenting new challenges. Developments that present themselves as both big problems and great opportunities are often the most interesting foresighting subjects.

The lists were extended and refined throughout the Horizon Scan process, thanks to meetings by sounding board groups, consultations and discussions with Dutch and foreign specialists. During the first

sounding board group meeting, held in the winter of 2005, the inventory of problems and opportunities was presented and tested before a broadly constituted panel of specialists. The focus during this session was on the list's exhaustiveness as well as on the value and utility of clustering. New items were added to the list during the meeting and participants saw the added value of clustering problems and opportunities as a way to clarify the dynamic strengthening or weakening involved in their relations.

The lists of problems and opportunities were validated in the spring of 2006 through a comparison with the result of the British scan made available by the Horizon Scanning Center of the Office of Science and Technology to the team that carried out the Dutch scan. It consequently appeared that the Dutch and British results manifested great similarities, but also that the cumulative outcomes have added value in that they can enrich and sharpen the lists (see appendices 4 and 5).

Box 2.1 Selection criteria used to determine problems and opportunities

The selection criteria for problems and threats were:

- » The chance of damage
- » Seriousness and size of the (possible) damage (lives, quality of life, economic damage, etc.)
- » Responsibility/who owns the problem (to what extent is it a public issue)

Selection criteria for opportunities in this Horizon Scan were:

- » The size of possible consequences (saving lives, improvement of welfare, benefit to nature, etc.)
- » The probability that these positive consequences might actually occur

Box 2.2 Categories within which problems and opportunities are divided. Problems and opportunities emerge either in the physical or social environment

» *Physical environment:*

- a) Atmosphere
- b) Geosphere
- c) Biosphere
- d) Hydrosphere
- e) Space
- f) The universe

» *Human environment:*

- g) Basic services
- h) Science, technology and education
- i) Social domain
- j) Economic, financial domain
- k) Political, administrative and judicial domain

Step 4: Evaluating threats and opportunities

The lists of opportunities and problems were made available to the broad public via the internet. Visitors to the website were asked to give their view of the importance of the developments sketched in the lists and the probability of their occurrence. These evaluations were primarily intended to stimulate discussion about the use of the lists. Members of the sounding board groups were also asked to evaluate the lists. Due to the large number of questions we posed, the question list was organized so that website visitors could select and answer only those questions they found interesting. The sounding board group members offered their views on all the opportunities and problems.

Steps 5-7: Linking and clustering

After having identified problems and opportunities, a meeting was called between representatives of the group that was carrying out the scan with the team from the British Horizon Scanning Center to discuss the following steps to be taken. One of the following steps was to organize problems of opportunities into clusters. Two approaches to the process of clustering were discussed:

- 1) The first approach relies on the perspective of a specific client. This, for example, can be a department or a business. According to this approach, the clustering of problems and opportunities is organized around the client's primary issues or goals. For example, if the client in question is the Ministry of Health, all the subjects that might have an impact on health, health policy and health-related research will form one cluster. Problems and opportunities that come together in a single cluster can, then, for example be climate change, demographic changes and technological developments that make new treatments possible or that can lead to new health problems.
- 2) The second approach calls on asking a broadly structured sounding board group to evaluate a number of high-impact problems or opportunities that, together with other subjects, form a rich and coherent whole. Beginning with random (high-impact) subjects, people look to see what other things they can be meaningfully coupled with. For example, the cluster 'Robotics and Interconnectivity' began with the convergence of nanotechnology, bio(techno)logy, informatics and cognitive science, as concluded by the American National Science Foundation. This convergence can be linked to new possibilities for solutions in many of the problem areas mentioned

in the lists – such as demographic changes and the graying of and other developments in the labor market. This leads to a trans-domain and trans-disciplinary cluster of interest to a wide range of clients.

The group that carried out the scan decided to follow the second approach and to work with broad, trans-domain and trans-disciplinary clusters that reveal the coherence between expected developments that can have major social consequences in the future. (Further information about the criteria used to assign problems and opportunities to clusters can be found in appendix 11.)

Following the first attempt at clustering at the start of 2006, the group that carried out the scan organized a second sounding board group meeting. During this meeting, participants advised on how the proposed clusters might be further refined or reconstituted. To begin, a selection of approximately forty fundamental problems and opportunities was made. Ten clusters were then established with which to search for other problems and opportunities that strongly interacted with the originally chosen problems and opportunities. Based on this meeting, the group that carried out the scan produced a cluster document in which the essential questions and goals of each cluster as well as the conglomerations of related problems and opportunities were sketched. The document spurred the formulation of related developments and signals within each cluster. Clearly, the construction of these images is a most complex business; the possibility of arriving at various divergent images certainly remains.

In order to make the new relations among developments contained in this document visible, a third sounding board group was convened in the spring of 2006. A special card game was developed for this purpose, which helped participants to look beyond the boundaries of their own domains and disciplines. Also, with a certain degree of caution, participants were asked to distance themselves both from the idea that the future can be engineered and from the prudent or strict demand that claims about the future be based on empirical data.

On the evening before Prince's Day 2006, an alternative 'State of the Nation' address was held in which the results from the analysis of problems and opportunities, the formation of clusters and the surprising connections discovered with the card game were broadly publicized (see appendix 7).

Step 8: The essay volume

The cluster descriptions were used as inspiration by a number of scientists, journalists and politicians who were chosen by the group carrying out the scan to write essays about possible future developments

that transcend borders, domains and disciplines. Authors were asked to offer their view of the clusters' core issues in an essay, the goals of which were consciousness raising and providing the reader with a feeling for future developments. They were explicitly challenged to transcend the boundaries of their own domains and disciplines, and even the boundaries of science's empirical metier. The essay form was chosen because of the freedom it offers a writer, among other things, to stimulate discussion. The resulting twelve essays can be found in a volume entitled *Polar bear plague in the Veluwe*. Eleven of them discuss the ten chosen clusters and one focuses on a cluster – 'democracy and technology' – that was added by a member of the sounding board group. The volume ends with a chapter in which connections between the clusters is sketched. A final meeting of the sounding board group, which was held in the autumn of 2006 and at which the essayists were also present, provided extra input about this to the group that carried out the scan. Participants were further challenged and provoked to transcend disciplines and domains during the meeting, the goal of which was to make the relations among the various clusters explicit. The eighteen attendees did this in sub-groups by developing mind maps (see box 2.3)². The results were exchanged in a plenary session.

Box 2.3 Relations among clusters were sought during the fourth sounding board group meeting.

Sub-group discussions

Two discussion sessions were held, the first in subgroups and the second as a plenary session in which the sub-groups' findings and conclusions were shared. The sub-groups used the following structure:

- A. Infra-structure, space, energy (clusters 1, 4 and 9)
- B. Infectious diseases, engineerable humans (clusters 3 and 8)
- C. Robotics, education/labor, ageing (clusters 5, 4 and 10)
- D. Conflicts, democracy and technology, economy (clusters 7, 10 and 2)

Groups A and B were combined in practice. The sub-groups were asked to provide two things: (1) a mind map of the relations between and aspects of the various clusters and (2) a 'report' with bullet points listing the major conclusions. Finally, the sub-groups' contributions were discussed during a plenary session.

Source: *Minutes, Sounding board group meeting 23 October 2006 – dated 7 Nov 2006*

2 According to a learning theory, a mind map is a graphic scheme (or information tree) that relates subsidiary issues and kindred concepts to an initially chosen central subject. A mind map can help to distinguish details from primary issues and to organize information in a logical order within a given analysis. Source: http://en. Wikipedia.org/wiki/Mind_map

Steps 9 and 10: Knowledge and strategic questions per cluster

The clusters and essays provided building blocks for the recommendation of strategic policy and knowledge questions. They also spurred insight into:

- » New relevant (knowledge) questions based on broad future analyses;
- » Gaps in knowledge in relation to knowledge questions for research and strategic questions for policy-making.

Multiple complexities were recognized within each cluster of issues (opportunities and problems).

The same was true for the relations among all the clusters. It is clear that the development of a coherent, strategic policy and knowledge agenda is no simple task – not simply a question of divvying up the work and stapling the results together in a final ‘synthetic’ report. A Horizon Scan should result in more than a single integrated document with strategic policy and knowledge questions for each of the clusters.

The aim is rather to spur the acceptance of one cluster as most urgent; ideally, every cluster should receive the same level of attention in the world of science. For every cluster examined in this foresight, the already-involved parties and other interested parties and organizations that need to be involved are the ones who should inter-subjectively extract, formulate and actualize the most urgent and relevant foresights and enrichment studies that need to be carried out.

This report will discuss one of the ten clusters in more detail. It will provide a first step toward establishing a strategic agenda and further foresights in this terrain in the form of questions, discussions and argumentations.

3. Results

In one continuous process of convergence, the Horizon Scan project has produced a number of products. Beginning with a rich and strictly structured literature study, a final list of 150 problems and opportunities was honed. Based on this list, ten clusters were formed, about which scientists, journalists and politicians were asked to write. Specialized sounding board groups were set to work at the various moments of choice and transition to help keep the project productively on track. This chapter examines the results of the Horizon Scan in more detail. The results until now are:

- » Literature study
- » Lists of problems and opportunities + score list
- » Cluster descriptions
- » Alternative 'State of the Nation' speech
- » Essay volume
- » Website
- » Card game
- » Awareness raising
- » Final report

3.1 The list with opportunities and problems

As already stated, a list of problems and opportunities was constructed out of a process involving a literature study, consultations and sounding board sessions. The final list consists of some 150 problems and new opportunities (see appendix 4). These lists formed a basis for the search for combinations and developments.

Website visitors and sounding board group members were subsequently asked to score the 'plausibility' and 'importance' of the problems and opportunities. Obviously, this estimation of how plausible it is that a particular problem will arise shows one side of the coin. Estimating how important a problem or opportunity is reveals the other. Yet, a single problem or opportunity can score highly as both 'plausible' and 'important'. We see this for the problem of lacking a robust strategy to combat the consequences of climate change.

The three problems considered to be most plausible were:

- » The lack of a robust strategy to combat the consequences of climate change
- » The scarcity of natural resources
- » The development of Africa and other barely developed lands.

Estimations of the three most important problems revealed a different order of themes in the second and third place:

- » The lack of a robust strategy to combat the consequences of climate change
- » The worldwide shortage of water which leads to political instability
- » Political unrest around the world

The three opportunities chosen as most plausible reveal a different situation:

- » Active senior citizens
- » Robotization
- » Converging technologies

The choice for three most 'important' opportunities was different again:

- » Development of a hydrogen-based economy
- » A robust strategy for energy supplies
- » Taking advantage of scientific knowledge and technological trends

An overview of the ten most and least 'plausible' and important problems and opportunities is found in appendix 8. The evaluation of almost all the problems and opportunities done by a panel of specialists (sounding board group) can be found in appendix 9.

Box 3.1 A number of interim products from the Horizon Scan Project.



Interim products from right to left: the problem and opportunity list with report of the creative session, the document "Problem and Opportunity Clusters" and the "Sounding Board Group Report" of 23 October 2006.

3.2 Clusters

Based on the lists of problems and opportunities and with help from a sounding board group and the members of COS, the group that carried out the scan put together ten clusters (see box 3.1). Various subjects and issues were grouped together in the clusters they developed.

The clusters descriptions are tentative and constantly being changed and improved. At the same time, they provide a structure, as more and other accents are certainly possible. They thus reflect what is currently considered of importance for the future.

Box 3.2 The ten clusters developed by the Horizon Scan project

Ten clusters

1. Infrastructure for the future
2. Changing economic and political world order
3. A global approach to dangerous infectious diseases
4. Work and education in a new context
5. Opportunities for robotics and inter-connectivity
6. Two related transitions: creating and utilizing space
7. Handling conflicts and security policy constructively
8. The engineerable and self-mutating human
9. Accelerating the development of new energy sources
10. What does 'the graying of society' mean?

Cluster 1. Infrastructure for the future

Infrastructural facilities (food, agriculture, energy, traffic and transportation, housing, water, healthcare, communication) last a long time and the determining pressure of existing trajectories is great. Current conditions follow the contours of old paths; a portion of currently available housing is more than a century old. How can we shape these basic facilities so that they fit better with new and future desires and demands? Infrastructural facilities should not only fit with future developments, they should cause them. Large-scale infrastructural developments have often triggered great social, economic and political changes. We might find ourselves faced with a new series of consequences as we currently look for answers to globalization, cosmopolitanism and other consequences of the last wave of infrastructural developments. The essence of this cluster is reflection upon the organization of services that have an infrastructural character, such as food, energy, traffic and transport, housing and communication, based on the developments that were identified by the Horizon Scan as important. This means: acting on the desires of the broader public, in the context of their consequences in a variety of terrains: physical, social, economic and political.

Acting on changes in the desires and demands of users

In addition to their service and network-like character, infrastructural facilities are capital-intensive. Once a particular technological trajectory is chosen, change is only possible at great cost. It is therefore wise to consider the future. It can be assumed that population size and composition will change. Various scenarios are possible; population decline or growth, as well as a totally different ethnic composition and age distribution, different life styles, social structures and values are possible. In each case, desires and needs in relation to facilities change. Available housing and the organization of traffic and transport, for example, are not resistant to the ageing of society. Anticipating social changes is important, but not sufficient because great changes can also take place in the physical environment. The damage that possible climate change can cause is great and current facilities are not designed to respond. Is it then smarter to invest more heavily in safe areas around Amersfoort (relatively far from the coast) or in transportable housing?



Major consequences in physical, social, economic and political terrains

As regards infrastructure, it is important to do more than anticipate developments in various terrains. Major developments in infrastructure take place every sixty years or so that have an enormous influence on socio-cultural, economic and political developments and the environment. Think of the rise of aviation and the globalization that followed. Are these sorts of major infrastructural developments and their consequences to be expected in these aforementioned terrains? What are the consequences of increasing cosmopolitanism for solidarity? What consequences will the network society cause? Will these trends have even more influence because of continuing infrastructural developments?

The coupling with the cluster robotics/interconnectivity is of great importance. The 'hard' physical infrastructure is becoming increasingly encircled by 'soft' infrastructure, within which the use and maintenance of the 'hard' infrastructure is organized.

The biggest problem and challenge is to examine whether there is any chance of major and radical breakthroughs in the development of physical infrastructure and the surrounding 'soft' infrastructure. Possible consequences for social, economic and political life need to be inventoried and evaluated. It is also interesting to chart the consequences of such previous infrastructural breakthroughs, especially if they still stimulate the need for adjustment or changes in other terrains and clusters.

The large number of problems and possibilities from the list that are important for forward-looking infrastructure development is remarkable. This is due to the service-oriented character of infrastructure. Examples from these themes are: the development of resilience, the availability of space due to the disappearance of agriculture, the increasing need for tourism and recreation, problems surrounding the affects of the market related to infrastructure and the increasing vulnerability of infrastructural facilities. Finally, the point is to decide what these insights about infrastructure mean for the present: foresights, knowledge questions, policy actions and experiments.

Cluster 2. Changing economic and political world order

The political and economic world order is experiencing great change. The American super power is still the most important economic and military actor in the world and produces top scientists, technologists and thinkers. But American power seems to be fading. While other countries choose to limit their actions in accordance with international agreements and treaties, the United States largely follows its own rules. This leads to growing resistance to the United States and makes the construction of international treaties and cooperation within the United Nations more difficult. The role of the United Nations and other international organizations needs to be considered further.

The rise of new super powers is being predicted. Potential candidates are Japan and Brazil, Russia, India and China (the BRIC countries). There are also the 'tigers' to consider, countries with a powerful and growing economy such as Taiwan, Singapore, Chile, Oman, South Korea, Thailand, South Africa, Poland and Canada. Are we entering the Asian century?

The position of the Netherlands within this changing political and economic force field of world powers needs to be determined and achieved. A number of traditional markets where the Netherlands is active are disappearing. Is the Netherlands sufficiently prepared for changes in economic conditions?

A number of countries, including the Netherlands, seem to be turning into non-innovative and lack-lustre countries in terms of economic achievement. Ambitions are set too low to be a world player, structures have become too rigid and risky projects are not undertaken. The chance is great that these countries and their companies will not be able to adjust to new rules of economic engagement such as rapid development capabilities and expansion capacity, connections to worldwide networks, continuous knowledge development and a dependable delivery system for goods and services. How do and should we respond to globalization and future competition from other developing countries?

Globalization

Globalization – the ‘increasing integration and interdependency of societies through the exchange of ideas, capital and goods’ – is expected to continue. Globalization takes place in various terrains: the economy, national culture and identity, norms and values. As a result of ICT developments, cheap transport and the division of labor, trade between nations is growing faster than production in individual national economies. Social, economic and political conditions such as faith in the financial system and the liberalization of world trade also influence globalization.

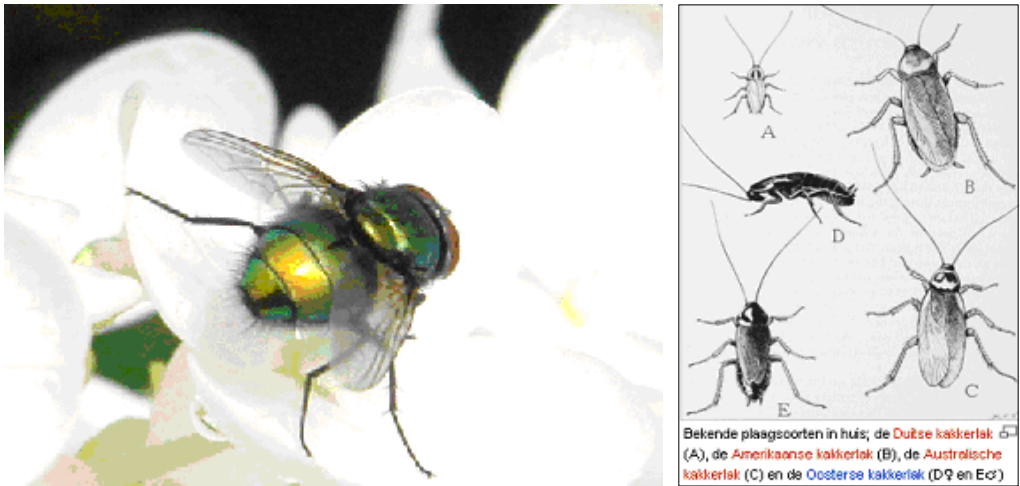
Though continued globalization is the most probable development, it is also possible that it will slow down and that world trade will decrease. Possible causes are loss of trust due to the collapse of the financial system, new waves of protectionism in countries that face losses in the new system, geo-political unrest resulting from phenomena such as rising energy prices or shortages of water, natural resources or food. If economic and social changes occur too quickly and take place in an institutional vacuum, this can lead to political resistance and authoritarian reactions that might threaten liberal values.

Rising nations

The rise of the BRIC countries will lead to new geo-political relations and conflicts that will need to be resolved. Domestic adaptation is bound to be necessary (lower incomes, changing work opportunities, a change or the end of growth, for example). All this will require social engineering or transition management, a discipline that still needs further development.

The goal of this theme is to gain insight into our new Dutch role and position in a globalizing world with new major actors, to see whether previously chosen key areas will continue to be implicated or

whether other areas offer greater opportunities. This might be determined by working out case studies in transitional areas, areas in which future world-wide demand might be expected and where specific opportunities have been noticed. The following sections of the Horizon Scan lists might be of interest to this cluster: agricultural transitions, resources, robotics, converging technologies, judicial services and services in the engineering and water sectors. This list can be extended with the lists of the Dutch Innovation Platform and NWO (Netherlands Organization for Scientific Research) as well as the UN-Millennium goals (directed toward developing nations).



Well-known domestic pests: (A) the German cockroach, (B) the American cockroach, (C) the Australian cockroach, and (D and E) the Asian cockroach.

Cluster 3. Global approach to threatening infectious diseases

Infectious diseases and pandemics that affect plants, animals and people form the most important threat and can have the most catastrophic consequences. Structural policy regarding this threat is desirable. This theme is organized around the chain of infectious diseases' origin, spread and cure. Insight in the process and formulation of adequate responses at all points along this chain are desirable. Questions that deserve examination are:

- » Which new infectious diseases have recently been noticed? What are their origins? Where do they come from?
- » How do new infectious diseases spread (via the quickly growing transport of goods and people, for example, or migrating birds, insects or rats) and how can this be dealt with (prevention, alerting)? Which (new) infectious diseases actually present a worldwide threat (and why)?

- » What do worldwide environmental changes such as climate change mean for the spread of (certain) infectious diseases? Especially this question, which is already being worked on by the initiative group 'Worldwide Environmental Changes' (The Institute for Public Health, Erasmus Medical Center, Rotterdam), involves a subject that transcends sectors.
- » Should a disease nonetheless spread, what responses are possible? Which scenarios are imaginable in a global approach to infectious diseases?
- » Who should do what? How can this problem be handled on an international scale? A variety of sectors will have to take measures. The theme of infectious diseases might be coupled with the development of new forms of international political cooperation and ways of strengthening the knowledge system through, for example, the co-production of knowledge by governments, the business community and social organizations.

As regards this cluster, it will be necessary to examine the relations that other problems and opportunities drawn from the Horizon Scan have with epidemiology and infectious diseases. What impact do climate changes, increasing intensification of agriculture, urbanization, tourism, development cooperation and demographic changes have on the spread, globalization and extensification of diseases and on health care and eradication costs that go along with them?

Cluster 4. Labor and education in a new context

Various bottlenecks and opportunities surround labor and education. One thing is certain: the role of labor in our lives is changing, as is demand in the labor market. The organization of education and the labor market (including social security) will have to respond in order to avoid tensions and to take advantage of social and economic opportunities. The following subjects might arise in further studies of this cluster:

- » It is possible that the Netherlands acts too much in terms of demand that used to structure the labor market and that education isn't sufficiently matched with new economic developments. Life biographies are bound to change in the future – from standard biographies to biographies of choice. The pattern of life is changing. Various phases of life such as work and learning are becoming more interwoven. Stacking studies, jobs and relationships is becoming more normal. To what extent will this continue as our life expectancy rises? More and more people will have to follow a non-linear career path and the labor value of youth will change. If the education system doesn't follow these trends and, for example, offer differentiated studies in a more flexible manner, we might see problems in both education and the labor market. Unimpeded, this can affect other, previously and yet to be discussed clusters.

- » Future population size and composition is uncertain. The ageing process is already underway and will only increase. Cosmopolitanism, both in and outside the Netherlands, is also a trend that involves well-educated youth as well as retirees. Such demographic changes can have an impact on the labor market. Will we have enough well-educated workers for a strong knowledge economy in the future? How do we attract and retain enough workers to staff the healthcare sector in a graying society? People are experiencing a new phase of life as we grow older and stay healthier; how can seniors be better integrated in the productive society?
- » Taking advantage of available, new technology increases the variety of learning and decreases attachment to one's location. Knowledge development and production increasingly take on the form of a hobby, carried out by semi-professional groups outside their program of study or work. At the same time, many schools seem to be increasingly isolated from society. This raises the question of whether schools in the future will be housed in a building or consist of a network of relations spread throughout the entire society.
- » The new economic world order described in cluster 2 carries with it a new context for the organization of labor and education. For in what areas can the Netherlands excel, if Asian countries can produce and deliver goods and services better, faster and more cheaply than we? How and where can we be competitive? What are our strong points and what forms of education are needed to realize them?
- » Technological changes such as robotics and converging technologies will bring about changes in labor. The rapidity of technological developments also requires rapid adjustments in education in order to use and apply their results. Whenever education fails in this regard, a large gap is bound to ensue between the digital or technological competencies of graduates and demands of the labor market. A similar gap can arise even when the newest technologies are educationally integrated – in this case between different age groups or sectors of the population, based for example on income or religious belief.
- » The number of households under the poverty line in the Netherlands rose between 2002 and 2005 and has since declined, according to the Social and Cultural Planning Bureau (SCP). What changes need to be instituted in both the fields of education and labor in order to maintain this declining trend in the future?

In sum, there are a number of developments that can and will alter both labor and education, and that call for responsive changes in education. How will the educational system have to respond in order to meet the expected changes and challenges of the labor market?

Cluster 5. Opportunities for robotics and interconnectivity

The last half century has seen an increase in the tempo of the developments in the computer-driven automation of industrial sectors and public services. Combined with the development of cable-based and other electronic forms of communication, this has opened up a number of new possibilities. An enormous amount of information can be conveyed worldwide between people, sensors, computers and automata in a matter of seconds. What knowledge base is needed to support this? How far can the interconnectivity of communications systems be taken? The introduction of advanced robots or robotic systems will have an intense impact on the economy. Who will be 'first', the East or the West? Or will the South be the surprising winner in 2050?

It is likely that interconnectivity will continue to evolve with full force from the start of this millennium. This development will not be limited to phenomena that we have already seen or can already predict, such as unmanned train stations, stores without cashiers and self-steering vehicles. It will expand to include movable robots and units that carry out any number of more complex tasks. Will humans also slowly be replaced by increasingly advanced robots or robotic systems in areas where, until now, people have been essential (such as doctors, lawyers or laboratory workers)?

The economic changes that accompany the introduction of such robots occupy an unexplored terrain, which current economic models are not equipped to describe. This is because the content of the factor 'human' labor will change drastically with the adoption of automation and robotics. How much more efficient can production processes become? Will a new situation arise in which people actively seek meaningful work and new manners of distributing consumption rights between those who work and those who don't?



The United States and various Asian countries are pursuing a number of initiatives to bring the NBIC disciplines (nanotechnology, biotechnology, ICT and cognitive science) into convergence with each other. This convergence can provide a solid basis for further developments of an intelligent robotics industry. New East Asian players will have a determining influence on the tempo with which mobile, intelligent robots

will develop and penetrate the economy. How can the Netherlands and Europe continue to play a role in a world where developments are moving with increasing speed in the direction of robotics? Will we be among the developers and producers of the new generations of robots or will we have to settle for the role of consumers who put robots produced elsewhere to work here? Will we steer robots, avatars (see third photo) and entire industrial plants from afar via the internet (see images on left and right), as was already realized in the glass fibre industry in the 1990s?

If they want to get involved, what (social and scientific) knowledge will the Dutch, European or international industry have to develop in order to produce the robots of the future? What opportunities directed toward the co-production of knowledge and applications do partnerships between government, business, social organizations and science offer?

The cluster 'robotics and interconnectivity' has a number of intersections with other clusters and problems and opportunities drawn from the Horizon Scan list. Problems and opportunities often have direct implications for each other. Thus future communication systems make inspirational learning possible (the avatars Andy and Baldy train deaf people in the use of sign language, for example). On the other hand, however, the chance of a digital knowledge gap is growing. There are other opportunities in the fields of space travel, new means of transport, infrastructure, healthcare and democracy (interconnectivity affords the technical possibility of becoming an expert or producer).

Problems lie, for example, with infrastructure itself, its increasing vulnerability and our dependence upon it. The past shows us that every new development for civil society also offers opportunities to 'criminal society'. The balance of power between law enforcement, criminals and terrorists is changing. How can we guarantee that society retains control over technology and its potential applications? How do we guarantee individual freedom (and immunity)? Another issue is our growing dependence on communication systems, which is already so great and renders both society and the economy vulnerable. 'Big Brother' is a constant risk, especially as the media's commercialization continues. But for whom and why is this a threat?

The question might be boiled down to one of whether the worldwide application of robotics will reiterate what happened with 'the computer'. That is to say: originally projected as minimal (in 1943 the chairman of IBM, T.J. Watson, anticipated there would be five computers worldwide), the computer came later to be seen as threatening the jobs of a large portion of the population. Reality worked out differently. Fifty to sixty years after this famous claim, everyone works with computers and society is largely dependent on them. But suppose that robots and intelligent systems affect 'mental' work in the same way that computers affected hand work, including the maintenance and development of new robots and expert systems. What will this mean for humans, society and social living?

Cluster 6. Two related transitions: creating and utilizing space

The disappearance of agricultural subsidies could lead to major changes in rural areas after 2012. What consequences will this have for the Netherlands? Will agriculture disappear? If so, what will take its place? How will the exchange between rural and urban areas look in relation to the ageing of the general population? It will become increasingly important to make good use of limited space and, possibly, to make new space available.

Creating and utilizing space

The disappearance of subsidies and regulations such as the Framework Directive Water 2010 means that it is possible that agricultural and dairy farms will also disappear, freeing up extensive amounts of space. Can this space be utilized to satisfy the social need for 'wellness'? Prosperity has advanced on all fronts, except for the quality of our living environment, which can be explained by the 'progress paradox': 'How life gets better while people feel worse'. This space can be used in the post-material society to improve the general welfare and, thereby, social cohesion as well. This fits with the 'wellness' trend and growing calls for recreational facilities. Think of senior citizens and Asian tourists for whom the Netherlands has much to offer. The Netherlands is a pack leader in the development of domestic care facilities and can strengthen this position by aiming at foreign markets. Making a link with the 'third' phase of life is of interest.

As the Netherlands moves from being an agricultural exporter to specializing in the export of knowledge and services related to the fields of agriculture and food, it might be possible to 'kill two birds with one stone'. The Netherlands already has a tradition of developing and cultivating new 'wild' nature and could export services in this area. The value of this sort of developments can be compared with alternative strategies such as scale leverage and the high-tech agricultural sector. The Dutch landscape is unique and offers great variation in a small space. Much more can be done to attract tourists, talented workers from abroad and (rich, creative) retirees.

No vast expanses

The claim that agriculture will completely disappear in the Netherlands might sound far-fetched. The agrarian sector's share of GNP has fallen from more than 25% in 1965 to less than 2% currently (CBS; Statistical Yearbooks from 1970, 1997, 2002, 2005). This shows just how drastically things can change. It is possible that this is comparable to the transition from regional, locally grounded agrarian production at the beginning of the twentieth century to the largely industrialized agriculture that mainly took shape after the Second World War. But what lessons does this teach us for the future?

It is true that the number of farmers is rapidly declining, but that doesn't mean that the land they leave behind can immediately be used for other purposes. Much of it is bought by other farmers who can lower their production costs by operating on a larger scale. Moreover, the soil is often used for growing non-traditional crops such as vegetables (both in fields and greenhouses), sowing seeds and potted plants. One can expect in the near future that the acreage used for energy crops (turnips, miscanthus and wheat) and other natural ingredients for the chemical and pharmaceutical industries will increase.

Alongside the primary structure of agriculture, in which large scale crop growth, cattle farming and greenhouse agriculture can be found, there is room for other forms of agriculture that are compatible with other facilities such as housing, health care, recreation and nature. Transitions in agriculture offer possibilities for the development of new arrangements between city and countryside, agriculture and nature, land and water.



This cluster intersects with other clusters as well. What does the rise of Asia, for example, have to do with our agriculture? Can we use our knowledge for development cooperation? How should we respond to geo-political tensions? In these turbulent and uncertain times, should we strive for a level of self sufficiency or invest in political stability and in fair and good trade relations with countries that support cheaper production costs? What effects will climatological and, for example, demographic changes have on a sustainable agricultural strategy? What does the silting of coastal areas brought on by the rising sea level mean for agriculture? How will sustainable agriculture, for example, look in fifty years? Will we try to maintain the landscape, allow it to return to a more natural state or build on it? Will we maintain experimental ponds for developing knowledge for export? Which questions need to be posed along these lines to scientists, politicians and society? Are we needlessly holding on to a sector that is past its prime?



Cluster 7. Handling conflicts and security policy constructively

Conflict management will remain a central activity at all levels of governance and government in the future, from municipalities to the level of the United Nations. This theme can be approached in at least two different ways. First, the future of security-related policy can be internationally researched, on a global scale. Second, problems and conflicts that affect individual citizens are developing closer to home.

On a global scale, one thinks of problems related to globalization, poverty, religious differences and terrorism. Globalization is expected to continue. While some poorer countries are profiting from globalization, a gap is growing between those that participate in the world economy and those that do not. How will the growing discontent of poorer populations manifest itself? The media keeps them informed of the welfare of others. Does this present an opportunity or a threat? The chance is great that the fifty or so poorest countries, most of them in Africa, will be totally shut out of the new economic world order. While our image of Africa is often too negative – there is peace, cooperation and democracy in a portion of its countries – it is not going well with the continent as a whole. Even current problems such as water shortages, prevention of natural disasters and diseases remain unsolved. There are those who say that the present form of development aid actually does damage. Religious wars are timeless, but concern is growing. Beside terrorist networks, there are countries where political turmoil and strife can arise, such as the area around the Caspian Sea, Indonesia, Saudi Arabia and Mexico. Many consider a clash between the 'Christian' West and Islamic countries to be in the realm of possibilities. But insight in deeper causes and in how to further peace is limited. How should security-related policy develop on a worldwide scale? Where does the Netherlands fit in these developments?

Problems surrounding social cohesion will play a role nationally in the future. Social cohesion will come under threat if established classes develop antagonistic feelings toward newcomers with whom existing facilities (housing, jobs and welfare payments) might have to be shared. Minority groups become isolated and feel detached from the ambient culture. Concerns about the inability to resolve conflicts between population groups are growing. The traditional characteristics of Dutch culture, such as openness and tolerance, are in danger. Alongside the threat of social cohesion diminishing within the Netherlands, Europe is facing a similar danger. Citizens of various European countries more often feel themselves citizens of the world than of Europe. The lack of a European culture or identity is a major hindrance to further economic and political integration.



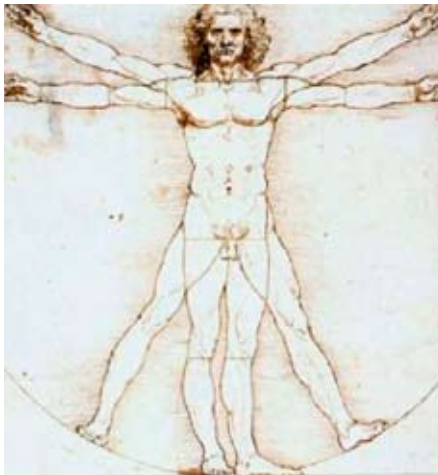
How will we relate to these tensions in 2050? Will we do so as minor actors on the world stage? And what about here in our own country? How will citizens of the future respond to such issues? Today's security policies are not always rational, but often driven by fear and directed toward calming the citizenry with highly visible gestures. There is a diversity of opinion regarding the effectiveness of these policies. Attention is given to the relations between conflicts and security in this cluster. It examines topics such as globalization, changing values, social and new economic world orders.

Cluster 8. The engineerable and self-mutating human

Life expectancy in industrialized countries has risen during the last century. Following the abandonment of 'humoral pathology' (based on the harmony between the body's four "humors" (body fluids)), medical knowledge made great strides. Contemporary medicine has embraced a different, more powerful paradigm. With the help of medical technology, its neighboring fields and attending areas of study, life expectancy has risen. Increasing understanding of general factors that determine health (such as balanced nutrition and hygiene), the nature of chemical and physical factors and how they affect health, have strongly influenced this rise. The knowledge that has been accumulated about the genome brings

1 The difficult to translate Dutch word used here is 'maakbaar', a word that implies progress through engineering of various sorts. I have chosen to translate the term as 'engineerable' throughout the text. (Editorial note)

opportunities and problems with it: will we be able to direct human mutations in a certain direction in the future? Will we be able to custom order our children in the future, with the desired sex, intelligence, hair, eye and skin colour via the internet?



How far will medical – convergent – technology go? Will it produce artificial arms, legs, eyes, livers, kidneys, hearts, ears, muscles, nerves or brains? Will they be mechanical or genetic? Will they be enhanced , modified, integrated, interconnected, natural or, maybe, none of these?

A number of dilemmas accompany these developments. The application of new developments in medical technology naturally leads to a rise in health care costs. One third of the autonomous cost increases in health care is determined by the ageing of the population while two thirds are the result of technological developments. One

can assume that governments in developed countries endeavour to lower the collectively financed portion of health care costs. An increased private portion of health care financing leads to the risk that the newest technologies will become prohibitively expensive for certain segments of the population. This will undermine social solidarity in relation to health care and create a divide between the 'haves' and 'have nots'. Will the realization of such possibilities increase the difference in life expectancy between countries and even between population groups within individual countries? Might this happen, for example, because the high costs attached to the wealthy's desire for perfection lead to a lack of basic facilities for the less well off? What demographic, social and economical consequences will follow? In the long term, the uneven distribution of these possibilities could have evolutionary consequences.

Based on an analogy with the development of genetically modified organisms, will resistance in the Netherlands have virtually no effect on the way these possibilities are treated elsewhere in the world? A situation might then arise in which discoveries made elsewhere that allow for possibilities such as life extension and perfection could force their way, as it were, into the Netherlands.

Gaining insight into these sorts of issues can give further direction to bio-medical, health care, social scientific and economic research. This will bring countless questions together. In addition to questions of a medico-technical nature, these will include the issues of how society must, can, may and will respond, as well as precisely who will take the initiative or responsibility to respond.

Cluster 9. Accelerating the development of new energy sources

Energy production and use are a point of great concern for our future; new and sustainable solutions will have to be sought. This search and the transition to durable energy facilities are made even more urgent by the increasing energy consumption of the rising national economies.

The energy from fossil fuels is limited. The reserves of these fuels will be depleted first in the industrialized nations. If the same level of production is maintained, Dutch natural gas reserves will be exhausted within twenty years. The demand for these fuels from developing economies such as China and India will grow. Depleting the natural fuel resources located in the West raises the risk of new large-scale geo-political tensions in relation to the sources that remain. Additionally, the increased use of fossil fuels leads to a higher concentration of carbon dioxide in the atmosphere, which intensifies the greenhouse effect.

Beside fossil fuels, nature harbours sometimes endless supplies of energy in the form of material such as uranium and deuterium, as well as – especially solar – radiation. Developing adequate processes to harvest this energy offers opportunities; consider nuclear fission and fusion, or either the direct or indirect harnessing of solar energy (bio-mass, wind, etc.). These processes do not lead to carbon dioxide emissions, but are not free of other negative environmental effects. The following must be taken into consideration as we seek out and weigh the various alternatives:

- » How energy is extracted;
- » How energy can be stored, transported and utilized by various energy-demanding functions (heat, labor and movement, lighting, etc.);
- » How these various forms of energy can be adapted to existing systems and/or whether they require new facilities (the issue of transition).

It is unlikely that these three points were integratively examined in previous foresights. Can the active search for realizing promising options be accelerated? This is especially desirable if time-consuming developments bring high investment costs with them (such as nuclear fusion). Considering riskier research projects that might yield big gains (such as low energy nuclear reactions and zero point) is another option. The theme of new energy sources can be combined with the 'circular economy', a development directed toward the endless recycling of materials and energy, which is being strongly pursued in China.

Though taking on the challenge for new sources of energy offers opportunities and problems for the Netherlands, an acceleration in tempo might be better achieved through 'neutral' internationally agreed developments. A possible starting point for this is a foresight carried out with international or European parties (government, business, research), based on previously conducted national foresights.

Cluster 10. What does 'the graying of society' mean?

The tempo of the global population's growth is slowly declining. As is the case with many European countries, the Netherlands must contend with the ageing of its population. A number of uncertainties make it difficult to predict how population size and composition will develop in the twenty first century. Increasing cosmopolitanism (to and from the Netherlands) can lead to an exodus of well educated youth, but might also lead to the departure of retirees. Migration from poor countries can lead to a new baby boom because newcomers tend to have larger families. The ageing of the population occupies a high position on the political agenda. But is it being approached in the right way? Will the typical senior of the future be a worn-out sixty-five year old or an energetic centenarian who competes in chess tournaments and pentathlons?

Financial and economic problems and opportunities are being seriously discussed before we even understand what it means to live in a society filled with active and healthy senior citizens. In and of themselves, demographic changes are not a problem. They offer opportunities as well as problems.

The image is a collage of various sports event logos and results for the year 2007. It includes:

- Team Ranking - World Senior Championship 2007**
- FEMALE WRESTLING**
 - 1st JAPAN
 - 2nd KAZAKHSTAN
 - 3rd UKRAINE
- GRECO ROMAN**
 - 1st USA
 - 2nd RUSSIA
 - 3rd GEORGIA
- FREE STYLE**
 - 1st RUSSIA
 - 2nd TURKEY
 - 3rd CUBA
- Events & Results: 1997 Senior World Championships** (Manchester, Great Britain) (Acrobatic)
- 07 World artistic roller skating championships**
- SENIOR WORLD CHAMPIONSHIPS 2007** (Gold Coast, Australia)
- Timeschedule of the Senior World Championships Duisburg 2007** (Kano)
- 17th Chess Senior World Championship 2007**
- FENCING - SENIOR WORLD CHAMPIONSHIPS**
- 2007 ISAF Laser World Championships**
- World Senior Curling Championships 2007**
- UIPM Executive Board meets in Berlin**
- 2009 Senior World Championships awarded to London, Great Britain**
- 15th Senior World Championships Taekwon-do**

Certain problems are either too little or too one-sidedly examined. What are the consequences of society's ageing, for example, on various markets, such as housing, healthcare and the labor market? On the other hand, a number of opportunities are going unnoticed. Think, for example, of new markets that arise because seniors stay healthy longer and form a highly capitalized group.

This cluster's approach is to understand what society's ageing means in a socio-cultural sense and what it means for our future society:

- » Can various groups of seniors with different life styles, needs and possibilities be distinguished?
- » Does a larger group of seniors follow a biography of choice, as is the case with younger generations today? What new roles await seniors and what do they themselves want?
- » What do demographic swings mean for various public facilities, such as energy infrastructure, and what will happen to the housing market?

The graying of the population doesn't only have to be seen as a burden; it also offers opportunities. The possibilities offered by a healthy, ageing society can be researched in this cluster. Seniors constitute an economic market that deserves serious attention, not in the least because of the large pool of un(der)-utilized talent.

3.3 An alternative ‘State of the Nation’ address

Based on the results up until that point, the group that carried out the scan wrote an alternative ‘State of the Nation’ address in 2006. The goal of this address was to raise awareness in the Netherlands about future problems and opportunities, which required looking further into the future than is the case in the address that is regularly delivered by the Queen. It had also to be exciting, to point out dilemmas and generate questions. It had simultaneously to bear a cautionary, shocking character and to inspire public involvement. People were asked to focus on the future through the posing of explicit questions such as regarding the possible future developments within various fields of policy. The address was published in the daily newspaper NRC Handelsblad on September 16th, 2006 (see figure 3.1 and appendix 7).



Figure 3.1 Image of the NRC of 16 September 2006 with the alternative ‘State of the Nation’ address. The group that carried out the scan got permission from the NRC to upload the page onto the site www.Horizonscal.NI. The address generated various positive reactions.

3.4 Essay volume 'Polar bear plague in the Veluwe'

The essay volume entitled *Polar bear plague in the Veluwe* was also an interim product about the results of the Horizon Scan. This volume contains twelve essays; eleven about the ten clusters and one about the cluster 'democracy and technology' which was added by a member of the sounding board group.

The essays do not contain predictions based on strictly formulated causal theories (see box 3.2). According to the London Horizon Scan Center, chaos theory will replace causal analysis in the social sciences within twenty five years³. In practice, chaos theory leads precisely to essential unpredictability. How can we learn now to take advantage of unpredictability when we are 'grown up' (regardless of the actual outcome).

Box 3.3 A fragment from the preface to the essay volume 'Polar bear plague in the Veluwe'.

...The essay volume 'Polar bear plague in the Veluwe' is, thus, not a compass but an invitation. Countless ambient magnets prevent the compass from being able to point due north. 'Northerly' also implies 'southerly'. To the extent that it is possible to find some order, it manifests a complex character. But finding one's course does not require a compass. One makes one's way in the worlds of knowing, doing and wanting by utilizing all one's competencies. One doesn't carry on like a lemming, but like a bat – blind to mundane delusions but not deaf to the sounds of the future.

Each essay sketches one or more images of the future, based on trends, expectations and current developments. Some are frightening while others give hope. The 'Polar bear plague in the Veluwe' can be ordered from the COS. A very short summary of the essays follows.

⁴ In mathematics and physics, chaos theory describes the behavior of non-linear dynamic systems that – under certain circumstances and at particular moments – seem to be very sensitive to certain small variations in circumstances. Apparently a minimal variation at a specific place is all that is necessary to create various future developments in a given system. The popular term to describe this is 'the butterfly effect', which refers to a lecture given by Edward Lorenz to the American Association for the Advancement of Science (Washington D.C.) in 1972. The title of the lecture was 'Predictability: Does the flap of a butterfly's wings in Brazil set off a tornado in Texas?' In his lecture, the flapping of a butterfly's wings was the minimal variation that set off a chain of events leading to a large-scale event. Without the flapping of the butterfly's wings the system would have experienced a very different chain of events. Source: Wikipedia, 'chaos theory'.

Environmental planning

As regards environmental planning in the volume, author Joost van Kasteren argues that enough ingredients exist for an environmental horror scenario. Nonetheless he thinks that other options are possible when seriously considering how to organize the environment and develop new arrangements between farmers and urban dwellers, city and countryside. Alternatives include arrangements that raise the possibility of new forms of interaction between human and nature and the creation of new landscapes.

Infrastructure

Seeking and finding positive points of entry is also Judith Schueler's approach, when it comes to standardization and decision-making regarding infrastructural projects. She calls for attention to the issue of governance, referring to the European Foresight Monitoring Network. According to this research on foresight studies in Europe, only 1% of their attention is paid to trans-national areas. Apparently Schueler touched on a very difficult issue regarding which even those directly affected do not dare quickly to get involved; cooperation is difficult and, in this case, international cooperation is even more so.

Energy

Coby van der Linde sketched the issues surrounding energy in a challenging way. She suggested that the age of oil will come to a definite end, that a number of energy carriers will be developed as well as a fourth generation of bio-diesel. This won't happen without problems, of course; these transitions will bring tensions with them.

After the basic conditions of space, infrastructure and energy are properly examined, the authors move to answer the question 'and now what?'

Robotics, technology and democracy

Remke Klapwijk and Victor van Rij see interesting developments taking place in the fields of robotics and artificial intelligence. Especially 'interconnectivity' deserves further foresighting and research in their view. Directly related is the question of the relation between technology and democracy. Siegfried Eschen notes that people easily become dependent on technology. On the other hand, people seem increasingly able to cast technology in its rightful role: as a tool.

Economy, conflicts and security-related policy

The world requires good conflict management procedures. According to Paul Rademaker, every world problem asks for its own manner of resolution.⁴ The Netherlands can make a contribution on this front, adds Gerd Junne. The necessary preliminaries are already taken care of, as seen from the development of Amsterdam as the 'NGO capital'. Johan te Velde and Anne Slootweg also see a role for the Netherlands in global questions involving peace and security. They sketch three future scenarios.

Education and labor market.

Our welfare and prosperity are largely based on education and the accumulation of knowledge, which is generated by scientific research and passed on to younger generations through education. Wim Groot and Henriëtte Maassen van den Brink point to the importance of education as a engine behind an open society with many positive effects that determine the quality of life in areas such as health care, social security and social participation. They offer a number of suggestions meant to help free education from an age dominated by horse-drawn carriages and writing quills.

Globalization and health

Pim Martens argues for combining a micro- and macro- approach at the national level to fight infectious diseases in the future. At the same time he sees that current insights are too rudimentary to allow for concrete statements. Here, then, lies a challenging task for science to do empirical research and develop theoretical and conceptual models regarding how to fight infectious diseases. Interdisciplinary research programs and integrated research methods will be of essential importance here.

Engineerable and self-mutating humans

That humans are capable of mutating is clear. The question for Ron Hendriks is whether they are also engineerable, should that be what we really want. The issue goes beyond bionic prostheses and implants. Even genetics is close to becoming a usable instrument. Developments are reaching their completion with a rapid tempo, for better or worse. Who will decide what? It's high time that we hurry with establishing our views, though we might find that we need to revise them in the future.

Ageing

Heemskerk sketches a different type of ageing. People are living longer, healthier lives and, for the first time, four generations will be living together. He argues that a number of prognoses need to be adjusted in order to bring opportunities into proper focus.

4. The author uses the Dutch neologism 'resolutiek'.

3.5 Horizon Scan website

The Horizon Scan website was developed to simultaneously 'send' and 'receive'. The website presents the lists of problems and opportunities to a broad public, as well as (later) the cluster documents. The broad public can respond to various individual problems and opportunities via the website. The importance of a website is ultimately determined by how many visitors it gets, certainly if the goal is to reach a 'broad public'.

Noteworthy points regarding visits to the website in 2006 include:

- » More visits take place on the days directly after books are published (for example, after the publication of "Mental Capital", which came with a bookmark provided by the Horizon Scan project.)
- » There is increase in the frequency of visits and hits; for 2006, there were 1000 visitors per month. (If this trend continues, the number will reach beyond 3000 per month in 2007.)
- » There is a relatively large and increasing foreign interest, according to web statistics from December 2006 that track where visitors come from. Only + 40% are Dutch, the rest are foreigners (of which + 34% come from the United States) and + 15% are of unknown origin (for example, from an 'org.').

3.6 Card game

The group that carried out the scan developed a card game to facilitate open discussion regarding interactions between subjects that the scan touched upon (see figure 3.2). Diverse problems and areas of opportunity are represented by over a 100 play cards. A few dozen task cards challenge players to come up with solutions that go against the grain as well as to create new problems or opportunities. There are three sorts of cards: opportunity, problem and task cards. The game trains participants to repeatedly provide creative answers to challenging and stimulating tasks and hypotheses.

The opportunity and problem cards treat the six categories of domain issues: physical, political/governance/judicial, basic facilities, science/technology/education, social and economic. These categories are the same as those from the problem and opportunity lists. Every task card assigns a task to do something with one or more problem and opportunity cards. For example, a player might be asked to transform three problem cards into an opportunity.

The crux of the game is to encourage players to see new connections as well as to exchange arguments, insights, judgments and even weak signals. The game can be played by anywhere and by anyone between two and ten people (see appendix 6).

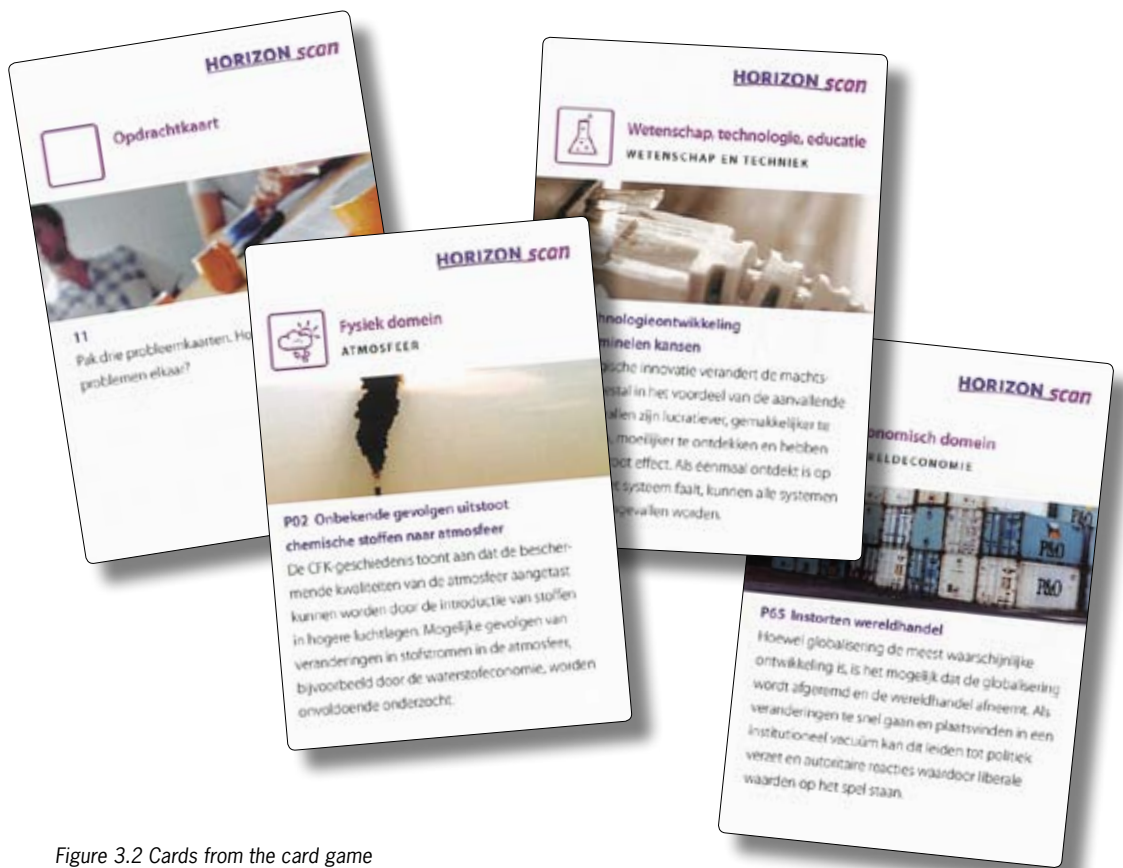


Figure 3.2 Cards from the card game

3.7 Raising awareness among participants and clients

Intangible knowledge is often seen as more important than explicit, tangible knowledge in current knowledge management terminology. At various times the Horizon Scan has invested space and energy in both nurturing and using this sort of knowledge.

Intangible knowledge is an important bi-product of the sounding board sessions and the external presentations that oversaw how the Horizon Scan was carried out. As earlier noted, countless implicit and explicit choices had to be made. The judgment and insight of specialists from various ranks of policy, politics, governance and science provided input and guidance for every step that was taken. At the same time, the insight and consciousness of sounding board group members was also raised.

Societal consciousness can be achieved by raising the issue of new ways to think about the future in the media. Other activities such as 'the Future Proof Test' still has to be carried out. Such a test would have to demonstrate just how resilient political party programs and other important policy reports are in rela-

tion to the future. Ideally, the Horizon Scan Method could be applied to the knowledge and know-how of the broad public. This would lead to programs for policy makers' interactive policy developments better being known and utilized.

4. Discussion and recommendations

The Horizon Scan is an important vehicle for broadening one's view of approaching problems and opportunities. Such a broad view isn't only necessary for optimizing one's ability to anticipate future developments. It can also aid the construction of policies that are relevant to the organization of Dutch society. Because the Horizon Scan is intended to provide broad and far-reaching insight in the future, it offers a counter-balance to the simple approaches and narrow views to which policy makers sometimes turn.

The development of clusters provides an important link. Not only do they chart the probable coherence of developments. They also help to point to both the connections with policy-making and to the new developments in regard to which further engagement is desirable. The scan thus makes it possible to react in a timely manner, though we need to remain vigilant regarding the future's complexity and limited engeneerability.

The Horizon Scan is only a first step in a foresighting process that aims to chart trends, weak signals, opportunities and threats from a long-term perspective. Repetitive scanning is necessary in order to see whether charted developments really do take place or weaken. Repetitive scanning also improves and update the identification of new emerging problems and opportunities. The frequency with which the scan is repeated should be closely linked to the tempo of ambient change.

4.1 Discussion

A countless variety of topics raised by the Horizon Scan deserve further analysis, which only additional foresighting and research can provide. In fact, this is more or less true for every cluster discussed here. To illustrate the point, chapter 5 focuses on one cluster. Nonetheless, the Horizon Scan's results have much to offer, even without further reflection on every cluster.

Firstly, the lists of problems and opportunities and the cluster descriptions create a palette of potential usages for a broad range of policy, research and business actors. They can be used to see whether sufficient attention is being paid to problems and opportunities that can influence the desired outcome of policy. In the United Kingdom, for example, policies of every department are measured against the results of the Horizon Scan that was carried out there.

Secondly, the Horizon Scan's unpolished results lead to further reflection and action. The problem 'no robust strategy to combat the consequences of climate change' included in the publication of the problem list thus points to an important gap in debates surrounding climate change. Much of the debate that has taken place so far has focused on the question of whether humans are responsible for climate change, rather than on which strategies we need to develop to combat the consequences. Soon after the lists were published on the internet (at the end of 2005), it seems as though this discussion became public property. This is one example of the fact that the scan closely links up with debate over the future.

Extending knowledge and technological application

One of the important observations made while carrying out the Horizon Scan concerns the increasing growth of knowledge and technological application. An important cause of this growth is the rapid tempo in which science and technology have developed. A second cause is the contribution of rising world economies such as India and China. They are joining the group of major producers of industrial goods and services and have both the need and resources to invest in science and technology.

Beside the fact that scientific knowledge and technological application generate problems and opportunities in their own right, they also influence almost everything or, at least, most of the problems and opportunities included in the Horizon Scan. They can yield solutions for problems, strengthen opportunities or change the nature of a problem or opportunity. Because the rate of change seems to be accelerating, the process of prioritizing strategic themes and knowledge agendas needs to include attention to the following:

a. The rapid growth of scientific knowledge and technological possibilities demands timely anticipation of and risk-taking investment in knowledge and development.

Noticing new (technological) developments, applications and solutions to problems in a timely manner is essential to the creation of sustainable policy. Tardy recognition of new scientific insights, future technological possibilities and large, looming problems such as pandemics, floods and conflicts can not only lead to the destruction of capital but also puts lives in danger.

Courage, combined with an eye kept open to future possibilities, is needed for making the right decisions and stimulating necessary research that can prevent unpleasant surprises and facilitate seizing opportunities. For example, long-term controversies surrounding a topic such as cold fusion can serve as prelude to a durable solution to the energy crisis. Courage is needed in order to invest at a very early stage, even if the return isn't clear or doesn't become so for quite some time. Solving extremely important problems requires that we try accelerating the pace of promising strategies (such as nuclear fusion).

b. The rapid growth of knowledge and interconnectivity requires new approaches for the retrieval and synthesis of knowledge and the interpretation of information and data.

Investment decisions taken at the national and international level require a broad view of all the (weak) signals given off by new scientific and technological developments – even those for which the pay-off isn't clear. It will often be necessary, in this context, to keep a number of options open and to spread investment to cover promising new technologies that compete with each other. The United States participates in various projects that hope to show the scientific and technological feasibility of nuclear fusion as a source of energy (IFE and ITER), which Europe concentrates only on one (ITER)⁵.

Creativity is necessary in order to take advantage of possible developments that are sometimes contradictory in nature. As long as climate models yield mutually contradictory results, strategies directed toward climate change will have to take the unexpected into account. This means not only anticipating a warmer and damper climate, but also the possibility of a colder and dryer one.

c. The rapid growth of knowledge and interconnectivity requires new approaches for the retrieval and synthesis of knowledge and the interpretation of information and data.

The volume of available knowledge is expanding thanks to the rapid growth of scientific knowledge and the rise of communication technologies. This makes it increasingly difficult to filter the desired knowledge out of the available volume and to see the right connections and relations⁶. In the short term, complex smart agents⁷ will be increasingly important as a means of support in searches for new knowledge. In the long term, however, meta-analyses will need to be made. Future generations will have to learn at the earliest stage possible to live with the explosion of knowledge and scientific results.

d. Increasing complexity requires a trans-domain and long-term perspective.

Future developments can give rise to new relationships in places where they aren't yet on the agenda. More and more actors operate in particular domains and new interactions take place between domains on a daily basis. The relation between opportunities, new possibilities and recognized problems need to be viewed from a long-term perspective, both within and between domains.

⁵ ITER: International Thermonuclear Energy Reactor, IFE: Inertial Fusion Energy.

⁶ "Dr. Bontis of the Institute of Intellectual Capital Research suggests the total accumulated codified data bases of the world, which includes all books and all electronic files, doubled every seven years in the 1970s. Dr. Bontis theorizes this data base will double twice a day by 2010." <http://aapp.net/Proceedings2003.pdf>(9-11 October 2003), p. 72.

⁷ Smart agents are a new type of computer program that functions as an intermediary between users and systems characterized by artificial intelligence. The acronym 'SMART' stands for 'System for Managing Agents in Real Time'.

Not only beyond the borders of domains, but also beyond national borders

What we present here is not only relevant to sustainable policy and investment in future-directed research in the Netherlands. It is of even greater importance at the European and global level. All developments are trans-national. For certain developments and domains, the same approach as that used by the Dutch scan is desirable at the European level.

It is not only clear that this coherent set of future problems and opportunities is increasing in complexity, but also that their trans-domain character needs to be examined in international context. Solving noted problems and taking advantage of opportunities will only be effective in most cases when countries recognize and act on them collaboratively. International cooperation in the area of Horizon Scans and foresight studies can make an important contribution here. A first start along these lines was initiated by the COS in the form of the ERA-NET Forsociety (a collaboration among nineteen organizations from fifteen European Member States in the area of foresight studies). ERA-NET is currently working with the Foresight Horizon Scanning Center of the British government's Office for Science, the Danish Ministry for Research and Innovation and the Maltese Research Council to develop a continuous international Horizon Scan, in which various international foresighting agencies (such as OECD, ESF and IPTS) as well as more countries will take part.

Toward a strategic agenda

The goal of a Horizon Scan is to feed knowledge and policy agendas. The process of transforming the scan's products and results into a knowledge and, ultimately, research agenda requires that the following steps be systematically taken:

- a) Identifying the knowledge that is required to profit from an opportunity or prevent a threat. This leads to a knowledge agenda.
- b) Find an answer to the question of whether this knowledge already exists or whether already-existing knowledge and research agendas can produce it in a timely manner.
- c) In case of a negative answer to question b., examine whether this knowledge can be developed, including how long it will take and what the costs will be. This search leads to a research agenda.

The material conveyed by this Horizon Scan shows that the development and establishment of a meaningful, future-resistant strategic research agenda is not a cushy job. The worldwide knowledge explosion and 'half life' of new technologies imply that much more information needs to be digested before a first step toward a research and strategic policy agenda can be taken. Based on the Horizon Scan results, the following section offers a number of suggestions for how to use and adapt both the method and current results.

4.2 General suggestions

1. Every policy needs to be investigated in terms of its future resilience. The scan should make a permanent contribution to discussions about the future.

At the start of the Horizon Scan it was clear that scans need to be repeated every two years, since new signals appear on the horizon in keeping with the passage of time. Based on the Horizon Scan experience, it is suggested that the scan be carried out frequently or on a continuous basis. The reason for this suggestion is that it was demonstrated during the scan that many developments occur with increasing speed and attention to the complex interaction between developments can only be maintained by continuous observation.

2. Bundle foresighting activities for each of the named cluster themes and investigate which subjects require foresights that transcend borders and domains.

The scan that was carried out was primarily interested in finding meaningful clusters of Horizon Scan topics that were not only assumed to have a great impact on the future, but that would also implicate a wealth of knowledge questions. Ten clusters were worked out and presented to a set of essayists. This selection offers a limited, but relevant excerpt of the material; in our estimation, further examination of any of these clusters would offer an instructive foresight for the Dutch knowledge and policy agenda.

3. Stimulate broad application of the Horizon Scan's data, information and knowledge.

The Horizon Scan forms a knowledge foundation that can be put to use by many users for a number of goals. The instrument is especially used in the United Kingdom to expand the view of departments and further inter-departmental cooperation. The method is seen as one that policy units can learn from in order to develop strategic policy which is anticipatory and resilient. Horizon Scans in the Netherlands and Japan are directed toward identifying knowledge gaps in the knowledge agenda and prioritizing research topics that are needed to make strategic policy. The Horizon Scan identifies points that need attention in further foresights almost everywhere. Its data can be of use at various levels of policy making. The European Commission recommends broad Horizon Scans, for example, in relation to the use of structural funds.

4. Develop alternative policy options that can withstand the future.

This suggestion certainly holds for all policy. However it deserves to be interpreted in a different way than usual; not only as a given in the sense of 'for the duration of the coming x number of years', but also in the sense that 'the policy option remains valid, even if presuppositions reverse themselves'. Think, for example, of a water-power station that must provide an answer to local energy demand, despite a proverbial ice age or desertification. The same holds for other sorts of choices and technologies: can they withstand the future?

5. Developing (inter)national cooperation

Many of the subjects noted in the Horizon Scan arise out of global developments that are not unique to the Netherlands. This already led to the conclusion at an early stage that international cooperation in the area of Horizon Scanning could be profitable, not only for more efficient data-gathering and development of method, but also for communal image creation in relation to topics that require a trans-national or European approach.

This is also the reason that a pilot project was started (thanks to Dutch and UK initiative) in the ERA Net ForSociety program, that is directed towards realizing a communal basis for national Horizon Scans, which can also be quite meaningful for the European Commission. The goal is to consolidate the work of this pilot and further extend collaboration in the area of Horizon Scans within and beyond Europe.

The data collection made possible by this collaboration can be used as a basis for developing trans-nationally coordinated foresights in areas where communal action is either desired or needed.

6. Horizon Scans are also of service at the provincial, regional and municipal level. The COS believes that the national Horizon Scan can also be of service as a societal basis for developing and reconciling views of the future at the provincial, regional and municipal level. It should therefore be recommended that the national Horizon Scan be brought emphatically to the attention of people at these various levels.

5. Recommendations for the cluster Robotics and Interconnectivity

In addition to general recommendations regarding how to carry out a Horizon Scan, the Horizon Scan project has led to a number of insights, ideas and recommendations regarding the ten clusters. As further impetus, the findings for one cluster have been developed into recommendations and suggestions. The cluster chosen is 'robotics and interconnectivity', based on the COS' view that it will have a great impact on virtually every area of our society. The recommendations are based on all the products and activities that contributed to this end report: the lists, cluster descriptions, essays and sounding board group meetings.

The subject 'robotics and interconnectivity' will have a great influence on welfare and prosperity, both as possible means and condition. We are facing the dawn of a knowledge revolution. The effects of this revolution will overshadow the effects of all previous (industrial) revolutions. There is a chance that the Netherlands and Europe will lose out in the changing world economy⁸ and it is now time to foresight and take hold of this area's possibilities in order to turn this prediction into a positive one.



5.1 Robotics and interconnectivity

The cluster 'robotics and interconnectivity' concerns the increasingly rapid development of more and more intelligent machines and systems. These systems are becoming increasingly autonomous and the connectedness between them is likewise increasing. The worldwide rise and application of intelligent apparatus and robots will have great consequences for society.

On one hand, these technologies create opportunities in a large number of areas such as research and education, health and healthcare, environment, security, transportation and energy. On the other hand, these technologies can pose new dangers and risks in these same areas.

⁸ D. Wilson and R. Purushothaman (2003), *Dreaming with BRICs: The path to 2050*. New York: Goldman Sachs Group.

This cluster's complexity is summarized in figure 5.1. This figure reviews the numerous areas in which this cluster can have an impact or from which it can be influenced. It will be immediately clear that the numerous relations can't easily be caught in simple mathematical extrapolations or scenarios organized around one or two central questions. Even this scheme cannot catch the full complexity.

The scheme does, however, provide us with insight into important issues and aspects that call for more attention in order to set robotics on a sustainable and resilient footing.

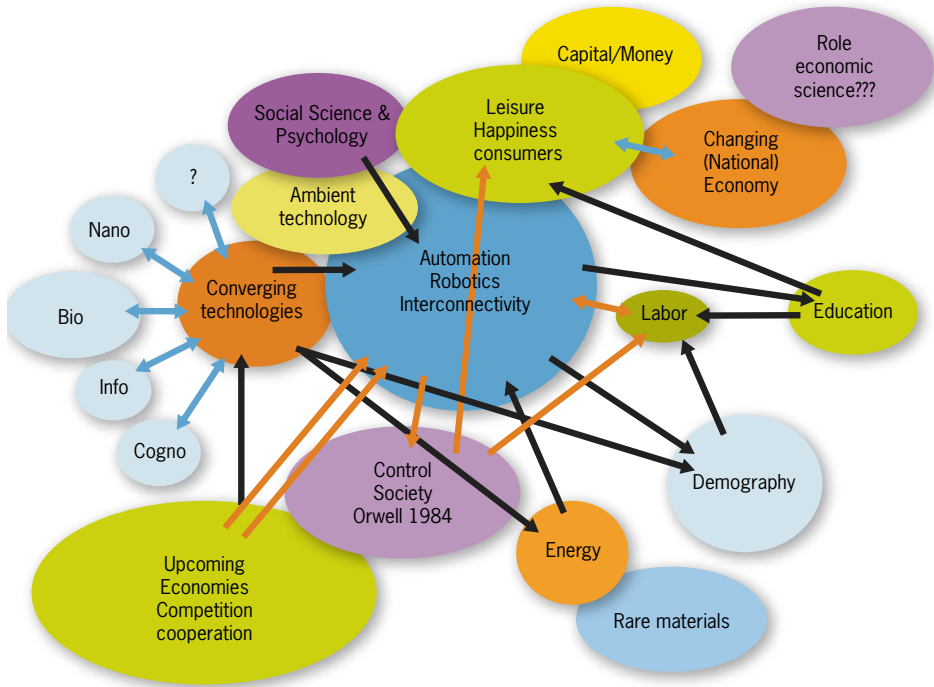


Figure 5.1 Complexity of the cluster 'Robotics and interconnectivity'

We need to give this cluster increasingly detailed foresighting attention in order to take full and responsible advantage of the fruits of its developments in an economically beneficial way. In addition to charting the possible future applications in this area, a foresight regarding the opportunities and problems surrounding developments in robotics and interconnectivity has the following goals:

- » Bring the opportunities and problems into greater relief;
- » Raise the consciousness of relevant actors in the fields of research, policy and society;
- » Develop a strategic view of the way in which the Netherlands can create an advantageous climate for helping robotics to progress in an economically and societal responsible manner;
- » Develop research, knowledge and development agendas that can further the utilization and production of robots in various sectors of Dutch society.

The increasing tempo of developments in robotics and interconnectivity has to do with a number of scientific and technological developments, described in the NSF report 'Converging technologies for improving human performance'⁹. This report sketches the enormous implications that a stimulated convergence of nanotechnology, bio(techno)logy, informatics and the cognitive sciences (NBIC) can have. Just such a convergence is currently getting underway in a number of countries and can be seen in the United States most particularly in the defence and production industries. The transport sector (autonomous vehicles) is an important center of activity in countries such as Japan and Korea, but the medical and health care sectors are also considered important areas within which applications can be realized by bundling NBIC knowledge. Examples of these applications are intelligent robots, embedded systems and interconnectivity. The Netherlands does not have a strong tradition in the field of industrial robots, but is one of the European countries that performs well in the area of ICT. Beyond this, attention is already being paid to the cognitive sciences, nanotechnology and industrial design in the Netherlands. A great hindrance to the attainment of a strong position in robotics is the gap that exists in the Dutch and European systems between fundamental research and commercial applications. What is missing is research in which the latest scientific insights are combined with innovative applications that are not yet market-ready. Though the foundation seems to be present, the current science system prevents a theme such as robots and artificial intelligent systems from being fully developed. We need to examine the extent to which and how the NBIC sciences can be made to converge in the Netherlands so as to increase the speed of developing applications in the field of robotics and interconnectivity. The COS/STT foresight 'Converging technologies' (2006) offers a good starting point for a similar follow-up study.

9 M.C. Roco and W.S. Bainbridge (2004), *Converging technologies for improving human performance*. National Science Foundation / Springer.

It is not only the NBIC sciences that contribute to the development of robots and the accelerated tempo of interconnectivity. Other disciplines such as social and language sciences might also play an important role in developing user-friendly intelligent systems. On one hand we need robots and apparatus that can do our work for us. On the other hand, we want to retain control and responsibility. A robot that takes work over from a person can quickly be experienced as obtrusive and intrusive. Can the social sciences be integrated with the NBIC sciences to make robots and apparatus that interact with users and the environment in a way that isn't seen as pushy or invasive? In order to answer this question, users' wishes and needs regarding robots and intelligent apparatus must first be assessed.

We can expect that the application of robots and intelligent systems will influence traffic and transportation, warfare, environmental planning and housing, agriculture, environment, education, political and judicial systems and countless other areas. If these systems become widespread in the next twenty years, the character of a portion of the future opportunities and problems that concern us now will change dramatically. The labor market provides one example. A great shortage of highly educated individuals from every field of study is a predicted outcome of the rise of the knowledge society. However, most predictions fail to take the rapid development of robotics into account and provide no insight into how the labor market will function if robots take on certain tasks. Another example comes from the issue of the aging society. Is it possible that the problems surrounding ageing can be solved or lessened with the help of robots? There are those who think that intelligent apparatus might help the handicapped and elderly to remain independent for a longer time. The other side of the coin might be a more individualistic society in which people do not consider it important to look after the aged.

The chance is high that we will all encounter robots at work, at home and in our free time, that will replace or assist us, or take on new tasks that were previously impossible. There are currently examples of robots that perform important tasks as well or better than humans, such as precision operations. It is clear that the introduction of intelligent apparatus in a large number of sectors will give rise to great changes in what we do and the skills required for our work. This can ultimately lead to changing or diminished employment opportunities¹⁰.

The expressions 'comfort kills' and 'use it or lose it' may apply whenever we deploy robots. Whenever we replace our own functions with external tools, our own ability to carry out the functions diminishes. In a comfortable society where things continue to get easier, we can expect that people will become increasingly dependent. The motivation to exert oneself declines in such a situation. More theoretical and

10 The American biologist, philosopher and feminist Donna J. Haraway made a case for the elimination of rigid boundaries between humans and animals, organisms and machines, men and women. See her *Cyborg manifesto* (1985).

applied research regarding the social and psychological effects of the structural application of robots and intelligent apparatus are needed in order to understand them.

An important question is how people and social groups will change due to the influence of future applications of robots and artificial intelligent systems. Social scientific research failed to take earlier ICT developments sufficiently into account; research was primarily directed toward electronic work groups and organizations, but this tells us little about the possible effects of ICT on districts and neighborhoods. The possibility exists in the field of robotics and artificial intelligence to pursue empirical research regarding actual situations. Social consequences and interactions can be studied in the Netherlands by setting up special environments in which new applications are concentrated. Because the Netherlands is densely cabled, culturally diverse, quickly adopts new developments and possesses a strong social structure and developmental power, it is an appropriate place for researching the societal and social consequences of accelerated developments in robotics and interconnectivity.

Robots and artificial intelligent systems form a development that isn't easy for most of us to place. Some robots that are already developed possess a hybrid character in which the boundaries between culture and nature, life and death, organism and machine are blurred. As soon as robots and artificial intelligent systems gain advanced perceptual, interpretive and reactive abilities, those things that make humans unique will no longer be so unique. The robot might seem human or to transcend humans because it can carry out tasks as well as or better than humans, or even carry out completely different tasks or operate in an environment (space, mines) where humans cannot function. There are robots that move freely, like humans, can provide their own energy or repair and even multiply themselves. This might awake the fear that humans are replaceable and that robots will not only take over the work of humans but even gain the upper hand.

Not only are mechanical apparatus such as robots becoming more and more like humans and more and more mechanical and artificial intelligent parts are being implanted into human bodies, such as artificial arms and brain implants. These developments raise the question of what or who we actually are.

Robotics, artificial intelligent systems and interconnectivity also intersect the field of security, control and privacy. To what extent should and can various technologies be applied to keep people under surveillance, to control and trace them? To what extent are technologies capable of supporting the safety of people, organizations and countries or to place them in danger? Big Brother might become a higher threat than we think, but on the other hand – thanks to nanotechnology – the devices and systems might also become invisibly small. How should politics respond to such developments?

The theme 'Robotics and Artificial Intelligence' deserves attention especially because it is applicable in so many fields and most probably of great importance for the ability to compete in all these fields. This is because developments in robotics, just as with previous ICT developments, seem to have become fundamental technologies. It is important to identify terrains in which users want to – be the first to – apply these new technologies.

After the NSF study (see note 9) appeared, a productive discussion began in both Europe and the Netherlands in which the social sciences were especially recognized as important to these developments. Nonetheless Europe has a long way to go to catch up with developments in the United States and countries such as Japan and Korea.

The Netherlands and Europe must now choose either to accept these technological developments from countries such as America, China and Japan, or to take on a leading role in the design and development of robotics. The Netherlands is not currently a front runner in the development of social robots, but there is potential. Not only do ICT businesses set a certain tone, such as ASML and Philips, located in the Netherlands. The Netherlands can also play a clear role in the robot industry for production robots. The Netherlands is relatively strong in a number of basic scientific disciplines that are necessary to the further development of robots. Think here of nanotechnology, the cognitive sciences, biotechnology and ICT.

To become a pioneer in robotics and interconnectivity, we need to bring about more coherence in research and development programs. A communal view will have to be developed regarding how the Netherlands (in cooperation with other countries and (multi)national industries) can create a favourable climate for the development and use of interconnectivity and robotics. A trans-domain approach that intersects with a number of ministries is necessary to achieve this.

5.2 Foresight recommendations and suggestions

The preceding shows that tempestuous developments are waiting at the doorstep in relation to the entire conglomeration of opportunities and problems surrounding robotics, interconnectivity, ambient, embedded and converging technologies. Serious reflection on what Dutch society needs to know, do and desire, is extremely important. The inevitable and accelerated character of developments surrounding robotics and interconnectivity necessitate further coordinated exploration. What follows is an initial set of questions and recommendations.

1. The foresights should be directed toward a number of questions:
 - a. How can the Dutch situation support convergence among nanotechnology, bio(techno)logy, informatics and the cognitive sciences?
 - b. How can the social and language sciences contribute to an optimal connection between the applications that arise from NBIC convergence and human desires and values?
 - c. To which future societal issues, industries and applications can robotics and interconnectivity contribute?
 - d. To what economic, societal and social changes will a revolutionary development in robotics lead? Consider employment opportunities, education, health care and so forth.
 - e. What are the ethical, threatening regulatory aspects of robotics and interconnectivity?
 - f. What sorts of international cooperation have to be developed in keeping with these aspects?
 - g. What does the education system need to do in response to the needs created by robotics?
2. It is recommended that a few areas of application at the national level be identified in the Netherlands where large demand and support for the application of robots and artificial intelligent apparatus exists, in order to strengthen Dutch innovativeness and competitiveness.
3. A unified view regarding how the Netherlands can provide a beneficial climate for the development and use of connectivity and robotics needs to be developed. Training, research and cooperation should be involved in this effort.
4. The multinational character of the robotics industry will necessitate that some of the aspects need to be explored further in trans-national context. This concerns analysis and standardization, but also research and development.
5. Given the above, it is obvious that a Delta Plan should be developed for the further development and exploitation of robotics.

Appendix 1.

The group that carried out the scan and the sounding board groups

About the COS and the Horizon Scan Project

The Commission for Consultation of Sector Councils (COS) is the platform for consultation and collaboration of cooperating sector councils and other think tanks. The sector councils are independent commissions, consisting of representatives from research, society, industry and government. On the basis of foresight studies –crossing disciplinary, sectoral and national borders- on the social and technological developments across the medium and long term, they come to the formulation of priorities for society-oriented research; financed by the government. The COS focuses in particular, on studies that deal with cross-sector subjects, at the interface of policy domains and scientific disciplines.

For more information see: www.cos-toekomstverkenningen.nl

Horizon Scan

The COS has set up a project group, led by Prof Roel in't Veld (chairman of the RMNO) and Hans van der Veen (director of STT). The commission's aim is to perform a future scan, the ultimate goal of which is to influence the agendas of agenda setters, decision makers and developers in government, knowledge institutions, social organizations and work ventures.

For more information visit the website: www.horizonscan.nl

Members and parties involved

Mr. prof. dr. R.J. In 't Veld

is professor at the Open University, professor of Good Governance at the University of the Dutch Antilles and lector of Democracy. In addition to his present functions he serves as senior consultant at Berenschot, chair RMNO (Dutch Advisory Council for Research on Spatial Planning, Nature and the Environment), chairman of the Utrecht School of Governance Advisory Council, member of the Oversight Board of Nederland Kennisland and commissioner of IBM Netherlands, HSK Group, ProRail (president). In the past he served as, among other things, Director-General for Higher Education and Science, Under-Minister for Education and Science and chairman of the Oversight Council for the IB Group. He was further dean of the Nederlandse School voor Openbaar Bestuur (Netherlands School for Public Governance), Chancellor of SIOO, Interuniversity Center for development in the area of Organisation and Change. Roel in 't Veld is responsible editor for countless publications, including 'Procesmanagement' and the 'Handboek Corporate Governance'.

Mr. Ir. J. H. van der Veen

is director of the Netherlands Study Center for Technology Trends (STT). STT foresees trends and develops inspiring vision of the future for 'technology and society'. Toward that end, STT offers a space within which enthusiastic interested parties can meet each other and construct visions of the future. The results of STT foresights are anchored in as many new initiatives possible. Van der Veen studied metallurgy (Delft University of Technology) and industrial marketing (ISW). Until 2000 he was director of the performance bureau of the Vereniging voor Oppervlaktetechnieken van Materialen (Society for Surface Technologies of Materials) and the Nederlandse Corrosiecentrum (Dutch Corrosion Center). In 1994, he was appointed by the Minister of Economic Affairs to serve as chairman of the Innovation and Research Program (IOP) Oppervlaktetechnologie (Surface Technology). Van der Veen is further a member of a number of advisory councils.

Ms. dr. Ir. R. M. Klapwijk

Worked for the COS as executive secretary for the Horizon Scan up through August 2006. She has published on various technological and pedagogical topics, with special attention to gender, sustainable development and the social aspects of technological innovation.. She was editor of the foresight study *Techniek als menselijk ontwerp. Nieuwe opleidings- en loopbaanroutes voor jongeren* (Technology as human design. New training and career routes for youth) (STT, 2005) and contributed to the book *User Behaviour and Technology Development, Shaping Sustainable Relations Between Consumers and Technology* (Verbeek & Slob, 2006). Since September 2006 she works at the Delft University of Technology for the program 'Aansluiting vwo-wo'. The goal of this program is to improve education in the exact sciences through better cooperation between secondary and higher education.

Mr. drs. drs. B. T. M. Verlaan

Obtained a degree in social psychology (1983) and in systematic philosophy (1986) in Utrecht, and worked as a student-assistant. With post-academic ICT training (for instructor/advisor in informatics and system/network management) he worked for a number of years in computerization/ICT in various business-related functions, before moving to the Ministry of Education, Culture and Science. He has filled a number of positions at the ministry since 1995, including that of senior policy staff member. In this capacity he was attached to the Horizon Scan, for reasons including his advance knowledge of the project. Additionally he is involved in a number of voluntary activities in the fields of innovation, knowledge economy, education and research information.

Ms. E. Hamstra, MSc.

Received her Masters in Biomedical Sciences in 2005 and rewarded herself with an extended trip through Thailand, Maleisië and India. Following a stint as salesperson for medical and surgical instruments, she worked as project staff member for the Horizon Scan. Unable to resist a dream job at the museum Naturalis, she began there in January 2007 as content developer for exhibitions. She then moved on to NorthernLight as content manager.

Mrs. prof. dr. H. Maassen van den Brink

is professor of economics in the Economics Faculty at the University of Amsterdam and dean of the Amsterdam School of Economics (ASE). She graduated cum laude and received her PhD at the same university. She is chairperson of the COS, chairperson of the NWO Managing Committee for Social Science (MAGW), government appointed member of the Education Council and member of the Oversight Boards of the Leiden University Medical Center and the Rijksacademie voor Beeldende Kunsten (National Academy for the Arts) in Amsterdam. She publishes in top-ranked (inter-) national scientific journals as well as in various weekly and daily newspapers. She also writes a regular column for the Financieel Dagblad and for Economisch Statistische Berichten

Mr. drs. P. Morin

Is executive secretary of the COS and head of the commission bureau at the Ministry of Education, Culture and Science. He has filled a variety of policy and management positions during the past twenty five years in the area of education and science, and was actively present for the birth of the Open University and the 'Weer Samen naar School'(Together to School Again) project. He was chairperson of the Comenius ICT project, member of the OECD Education Committee in Paris and the National Unesco Commission, and member of various foresight, advice and guidance commissions of projects in areas including distance learning at the higher education level, trans-disciplinarity, public-private cooperation (PPS), system innovation and mental capital. He was further chairperson of the preparation group for a sector council on public governance, justice and security, and is member of the EU ERA-Network Foresight for Society en vice-chairperson for the project Evaluating Research in Context. He studied English, Dutch and Applied Linguistics at the Free University in Amsterdam.

Mr. drs. L. Meuleman

Works as executive secretary-director of the sector council RMNO, is chairperson for the Society for Government Management and senior lecturer at the University of Nyenrode. He is further completing a dissertation in public administration. Since 1981 he held various positions for the provinces of North Brabant and Gelderland, as well as the Ministry of Housing, Spatial Planning and the Environment (VROM), until he moved to RMNO in 2002. He studied (environmental) biology in Nijmegen.

Mr. drs. V. van Rij

Works as senior advisor for foresight studies at the COS bureau since 2003 and is national coordinator of the ERA-Net ForSociety, which was formed by fifteen countries to further develop cooperation in the area of foresight studies and Horizon Scans in Europe.

Before this work for COS he assisted the coordinator for science foresights of the KNAW. He has been involved in a great many foresight studies and international projects. He began his career at the University of Amsterdam as strategic advisor for research affairs and (international) curriculum development (in biology and biomedical science). He has a degree in biology.

Sounding Board Groups

The members of the sounding board group came from various areas:

- » Knowledge institutions
- » Network Foresight Studies;
- » Business community;
- » Government;
- » Societal organizations.

We thank all those involved for their willing and enthusiastic cooperation during the Horizon Scan operation.

Group A

- » Mr. drs. H. F. Aalst, Lector Fontys PABO Eindhoven
- » Mr. prof. dr. F. G. H. Berkhout, Free University Amsterdam, Institute for Environmental Issues
- » Mr. Ir. J. A. Bordewijk, Unilever NV, senior vice president supply chain excellence program
- » Mr. drs. L. Meuleman, Council for spatial, environmental and nature research (RMNO)

- » Mr. drs P. Morin, COS
- » Mr. prof. dr. Ir. J. A. E. E. van Nunen, RSM Erasmus University and Transumo
- » Mr. drs. P. Rademaker, Netwerk Toekomstverkenning (Network Foresight Studies)
- » Mr. dr. R. van der Sande, Council for health care research
- » Mr. prof. dr. B. Van Steenberg, professor Universiteit Nyenrode
- » Mr. prof. Sutorius, University of Amsterdam, Law Faculty
- » Mr. prof. dr. Ir. G.J. Teisman, Connekt
- » Mr. drs. V. van Rij, COS
- » Mr. prof. dr. R.J. In 't Veld, RMNO
- » Ms. drs. R. M. Weehuizen, University of Maastricht, MERIT
- » Mr. drs. A.J. F. de Wit, RMNO

Group B

- » Mr. Ir. F. A. van Beek, Advisory service Traffic and Transportation, department for Strategic Models and Prognoses Mr. D. Bosch, Dexter
- » Mr. dr. K. H. Chang, Foundation for Fundamental Research on Matter (FOM)
- » Mr. prof. Ir. W. D. Van Dansik, Dvd-arc holding Inc.
- » Mr. A.J. van Dijk, Council for Public Administration/ Council for Financial Relations (Raad voor het Openbaar Bestuur/ Raad voor de financiële verhoudingen)
- » Ms. drs. C. M. Enzing, TNO, Knowledge, Economy and Innovation
- » Mr. R. van Hattum, VPRO
- » Mr. dr. C. A. Hazeu, Scientific Council for Government Policy
- » Ms. dr. Ir. R. M. Klapwijk, COS
- » Mr. drs. F.J. G. van de Linde, Prisma & Partners
- » Mr. prof. Dr. W.J. de Ridder, Foundation for Society and Entrepreneurship
- » Mr. Ir. J. H. van der Veen, Netherlands Study Center for Technology Trends (STT)
- » Mr. prof. dr. Ir. T. de Vries, professor of future studies in health care, University of Twente
- » Ms. prof. dr. Ir. M. P. C. Weijnen, Technical University of Delft, Faculty Technology, Governance and Management

Sounding Board Group meeting 2

The second meeting of the sounding board group took place on 30 January 2006. During this

session the problems and opportunities were organized into a manageable list of clusters.

Participants were:

- » Mr. drs. H. F. Aalst, Lector Fontys PABO Eindhoven
- » Mr. Ir. F. A. van Beek, Adviesdienst Verkeer en Vervoer Afdeling Strategische Modellen en Prognoses (Advisory service traffic and transportation, Department of Models and Prognoses)
- » Mr. prof. dr. F. G. H. Berkhout, Free University of Amsterdam, Institute for Environmental Issues
- » Mr. A.J. van Dijk, Council for Public Administration/ Council for Financial Relations
- » Ms. drs. C. M. Enzing, TNO, Knowledge, Economy and Innovation
- » Mr. R. van Hattum, VPRO
- » Ms. dr. Ir. R. M. Klapwijk, COS
- » Mr. drs. F.J. G. van de Linde, Prisma & Partners
- » Mr. drs. L. Meuleman, Council for spatial, environmental and nature research (RMNO)
- » Mr. prof. dr. Ir. J. A. E. E. van Nunen, RSM Erasmus University and Transumo
- » Mr. prof. drs. P. Rademaker, Network Foresight Studies
- » Mr. dr. M. van Rijswijk, Ministry of Economic Affairs, Entrepreneurship and Innovation
- » Mr. dr. R. van der Sande, Council for Health Care Research
- » Mr. Ir. J. H. van der Veen, Netherlands Study Center for Technology Trends (STT)
- » Mr. prof. dr. Ir. T. de Vries, professor future studies for health care, University of Twente
- » Mr. prof. dr. R.J. In 't Veld, RMNO
- » Mr. prof. dr. B. van Wee, TU Delft, TBM, Transport policy and logistics organisation
- » Mr. drs. A.J. F. de Wit, RMNO

Creative session:

- » Mr. Ir. Willem Bos, Bosvariant ScheppingsStrategen
- » Ms. B. Broekhans, Ministry of Transport, Public Works and Water Management, RIZA
- » Mr. prof. M. Chavannes, University of Groningen and NRC
- » Ms. E. Hamstra Msc., COS
- » Ms. I. Hulshof, Hulshof Architects, inc.
- » Ms. C. Hummels Msc, Technical University of Delft, Industrial Design
- » Ms. K. Jonkers, Atos Origin
- » Ms. drs. Ira van Keulen, STT
- » Ms. dr. Ir. Remke Klapwijk, COS
- » Ms. Ir. H. Koutstaal, Ministry of Agriculture, Nature and Food Quality
- » Mr. A.J. Kruiter, Dutch School for Public Administration
- » Mr. drs. Louis Meuleman, RMNO

- » Ms. dr. R. Mourik, Technical University of Eindhoven
- » Mr. Ir. J. Niesten, Cocreation
- » Mr. prof. drs. P. Rademaker, Network Future Studies
- » Mr. drs. Victor van Rij, COS
- » Mr. drs. Ed Romein, Dutch School for Public Administration
- » Ms. drs. Y. van Sark, Young Works
- » Mr. Ir. J. H. van der Veen, STT
- » Ms. dr. E. Veenis, Ministry of Social Affairs and Employment
- » Mr. prof. dr. R.J. In 't Veld, RMNO

Third sounding board group meeting

- » Ms. dr. F. M. R. C. Basten, Orléon
- » Mr. drs. S. Eschen, Ministry of Justice
- » Ms. E. Hamstra MSc, COS
- » Mr. drs. F. Heemskerck, Member of Parliament, Labor Party
- » Mr. P. Helmholt, Society for Government Inspection of Education (VRO)
- » Ms. I. Hulshof, Hulshof Architects
- » Mr. dr. Ir. J. van Kasteren, University of Amsterdam
- » Ms. dr. Ir. R. Klapwijk, Technical University of Delft Mr. J. Knops, Ministry of the Interior and Kingdom Relations
- » Mr. prof. dr. Ir. J. van Nunen, RSM Erasmus University and Transumo
- » Mr. prof. drs. P. Rademaker, Network Future Studies
- » Ms. drs. A. Slootweg, Pax Christi
- » Mr. prof. dr. B. van Steenberghe, professor University of Nijmegen
- » Mr. Ir. J. H. van der Veen, STT
- » Mr. prof. dr. R.J. In 't Veld, RMNO
- » Mr. drs. J. te Velde, Pax Christi
- » Mr. drs. drs. B. Verlaan, COS
- » Mr. prof. dr. Ir. Th. de Vries, professor University of Twente
- » Mr. drs. B. de Wit, RMNO

Appendix 2.

Application of the Horizon Scan by sector councils

Various people from the domains named by the sector councils were frequently involved in carrying out and steering this Horizon Scan. They learned from and fed the project's various interim steps and products. A concept version of this final report was also given to a number of representatives of the sector councils. Based on the results of the Horizon Scan, they were asked a number of questions, a personal selection of which they answered in their replies. This entailed questions such as, what are (possible):

- » knowledge gaps, strategic questions and recommendations for follow-up foresights, points requiring attention for policy, knowledge agendas and policy-oriented research from standing clusters;
- » new links that lead to other knowledge and strategic questions;
- » productive cooperation with other countries that deserve attention and recommendation (with a wide range of countries, approaches and cultures) – for example, a European scan with ERA-NET;
- » recommendations regarding questions from the lists that were regarded as important, but which were not treated in the clusters;
- » relations with specific European and other international issues and activities surrounding knowledge, know-how, ability and desire more than twenty five years from now.

The separate contributions were brought together and used in a first attempt to construct a coherent and communal view. The various perspectives brought together include:

- » nature, environment and spatial planning (RMNO),
- » green space and the agro-cluster (Innovation Network – NRLO),
- » health care (RGO),
- » development cooperation (RAWOO),
- » technology and technique (STT),
- » public governance, justice and safety.

What follows is a summary of the first view and impression of a number of contact people from the sector councils. Based on the perspective of their sector and, periodically, on their direct involvement with the Horizon Scan, they sketch a number of possible questions that take up impulses for knowledge and strategic questions. Attention is here directed toward the foresighting, identification and reaction to weak signals from future knowledge and, possibly, strategic questions.

Each sector council function seems to intersect with a number of axes, including A environment (space, infrastructure, energy and robotics), B humans (education, disease, engineerable humans and ageing) and C (the interim stations, democracy and technology). This underscores the need for an integrated approach that transcends boundaries, domains and disciplines.

Technologically speaking, it is immediately clear that, in and of itself, this harbours both a problem and an opportunity; that is, the unknown and unintentional effects – both positive and negative. In other words, carrying out the Horizon Scan Project did not take us across the finish line. We stand, rather, at the beginning. It is too soon to formulate knowledge and research questions. The same holds true for strategic questions. Follow-up steps might begin with creating broad consciousness amongst governments, societal organizations and the business world. This last group is increasingly busy with developing future scenarios, but that is not enough. Policy must be made to withstand the future. That is to say, chosen solutions and policy answers must be made to remain effective, useful, applicable and lasting, even if the nature of a policy problem suddenly changes in the future.

A number of topics bundled together for policy and the establishment of a knowledge agenda fit with standing priorities. That might be:

- » Sustainability (energy, water, space, safety, etc.);
- » Health (life style, healthy ageing, infectious diseases, nutrition, engineerable humans, domotics, etc.);
- » Education (the basis for our future, focus on talent development).

Infectious diseases can be taken as a starting place for the second point. The first question is what climate changes will mean for the (global) spread of infectious diseases. The combination of effects of climate change (locally extreme drought or flooding, dislocation of agriculture) and a growing field of contagion for infectious diseases is most fearsome in Sub-Saharan countries. The combination of an unfavourable climate and a worsening health situation can initiate a self-strengthening process that leads to economic and political instability, especially in African regions. Is it still possible to turn the tide? If so, who must intervene? How can this problem be internationally attacked?

This addition frequently intersects with the influences of climate change in terms of spatial, environmental and nature-oriented research. In 2050 The Netherlands or the Dutch region might appear very different than it does now. If the IPCC's current expectations about climate change are taken seriously, this will lead to large-scale intervention in the environmental organization

of our country. This will be accompanied by opportunities and threats for nature and the environment, which raises countless issues:

- » How can the concept 'sustainable development' be maintained in relation to the balance of trade-offs between the social, physical and economic domains (people, planet, profit);
- » What are the consequences of this for policy theories upon which policy choices are based, now and in the future?

We know that many policy makers (this is true both for government and also, for example, business ventures) are often barely aware of the policy theories that implicitly guide them. A reorientation of reigning policy theories is needed for policies regarding nature, the environment and spatial planning. A similar reorientation or the way in which issues and prevailing solutions are framed leads to posing new strategic knowledge questions, then examining their researchability and, then, setting up research programs.

Sometimes questions are still so weak that the opposite approach is meaningful: first research, then formulate policy questions and, finally, deeper research. Within the domain environment, nature and space, we see a few of this sort of clusters:

1. The impact of 'glocalisation' on environment, nature and space;
2. What knowledge still has to be developed to provide a foundation for policy choices in nature and space related policy surrounding the migration of species in reaction to climate change;
3. A reconsideration of the concept and functionality of 'landscape';
4. Innovation, particularly through making unusual combinations; the future might well be one of the 'survival of the wittest' rather than of the 'survival of the fittest';
5. An examination of the cultural base upon which the three pillars of sustainable development.

Climate change is thus the cluster that binds together the 'political world order', 'globally threatening infectious diseases' and 'developing new energy sources' (this last as contribution to solving, among other things, the climate problem). Unfortunately, the current point of entry for development cooperation¹¹ is virtually blocked off by the cancellation of the responsible sector council function at the time that this report went to press. There is undoubtedly much

to report – one need only think of the millennium goals, development cooperation relations deriving from organizations such as the United Nations, WHO, World Bank, IMF, OECD, the EU and, of course, our own national government.

All these thoughts nonetheless fall within the range of the familiar post-industrial goal-directed rationality. From the perspective of public governance, justice and security, the question of whether science and technology should occupy a similar position for developing and carrying out policy in forty years as they held in the previous decennia, should be posed. This leads to a number of other questions:

- » What will the importance be of, especially, foundational issues? Will hope of and belief in life after death determine for many how they organize their lives in 2050? For most people, the dominant views of life after death in 2050 will probably not differ much from now. In this perspective, what is forty years, compared to the thousands of years in which these views arose, were developed and believed?
- » How does the great diversity in current public governance between countries and continents develop? If technology shrinks distances, will this lead to more or less segmenting, sharpening of differences and, thus, to more power struggles and conflicts or to more cooperation – the one and the other exacted by demographic, climatological, food, drinking water and energy-related issues?
- » How will the manipulability of humans, of the citizen him/herself, be addressed? Technological developments seem to make the impossible possible. But where will the boundaries between what is possible, what is obtainable and what is desirable be set in the future? How and by whom?

People need to see the coherence between innovation and the development of new technologies in relation to societal aspects in previously mentioned areas. Though the urgency is (very) great, we should 'hurry slowly'. As already said, it isn't answering quickly that counts, but finding the right answers.

11 The RAWOO was decommissioned down in 2006 by the Minister of Development Cooperation during the third Balkenende government. This led to the death of a carefully built-up international network of experts and the council was not able to evaluate the merits of the Horizon Scan's results.

Appendix 3

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(amended until 20/12/2006)

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Appendix 4

Opportunities and threats Horizon Scan

1. Problems

We will successively discuss the problems from the following domains:

- » Physical environment
- » Basic facilities
- » Research, development and education
- » Social
- » Economic
- » Political, administrative and legal

The numbers between brackets that follow the explanation of problems and opportunities refer to the numbers listed in the bibliography for problems and opportunities. The literature references have been numbered, the internet sources are indicated with I1, I2 etc. (See Appendix 3)

PHYSICAL ENVIRONMENT: Below is a list of possible problems which may occur, based on a scan of threats arising solely from the physical environment. For each physical domain (atmosphere, hydrosphere, soil etc.) what can go wrong or the threat is discussed.

1 ATMOSPHERE

No concrete strategy against the consequences of climate change

Irrespective of the exact causal relationship, it is clear that the climate is (sometimes) prone to accelerated and permanent change. The question of whether these changes are caused by human activity is less important than the conclusion that the climate can change in a relatively short period, with different regional consequences – is this really so? The European countries lack a firm defensive strategy against these consequences of climate change. This strategy should not only focus on the protection or evacuation of territories against/from flooding, droughts and storms, but also on facilities for food, housing, infrastructure, agriculture, energy and health. [31; 37; 43; 57; 61; 68; 72; 96].

2 ATMOSPHERE

Unknown consequences of emissions into the atmosphere

The history surrounding CFCs shows that the protective layer of the atmosphere can be affected by the introduction of chemicals into the air. The possible consequences of changes in the chemical flows due to the hydrogen economy, for example, are currently being insufficiently studied. [31]

3 ATMOSPHERE

Persistent air pollution in urban areas

Air pollution in urban areas, particularly nitrogen oxides and fine dust, remains a health threat. The large “penetrative strength” of small dust particles, makes them extra harmful. An important cause of this air pollution is heavy traffic and transport. [23; 179]

4 HYDROSPHERE

Diffuse water pollution

The diffuse dispersion of bioactive agents, like medicines and pesticides, threaten the drinking water and food supply of both people and animals, as well as the functioning of ecosystems. It is not inconceivable that the natural fertility of species, including humans, may be drastically affected.

5

Pollution of the sea

Another unsolved issue is the pollution of the sea. The number of accidents involving ships is increasing. Despite international regulations, many ships still discharge oil and other waste into the sea. In addition, the sea is also polluted from the shore. [31; 57; 72; 97; 118]

6 HYDROSPHERE

Global water shortage may give rise to political instability

A global shortage of clean drinking water is predicted, resulting in the possibility of political instability. The UN millennium target, aimed at halving this problem by 2015 will remain far out of reach. [22; 23; 31; 57; 98]

7 HYDROSPHERE

Flooding of rivers and the sea

Danger of flooding because of extreme rainfall and/or weather conditions remains a serious problem in densely populated areas, especially for those below Europe’s current sea level (see also climate change). In case of dikes bursting large areas will be flooded. This is because of the bowl-shaped, low-lying situation of large parts of countries like the Netherlands. [69]

8 HYDROSPHERE

Little flexibility left in the use of (national) water supply

The intensive use of water for diverse functions such as transport, recreation, protection, agriculture and cooling-water is approaching its limits in many urban areas, because of which not all functions can be fulfilled optimally. Enduring draught can therefore cause serious problems despite the abundance of water.

9 GEO-SPHERE

Natural disasters

Three-quarters of the global population live in areas, which have been hit at least once in the past twenty years by earthquakes, tropical cyclones, floods or drought. This problem is increasing because ecosystems are losing their natural buffer capacity and because more people are living in vulnerable areas. Climate change could also be another causal factor. For Europe, the consequences of natural disasters will mainly be indirect because of the interconnectedness of economies. [57; 69; 101]

10 GEO-SPHERE

Shortage of fossil fuels

The global demand for energy is increasing, due to rapidly industrializing countries such as China. In the end, there will be a shortage of fossil fuels from the geo-sphere. The global oil reserves will probably only be sufficient for a few more decades. Europe, as an importer, finds itself in an increasingly disadvantaged and vulnerable position. [22; 28; 29; 31; 41; 66]

11 BIO-SPHERE

Loss of natural resources

Over-fishing, environmental pollution, erosion, logging and diseases have caused the rapid decline of nature areas and agricultural land, in both developed and developing countries. These areas fulfill many functions such as food production, gene banks, air and water purification, acting as a buffer against flooding and recreational. Tropical forests and coral reefs are insufficiently protected by national governments and by the international community. Countries manifesting high levels of corruption display deforestation on the greatest scale. Natural resources could well hold significant, yet unknown, opportunities that could benefit many people. Therefore, the loss of these not only presents a problem for the countries involved; it can have a global effect. [22;31;40; 57;61;68;74]

12 BIO-SPHERE

Disruption of fertility

Presently, one in six couples is infertile. There are indications that suggest that fertility in industrial countries is declining, including biological fertility. The exact causes are unknown. One suggestion is that it is related to these societies' ways of life. The consequence is a disruption in the composition of the population. [111; 110; 111; 118]

13 BIO-SPHERE

Infectious diseases constitutes a permanent threat

A quarter to a third of all deaths is caused by infectious diseases such as aids, malaria and tuberculosis. Various new epidemic diseases and variants of diseases are appearing with both known and unknown origins. For several of these diseases, there is no vaccination or medicine yet. Studies have shown that pathogens of known infectious diseases can become drug resistant. The evolution and mutation of pathogens along with the distribution mechanisms, either through human action or through nature (such as via migratory birds), pose a threat to humans, agriculture, cattle breeding etc. in all countries. [22; WHO in 31; 57; 68; 150; 151]

14 SPACE

Lack of space

The increasing global population and rising levels of prosperity are resulting in a lack of space. Worldwide, an increasing number of people are living in densely populated areas. Some of these are also known to be prone to natural disasters (river valleys, river deltas). This does not currently appear to be a particularly threatening issue for Europe. However, if we look at this from a long-term perspective, an increasing number of areas might well become more vulnerable than first thought. [57; 69]

15 OUTER SPACE

Exponentially expanding space debris

Space debris has the characteristic of rapidly expanding in volume. Each fatal collision between a space vehicle and existing space debris results in new debris. This is a threat to the present and future use of space, for vital communication, observation satellites and for further exploration. [19]

16 OUTER SPACE

Asteroid impact

The impact of a substantial asteroid could have disastrous consequences for a major part of the global population.[31]

17 OUTER SPACE

Solar gamma bursts

A solar flare can have far-reaching consequences for modern communication techniques. In addition, high-energy bursts from space, which hit the earth by coincidence, can have major consequences for communication and possibly for our health.

18 OUTER SPACE

Contact with extraterrestrial life

It is unclear whether life is a phenomenon unique to the earth. Contact with extraterrestrial forms of life (primitive or intelligent) may involve all kinds of threats.

HUMAN BASIC FACILITIES: Each population makes use of basic facilities to survive, stay healthy and shape society in its many facets. These basic facilities are partly related directly to the physical environment and often have an infrastructural character.

19 FOOD - AGRICULTURE

Hunger

The dependence of densely populated territories on the transport of food makes the population vulnerable to disturbances in the production and transport flows. Worldwide, hunger is a persistent, self-reinforcing problem. An underfed population and lack of means is responsible for poor agricultural results. [20; 23; 31; 57; 99; 102]

20 FOOD - AGRICULTURE

Obesity increases

People tend to overeat in prosperous countries. Obesity is a serious problem, not only in the US, but also in European countries. The consequences of this on public health and life expectancy are huge. The causes are numerous including manufacturers stimulating demand and changes in the living environment. Governments see obesity as the result of irresponsible behavior by consumers and, consequently, do little to regulate manufacturers. The (future) costs, in terms of health care and absence due to illness, are astronomical. [34; 109]

21 FOOD - AGRICULTURE

Use of drugs

The use of drugs and the criminality connected to it, has long been a problem for many European countries. The rise of synthetic drugs causes additional problems. The enormous market revenue ends up in the hands of gangster countries, terrorists and criminal and corrupt officials. [57]

22 COMMUNITIES, SPATIAL PLANNING, HOUSING,

Quality of living environment

The quality of the living environment is threatened due to population growth and lack of attention to issues related to well-being. Quality of life is low in many urban areas, which is often caused by bad urban planning.

23 TRANSPORT

Stagnating traffic in urban areas

Increased traffic causes congestion and extra pollution in urbanized areas. The damage to health, the economy and commuting time will increase if nothing is done.

24 TRANSPORT

The end of (cheap) aviation

There is a great risk that the present worldwide transport system will end up as a dead-end trajectory. This system is sensitive to the exhaustion of fossil resources; this applies in particular to aviation because here a complete transition to liquid hydrogen is associated with greater safety risks. The social and economic consequences for a 'global' world and for nations depending on trade will be enormous.

25 HEALTH CARE

Increasing costs of health care

The cost of health (care) is increasing rapidly in the OECD countries; the causes have not yet been pinpointed. The increase is not, as is widely believed (even by policymakers), primarily caused by acceleration of the population's ageing. There are other factors such as the move toward a technical age and altered demands for health care (cosmetic surgery, IVF etc). However, these are just suggestions; a thorough analysis into the real causes is still lacking. [86; 88; 115; 116; 117; 118; 113]

26 HEALTH CARE

Division in health care

The increasing costs of health care, along with the privatization and individualization of health care provisions and insurances, make for declining solidarity in many countries. Consequently, the differences in health levels and facilities will increase between groups of the population.

27 HEALTH CARE

Incurable diseases

Despite the vast amount of research over the last fifty decades, many diseases are still basically incurable (such as many forms of cancer). [27]

28 HEALTH CARE

Insufficient “insight into” and “vaccinations for” epidemics

The alarm systems to prevent exposure and dissemination of infectious diseases are insufficiently transparent and effective. In particular, they are lacking in developing countries. For many threatening infectious diseases, insufficient vaccinations are available worldwide, including in Europe. For some diseases, there is a complete absence of vaccinations. As mentioned earlier, pathogens, in many cases, develop a resistance to medicines. [31]

29 COMMUNICATION

Commercialization of communication

Commercialization of communication media reduces the possibilities of public debate and poses a threat to the political system and European democratic values. Commercial parties will increasingly create possibilities to influence the behavior of citizens in an indirect way (advertising through life style influencing programs), causing social developments such as over-feeding and an increased demand for ‘make me beautiful’ treatments. There is a risk that a limited number of media owners will have a hidden influence, which could undermine a free democracy. [120]

30 COMMUNICATION

ICT-dependency

Many of our facilities are becoming extremely dependent on ICT facilities, e.g. the supply of energy, transport movements and financial transactions. A disruption of these ICT

facilities not only disrupts the economy, but can also result in calamities involving the lives of many people. Disruption can be caused intentionally or by a natural phenomenon. [57; 60; 170]

31 COMMUNICATION

Digital gap

Although ICT communication technologies are penetrating remote areas, there is much concern about the digital gap. The main reason for this is the increased importance of linking up with the international economy. [31; 37; 57]

32 WATER PRODUCTION and DISTRIBUTION

(Drinking) water supply on the edge

Meeting the growing demand for various water functions is a problem, especially in densely populated areas such as the Netherlands. Fluctuations in the water supply may have a disruptive effect on various functions with consequences for the economy, living environment, environment and health.

33 ENERGY PRODUCTION and DISTRIBUTION

(this is almost identical to those from the physical domain concerning energy)

Exhaustion of energy sources

Fossil fuels are limited yet present production methods rely on them. The use of energy is increasing despite austerity policies. The rate at which renewable base materials are introduced is low. Europe and the Netherlands are becoming increasingly dependent on other countries for their energy supply, which might involve serious threats, especially in the context of changing geo-political relations. [31]

34 CONSTRUCTION

Ageing Infrastructures

In many urbanized areas, old pipelines (gas, sewage) are time bombs. In many cases, there is a lack of information about the status and exact location of this underground infrastructure.

35 RECREATION, ENTERTAINMENT, TOURISM

Overexploitation by tourism

Tourism and recreation fall under economic growth sectors, in which the Netherlands

might invest more money. Won't this lead to a decline in scenic areas?

36 SAFETY AND EMERGENCY SYSTEMS

Crisis control

Today's threats are more complex and large-scale than before. Crisis control still focuses too much on 'classical disasters'. The steering is unclear and non-committal. Operational services lack coordination. The balance between the responsibilities of the government and those of the business community and citizens needs to be redefined. Fragmentation at the international level and the fact that each sector has its own approach, are also bottlenecks. [60; 170]

37 SECURITY

No rational security policy

Regarding security-related decisions, any trade-offs in terms of costs, comfort, privacy etc. are not approached with the appropriate importance. All too often, technologists, governments and other leaders want to show the public that they are making decisions. The presence of the measure is more important than its effect. Another problem is that technology is expected to solve the impossible. Especially in achieving security, technology does not function properly. Technology is not a tool for the 'users', but is used to make things impossible. In this situation, people are looking for weak spots in the system. If a security system already has problems in situations where no current danger exists, a real attack will not be adequately recognized and handled. Finally, the reliability of authorized persons is an unrecognized weak spot. [60]

38 INFRASTRUCTURE –GENERAL

Insufficient investment in vital infrastructure

Insufficient investment in embankments, water inhibiting systems, rails, roads and communication channels only becomes visible when it is too late (e.g. New Orleans). Both public and private administrators of infrastructural facilities such as energy, drinking water, water protection and communication frequently postpone investments for the prevention of disruptions. This is a short-term view. Public involvement is also often lacking [112; 170]

39 INFRASTRUCTURE –GENERAL

Insufficient planning infrastructures

The size and composition (age, ethnical background) of the population will change. After a period of growth, reductions to 10-12 million citizens might be possible in the Netherlands. As a result, the demand for various services will change considerably. In designing infrastructures, these changes have not been taken into account. The future generations will thus 'inherit' massive, inflexible infrastructures that do not correspond with their wishes. [in response to 100]

40 INFRASTRUCTURE –GENERAL

Free market system for infrastructures.

Increasingly, private parties are responsible for infrastructural facilities. Their primary interest is profit; not providing a social desirable level of facilities that have an adequate price/quality ratio. This endangers the long-term reliability and continuity of these provisions, which in the long term might cause economic damage and high public costs.

Science, technology and education. Below follows a list of problems which occur in the domain of science and technology development, as well as in the educational system.

41 BUSINESS OF SCIENCE AND TECHNOLOGY

Insufficient knowledge management due to rapid and exponential expansion of knowledge

The production of scientific knowledge is continually expanding because of the application of new technologies plus the growth of research expenditure in new economies. Knowledge management is becoming increasingly important because there is more knowledge available. In many places, new knowledge is used insufficiently; this also applies to the government. The available systems for data mining, proficiency of foreign languages (needed for full exploitation of the world production of knowledge) etc. are inadequate.[31; 123]

42 BUSINESS OF SCIENCE AND TECHNOLOGY

The leading role of the US and Europe is in danger

Today the US, Japan and Europe spend the most on research and development. Some sources predict that the dominance of the West will continue to exist in the following decades; others expect Asian countries to outpace the West. It is argued that they are

rapidly making up arrears and a lot of the production is being relocated there. Although in Lisbon (2000), Europe agreed to invest 3% of the GNP in research and development, it is unlikely that this will be met. Since the end of the cold war, government contributions to research and development in Western countries has, in a relative sense decreased [31; 200]

43 BUSINESS OF SCIENCE AND TECHNOLOGY

Threat to intellectual property rights.

Intellectual property rights were created, to promote investing in innovations and constitute one of the pillars of the knowledge economy. Protecting products via intellectual property rights will become increasingly difficult, due to the increase in open sources and globalization. This is not only the consequence of open sources, but also of the increasing parallel development of knowledge in various large language regions (like China and India). Parties, which depend on traditional protection, find it increasingly difficult to recover their investments and are involved in frequent litigation. Others hold that certain parties already have too much power because of their present intellectual property rights. Multinationals regularly obtain control over patented seeds and plants and thus limit the possibilities for developing countries. [31; 37; 57; 193]

44 BUSINESS OF SCIENCE AND TECHNOLOGY

Decreasing confidence in science

Despite the enormous increase in scientific production, many important questions seem to be without clear scientific answers. Furthermore, major social problems have not yet been solved, while even greater new problems are presenting themselves. The relationship between science and society therefore, can be described as a tense one. Science feels misunderstood and finds the interest from the population too limited. The confidence in science, demonstrated by society, may be further jeopardized by consequences for financing and the future capacity. [121; 122]

45 SCIENCE AND TECHNOLOGY

New risks, ethical issues and social problems

The development of science & technology and new solutions involves new risks and ethical issues. This applies, in particular to, converging technologies (NBIC), stem cell research, ICT, genomics and robotics, but also to measures for CO₂ storage. For instance, where is the boundary between medial intervention and non-intervention, in the

case of premature birth or illness? Rapid developments involve new fears and increase the communication gap between generations. [31; 33; 60; 190; 199]

46 SCIENCE AND TECHNOLOGY

Custom-made man

Can NBIC and in particular, genomics create powerful tools to alter human evolution? The potential development of cyborgs or human artificial intelligence was never so close? The fact that humans seem to find it increasingly difficult to accept the imperfect, might lead to a society with many ethical questions, which will have to be resolved.

47 SCIENCE AND TECHNOLOGY

The development of technology gives criminals opportunities.

Technological innovation usually alters the power equilibrium to the advantage of the offensive party. Attacks are more lucrative, easier to organize, more difficult to discover and often have a greater effect. This is because attacks are automated and the defenders make incorrect assessments of the way in which the innovation of the attacks will take place. The standardization of systems moreover results in so-called class-breaks. Once it has been discovered how a system is vulnerable, this knowledge spreads and it becomes a possibility for anyone because all the systems are similar.

48 SCIENCE AND TECHNOLOGY

Robots ousting humans

Every wave of automation brought with it the fear of increasing unemployment. Time after time the negative predictions proved not to be true because of the rise of alternative employment opportunities (often at a higher intellectual level) in directions that were virtually impossible to predict. It is expected that a completely new wave of automation will arise that follows a different pattern. This new wave will involve mobile and intelligent automata (robots) that will, more than ever, be directed toward fulfilling the most complex tasks as well as tasks that couldn't previously be automated because of specific problems. It is extremely difficult to foresee which niche humans will occupy in the labor market of the future. Will a niche remain? What kind of economy should we imagine in which the majority of production work will be done by robots? Which market mechanisms are

49 SCIENCE AND TECHNOLOGY

Economic models

Many of the influential economic models are increasingly less applicable due to structural changes in the economy.

50 EDUCATION

Insufficient educational level of the population

The increasing dependence of society on complex systems requires an adequate educational level in numerous fields. In affluent countries, hard work is no longer self-evident, certainly not in countries with an elaborate social system and persisting high rates of unemployment. In one's work, self-fulfillment is becoming increasingly important. On the one hand, this appears to fit in with the increasing need for motivated, creative employees. On the other hand, this may result in shortcomings in certain fields of learning at all educational levels with major economic consequences. The limited interest in technical subjects among non-science students, the falling interest in technical subjects at vmbo (Dutch lower secondary professional education) and mbo (Dutch intermediate vocational education) and the vmbo dropouts without diplomas are a cause of concern in this context. [5; 25; 123; 124; 125; 126]

51 EDUCATION

The educational system is not attuned to the educational biography

The problem is that the Netherlands still takes the 'old demand' as its starting point and tailors education accordingly, for example in the Delta Plan science/technology. The educational system is not adapted to the changes in society i.e. the wide range of choices that people have in terms of the labor market.

52 EDUCATION

Access to education

Access to education for everyone and realizing quality is a persistent problem in many developing countries. The gender segregation in education makes for a suboptimal use of talent and has negative economic consequences and for the career opportunities of women.[5; 22; 37; 57]

SOCIAL ENVIRONMENT This domain describes the problems associated with the social interaction within societies. First the developments in the field of demography and migration are outlined, subsequently the developments in social relations and cohesion worldwide and in the Netherlands and finally the changes in value systems, religion and philosophy. This section also lists a number of actual developments, which are not so much of a problem right now but may lead to problems (and also opportunities) in the future.

53 DEMOGRAPHICS

Uncertain size and composition of the population

Worldwide the population is increasing, but the pace at which this takes place is decreasing. Like many European countries, the Netherlands will probably face an ageing population. There are many uncertainties which makes it difficult to predict what the size and composition of the population will look like in the 21st century. Possible demographic trends are:

1. An increasing cosmopolitanism (from and to the Netherlands) of highly educated young people but also of retired persons.
2. Migration from poor countries by an increased pressure from poorer regions.
3. Emigration to countries like Canada, New Zealand, Australia.
4. Changes in the birth figure of several groups of populations (with a cultural and biological component).
5. Changes in the death figure by an increased average life expectancy, but also as a result of disasters.

The uncertainties regarding the changes in the size and composition of the population are also insufficiently taken into account. Explorations of the future and policies often start from simple, linear forecasts ignoring any shifts in trends and the like. As a result, there is insufficient insight into bottlenecks in themes such as the costs of health care, the social security system and the labor market.

54 DEMOGRAPHICS

No adequate response to demographic changes

Demographic changes in themselves are not a problem. They create opportunities as well as problems. The changing composition of the population has consequences for markets, the production capacity, human resources and flows of capital. The rapidly changing composition of the population calls for a timely review of existing institutions, such as the social security system and pension schemes.

Some consequences receive too little attention. What will happen, for example, when cosmopolitans with a relatively large capital or half of the non-working elderly leave the Netherlands? They will spend their money outside the Netherlands, especially if they take their pensions and medical health insurances with them. What consequences do these migration processes have on markets such as the Dutch housing market, the health care market, the entertainment industry and the labor market? The problems are great – also for the economy and innovation – if a considerable part of the social-cultural elite leaves the Netherlands and if the Netherlands is not popular with people from abroad who have social-cultural capital.

Arising opportunities because the elderly remain healthy for a longer time and continue to be a financially strong group are ignored.

55 DEMOGRAPHICS

Tensions due to migration from poor countries

Migration has both advantages and disadvantages, for the host country as well as for the country left behind. The chances for migrants from poor countries to contribute to society and the economy are lower in Europe than in the US. In the US immigrants set up many businesses and their social mobility is high. In Europe, the economy is less dynamic, migrants are attracted for different reasons ways (selected for their capacities) and the integration is a more complicated affair. Social cohesion is in danger because already established classes develop feelings of hostility due to the fact they now need to share existing resources (housing, jobs and benefits) with the newcomers. Minorities start isolating themselves and do not feel connected with the culture at large and develop feelings of hostility. Countries that are witnessing an outflow of their talented young people and are faced with the fact that their youngsters no longer see any opportunities in their own country can end up in a downward spiral. [31; 61; 68; 110; 122]

56 DEMOGRAPHICS

Pressure on physical resources and infrastructure/basic services

The combination of a growing world population and an increase in welfare causes enormous pressure on physical resources. This has consequences for the availability and prices of these resources in the Netherlands. Probably the Netherlands has a temporary shortage of space for traffic, transport, housing and agriculture due to the increasing population; any decrease will reduce claims on space. A problem is that currently, in many industries, any changes in the size and composition of the Dutch population are insufficiently anticipated. This will be dealt with under these categories. [100; 101]

57 FAMILY AND WORKING LIFE

Family and other social networks

Many mainstream sources emphasize the rise of individualism and the diminishing role of collective social groups. The number of persons per household, for example, has been decreasing for some time now due to the high divorce rate and the limited number of children per household. Other researchers have established that it is not just a matter of increased individualism. For the internet generation, for instance, developing an own identity goes hand in hand with building authentic, long-term relationships and participating in networks. Some trend watchers expect to see an increase in networks of citizens who care for one another because the state provides increasingly fewer basic facilities. An example of this is the introduction of the sandwich family in which the partners take care of themselves, their children, their elderly parents and other family members. [25; 31; 110; 187; 188; 189]

58 FAMILY, WORKING AND SOCIAL LIFE

Biography of options

Life patterns are changing. From a standard biography, we now turn to a biography of options. The different phases of life, such as working and education, are becoming more intertwined. Stacking studies, jobs, and relationships is more normal. If our life expectancy increases, this will progress even further. The learning biography is also changing. Problems arise because educational and labor organizations still fail to make sufficient use of this. [5; 31; 68; 121; 122]

59 FAMILY, WORKING AND SOCIAL LIFE

Possible increase in mental health problems

One in five people presently has a psychological problem. It is difficult to determine whether there is an actual increase or that problems are increasingly being diagnosed as such. Possible causes are urbanization, the rise of knowledge-intensive work that causes stress and the quality of social relations (extended family). In addition, migration and rapid innovation can play a role. [15; 119; 203]

60 VALUE SYSTEMS

Absence of European culture and identity

Citizens of the individual European countries feel more cosmopolitan than European. The absence of a European culture and identity is an important impediment to the ongoing economic and political integration [25; 202]. Not everybody considers this a problem.

61 VALUE SYSTEMS

Changes in value systems

Value systems change more rapidly than before, as a result of globalization, the increase in prosperity and technological development. Currently the American way of life is the lifestyle aspired to by most people in the world, with the associated consumption behavior. This may possibly change in the 21st century. Worldwide the dissatisfaction with the way in which the US plays its role as the only superpower increases. American ideals of beauty may possibly be replaced by Asian or Islamic aesthetic ideals.

When an individual or a society reaches a certain level of welfare, the values of the population change. Instead of surviving, self-expression becomes more important. Religions change in to substance and play a different role than before. In the Netherlands, increasingly fewer people join a church, many of them, however, still believe in 'something'. The Islam is increasingly re-interpreted from a Western context. Some sources emphasize the progressing secularization of the Western culture, while other sources expect an upsurge of religion.

In the Netherlands, there are concerns about the increased isolation of groups of the population and their inability to handle the differences. Out of fear, the own cultural and religious identity is practiced in a rigid way, thus reducing the ability to solve conflicts. This process has gained momentum after the attack on the Twin Towers, both in the Islamic and the Christian worlds. The 2nd and 3rd generations are also disappointed because they feel insufficiently embraced by society, think for example of discrimination on the labor market. Violent confrontations cannot be excluded.

Traditional characteristics of the Dutch culture, such as openness and tolerance – which are very important for social cohesion and innovation – are at risk. [25; 31; 53; 60; 61; 68; 110; 183; 184]

62 VALUE SYSTEMS

Insufficient or inadequate communality

The diversity of the multi-cultural society is both abused and praised. Despite all the problems that diversity causes, it still appears to be vital. Management literature shows that diversity is necessary for functioning successfully in a dynamic, complex context and that open societies are more creative and innovative. Teams with a varied composition but which had not developed a common framework, did not function well.

How can we combine the diversity of our multi-cultural society with sufficient communality? How to create a new identity to which all groups can connect? A great feeling communality within groups is a problem if this results in opposing other groups of the population. [114; 121; 204]

Economic domain

63 WORLD ECONOMY

Insufficiently anticipating a new economic world order

The United States is currently the only superpower, the main economic and military player in the world and also provides excellent scientists, technologists and thinkers. Where other countries opt for being limited by international agreements and treaties, the United States sets its own rules. As a result, the resistance against the US is increasing whilst the drawing-up of international treaties and collaboration in the UN is a difficult process.

The rise of new superpowers is predicted. Potential candidates are Japan, Brazil, Russia, India and China. Are we entering the Asian century? Besides these there are the 'tigers', small countries with a strong and growing economy, such as Taiwan, Singapore, Chile, Oman, South-Korea, Thailand, South-Africa, Poland and Canada.

The position of the Netherlands is to be reformulated and conquered, whilst it is uncertain how the new economic and political world order is going to develop. A number of the traditional markets on which the Netherlands is still active will disappear. Is the Netherlands sufficiently prepared for changes in economic relations? [31; 61; 68; 110]

64 WORLD ECONOMY

Problems associated with globalization

The globalization – the 'increasing integration and interdependency of societies through the exchange of ideas, capital and goods' – is expected to continue. Trade flows between countries are growing faster than the production of individual national economies due to developments in ICT, cheap transport and the split-up of work processes. Social, economic and political conditions, such as trust in the financial system and liberalization of the world trade, also play an important role.

Proponents state that globalization leads worldwide to efficient production and a more rapid economic growth. Anti-globalists point out the disadvantages for poor countries. Although some of the poorer countries profit from globalization, the gap is growing between the countries that are part of the world economy and those that are not. The inequality in welfare between countries is increasing.

The increasing dependency between countries is an important source of conflict. In addition, the pollution, the exhaustion of resources and the growing dissatisfaction of poorer populations – who via the media are aware of the welfare in other countries – pose a major threat. [31; 57; 68; 95; 100; 110]

65 WORLD ECONOMY

Collapse of world trade

Although globalization is the most probable development, it is possible that the globalization is slowing down and that the world trade is slackening. Possible causes are the loss of confidence as a result of a collapse of the financial system, new waves of protectionism by countries that are losing out too much under the present system, geopolitical unrest or increasing fuel prices. If economic and social changes are developing too rapidly and take place in an institutional vacuum, this can lead to political opposition and authoritarian reactions as a result of which liberal values are at stake.

66 WORLD ECONOMY

The Netherlands is a dormant country

A number of countries, including Germany, Sweden and the Netherlands, tend to develop into non-innovative and mediocre performing countries. They seem to lose their ambitions to keep or improve their role as important players in the world. Their structures have become rigid. Endeavors with risks are avoided by these societies. The working ethos is lower in Western Europe than in Eastern Europe. Applying pure economic self earning scenario's for large public projects impedes not only high risk endeavors with potential high outcomes but also endeavors with certain positive long range outcomes or outcomes for non economical "public values".

The chances are high that these countries and their businesses will be unable to adjust to new economic rules, such as a very short development time and a rapid expansion of capacity, connection to the worldwide network, an ongoing development of knowledge

and a reliable supplier of goods and services. This situation is regarded by most sources as a great threat. History shows that time and again, high-technology, prosperous societies succumb to their own welfare.

A less frequently heard view is that these countries can survive because of investments made in times that are more prosperous. The quiet, stable climate makes that these countries of independent means are agreeable to live in and attract many tourists. [25; 57; 110; 125]

67 WORLD ECONOMY

The threat of financial instability

Little progress is made in the improvement of the worldwide financial architecture. Regulations do not go beyond the national level, and at the international level are even cut back according to some sources. As a result, the financial stability is insufficient, thus threatening the globalization and economic growth of both developed and underdeveloped countries. Recent calculations show that Latin America has missed out on a growth of about 2% per year due to the various financial crises in the 1980s. The stacking of bad loans in the banking sector, the poor supervision by banks, the increasing debt position of the US and a possible rapid fall of the price of the dollar are great threats. Money laundering is insufficiently tackled and the system seems insufficiently prepared for the arrival of electronic money. Because of the increasing integration of money systems, both the risk and the disruptive effect of a crisis more significant. [31; 37; 57; 60; 191]

68 WORLD ECONOMY

Bottlenecks international trade rules

The present trade, investment and competition rules are not adequate for a globalizing world. Although the past has proven that open trade contributes to economic growth, there are many bottlenecks. Trade barriers and subsidies are common because liberalization and abolishing subsidies imply a redistribution of jobs, income and welfare that is not beneficial to everyone. For developing countries, a further liberalization can turn out negatively if problems at home are not solved. For example, a poor infrastructure and quality controls and their foremost export product (agriculture) facing artificially low prices due to subsidies in developing countries. Rich countries protect their borders by making an appeal to environmental and other rules and do not fully allow the import of manufactured goods such as textiles.

Due to liberalization, the supervision of businesses by society is diminishing. The absence of investment and competition rules on a global level makes supervision by governments difficult. On the other hand, companies operating in several countries are faced with a tangle of rules and regulations because many countries fail to coordinate these properly. [57; 95; 191]

69 WORLD ECONOMY

Tax systems

Globalization and the technological development encourage thinking about the present tax systems. Companies and citizens who pay tax are more mobile than before and are often established in more than one country. Some countries tax their subjects irrespectively of where they live. Other countries do this on the basis of residency. Transactions via e-commerce are not as easily traceable as paper transactions. Finally, there is a need for imposing international levies to prevent environmental problems (Kyoto). Possibly the traditional taxation principles are ripe for replacement. [57]

70 WORLD ECONOMY

Development of Africa and other hardly developed countries

The risks are high that the approximately fifty least developed countries – mostly situated in Africa – are unable to find any connection with the economic world order. Although the picture of Africa is often too negative – part of the African countries have peace, collaboration and democracy – this continent is not doing well. Because of this, many other problems – such as shortages of water, the avoidance of natural disasters and diseases – are not solved. The problems of Africa are largely related to the international economic and political system. The political forms of administration aimed at personal gain and the external focus of African economies are said to be caused by the large international debts of these countries and their limited economic bases (primary products). The export of primary products is moreover a major source of income for military forces, which increases the risk of a civil war. Finally, insufficient local capacity is being developed because organizations for development aid are still hiring external expertise. There are rumors that the present forms of development aid actually inflict harm. [36]

71 BUSINESS OF BUSINESS

Financial corporate scandals

There is a great increase in financial corporate scandals. This has to do with changes in

the shareholder market. As a result of which companies and managers put short-term booking results above long-term continuity, the importance of an increase in scale and internationalization and finally the development of a management culture aimed at quantitative parameters which paves the way to deception and fraud. The interrelatedness of accountancy and consultancy is another cause. [9; 127; 192]

72 BUSINESS OF BUSINESS

Changes in the nature and role of the factor labor

The increased level of automation and robotization will fundamentally change the value of the factor labor. Labor will be increasingly removed from the primary production; the number of knowledge brokers and directive functions will increase. The consequences might be temporary or even structural unemployment for large parts of the populations. A basic understanding of this development and the consequences for the competences required in this new economic order is limited. The differences in salary between those educated and uneducated workers have already increased in the Anglo-Saxon world, and this phenomenon appears to be spreading further. In particular, in countries that are now increasingly joining the world trade, such as Russia and Armenia, large internal differences in salary are arising. [5; 57; 121; 122]

73 BUSINESS OF BUSINESS

Threats from other domains

In other parts of this horizon scan scores of problems have been described that may disrupt the economic system. Think for example of infectious diseases, environmental pollution, flaws in the geo-political relations, the lack of a proper functioning of science and education, etc. These types of disruptions often cause great economic damage in varying sectors, think of situations such as SARS, BSE and the avian flu. [22; 31; 68]

74 BUSINESS OF BUSINESS

Dutch family companies

Private companies with limited liability – often family companies – are very successful economically and are responsible for 40 to 50 percent of employment in the Netherlands. Their success is often explained by their commitment to continuity and long-term relationships of trust with shareholders. This focus on continuity is threatened by new regulations, among other things those involving the transfer of businesses. [201]

75 BUSINESS OF BUSINESS

The cheating culture

An increasing number of companies and public services hold their staff accountable for production volumes in order to increase the efficiency of their organization. In practice, this quantitative focus of the management results in a lack of professionalism and a reduced quality. It also encourages cheating in the form of creative bookkeeping and performing unnecessary actions. This culture, which has been adopted from the US, is moving up into the Netherlands, and is found with the police, in health care, companies (oil company, supermarket group) and in public transport organizations. [9; 127; 128]

GOVERNMENT/LEGAL

76 INTERNATIONAL STATE SYSTEM

Political unrest

As already indicated under economy the world order will change. Within this world order a number of countries will be a source of confusion. Besides terrorist networks, there are several countries where political unrest and/or conflict can arise, such as the area around the Caspian Sea, Indonesia, Saudi Arabia and Mexico, etc. [31; 68; 110]

77 INTERNATIONAL STATE SYSTEM

Rigidity of Institutions

The economic world order is changing rapidly, but social institutions in general change slowly, whether these are nation-states, government organizations, international organizations or companies. The organization of many of these institutions is too hierarchical and rigid, because of which changes are not anticipated quickly enough. The nation-state is struggling with its role, increasingly problems and opportunities are beyond its reach (e.g. economical and financial system, infectious diseases, environmental problems, terrorism, and growth of the population) and international collaboration is necessary. Many sources indicate that the present forms of international cooperation - e.g. via international treaties and in the UN - are inadequate, and they suggest alternatives. The Montreal Protocol is the exception to the rule. [31; 57; 61; 65; 68]

78 INTERNATIONAL STATE SYSTEM

International agreements on technological developments

Biotechnology is in full swing, consider for example transgenic plants and animals, stem cell research, cloning and the human genome project. Rules are desirable from an ethical perspective, to avoid damage to ecosystems and species and to handle the genetic information of people carefully. At present, there is no international standard. If countries formulate rules purely on a national level, the safety and carefulness cannot be sufficiently safeguarded. Organizations and individuals will flee to other countries. Countries with stricter rules are running the risk of lagging behind as regards innovation and will be faced with (unethical) offers from other countries. [57]

79 TENSIONS

Shortage, a breeding ground for conflicts

Shortage of essential means of existence such as food and water are a breeding ground for (political) conflicts. This is also true for poverty, natural disasters and a possible collapse of the financial systems. Such situations may cause an outburst of repressed conflicts.[22; 31]

80 TENSIONS

Terrorism as virtual network

Increasingly, terrorism has the character of a virtual network. Via the internet and in other ways, young people from Western countries come into contact with terrorist organizations. In particular, well-educated young people from minority groups appear to be sensitive to the promises of these organizations. The almost virtual character of the network calls for new forms of prevention and combat. Many of the threats stated earlier in this horizon scan, can have been put in by terrorists to create chaos and confusion. [m-MAGAZINE; 60]

81 TENSIONS

New resources for terrorists

Terrorists and countries at war will deploy new weapons and resources, e.g. biological terrorism. Interconnectivity – a quick and effective supply of information and communication – is increasingly important in acquiring dominance.

82 NATIONAL STATE

Loss of confidence in politics and government

The accumulation of challenges that cannot be solved within the present political system makes for a permanently poor appraisal of politics at national level. There is resentment about the short-term vision of politicians and the poorly functioning administrative system. This problem cannot be solved by improved communication. [22; 57; 114]

83 NATIONAL STATE

Lack of partnerships government and businesses and social organizations

The government is insufficiently capable of solving social problems, and research is too commercial. By reinforcing the partnerships and collaboration between governments, the business sector and social organizations it is possible to solve complex problems more effectively. Citizens have more confidence in social organizations than in the government. The number and the influence of these organizations is increasing and their expertise in specific areas is great. Unlike the governments, companies have an international focus and have the structure and culture to roll out new projects on a large scale and within a short time scale. The government should put more energy into partnerships with social organizations and companies. Examples are educational and health care projects. [5;31;57]

84 NATIONAL STATE

Insufficient reflexive and strategic capacity of governments

Policymakers do not place focus on the future and are not very reflexive. The development of strategic visions receives too little attention. As a result, too many problems are tackled too late. The problems of obesity and the spreading of diseases, for example, have been poorly managed, and too late. The government should have intervened earlier in the production and consumption structures with high external, collective costs. In many areas, ad-hoc measures are taken all the time, for example in the area of social security and the employment scheme. [3; 22; 57]

85 NATIONAL STATE

Quality of the public service

The quality of the public service is a source of concern. [114]

86 NATIONAL STATE

Too much is expected from the market

Now that the central planning model and the idea of the hierarchical, paternalistic government have disappeared, the market is seen as a solution to all problems. This is dangerous, because new social problems do not receive sufficient attention from commercial parties. In addition, market thinking within the public sector causes problems – see under cheating. This also applies to the privatization of state companies. Internal processes fail to safeguard social interests, and unprofitable rail connections are terminated which from a public perspective could still possibly be profitable. The loss of control over quangos, which have been placed at some distance from central government, is a similar problem.[57]

2. Opportunities

The opportunities from the following domains will be discussed in succession:

- » Physical environment
- » Basic facilities
- » Research, development and education
- » Social
- » Economic
- » Politics, administrative and legal

PHYSICAL ENVIRONMENT: Below follows a list of opportunities arising from a scan of the opportunities that result solely from the physical environment. For each physical domain (atmosphere, hydrosphere, soil, etc.) the question is asked which opportunities have not been utilized and might be more intensively used in a sustainable way in the future.

1 ATMOSPHERE

Climate change

For some regions, the changing climate might be advantageous, resulting in a climate that is more profitable for agriculture and generating power from the wind or the sun or for tourism, for instance. This might also be the case for the Netherlands. [68]

2 ATMOSPHERE

Wind

There is an abundance of wind available in the Netherlands and Dutch offshore territories, which can be used for the generation of energy after the Danish example. Still, many Dutch provinces do not or only with difficulty achieve the target of the BLOW agreement (Bestuursovereenkomst Landelijke Ontwikkeling Windenergie, Governmental Agreement for National Development of Wind Energy). The province of Flevoland is an exception. Much turbulence also remains unused in urban areas. Recently, windmills were developed that can be incorporated into a building. “Specialist” wind scoops can ensure a better use of the wind potential. [129; 159]

3 HYDROSPHERE

Tides, waves and drop

When reorganizing the coastal areas, the drop of tidal currents could be used for generating energy. It should in principle be possible to convert the flow of rivers into

(transport) energy. At sea, wave energy might be used. Another possibility might be the artificial creation of drop conditions, as has been proposed by Lievense. [40]

4 HYDROSPHERE

Deuterium

The ocean supplies an inexhaustible source of deuterium which could be converted into an abundance of energy by way of nuclear fusion. [35; 196; 197]

5 HYDROSPHERE

Gas hydrates, minerals

In addition, the ocean floor supplies an enormous reservoir of so-called gas hydrates, which supply a huge supplement to the fossil fuel supply but is difficult to utilize. The ocean water and ocean floor supply a number of commercially interesting minerals and ores. (Extraction of gas hydrates and minerals can cause serious disruptions of the marine ecosystem.) [35; 196; 197]

6 GEO-SPHERE

Geothermic energy

Geothermic energy is considered a developable source for specific regions where much geothermic activity takes place, such as Iceland. In the end, making use of geothermic energy and underground storage might also be an important supplementary option for the Netherlands' 'home-grown' energy supply. [211]

7 GEO-SPHERE/BIOSPHERE

Moving with nature

The use of natural processes in civil engineering projects is an old tradition, for instance forming dunes with the aid of matting. Natural processes could be deployed to a much larger extent against flooding, dehydration, climate change and in order to create attractive (wild) nature reserves. See also Space. [40; 130]

8 BIOSPHERE

Inspiring life processes

Living nature offers a lot of inspiration for the development of products and materials, purification techniques and industrial processes and often serves as a model for technical designs and constructions. The importance of studying biological processes and their exemplary functioning is also emphasized in the conversion of NBIC (Nano, Bio,

Info and Cognitive Sciences, for instance self-replication, self-regeneration, etc.). Living nature includes many other processes and products that have not yet been studied and that can be of potential and vital importance. [61, 68, 194]

9 BIOSPHERE

More focused development of the marine environment and other wild areas

In spite of the many signals of overdevelopment of the marine environment, tropical rain forests, deserts and other ecosystems, these areas are simultaneously underused in many cases, because only part of the available sources are exploited. Many species of plants and animals are not used in any way. In order to profit from the available riches, the sources have to be studied in detail and new harvest methods, applications and markets have to be developed that simultaneously stimulate sustainability. [40; 61; 195; 196]

10 BIOSPHERE

(Re-) creating a living environment can contribute to more life

Planting is of value as a CO₂ filter and food production and provides a positive living climate. Plants and trees can be used more often as fencing or as a living part of houses and other constructions. Living nature can be re-introduced in urbanized areas, as in Manchester, by way of nature strips. Additional functions can be added by applying other types of planting. Parks produce food, the green spaces around schools contain plants that stimulate education and play, and architects develop parks and green spaces on roofs. There is a risk of spreading diseases by animals because of increased contacts with humans. [based on I14; I23; 110; 164]

11 BIOSPHERE

Intervention in humankind's own evolution

Humans are the first living creatures on earth able to intervene in their own evolution because of mental capacity. The possibilities in this context are constantly increasing due to science (see KNOWLEDGE). This creates opportunities for preventing diseases, but also for stimulating desirable qualities. Whether or not to use these possibilities will create extremely complicated ethical issues.

12 SPACE

Land from the sea

The Netherlands has a unique landscape, which for a large part is manmade. Creating wild nature reserves and land from water – for instance a new airfield or a new town in

the North Sea – provide an extension of living space and an interesting landmark for the Netherlands. The elaboration of this type of visionary plans is always accompanied by huge technical and professional spin-offs. An example is the Waterman Plan. [40; 110]

13 SPACE

Underused areas in the Netherlands

Making use of space for as many functions as possible is a Dutch specialty, which could be further developed. How can economic, cultural and natural values be developed at the same time, for instance in relatively empty provinces? Areas such as the Green Heart of Holland, for example, can be made more easily accessible for recreation and tourism. [40, 116]

14 SPACE

Building underground

Although building underground is increasing, there is relatively a lot of unused potential. [15]

15 OUTER SPACE

New functions of space

In science fiction books, people move to outer space in order to build up their existence there. In these scenarios, it is also possible to transport base materials from outer space to earth, or to use space as a prison for felons. Although the realism of this is limited, the question of which new functions space might have for us is relevant when we consider how many new functions were created over the past century. [2]

16 OUTER SPACE

The sun as an inexhaustible source of energy

The sun is in principle an inexhaustible source of energy that directly (by way of solar cells and heat extraction) or indirectly (by way of the production of fossil and non-fossil biomass, wind and water motion) supplies energy to be utilized by humankind. The recovery of solar energy can be profitable in an economic sense, even in countries with a relative lack of sun, such as the Netherlands. Exploitation of desert areas may be a possibility. This has the advantage that no space has to be sacrificed for CO₂ interception areas, as is, for example, the case in the production of biomass. [198]

HUMAN BASIC FACILITIES. Each population makes use of basic facilities in order to survive and give shape to society. These basic facilities are partly directly related to the physical environment and are often of an infrastructural nature.

17 FOOD - AGRICULTURE

Strategic function agriculture.

The abolition of agricultural subsidies and application of environmental requirements necessitate a review of Dutch agriculture. The transition will have to lead to a situation in which agriculture will integrate with new functions for rural areas, such as education, tourism, relaxation and the development of nature. Furthermore, agriculture should be organized in such a (diverse) way that in case of a halt to food imports new capacity can be built up quickly. [36; 57; 165; inspired by 110]

18 FOOD - AGRICULTURE

Modern craftsmanship

The Netherlands has a strong tradition in food processing. Like its foreign competitors, this industry aims at increasing its market share within the Western world, which has partly been responsible for over-consumption. Undoubtedly, things will run their course, but then there will be a price to pay. The clear challenge for this branch of industry is therefore to aim at other markets such as the growth market for exclusive products with a traditional and regional character. Developing these means of production in poorer countries could be a starting point for involving them in food production on a fair basis. The development of a network of companies and research institutions aimed at the production and marketing of quality products with a regional character is desirable toward this end. The preservation in the Netherlands of gene banks, for example on the form of old fruit varieties, fits into this strategy. [40]

19 FOOD - AGRICULTURE

Healthy due to a different eating pattern and functional foods

Food influences our health. Increasingly more consumers are interested in this. Take, for example, recent research about the development of the brain showing that it needs thirty-nine essential elements, a lack of which causes depression. By stimulating new eating patterns and developing new foods, the Netherlands could become a front-runner in the area of health and food. [118; 160]

20 SPATIAL PLANNING (HOUSING, COMMUNITIES, CITIES)

Healthy living environment

The way their environment has been built influences how people feel and behave. In technology-dynamics, the phrase 'script' is used for this. The script stimulates certain behavior or contains it. Studies into obesity show that the present living environment does not promote physical activity. The Netherlands can distinguish itself by developing a design tradition – aimed at an integral incorporation of social objectives into design processes. In this area, the Netherlands is already a front-runner as far as designing hospitals that promote the recovery of patients. In addition, manufacturers of equipment, such as Philips, are increasingly focusing on ambient design. [8;9; 161; 163; 164]

21 SPATIAL PLANNING (HOUSING, COMMUNITIES, CITIES)

From city to metropolis

A metropolis is an urban area in which global relations are more important than local relations, and where a higher concentration of people and global connections (aviation, shipping, telecom) come together. There are few cities that match the score of the Dutch Randstad on all rating lists of trade networks. Special about our own Dutch metropolis are the many local differences that make the Randstad diverse and attractive. In order to avoid a lack of cohesion, a Randstad government should be put in place, which coordinates and promotes the establishment of a full-fledged metropolis. [110; 205; 206]

22 TRANSPORT

New means of transport and systems

The need for renovation as far as traffic and transport systems are concerned is so great that both incremental and radical innovations can be very successful. Suggestions include lighter materials, hybrid engines and the application of intelligent systems for navigation, safety and fuel consumption and reduction of wear. By thinking in terms of chains, very new organizational concepts can be tried out. The sense of urgency is possibly great enough to initiate radical experiments. A problem is the strong dependency on trajectories of these kinds of systems. These concern investment-intensive, standing facilities. [39, 214]

23 HEALTH CARE

Supporting individual care with automatic resources

Increasingly more people need care and attention. Currently, one in seven employees is already employed in the care industry. Much more use can be made of technical resources in care – from hospitals to the home situation. The cure side of health care is

technology-minded, whereas the care side lacks this focus.

By developing the demand side and stimulating co-innovations by care institutions and companies, promising technical means can be developed and/or implemented. [166]

24 HEALTH CARE

Monitoring/developing vaccines for infectious diseases

Developing an adequate monitoring and response system for infectious diseases is a challenge, possibly in partnership with other countries, including developing countries. See also partnerships government, business sector and NGOs under politics. [31]

25 HEALTH CARE

Care tourism

Care tourism is on the increase. Countries such as Spain and Thailand offer top-quality care against low costs and have an attractive climate. In addition, methods of treatment that are not allowed in the Netherlands for ethical reasons are available elsewhere. The Netherlands is a front-runner in developing care locations abroad and can strengthen this position by also targeting markets abroad. [110]

26 HEALTH CARE

Preventive medicine

In the past, measures in the area of hygiene saved the lives of many people. The future may see the development of preventive medicine based on new scientific insights – such as knowledge of the human genome. According to some, most people are unwilling to cooperate in prevention.

27 COMMUNICATION

Internet connectivity

ICT is still in its infant stage, the worldwide inter-connectivity of people and equipment will only increase. This can be used to improve understanding, creativity and democracy. Most Dutch households and companies are connected to broadband internet. This offers the Netherlands a good starting position for e-commerce stimulation. Coaching of (starting) e-commerce businesses is important in order to profit from this starting position for our economy and employment.

28 ENERGY PRODUCTION

Robust strategy for energy supply

The further use of energy sources like the sun and the wind offers a country like the

Netherlands a good opportunity to become less dependent on foreign energy supplies. Solar energy could be used in built-up areas, particularly through a multifunctional use of space (think for example of electricity and heat production). The Netherlands should also again become the front-runner here. In addition, it might be rewarding to invest in promising but less well-understood and even controversial concepts (such as “low energy nuclear reactions” and “sono- (luminescence) nuclear fusion”). In addition, to contribute to accelerated searches for the development of a commercially feasible hot nuclear fusion reactor, because also with these concepts an independent energy position can be obtained for Europe and the Netherlands. [198]

29 ENERGY DISTRIBUTION

Strong position for energy distribution

The use of wind and solar energy and the unequal distribution of energy sources in the world calls for special attention to transport and conversions in which context the electricity grid and hydrogen transport will presumably play an important role. The prominent presence in the Netherlands of an infrastructure for gas offers opportunities in a hydrogen economy. It is important to exploit our experiences with natural gas in this context, to develop and try out concepts for the distribution and use of these sources by households and other users (in case of new sources being used – see above). Smart (geo-political) relations with suppliers are needed to have sufficient sources in the future and to remain a European gas supplier. It is proposed among other things to buy and store stocks now. [AER; van der Veen]

30 BUSINESS OF SCIENCE AND TECHNOLOGY

Open sources for innovation and government

To solve problems innovatively, Dutch companies currently make use of scientific knowledge that is available worldwide. Not only do they use the open source model, but they also often buy knowledge from abroad. Governments fail to make sufficient use of globally available scientific expertise, which would increase possibilities for problem solving, as it does for companies. Making investments particularly in human resources and institutions that contribute to the assimilation and processing of knowledge and expertise from both established research areas and Asia will pay off. In addition, attention should be given to establishing good arrangements to ensure the open source character of academic knowledge worldwide. For the Netherlands, good cultural and scientific relations with the new parties are essential. [207]

31 BUSINESS OF SCIENCE AND TECHNOLOGY

Taking advantage of shifts in paradigms

Shifts in paradigms allow for challenging science, which opens up new horizons and makes for better solutions. Said shifts usually follow an accumulation of anomalies, phenomena that cannot be explained within the existing paradigm. The leading edge of new science can be traced by seeking out anomalies. This can be done by improving the possibilities for risky research in our research system and by actively seeking out anomalies and scientists dealing with these anomalies. Please note that this will be high-risk research, but with relatively low costs and perhaps epoch-making results. [35;156;157]

32 BUSINESS OF SCIENCE AND TECHNOLOGY

Supplementing planning bureau functions with foresight functions

Planning bureaus monitor, develop and predict the future in a quantitative way. These bureaus can augment the value of their activities by taking into account non-quantifiable, trend-setting developments that are revealed by foresights..

33 SCIENCE AND TECHNOLOGY

Threats as leitmotif for innovation

It is a well-known fact that defense and NASA in the US are an enormous drive for technological development and innovation of that country, which is productive for national science and economical growth. The EU lacks drives of this kind. This absence could be counter-balanced by consciously creating a comparable drive for the EU states by accelerating the finding of solutions to the most important future threats and problems our society is facing, as this will create spin-off and future (economic) harm can be combated. [208]

34 SCIENCE AND TECHNOLOGY

Promising new fields of science

ICT, life sciences, biotechnology, energy sources, smart materials, nanotechnology and neuro-technology are globally considered promising new science fields. The negative aspect of choosing these fields is that there is no lack of countries and researchers focusing on these areas. A distinction can be made between a smart mix of (niche) fields within these promising fields, complemented with socio-scientific subjects. As far as we are aware, such an overview does not exist for the humanities and social science. [27; 31; 132-147]

35 SCIENCE AND TECHNOLOGY

Converging technologies (CT)

Hopes are high for the future when it comes to the convergence of nanotechnology, biotechnology, information technology and cognitive sciences, which can also be anticipated in the Netherlands. The NSF study forms the primary basis of these hopes. The assumption here is that the relevant science fields enhance and complement one another in various ways and that various combinations offer completely new solutions to a multitude of problems. Convergence can be achieved by determining a focus. The NSF study examines five Focus Themes plus promises. A concise representation of the themes can be found below. [194]

36 SCIENCE AND TECHNOLOGY

CT to develop human cognition and communication

The development could be crystallized by converging NBIC knowledge in order to

1. Unravel the composition and working of the human brain in the same way, as the genome has been unraveled (by means of MRIs, PETs and MEGs with super data processing).
2. Enhance human sensory scope by linking miniature sensors with this increased scope (in hearing, vision, etc.) to the human nervous system.
3. Expanding the life environment of humans by means of a wide range of miniature robots, intelligent devices and information sources.
4. Enhance the ability to learn by means of a combination of cognitive sciences and educational software (including virtual reality).
5. Develop improved instruments for creativity.

37 SCIENCE AND TECHNOLOGY

CT for improving human health and physical capacities

As to medical applications, the NSF study deals with swift diagnosis and monitoring by means of intelligent mini-sensors linked to expert and data processing systems, artificial organs and regulators, placing mechanical sensors (in deaf or blind people), tissue regeneration, stem cell therapy, focused cancer therapies, improved artificial joints, personalized medicines, artificial limbs linked to the nervous system and even direct brain-computer interaction.

38 SCIENCE AND TECHNOLOGY

CT for improving the results of group processes and social processes,

This is done among other things by developing machines and systems such as:

- an ideally automated communicator (director of group processes),
- an intelligent research assistant for studying complex systems (such as eco-systems),
- developing fundamentally new processes, products and systems, the principle being: intelligent, self-developing and adapting systems (aircraft of the twenty-first century)
- developing a brain virtual reality interaction (near real life experience)

In short, the National Science Foundation (NSF) really sees us entering the world of robotics. This is congruent with the opinion of a great many CEOs in US industry. [194]

39 SCIENCE AND TECHNOLOGY

National security

There are many developments worth pursuing. Consider mini-monitoring devices which directly communicate to the information system of leaders about the physical and psychological state of soldiers. These monitoring systems can also detect from a distance explosives or biological and chemical weapons. Other items with which to equip the army are: mini fuel cells, extra artificial senses for soldiers, intelligent decision-making support, power suits, direct brain machine interface (to operate and steer weapons), selective membranes, unmanned fighting and espionage machines, solid light-weight materials. [194]

40 SCIENCE AND TECHNOLOGY

Automation becomes robotization

The following decades will revolve around ever-increasing automation and robotization in the field of home appliances and highly skilled occupations (as never seen before). Household markets will turn out to be amongst the largest markets for robotics. [17; 194]

41 SCIENCE AND TECHNOLOGY

Unprecedented real time observation of complex systems

Possibly in combination with other monitoring systems – such as remote sensing – biological and environmental mini-sensors will play an important part in not only the monitoring but also the conceptualization, study and control of many dynamic systems (such as the earth, climate, migration of species, development of chemical processes). Obviously, the same monitoring techniques can be deployed in artificial dynamical systems (such as robots). [17]

42 SCIENCE AND TECHNOLOGY

Revolutionary new technologies for energy and transport

Energy could be supplied by the abundantly present deuterium via nuclear fusion. To prevent an energy crisis, it is advisable (for the Netherlands and the EU) to accelerate

the research and development of energy-producing nuclear fusion processes through all options even if they seem unlikely or evoke controversies (like low nuclear energy reactions (LNER) or chemically assisted nuclear reactions (CANR).

Parallel to this it may be considered whether there are any surprises in store regarding air transport (new technology to overcome gravitation). [A. Clarke/Krivit op 17]

43 SCIENCE AND TECHNOLOGY

Revolutionary new technologies/concepts for transport

The development of increasingly lighter vehicles fitted with intelligent systems for positioning and route determination and for the regulation of fuel consumption is well underway. Meeting the highest safety demands, energy saving requirements and desires of drivers and passengers in different ways has become part and parcel of today's approach. The development of strong light materials and hybrid engines and intelligent transport related systems and devices have made an enormous progress that is still evolving. As the aviation sector might suffer from the environmental pollution it causes, it makes sense to look for fundamentally different propulsion mechanisms for transport through the air.

44 SCIENCE AND TECHNOLOGY

Essential understanding of diseases with developmental biology

For actually fighting diseases that are yet incurable, such as different forms of cancer, it is important to obtain a more essential understanding of developmental biology. This provides insight into how the body fights diseases naturally, as well as the possible causes for these mechanisms' to malfunction. The advantage is that diseases can be combated more effectively; probably with fewer side effects.

45 SCIENCE AND TECHNOLOGY

Biological research into pathogens

Biological research into the evolution of pathogens in connection with vectors and hosts and the extinction of species (and generic groups) seem to be an important means to combat the spread and development of epidemics and hence possibly to prevent the extinction of our own species.

46 SCIENCE AND TECHNOLOGY

Biomedicine and the prolongation of life

Genomics not only leads to the prevention of hereditary diseases but also offers possibilities for developing 'individualised medicines' [162]. A better understanding of the

influence of environmental factors and food in combination with increased insight in developmental biology and ageing might lead to a further extension of our life span than already has been achieved by our present knowledge.

This means that people will stay healthy longer and that treatments will not result in an (extra) long and painful sickbed in the final phase of life.

47 SCIENCE AND TECHNOLOGY

Water champion

To strengthen the solid expertise position in the field of water (drinking water, water treatment, multi-functional use of rivers), the Netherlands could develop and launch new expertise, for example in the field of salt water, floods and droughts.

48 SCIENCE AND TECHNOLOGY

Positive psychology

Traditionally, psychology has focused on problems, abnormalities and the malfunctioning of people. Positive psychology emerged by the end of the twentieth century, especially in the U.S., which focuses on the proper functioning and the use of positive qualities in people. The idea is that this is more beneficial for organizations and for people's lives than a purely problem-oriented approach. [203]

Research, development and education

49 EDUCATION (general)

An educational system that can keep up with the increase in knowledge worldwide

Knowledge production in the world has assumed enormous proportions and is expected to increase ever more rapidly. On the other hand, through the automation of scientific observations and related data processing and an increasing number of major players, such as Japan, Korea, India and China, becoming parties to the world arena of science. This boom of knowledge and insight can only be utilized if we do not lose the ability to absorb this knowledge and translate it to our own situation. Obviously, this requires that a large segment of the population be qualitatively highly trained in science, technology, and a (post) curricular focus on “data mining” and “linguistic and cultural knowledge” in both scientific and social education.

50 EDUCATION (general)

Creativity in education

Training students in out-of-the-box thinking and creativity could be very productive for Dutch society and science. Examples of this new type of education are designing technical and other products and services, the interdisciplinary solving of problems, students starting small companies, and schoolchildren designing buildings and other devices. New institutions need to be set up in order to pursue this type of education on a large scale. [5; 121; 122]

51 EDUCATION

Academics as teachers

Children are our human resources of the future and they are of overriding importance for economics and society. Only the best is good enough. Primary and secondary education is given by (partnerships of) academics and other professionals (theatre makers, technicians) with excellent teaching qualities. The educational system has both solid and adaptive qualities. [Leijense, In't Veld ; 218]

52 EDUCATION

New educational and career models

Learning and working processes run increasingly parallel with one another. An education for life is something of the past. Arrangements for various target groups, such as the unemployed, people who have temporarily left the labor market to take care of children or to offer voluntary aid, workers in disappearing and/or changing branches or professions, workers aiming to broaden their horizons (horizontally or vertically), enable everyone to keep developing knowledge and experience. Providing elderly people with education and work placements is increasingly considered a collective responsibility. [5]

Social environment

53 SOCIAL, FAMILY AND WORKING LIFE

Ageing – the Silver Fleet

Demographic changes are not a problem in and of themselves. Many opportunities are insufficiently recognized. Think for example of new markets that arise because senior citizens stay healthy longer and form a wealthy group.

54 SOCIAL, FAMILY AND WORKING LIFE

Ageing actively

The phase of active old age precedes the phase of the dependency of the elderly. During this phase, there is a surplus of spare time.

Via new employment arrangements, fit and healthy senior citizens can continue to work longer than before. A first step is that, as in the United States, companies employing people that reach the retirement age are no longer allowed to dismiss them. Through an age-conscious policy the qualities of elderly persons can now be utilized better, e.g. by investing more in training and careers of the elderly employees. Organizations and schemes are to be attuned to (fit) senior employees, just like labor organizations in the twentieth century had to focus on two-earners. Revamped schemes are required, such as reaching the retirement age step by step via part-time work or forms of leave for situations that often face older employees, e.g. caring for the partner or leave for grieving. [68; 191; 192]

55 VALUE SYSTEMS

Cultural ambitions of Europe

Europe has a lot of to gain by building up a European culture because this will reinforce political and economic partnership processes. Without a European identity, there is no Europe.

56 VALUES SYSTEMS

New forms of solidarity

Solidarity and collective services are often geographically organized. But the sense of geographical, communal attachment is disappearing because of the increasing movement of people between countries. Ethnic or cultural groups (such as gays) form worldwide networks.

ECONOMY

57 NATIONAL ECONOMY

Investing in vital infrastructure

Investing in vital infrastructures gives the Netherlands a social and economic advantage in the longer term.

58 NATIONAL ECONOMY

Hydrogen economy

59 NATIONAL ECONOMY

Employment at all levels of education

Full employment can be reached by stimulating a proper combination of industries and searching for activities for lower skilled employment. The demand for lower educated

staff – which group threatens to show a surplus – can for example be stimulated by developing international tourism, care services and personal services. Work for more highly educated people can be developed by strengthening education, marketing, finance, and various directive functions in technology. [110]

60 NATIONAL ECONOMY

Country branding

Country branding is an effective means to stimulate international tourism to the Netherlands. Today we are renowned for our flowers, cheese and water. Also other specific characteristics of the Netherlands (such as its compactness, hospitality and entertainment) are to be clearly communicated to other countries. A strong creative industry could contribute to this. [110]

61 NATIONAL ECONOMY

The right economic growth

Economic growth often goes hand in hand with growing inequality and environmental pollution. Governments and companies are to focus more on economic growth that makes for less inequality and a sustainable development. Societal responsible entrepreneurship is an instrument for renewal. Completion in the form of international policy is necessary to make sure that all companies operate in a sustainable way. [57]

62 NATIONAL ECONOMY

Diaspora management.

The network of emigrated Dutch people and/or Dutch people who live abroad part-time has a social and economic value that could be exploited to a higher degree. The same applies to foreigners who live in the Netherlands for all or part of their time, and who have a network in their home country. [110]

63 NATIONAL ECONOMY

Entertainment industry

The entertainment industry (trips, short holidays in the own country, foreign tourism) has a huge potential for expansion. Wealthy elderly people and Asian tourists are expanding target groups. Specific opportunities are: enhancing Chinese and Islamic attractions, country branding and the link with the unique Dutch scenery. [110; 130]

64 NATIONAL ECONOMY

Wellness

The attention to wellness is increasing. This branch, which offers many opportunities due to new values and the increased amount of spare time, can be used to attract tourists. [110]

65 NATIONAL ECONOMY

No use made of uniqueness Dutch scenery

The Dutch scenery is unique and offers a lot of variation on a small surface. This should be exploited much more to attract tourists, foreign, talented employees and (affluent, creative) retired people. [110]

66 COMMUNICATION

Creative industry.

The creative industry is a rapidly growing sector worldwide in which the Netherlands plays an important role. An option is, for example, the further development of gaming. The government can work on links with education, country branding, science and technology communication, art and culture policy, improving the relationship between government and citizens, and other social objectives. 'Serious gaming' is hot. [121; 122; 167; 168; 169]

67 NATIONAL ECONOMY

New technical products and services

The Netherlands should translate scientific knowledge better and more rapidly into new products and services.

POLITICS/GOVERNMENT/LEGAL. In this domain, the political, administrative and legal opportunities are described.

68 INTERNATIONAL STATE SYSTEM

International 'government'

Many worldwide problems call for new international institutions and organizations. Some authors propose developing international networks that can tackle problems more quickly than is possible under current international treaties.

69 NATIONAL GOVERNMENT

Partnerships

Entering into partnerships with companies and NGOs is necessary to solve complex

social problems. Companies, for example, are able to quickly distribute successful educational reforms internationally. Governments that act as co-producer in technology developments (e.g. infrastructure) are thus better able to realize social interest. Is this a means for resilience, ambition and creativity? [57]

70 NATIONAL GOVERNMENT

Combating the cheating culture

The rise of the cheating culture can be combated by reinforcing a system of supervision based on professional standards instead of controlling quantitative parameters. The advantage of this approach will be that labor becomes a greater source of fulfillment. Auditing is to be organized differently. In addition, management is no longer to focus solely on output in figures, but to pay attention to the integral work process so that acting in a professional way becomes the standard again.

71 INTERNATIONAL STATE SYSTEM

Political role for the Netherlands

Connectivity with Europe and focus on other countries and cultures is relatively great in the Netherlands. As a result, the transition to a European identity is easier to make than for other European countries. The Dutch can play an important political role in Europe. Other advantages are: familiarity with other countries because of traveling, studying and work placements and an averagely in-depth knowledge of other languages. The various 'colors' in the Netherlands offer opportunities in this context. [110]

72 NATIONAL

Combat terrorism and criminality creatively

In combating terrorism and crimes like drug trafficking strategies that focus on the wider psychological and economical causes of these activities, might be more effective and rewarding than military or judicial approaches.

73 NATIONAL

Customization in the legal domain

In the legal domain, much more variation and customization is possible. New forms can be inspired by the Middle Ages, when each city applied its own specific form of law and jurisdiction. of drugs. This robs criminal organisations of a major source of income.

Appendix 5

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Other sources not explicitly cited, were (implicitly) used in countless deliberations and discussions with experts and sounding board members. These can sometimes be found in the various interim products of the horizon scan, such as the cluster document, the essay volume Polar bear plague in the Veluwe. Essays about the future, news reports, columns and notices placed on the horizon scan and COS websites.

These sources were used and analyzed to a greater or lesser extent and played a role at some point. The common characteristic is that knowledge about this is broadly diffused among individuals; even those involved sometimes experienced it as generally known.

These sources can be divided globally into a few categories:

- » books from the World Future Society's top 100, the key technology studies done by DG Research of the European Commission, the Sigma Scan of the Joint Doctrine and Concept Center (JDCC) of the British Ministry of Defence;
- » the COS library;
- » de 'classical studies' in future research (Facing the Future van de Interfutures Study

- » Group from the OECD, the BTV's of the WRR, the Club of Rome, Töffler's Future Shock);
- » methodological analyses and commentaries on future research (for example, 'Restored honour for Cassandra', R. in't Veld) ;
- » Countless relevant and sometimes prominent studies and commentaries of recent publication date, especially from the specialized databanks of British and other foresight organisations (for example, those of the European Foresight Monitoring Network; this has played a special role in the identification of problems and opportunities).
- » Innumerable specialized websites with databanks, overviews and monitors regarding all sorts of future directed topics or those oriented around problems and opportunities (think of databases for all sorts of catastrophes);
- » Future studies and prognoses of Dutch organizations such as CPB, CBS, KNMI, RPB, NMP, ROA, Shell, as well as a diversity of foresight studies done by the sector councils themselves;
- » Future studies and prognoses carried out by various international organizations (OESO, ESF, IPTS, EU, UN);
- » Countless articles in a broad range of research journals (for example De Ingenieur, published by KIVI/NIRIA) and media reports (both paper and digital);
- » Innumerable studies and individual productions of Netwerk voor Toekomst Verkenners (Network of future forecasters) members (a society);
- » The so-called gray literature (working papers and studies by future researchers and research organizations);
- » Literature (various future novels and essays; Aldous Huxley, George Orwell, H.G. Welles, Orson Welles, Isaac Asimov);
- » Also popular science fiction (books, films, television series such as Star Trek, Raumschiff Orion, Star Wars, Dune, Blade Runner).

As an example of such implicitly used literature and knowledge, excerpts from the bibliography of 'read/studied' sources from a member of the group that carried out the scan follows:

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- » Concept-manuscripts/working documents of dr. H.L. Jonkers (related to each other)
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- » Grote vragen, de nieuwe eeuw tussen hoop en vrees (Big questions, the new century between hope and fear), Bas Heijne (2006)

Appendix 6

Card game

The group game is played with two or more (up to five) people. The card game contains three kinds of cards: problem cards, opportunity cards and task cards. Make three decks with the cards. Each pile should be well shuffled. The game centers on the task cards and the players' creativity and inventiveness in thinking up surprising solutions, combinations and answers.



Player 1 picks a task card and carries out the task, followed by the other players. After each task is carried out, the player puts all the used cards in three separate piles of problem, opportunity and task cards, but not before other players also have the opportunity to give their own answers to the task.

The goal of the game is to make creative and unexpected connections between the arbitrary problems and opportunities that a player draws.

When all the task cards have been used, the game begins again. There are no winners or losers.

Examples of tasks are:

- » Take three opportunity cards. How do the opportunities change each other?
- » Take an opportunity and a problem card. Make up relations between the two cards.
- » Take five problem cards from the problem card pile. What happens if these five problems occur at the same time? To which opportunities would this give rise?
- » Take an opportunity card and reformulate the described opportunity as a problem.
- » Take four problem cards. Which problems strengthen each other?

- » Take an empty card and write a problem on it that you find very interesting. Next take a card from the opportunity and problem piles and list the possible connections for each.

In combination with the tens of problem and opportunity cards, there are many possible combinations of problems and opportunities that influence each other and produce much material for discussion, as well as many surprises in relation to finding challenging solutions and answers to the tasks.

For your convenience, the text of the playing cards on page 41 was translated.

For example for Basic facilities:

COMMUNICATION

P31

Digital gap

Though ICT communication technologies are even invading far-flung territories, there is great concern that a digital gap will arise. The most important reason for this concern is the increasing importance of connection to the international economy.

INFECTIOUS DISEASE

P13

Infectious diseases form a continual threat, especially for dense and contact-rich populations

Between one quarter and one third of all deaths worldwide are caused by infectious diseases. New epidemical diseases constantly appear and germs seem able to develop resistance to medicine. The evolution and mutation of disease causes and dispersion mechanisms form a threat for humans, agriculture, livestock and fish breeding in all countries.

ECONOMY

P63

Insufficiently prepared for the new economic world order

The rise of new super powers is predicted. Potential candidates are Japan, Brazil, Russia, India and China. Are we entering the Asian century? The position of the Netherlands needs to be reconsidered and achieved. Some traditional markets will disappear. Is the Netherlands sufficiently prepared for changing economic relationships?

Task card

11

Take three problem cards. How do the problems connect to each other?

Appendix 7

Alternative 'State of the Nation' Address

Waar zou de troonrede eigenlijk over moeten gaan? De werkgroep Horizonscan, met als leden hoge ambtenaren, mensen uit de wetenschap en het bedrijfsleven, probeert in deze troonrede een toekomstvisie te ontwikkelen. Voorzitters van de groep zijn Koel in 't Veld (bijzonder hoogleraar organisatiekunde aan de Universiteit van Amsterdam) en Hans van der Veen (directeur Stichting Toekomstbeeld der Techniek). De rede die op Prinsjesdag wordt uitgesproken kan afwijken van deze tekst.



Leden van de Staten-Generaal,

This article appeared previously in the 'Opinion and Debate' section of the NRC Handelsblad, 16 September 2006.

Members of the States General,

Together with us, the Queen of the Netherlands, you have agreed that the monarchy is no longer constitutionally relevant. Now that our power is gone, our freedom has grown, so that I can express myself in the singular. Solving some issues takes a lot of time. The reproach is often heard that the periodic elections within a parliamentary democracy lead to short-sighted decision making. Politicians are said not to look beyond the next election, where they receive their rewards or 'just desserts'. This reproach strikes me as only partly true. Politicians reflect the voters' time horizon. If voters want politicians to consider the interests

of their grandchildren, the time horizon of politicians will immediately expand accordingly. Still I wish that we would look beyond what is immediately before us. Various images of the future are sketched in novels, screenplays and religious documents.

This seldom leads to certainty about the future. The most important lesson we can draw from these predictions is that we should meet uncertainties with flexibility. I will mention a few important developments and dilemmas that I want to bring to the attention of both those alive today and a few generations to come.

The mood in this country reaches us via the media. What is uncertain is whether the media register this atmosphere or indeed creates it. If they only register it, the optimism that is noted today is a manifestation of what was concretely experienced last year. Balance is difficult to find; hysteria is always waiting in the wings in the Netherlands. But there is also a more restful image: even if we are mostly Europeans, we – as Dutch – have our own identity of which we can be proud. During my many state visits I noted that many have great admiration for our country. The Netherlands wins prestigious prizes in architecture and design. Dutch disk jockeys are among the best in the world, just as choreographers from the Nederlands Danstheater and the artistic direction of the Nederlandse Opera. The 'Randstad' (the area that stretches between and includes Amsterdam, Utrecht, Rotterdam and The Hague) is a globally admired phenomenon. The Netherlands is a pack leader in the area of development cooperation and agriculture. Along these lines, 'care tourism' is new: hundreds of care farms already exist in our country where 'burnt-out' managers can stay. Because of our attractively cool climate and unique landscape, we can easily make these facilities into high quality locations for 'care tourists' from around the world. Our identity is fragile. Let us proceed carefully without falling into nationalism. In this globalizing and, yet, localizing world, it is important to make our strong points visible. This gives the economy, trade and tourism a boost. The Dutch are creative and good at improvising, a characteristic that inhabitants of the rising economies of Asia frequently miss. The prizes won by the Netherlands are mostly won by designers. They seem pre-eminently able to forge social and technological dimensions together. In order to bring the natural and social sciences together, we need educational programs to which this combination is central.

We tend to speak about education in the Netherlands primarily in economic terms. Education is thus an investment in future human capital. This approach focuses our attention on the relation between education and the labor market. But we risk weakening education's cultural dimension thereby. Developing talent does not only lead to gains in the labor market. It raises

the quality of life. What one notices in the Netherlands is that time spent at school is long, while many schools are becoming socially isolated. This isolation seems both unnecessary and undesirable to me. Making use of available new technologies raises the variety of learning and lessens dependency on a single location. Children already learn more outside than in the classroom. This raises the question whether future schools will be in a building or whether they will be composed of a network of relations spread throughout the entire society. Such a scenario envisions teachers and practical advisors collaborating in study centers, businesses and laboratories furnished with advanced technology.

Ageing is seen as a problem in the Netherlands. What bothers me about this is the internal contradiction of the government's stance. On one hand senior citizens hear that their contribution as workers is wanted because of scarcity in the labor market. On the other hand, they are often sent home in practice. In the past few years it is the government that has provided us with the worst example. Tens of thousands of healthy civil servants have been prematurely let go – with quite ample pensions, it is true, but also with the message that they are no longer wanted. Political lamentations about the costs of ageing continue while senior citizens are not generally the sick and the needy, as they once might have been. They are better educated than previously, are well travelled and richly experienced. We should not forget that they have experienced great changes that are historically unique. Old age continues to be accompanied by infirmities, but now also material and – especially – immaterial wealth. The great advantages of a grayer society remain under-emphasised. Rather than speak of the burden of ageing, I speak of the silver generation that offers us great opportunities. The new doyens have employable money and time on their hands. This makes them a meaningful social and economic factor. It is a shame if senior citizens move to the Mediterranean and spend their money in foreign countries because they no longer feel welcome at home. Our society continues to need the presence of a large enough labor force. I support the analysts who conclude from this that we should establish a generous immigration policy and welcome many young workers, though I understand that many politicians have chosen a different direction.

Many fear that the rising costs in the health care sector are caused by the growing longevity of older people. But this fear is unfounded. The rising costs are only minimally caused by ageing. Rather it is largely new treatment methods and new medicines that are responsible for an increasingly larger percentage of GNP going to the health care sector. A wealthier society simply spends more of its income on care. New technologies enable us to make diagnoses at an earlier stage. This leads to an emphasis on prevention, changing lifestyles and individu-

alized medicine. People will live longer and have a better quality of life in the future. This has major consequences for the economy. Economic growth does not always mean good mental health. Both physical and mental welfare are important production factors. Costs will move to a great extent from care to prevention.

Scarcity of natural resources, water and energy is a much-discussed topic. The increasing global shortage of natural resources, water and energy will soon lead to economic depression, war, disease and death – in the Netherlands as well. Scarcity arises partly from the exhaustibility of supplies, but mostly because natural resources are not fairly distributed. This unfair distribution leads to international political tensions. The Netherlands must continue to work toward strong international political alliances and trade relations. But this is not enough. Great efforts are needed now and in the future to conserve our resources. Our country has developed a strong economic position by being frontrunners in the development of creative substitutes for scarce materials. Sustainability is an important criterion here: the increasingly difficult availability of materials and natural resources must be coupled with renewable alternatives. Let us place solar panels on every house and along every railway. Let us call on farmers to grow nettles for the textile industry, and fishermen to engage in algae production to feed cattle!

The risk of dying from infectious diseases seems to be growing, not only in developing countries, but here as well. Viruses are increasingly capable of infecting animal disease carriers and hosts, including humans. They sometimes evolve more quickly than medical science can develop vaccines. Extensive urbanization of nature areas, the intensification of agriculture, poverty, globalization and climate change all raise the risk of new diseases – diseases that can spread more quickly than we can stop them. Thanks to increased air traffic, viruses can spread around the world in a matter of hours. The global rise in temperature allows mosquitoes with malaria, yellow fever and dengue fever to spread to regions where they previously could not survive. It is only a question of time before a pandemic breaks out. Only careful governance can provide for adequate research, timely notification and appropriate measures.

In the future science will be able to manipulate and change human beings. Implantable chips that repair paralysis and vision, chips and dosage systems that allow for medical monitoring, genetic manipulation to combat threatening viruses and cancer – these are all things that are already possible. Possibilities will only grow in the future. Extending a healthy life through genetic intervention sounds far off, but it can become reality more quickly than

we think. This could lead to a fit population that can continue to contribute longer to the labor process. Ageing takes on a positive and economic significance in such a context. But the question here is whether we want this. To what extent do we want to allow these manipulations and developments? Many people fear these technological developments. Where is the boundary of intervention? Privacy, moral values and security can come under pressure by medical monitoring, genetic manipulation and DNA research in which insurance companies are interested.

Robots and smart, interconnected systems will – more than we suspect – play an increasingly important role in our lives. Isaac Asimov's 'nanites'— intelligent robot ant repairers – are closer than you think. The global application of intelligent apparatus will have major consequences for our entire lives. Robots that can carry out human tasks as well as we, can be frightening. Will robots afford people the chance to live more individualistically? Will we lose our sense of human involvement if robots take over care duties? Might we cease to be needed? Or will a major change occur in the labor market that moves people into positions of oversight and development? And what will we spend our days if we are no longer needed at the office, on the assembly line, in the work place or the operation theatre?

Concern is justified about how little we have learned from the past regarding poverty, repression, armed conflict and peace missions. The Netherlands has always had a great reputation for finding new and creative solutions in the field of development cooperation. But during my trips abroad in recent times, I have been asked more and more questions about the Dutch position on supporting foreign aid. Are we really directing ourselves toward the future? Do we know what sustainable urbanization entails? I believe not. More than a billion people already live in slums.

In this changing world we have to make our choices carefully. We need to ask ourselves what new technologies have to offer and which problems might arise – not only now, but in fifty years as well. We will thus have to invest in future directed research, not only regarding technical aspects, but especially regarding the social scientific, cultural, political and ideological aspects of technological developments. But beside problems, opportunities also exist for the Netherlands to play a meaningful economic role in these developments.

The Netherlands is full, not with people, but with rules and institutions. This makes many people anxious. Loosening up and relaxing are thus very important for the future. Trusting in society's ability to regulate itself is strange to many politicians. They believe that new is-

sues require new policy. But that is less the case than ever before. Society itself possesses sufficient flexibility. The business sector and NGOs try, often through extra-political channels, to construct flexible concepts for sustainable development that can help avoid catastrophes. These are often highly admirable actions, though I cannot evaluate whether they have found the best solutions.

I thank you for this opportunity to share my reflective experiences with you in this future-directed speech. I have been far from complete, but have chosen topics based on my passion and knowledge. I do not say that I know the right way. For me it is enough if you discuss what I have said at birthday parties. And that you tell me your opinion. For I can learn from your reactions. They will inspire me for next year. Nonsense is of no value, even if it is royal nonsense.

Appendix 8

Web response

Explanation

You find first a description of what was understood under the rubrics 'importance' and 'plausible'. Then come overviews of the evaluated opportunities and problems. The highest and lowest ten are always marked. Via the numbers assigned to opportunities and problems, one can see precisely which opportunities and problems are referred to in the list.

The scores listed below refer exclusively to the evaluations of website visitors. Most visitors only evaluated a few hypothetical opportunities and problems – those which they found of most interest.

Importance

How important do you find attention to a problem or opportunity? You can choose from a scale of 1 to 5 for each problem and opportunity. The score 1 stands for not plausible/important, 5 for very plausible/important.

This much used categorisation of values can be used as an aid;

24. Biological values. This concerns such topics as survival, safety, health and living as long as possible.
25. Economic values. This concerns national prosperity, incomes and material facilities.
26. Social values. This concerns welfare. Social relations between people are important here.
27. Solidarity, mutual respect. Values such as independence and autonomy are also included here.
28. Democratic values. This concerns equality, freedom of speech, faith and the right to participate in the governmental decision-making process.
29. Ethnic and religious values. Values that can be attached to a specific belief and that indicate what is good to do. Animal rights and the intrinsic value of nature also belong here.

Plausibility

To what extent do you consider it possible that a particular problem will occur or that an opportunity will actually arise? In other words, how plausible or believable is the proposition? You can choose from a scale of 1 to 5. The score 1 stands for 'not plausible/important', 5 stands for 'very plausible/important'.

PROBLEMS		NR	Plausibility	
Important average	N		N	average
4,27	22	1	22	4,14
3,11	18	2	18	3,17
3,21	19	3	19	3,53
3,39	18	4	18	3,06
2,88	17	5	17	3,24
4,17	18	6	18	3,67
3,83	18	7	18	3,39
2,83	18	8	18	2,89
3,24	17	9	17	3,29
3,67	18	10	18	4,06
3,53	19	11	19	3,63
2,35	17	12	17	2,65
3,56	18	13	18	3,56
2,76	17	14	17	2,88
2,33	18	15	18	2,61
3,00	19	16	19	2,00
2,22	18	17	18	1,78
1,68	19	18	19	1,16
3,33	18	19	18	2,89
3,32	19	20	19	3,79
2,95	19	21	19	3,42
3,00	19	22	19	2,84
2,89	18	23	18	3,50
2,79	19	24	19	3,21
2,84	19	25	19	3,63
3,21	19	26	19	3,26
3,00	18	27	18	3,56
3,53	19	28	19	3,79
3,12	17	29	17	3,06
3,47	19	30	19	3,68
2,56	18	31	18	2,33

■ = Highly valued

■ = Poorly valued

PROBLEMS				
Important average	N	NR	N	Plausibility average
3,06	18	32	18	2,56
3,76	17	33	17	3,82
2,76	17	34	17	3,41
2,47	17	35	17	3,00
3,39	18	36	18	3,39
2,88	16	37	16	3,00
3,61	18	38	18	3,61
2,71	17	39	17	3,12
2,76	17	40	17	3,18
3,50	18	41	18	3,72
3,06	18	42	18	3,44
2,75	20	43	20	3,60
2,75	16	44	16	2,56
3,39	18	45	18	3,78
3,26	19	46	19	3,79
2,53	17	47	17	3,35
2,63	19	48	19	3,32
1,94	18	49	18	3,11
3,89	18	50	18	3,56
3,35	17	51	17	3,24
3,38	16	52	16	3,31
2,79	14	53	14	3,43
2,67	15	54	15	3,13
3,47	15	55	15	3,47
2,87	15	56	15	3,20
2,50	14	57	14	3,21
2,07	14	58	14	2,93
3,21	14	59	14	3,57
2,58	19	60	19	2,95
3,50	16	61	16	3,81
2,71	14	62	14	3,07
3,18	17	63	17	3,59

■ = Highly valued

■ = Poorly valued

PROBLEMS				
Important average	N	NR	N	Plausibility average
3,50	14	64	14	3,86
3,35	17	65	17	2,76
2,93	14	66	14	2,50
3,46	13	67	13	2,77
3,47	15	68	15	3,33
2,86	14	69	14	2,93
3,80	15	70	15	4,00
2,33	15	71	15	3,27
2,92	13	72	13	3,38
3,14	14	73	14	3,71
2,25	12	74	12	2,67
2,42	12	75	12	3,25
3,92	13	76	13	3,23
3,33	12	77	13	3,62
3,54	13	78	13	3,54
3,42	12	79	13	3,69
3,43	14	80	14	3,71
3,07	14	81	13	3,38
2,92	12	82	12	3,00
3,09	11	83	11	2,82
3,00	12	84	13	3,00
2,83	12	85	12	2,58
2,42	12	86	12	2,75

■ = Highly valued

■ = Poorly valued

Important		PROBLEMS		Plausibility	
average	N	NR		N	average
3,00	13	1		13	3,77
3,08	13	2		13	3,38
2,73	11	3		11	2,73
3,45	11	4		9	2,89
3,20	10	5		10	3,50
3,42	12	6		12	3,42
3,82	11	7		11	3,45
3,73	11	8		11	3,55
3,38	13	9		13	2,46
3,27	11	10		11	3,00
3,58	12	11		12	3,17
3,82	11	12		11	3,64
3,00	11	13		11	3,27
2,82	11	14		11	3,09
2,08	12	15		11	1,82
3,82	11	16		11	3,64
3,08	12	17		12	2,92
2,58	12	18		12	2,92
3,67	12	19		12	3,58
3,00	13	20		13	3,62
3,18	11	21		12	3,67
4,00	10	22		11	3,45
3,82	11	23		12	4,00
3,60	10	24		11	3,45
2,62	13	25		13	3,46
3,83	12	26		12	3,83
3,67	12	27		12	4,08
4,25	12	28		12	3,17
3,33	12	29		11	3,18
3,42	12	30		12	3,42
3,36	11	31		11	3,00
3,25	12	32		12	2,67

■ = Highly valued

■ = Poorly valued

PROBLEMS					
Important average	N	NR	Plausibility N	average	
3,36	11	33	11	2,91	
3,62	13	34	13	3,46	
3,67	12	35	12	4,08	
3,33	12	36	12	3,75	
3,67	12	37	12	3,75	
2,82	11	38	11	2,91	
2,91	11	39	11	3,27	
3,45	11	40	11	4,18	
3,18	11	41	11	3,73	
3,64	11	42	11	2,73	
3,55	11	43	11	3,18	
4,18	11	44	12	3,33	
3,00	10	45	10	2,70	
3,45	11	46	11	3,64	
3,45	11	47	11	3,55	
2,55	11	48	11	2,27	
4,00	10	49	10	3,30	
3,82	11	50	11	3,00	
3,55	11	51	11	2,91	
3,70	10	52	10	3,60	
3,40	10	53	10	3,80	
3,27	11	54	10	4,30	
3,50	10	55	12	2,58	
3,22	9	56	9	2,56	
3,70	10	57	10	3,00	
4,36	11	58	11	3,36	
4,00	9	59	9	2,89	
2,90	10	60	10	2,90	
3,44	9	61	9	2,89	
2,50	8	62	8	2,25	
2,82	11	63	11	3,18	

■ = Highly valued

■ = Poorly valued

PROBLEMS				
Important average	N	NR	N	Plausibility average
2,90	10	64	10	4,00
3,00	10	65	10	3,70
3,13	8	66	8	3,75
4,20	10	67	10	2,90
3,60	10	68	10	2,60
3,40	10	69	10	3,10
2,50	10	70	10	2,80
3,20	10	71	10	2,60
2,67	9	72	9	2,44
2,88	8	73	8	2,25

■ = Highly valued

■ = Poorly valued

Appendix 9

Evaluation by sounding board group members

Explanation

Selection of highest/lowest ten problems and opportunities. Scores from sounding board group members. (Note that absent members of the sounding board group submitted their evaluations via the website. It is also the case that some of the problems and opportunities were not evaluated by any members.)

Explanation

The following ranking is based on scores given by members of the sounding board group at a session held on 23 October 2006.

They were asked to evaluate all the problems and opportunities by ascribing (subjective) values to their plausibility and importance. It should be clear that individuals might have interpreted these terms differently, just as when one person associates the term 'tree' with an oak tree while another person associates it with a pine or palm tree.

The score 1 stands for 'not plausible/important', the 5 for 'very plausible/important'. Below you find an overview of the ten most and least plausible as well as important problems and questions.

Ranking Problems' Plausibility

Most Plausible:

Problem	Description	Average score	N
1	No robust strategy against the consequences of climate change	4,14	22
10	Scarcity of fossil fuels	4,06	18
70	Development of Africa and other barely developed countries	4,00	15
64	Problems surrounding globalisation	3,86	14
33	Exhaustion of energy sources	3,82	17
61	Changes in value systems	3,81	16
46	The engineerable human	3,79	19
28	Inadequate vision of epidemics and shortage of vaccinations	3,79	19
20	Increasing obesity and overweight	3,79	19
45	New risks, ethical issues and social problems	3,78	18

Least Plausible:

Problem	Description	Average score	N
12	Disturbances in fertility	2,65	17
15	Exponentially increasing space debris	2,61	18
85	Worsening of public services	2,58	12
44	Diminished trust in science	2,56	16
32	Pressures on water supply	2,56	18
66	The Netherlands has fallen asleep	2,50	14
31	Digital gap	2,33	18
16	Collision with an asteroid	2,00	19
17	Gamma ray bursts	1,78	18
18	Contact with space aliens	1,16	19

Ranking Problems' Plausibility

Explanation

The following ranking is based on the scores of members of the sound board group who attended the session of 23 October 2006 and those of website visitors.

They were asked to evaluate all the problems and opportunities by ascribing (subjective) values to their plausibility and importance. It should be clear that individuals might have interpreted these terms differently, just as when one person associates the term 'tree' with an oak tree while another person associates it with a pine or palm tree.

The score 1 stands for 'not plausible/important', the 5 for 'very plausible/important'. Below you find an overview of the ten most and least plausible as well as important problems and questions.

Most Plausible:

Problem	Description	Average score	N
1	No robust strategy against the consequences of climate change	4,27	22
6	Worldwide water shortage will lead to political instability	4,17	18
76	Political unrest	3,92	13
50	Inadequate educational level	3,89	18
7	Flooding of rivers and sea	3,83	18
70	Development of Africa and other barely developed countries	3,80	15
33	Exhaustion of energy sources	3,76	17
10	Scarcity of fossil fuels	3,67	18
38	Under-investment in vital infrastructure	3,61	18
13	Infectious diseases form a continual threat, especially for densely populated areas whose inhabitants come most in contact with diseases and their causes	3,56	18

Least Important:

Problem	Description	Average score	N
18	Contact with space aliens	1,68	19
49	Economic models	1,94	18
58	From standard biography to a biography of choice	2,07	14
17	Gamma ray bursts	2,22	18
74	Dutch family companies	2,25	12
15	Exponentially increasing space debris	2,33	18
71	Financial scandals in the business world	2,33	15
12	Disturbances in fertility	2,35	17
75	The cheating culture	2,42	12
86	To much expected of the market	2,42	12

Ranking Opportunities' Plausibility

Explanation

The following ranking is based on the scores of members of the sound board group who attended the session of 23 October 2006. They were asked to evaluate all the problems and opportunities by ascribing (subjective) values to their plausibility and importance. It should be clear that individuals might have interpreted these terms differently, just as when one person associates the term 'tree' with an oak tree while another person associates it with a pine or palm tree.

The score 1 stands for 'not plausible/important', the 5 for 'very plausible/ important'. Below you find an overview of the ten most and least plausible as well as important problems and questions.

Least Important:

Opportunities	Description	Average score	N
71	Political role granted to the Netherlands	2,60	10
68	International 'government'	2,60	10
55	Europe's cultural ambition	2,58	12
56	New forms of solidarity	2,56	9
9	More directed exploitation of wastelands	2,46	13
72	Combating criminality creatively	2,44	9
48	Positive psychology	2,27	11
73	Made-to-order services in the judicial domain	2,25	8
62	Diaspora management	2,25	8
15	New functions for outer space	1,82	11

Most Important:

Opportunities	Description	Average score	N
54	Active retirement	4,30	10
40	Robotization	4,18	11
35	Converging technologies	4,08	12
27	Interconnectivity	4,08	12
64	Wellness	4,00	10
23	Automated assistance to support health care	4,00	12
26	Preventative medicine	3,83	12
66	Creative industry	3,75	8
1	Climate change	3,77	13
53	Ageing – the 'silver fleet'	3,80	10

Ranking Opportunities' Importance

Explanation

The following ranking is based on the scores of members of the sound board group who attended the session of 23 October 2006 and those of website visitors. They were asked to evaluate all the problems and opportunities by ascribing (subjective) values to their plausibility and importance. It should be clear that individuals might have interpreted these terms differently, just as when one person associates the term 'tree' with an oak tree while another person associates it with a pine or palm tree.

The score 1 stands for 'not plausible/important', the 5 for 'very plausible/ important'. Below you find an overview of the ten most and least plausible as well as important problems and questions.

Ten Least Important Opportunities:

Opportunities	Description	Average score	N
38	CT for improving outcomes of group and social processes	2,82	11
14	Building underground	2,82	11
3	Tides, waves and declining sea level	2,73	11
72	Creatively combating criminality	2,67	9
25	'Care' tourism	2,62	13
18	Modern crafts	2,58	12
48	Positive psychology	2,55	11
70	Combating the cheating culture	2,50	10
62	Diaspora management	2,50	8
15	New functions for outer space	2,08	12

Ten Most Important Opportunities:

Opportunities	Description	Average score	N
58	Hydrogen-based economy	4,36	11
28	Robust strategy for energy facilities	4,25	12
67	Taking advantage of scientific knowledge and technological trends	4,20	10
44	Developmental biology for fundamental understanding of diseases	4,18	11
59	Employment possibilities at all levels of education	4,00	9
49	Education system that can keep up with the global growth of knowledge	4,00	10
22	New means and systems of transportation	4,00	10
26	Preventative medicine	3,83	12
50	Creativity in education	3,82	11
23	Automatische hulpmiddelen Support for health care	3,82	11

Appendix 10

Polar bear plague in the Veluwe essays

- » Introduction, summary and conclusion by Roel in't Veld en Hans van der Veen,
- » With essays offering recommendation for various subjects by creative scientists, publicists and politicians:

Spatial planning: The Promised Land,

Ir. Joost van Kasteren is an independent science journalist and writes for, among others, the NRC Handelsblad, Trouw, De Ingenieur en Natuurwetenschap & Techniek;

Infrastructure: the power of the metaphor, The Netherlands as the center of trans-national infrastructure systems,

Drs Judith Schueler works as manager of foresight studies at the Netherlands Study Center for Technology Trends (STT) and directs the foresight study of European infrastructure networks;

Energy: My mother's century,

Prof. dr. Coby van de Linde is director of the Clingendael International Energy Program. She is professor of 'Geopolitics and Energy Management' at the University of Groningen en member of the General Energy;

Robotics: What opportunities do robots and intelligent apparatus offer?

Dr. ir. Remke Klapwijk worked while writing her Horizon Scan essay for the COS and

Drs. Victor van Rij works since 2003 as senior advisor for COS foresight studies and as national coordinator of the ERA Net ForSociety that bundles nineteen national foresight study programs of fifteen European countries;

Technology and democracy,

Drs. Siegfried Eschen MPA is policy coordinator at the Ministry of Justice's Strategy Development Department;

Economy: toward a new world order – between dream and nightmare,

Prof. drs. Paul Rademaker became project professor of 'World Problems' in 2006 at the University of Amsterdam's Institute for Interdisciplinary Studies (IIS). He is chairman of

the Club of Rome Netherlands and of the Network for Foresight studies (NTV);

Capitalize on Conflicts,

Prof. dr. Gerd C.A. Junne is professor of International Relations at the University of Amsterdam and director of The Network University (TNU);

Conflict management: exporting mediation,

Drs. Anne Slootweg (1981) worked between July and December 2006 for the NGO Pax Christi (now IKV Pax Christi)

and

Drs. Johan te Velde has worked as team leader of the Africa and Latin America department at IKV Pax Christi since 1 January 2007, when IKV and Pax Christi joined forces;

Education and labor market: investing in the future,

Prof. Dr. Wim Groot is professor of health economics at the University of Maastricht and co-initiator of the NOW priority program "SCHOLAR" (Schooling, labor market and economic development) at the University of Amsterdam

and

Prof. dr. Henriëtte Maassen van den Brink is professor of economics in the Economics Faculty, University of Amsterdam and dean of the Amsterdam School of Economics (ASE);

Globalisation and health: a new plague or sustainable future?

Prof. dr. Pim Martens is professor of Sustainable Development and director of the International Center for Integrated assessment and Sustainable development (ICIS; <http://www.icis.unimaas.nl>) at the University of Maastricht;

The engineerable and self-mutating human

Drs. Ron Hendriks holds a number of positions on the Oversight Boards of various care facilities. He is also a member of the Steering Group for Generic Medicines and advisor to the Asian Development Bank;

Ageing lives: opportunities and choices in an ageing society,

Drs. Frank Heemskerk was a member of the lower house of the Netherlands' Parliament from 30 January 2003 to 22 November 2006, for the Labor Party (PvdA).

Appendix 11

Criteria for identification of problems and opportunities

During the first selection of subjects from the future literature, subjects were chosen that the literature indicated would have a great impact on our future society. It wasn't a question of establishing scientific truths but of identifying claims made by various authors regarding future threats, problems and opportunity-rich developments (in science, for example). Because weak signals were also consciously sought, controversial subjects (about which opinions seemed strongly divided) were also selected.

For determining impact, special attention was paid to (indicated) impact on the following dimensions:

1. *Biological dimension*

Is there indication of a direct/indirect positive or negative effect on survival opportunity, health and/or the life expectancy of humans and/or the ecological system?

2. *Social dimension*

Is there indication of a direct/indirect positive or negative effect on social cohesion, prosperity and welfare of individuals, mental health, etc.?

3. *Economic, financial dimension*

Is there indication of a direct/indirect positive or negative effect on the economic base, growth of prosperity, financial possibilities?

4. *Governance-judicial dimension*

Is there indication of a direct/indirect positive or negative effect on the legal basis of our society, the democracy, maintenance of human rights?

5. *Cultural, ethical and intellectual dimension*

Is there indication of a direct/indirect positive or negative effect on society's cultural and intellectual development, on cultural and religious freedom?

6. *International relations*

Is there indication of a direct/indirect positive or negative effect on the development of geo-political relations?

For many of the selected subjects, impact on more than one dimension is indicated; it is evident that a tsunami or a hurricane will not only cause great financial damage but also kill people and influence the life expectancy of survivors (through the occurrence of diseases, etc.). In the long term yet other effects appear. Given its enormous impact on a number of dimensions, it is evident that the subject in question deserves a place on the list.

But also the recognition that the media's privatization and monopolization can threaten the democratic decision-making process is a subject that deserves to be included. The fact that a subject is chosen does not mean that the makers of the Horizon Scan support the proposition, but only that the proposition in connection with those that surround it deserves attention in discussions and further research regarding the future.

Appendix 12

Sources of illustrations

Cover:

Image of the RI-MAN care robot.

Permission for use given by the Public Relations Office of the Bio-Mimetic Control Research Center (www.bmc.riken.jp), RIKEN (www.riken.jp). *RI-MAN exhibits the skill and ability to realize human care and welfare tasks.*

Other photographs

Pg 20: diptych

- » Achterbergh, Ronald (Miami Metroline train approaches Civic Center station)
- » Verlaan, Bernard (Bridge over the Sund between Denmark and Sweden)

Pg 23: diptych

- » Coumans, Michel (Strontvlieg)
- » Wikipedia, Dutch language, under 'kakkerlak' (cockroach).

Pg 26: four photos

- » RIKEN, image of the RI-MAN robot. Permission for use given by the Public Relations Office of RIKEN (www.riken.jp). For more information about the robot, see http://www.bmc.riken.jp/~RI-MAN/index_us.html.
- » OPTE, image of internet traffic on 23 November 2003. The colours represent the sender's country characteristics. (<http://www.opte.org/maps/>).
- » www.NewsAtSeven.com: Avatar-newsreader... is a system that automatically and independently collects, organizes, edits and prepares (person-specific) news to be read by an avatar. (Such avatars are used in a number of situations, such as to provide sign language translations for transmissions. The avatar teachers are called respectively Baldy and Andy.)
- » Honda's robot Asimov. English language Wikipedia, under 'robot'.

Pg. 29-30: four photos

- » Achterbergh, Ronald (Downtown Miami, Doclands London)
- » Coumans, Michel (Estate near Almelo, Sittard Municipal Park)

Pg 31: Diptych

- » Verlaan, Bernard (Building and great hall of the European Parliament)

Pg 32: Vitruvian Man

- » Wikipedia (Dutch site, under 'Leonardo da Vinci')

Pg 34: Collage Seniors' World Championships

- » Based on a selection of internet results
 - Acrobatics: http://www.gymmedia.com/ac/events97/wm_manchester.htm
 - Curling: <http://www.Thistlecurling.ab.ca/wsc2007/>
 - Canoeing: http://kanuwm.de/index.php?option=com_content&task=view&id=26&Itemid=51
 - Pentathlon: http://www.pentathlon.org/fileadmin/download/pressrelease/pr16122006_EB_meeting_Berlin.pdf
 - Roller Skating, Artistic: http://www.2007worlddartchampionships.org.au/pdf_lib/05_11-10_11_Senior_provisional_program.pdf
 - Chess: <http://www.chess-worldseniors.austria2007.com/engl.htm>
 - Fencing: <http://www.olympics.org.uk/eventscalendar.aspx?event=1730>
 - Tai Kwon Do: <http://www.aitf.com.au/aitf/content/view/15/36/>
 - Wrestling: <http://www.fila-wrestling.com/baku07/index.php?lang=en>
 - Sailing (Lasers): http://www.laserinternational.org/ILCA%20events/Worlds/worlds_index.htm

Pg 49: in section 'robotics'

- » Robot Asimov; Dutch language Wikipedia, under 'Asimov'

Report from the COS(Consultative Committee of Sector Councils for research and development: <http://www.cos-toekomstverkenningen.nl>). The organisation of sector councils is intended to cover the following sectors:

- » nature, environment and spatial planning (RMNO)
- » green space and the agro-cluster (Innovation Network-NRLO)
- » health care (RGO)
- » development cooperation (RAWOO)*
- » technology and technique (STT) and
- » traffic and transportation (Connekt).

The COS is a platform for cooperation between the sector councils and the Netherlands Study Center for Technology Trends (STT), established by article 12 of the Sector Councils Framework Act, promulgated in 1987. COS members are knowledge network organizations that carry out foresight studies, based upon which strategic knowledge questions are formulated that contribute to research-programming and policy. Sector councils are composed of representatives of government, society, the business community and science. They bring the government, knowledge world and society together.

The structure of the organization of advice councils is under reconsideration since 2006.

* now defunct.

