Joint horizon scanning: identifying common strategic choices and questions for knowledge

Victor van Rij

Over the past decade, horizon scanning has been recognised as part of forward-looking government processes in a number of industrialised countries. It helps policy-makers in addressing the diversity of future societal and environmental challenges and in addressing the potential of emerging areas of science and technology in an integrated way. This paper discusses the usefulness of horizon scanning as an additional tool for future-oriented technology analysis activities, such as technology foresight and scenario building. Analysing the national horizon scans of the UK, the Netherlands and Denmark in a joint horizon pilot project initiated under the ERA-Net ForSociety, this paper makes a series of recommendations regarding horizon scanning processes at the national level and the construction of common future-oriented policies.

I N 2004, THE ERA-NET FORSOCIETY[1] began its mission to develop sustainable cooperation between national foresight programming bodies in 15 European countries. One of the aims of this network was to initiate joint transnational (foresight) activities which combined the foresight activities of at least 3–5 of the foresight programming bodies. To achieve this a pilot project, the *Joint Horizon* project was launched, focused on assessing the feasibility and desirability of joining the individual horizon scanning activities of the participating countries (the UK, Denmark and the Netherlands).[2] Since these activities share and are characterised by their broad scope, it was envisaged that it would be less difficult

to create a joint approach in contrast to foresight activities with a more specific focus. This paper makes a detailed comparison of the experiences of three countries,[3] and discusses amongst other topics the usefulness of horizon scanning as an additional tool to set the agenda for more specifically focused foresight activities and other future-oriented technology analysis (FTA) tools.

What is horizon scanning?

The word *scanning* usually refers to a repeated and systematic observation of a space or a body, which is meant to distinguish and locate phenomena that for some reason need to be watched more closely. It is frequently used in warfare to develop early warning for attacks (radar, sonar scans) but also in medicine, where it can be used to locate infected tissues or malignant cancer (nuclear magnetic resonance, ultrasound etc.). In business management the term environmental scanning is used to refer to the systematic observation of developments that present either threats or opportunities for the business. These may take place in the immediate business (or transaction) environment, but may also be broader social or regulatory trends.

There are many descriptions and definitions of *horizon scanning* in use. Here we give one based on definitions used in different horizon scanning programmes in the UK and the Netherlands.

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Horizon scanning is the *systematic* examination of potential (future) problems, threats, opportunities and likely future developments, including those at the margins of current thinking and planning. Horizon scanning may explore novel and unexpected issues, as well as persistent problems, trends and weak signals. Overall, horizon scanning is intended to improve the robustness of policies and to identify gaps in the knowledge agenda (this definition has been derived from the UK Foresight Horizon Scanning Centre (HSC) and Horizon Scan Netherlands),

Horizon scanning is also: looking *ahead, beyond usual timescales (as far as we can see)* and *across disciplinary and departmental borders (cutting across different policy domains)*, seeking out alternative sources of information and challenging implicit assumptions about the future that underlie today's decisions (UK HSC).

It distinguishes itself from more thematic and science and technology (S&T) foresight and other FTA tools by its wide scope and its function to envisage the complexity of future societal problems and the variety of opportunities and instruments that may be used to resolve or prevent these problems or to diminish the negative impacts of these problems. Horizon scanning does not replace the more focused FTA activities but can be considered highly supportive of them because it may be used to select and scope the themes that have to be examined in more depth with other FTA tools. In addition, it gives direct input for policy options, debate and research agenda setting by revealing new angles and relations, knowledge gaps and potential hazardous or promising developments

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Characteristics of government horizon scanning

An analysis of different horizon scanning exercises and descriptions highlights the following characteristics:

- A *systematic process*, which is designed to give a comprehensive picture of relevant future issues for an actor (or a set of actors), to support strategic considerations, decisions and actions. In general, this means that the future horizon is divided up into *a set of categories* that serve as coordinates (in parallel with the spatial coordinates used by radar and other scanning techniques), covering the area that is to be scanned.
- A focus on all signals that might have *significant impact* on the strategic missions and *underlying values* of the actor(s).
- *No particular time frame* (try to look forward as far as we can see or imagine), and the deliberate inclusion and recognition of *weak signals*.
- There is deeper analysis of weak signals and of the *possible interaction of all scanned issues* and their relevance for strategic decision-making.
- A *repetitive character*: since the horizon reveals more details each year, it is necessary to repeat the scan to see what has changed. Not only on the far horizon, to search for new emerging issues, but also to check whether and how phenomena that were observed at an earlier stage are developing over time.
- *Participation* and involvement of societal and government stakeholders, not only during the collection of data, but also to guide the interpretation and synthesis of data and to create support for the *implementation of results.*

Who engages in horizon scanning?

Horizon scans are initiated and used by different private and public organisations, mainly for strategic reasons. Most of the broader governmental horizon scans were initiated by ministries of defence or their agencies (Development, Concepts and Doctrine Centre, 2006; Defence S&T Agency Singapore, 2009; Spring *et al.*, 2007; Quiggin, 2007). Other examples were initiated by ministries or departments, such as the Department for Environment, Food and Rural Affairs (DEFRA) in the UK (DEFRA, 2006), the Ministry of Economic Affairs of the Netherlands (Ministerie van Economische Zaken, 1998), the French Department of Transport and Maritime Affairs (Direction générale de l'Industrie, des Technologies de l'information et des Postes, 2000) and of Industry (Ministère de l'Écologie, de l'Energie, du Développement durable et de l'Aménagement du territoire, 2006). Horizon scanning also appears in departments of health (and ageing), e.g. in New Zealand, Australia[4] and Canada,[5] but these scanning activities seem to have a very limited scope (only assessing new health technologies). Departmental

horizon scans can be narrower in scope (only looking for new technologies), but tend to have a much wider scope if they focus on security, environment or the economy.

Horizon scanning on the national level, across all policy areas (including S&T opportunities) is a recent development and is still relatively rare, but fits well with the observation that there is an increasing need for more holistic approaches to informing strategic decision-making (e.g. environmental scanning, trend monitoring, trend research and strategic early warning (Schwartz, 2006; 2008).

The Government Office of Science in the UK started its national horizon scanning in 2004.[6] This activity covers a wide range of S&T forecasts (Delta Scan) and future developments across all policy domains (Sigma Scan).[7] In the same year, the Netherlands[8] started a national horizon scanning activity that covered a wide range of (potential) future problems, threats and opportunities in all policy domains (societal sectors) and in S&T. Denmark started a horizon scan process in 2006, focusing on the societal needs of the future and emerging S&T. NISTEP (2005) in Japan executed a scanning-like activity during 2005, which covers expectations across a wide range of societal areas and provides a broad scan of S&T developments and opportunities. The NISTEP exercise combines this broad-scope foresight with a thorough analysis of strengths and weaknesses of Japanese research and development (R&D), and connects this to emerging challenges. An increasing number of countries in Europe are considering undertaking horizon scanning activities in the near future like Malta, Norway, Belgium and Switzerland (Habegger, 2009) while other countries are building up scan-based policy documents (Finland (Academy of Finland and TEKES, 2006)*,* Canada (Smith, 2006) or have recently carried out scan-like exercises that were solely used to design foresight programs (Germany and France)

Scans that were initiated by public bodies and government were usually carried out by special units and/or councils and agencies. Most of these scans targeted a wide variety of users (policy-makers, researchers, consultancies, enterprises, departments etc.).

Nongovernmental organisations have carried out both narrow and broad horizon scanning, even at a global level. Well-known examples include the International Council for Science (2002) exercise that focused on societal issues and research agenda setting and also its foresight analysis (International Council for Science, 2004). A more recent case is the Horizonscan of the Environment Research Funders' Forum in the UK (Environment Research Funders' Forum, 2007). The exercise of the High-Level Expert Group on Key Technologies for Europe[9] can also be considered a horizon scanning exercise, but with a scope that is more directed towards technology. The Euro-scan[10] is also worth mentioning as an example of a scan with a more focused character (new health technologies).

Why join and compare horizon scanning?

The rationale for joining and comparing horizon scans lies in the expectation that the sum of the scans may reveal issues that have been overlooked in the separate national scans. It was also hoped that the comparison and the exchange of experience and know-how would be useful in strengthening the national scans and create more insights into their many purposes.

Finally, we are persuaded that horizon scanning gives us a tool to create a *common understanding and shared awareness of a wide variety of future problems, threats and opportunities (PTOs)*, often originating in areas of activity or parts of the world that are ignored by mainstream media and generally under-researched which might have a significant impact on our future way of living and which need to be incorporated in our deliberations to develop robust (resilient and adaptive) shared strategies including joint research programmes.

Methodology

The objectives of the joint horizon scanning pilot were mainly to:

- exchange experiences and know-how on horizon scanning at the national level;
- compare basic data (lists of issues and issue descriptions) from the horizon scans of the UK, the Netherlands and Denmark;
- develop a model for continuous data sharing and comparison;
- compare working methods and methodologies used by the different horizon scans and formulate recommendations for improvement; and
- formulate recommendations for the development of international cooperation in horizon scanning, including how it can be used.

Exchange of experiences, know-how and comparison methods

Descriptions of horizon scanning processes in a number of countries were collected and discussed during a workshop with external experts. Where necessary, additional information was requested from representatives of the partners in the project. In this way information was gathered not only about the rationales for national horizon scanning, its goals, positioning and design, but also about the premises and values that were taken into account for the identification and prioritisation of the issues collected by the scans, and the ways in which the scan data were used.

Table 1. Main categories used in the different scans

Categories		
Netherlands	**UK**	**Denmark**
• Social context	• Society (including public services)	• Culture • Work life • People
• R&D and education	• S&T	• Development
• Economical context/finance	• Economics	• Economy
• Physical environment	• Environment	• Nature • Resources
• Political, administrative and legal	• Politics	• State • Global
• Public services		

Joining up the data

To compare the data of the different scans and create a common corpus for further analysis a joint database was developed on basis of the Sigma Scan of the UK Foresight HSC. This database was adapted to incorporate the data from the Danish and Netherlands horizon scans.

Comparison of the scan data

The comparison of data was based on the data of the UK HSC Sigma Scan[11] and Delta Scan[12] as published on the internet, and the data in the report on Denmark (OECD, 2007) and the Netherlands' Horizon Scan Report 2007 (In't Veld *et al.*, 2008).

To facilitate the comparison, some re-labelling of the categories that were used was necessary (see Table 1). From these categories[13] we derived the following set of main categories:

- society (including demographical issues) without public services;
- S&T (including S&T policy);
- economy and finance (including its governance);
- environment (ecological); and
- politics and public services.

Although some issues could be placed in two or even three categories, it was not difficult to label the majority of issues according to these main categories that are nearly identical to the themes as used in the STEEPV approach (see Loveridge, 2002).

For further comparison and analytical reasons, these main categories have been given a completely new set of subcategories based on the different sets of subcategories that were used in the UK and Netherlands scans (see Table 2). A number of issues could be placed under several of these new subcategories. These issues were noted during the process of comparison. These categories were principally used to compare the issues. They were neither used to create a new taxonomy, nor to draw any conclusions on how the subcategories should be weighted.

Analysing data

Data were compared on the subcategory level. An attempt was also made to select some *issue clusters* with estimated high impact to investigate the usefulness of joint horizon scanning as preparation for more in-depth foresight to design common policies and research programming on strategic challenges and questions within these issue clusters.

Preparing further cooperation and joint activity

To prepare further cooperation, a network of ForSociety partners was established including some external organisations that had shown interest in the concept of government-initiated horizon scanning. A

Table 2.

Subcategories				
Society	**S&T**	**Economy and finance**	**Environment (ecological)**	**Politics, government, public services**
Social values	S&T reflection	Market	Hydrosphere	Legitimacy-democracy
Demographicsl	S&T policy - governance	Labour	Geosphere and landscape	Law and legislation
Life styles – families	Psychology	Finance – tax	Atmosphere	Security
Labour – leisure	Physics		Outer space	Health system
	NBIC			Educational system
	Nano-tech and science			Agri-food supply
	ICT mathematics			Infrastructures
	Mathematics			Armed forces
	ICT			
	Geology			
	Engineering			
	Economics			
	Chemistry			
	Biology			
	Medicine			

first discussion with this network was held in March 2007 and a second in October 2007. The possible use of the horizon scan data at the European Commission (EC) level was discussed in interviews with representatives of different directorates within the EC.

Results policy impacts and implications

Comparison of national horizon scans

Rationales for governmental horizon scanning All three scans can be considered as very broad-scope foresight processes that look well beyond the present-day horizon for new emerging challenges for society, but also for promising opportunities, some of which may originate in new or emerging S&T findings and insights. All the scans are designed to generate themes and questions that cross policy domains and research disciplines, meaning they may play a useful role in informing research agenda setting. In the case of the Netherlands and the UK, the aim was also to influence the framing of policies into a more future-oriented mode, and to encourage more resilient policy-making. UK horizon scanning and foresight are explicitly aimed at developing resilient policies that are adaptive to changing and uncertain futures. In addition to the scanning and foresight, there is a large effort to spread good practice to other parts of government and society. In the Netherlands the aim is to contribute to the future orientation of policies towards sustainability, not only in the economic and environmental sense, but also in different other societal value dimensions (health, longevity, human rights, social cohesion, law-based democratic society, international relations etc.).

Horizon scanning can therefore be seen as an adaptive foresight (Eriksson and Weber, 2006) instrument that deliberately challenge policy-makers to look at the uncertainties and the unexpected and develop resilient policies towards sustainability. Governments use horizon scanning to:

- Widen the scope for policy- and decision-makers (by supplying systematically gathered and analysed data on opportunities, challenges and options) to provide the basis for resilient and (where

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appropriate) cross-departmental policies. Policy-makers are encouraged to expose their analysis to possible future trends to prepare themselves better.
- Alert policy-makers to forgotten and emerging (new) risks and opportunities, to provoke reflection and further investigation of the uncertainties, to challenge dominant, implicit assumptions about the future.
- Stimulate decision-makers and their staff to use horizon scanning in decision-making on different levels, to broaden their thinking, and to envisage the future in a more systematic way.
- Identify new challenging issues for policy, research, development and innovation.
- Identify knowledge gaps (relevant for resolving future problems or for exploiting potential opportunities).
- Identify possible inter-linkages (enhancers, inhibitors, multipliers) between future issues (from different parts of the horizon) with a potentially major impact.
- Identify new transdisciplinary and sets of issues which cross policy domains for further focused foresight (improving the scoping of these foresight activities) and research.
- Deliver input to research and innovation, policy, public debate, and departmental policies, particularly on the strategic level.
- Deliver information to a diversity of societal actors which for instance could be used for setting priorities for future investments but also for initiating public debate.

Development of the national horizon scans

Data collection All three scans were developed in phases. In the first phase, issues were collected from a variety of (future) literature and the internet and through consultation with experts (workshops, interviews etc.). In the UK scan, experts were asked to write brief papers on the selected issues to deepen the contents; these essays were then published in the Sigma and Delta Scan databases. In the Netherlands, papers were drafted after *issue clusters* had been developed using creative group thinking exercises. The issues in the OECD scan were first drafted by OECD staff, then amended by the DASTI, and further used as input for prioritisation discussions in expert and user panels in Denmark.

The gathering of data for the UK Sigma Scan was facilitated by Outsights-Ipsos MORI, while the Delta Scan of the S&T developments was carried out by the Institute for the Future. After the issues had been selected, experts were asked to write synthesis papers, based on a number of cited evidence sources, to explore each issue, including its implications.

The primary data for the Danish scan were delivered by the OECD International Futures Programme Unit with support from DASTI, which adapted the issue descriptions to the Danish situation after

discussions with representatives from different ministries. The primary data for the Netherlands scan were collected by the COS Horizon Scanning team and discussed with expert panels.

Within the UK scan and the Netherlands scan, attempts have been made to rank the issues according to estimated overall impact (on implicit or explicit values, see section on 'Premises and values for identifying and filtering issues' below) and likelihood by inter-subjective judgement. In the Dutch scan as well as in the UK scan, networks of future analysts were used to support the scan as a permanent sounding board.

Once complete, the UK horizon scans were published on a public internet site (see Notes 11 and 12). The Netherlands horizon scan was published on an open internet site (see Note 8) at an early stage of the project, giving all visitors the opportunity to contribute a new issue and/or to comment and assess the published issues with regard to their plausibility and impact (taking into account the sustainability dimension). At the end of the 2007 round, the issues were published in a final report. After completion, the data in the OECD–DASTI scan were published on the OECD website.

Principal use of the scan data The UK horizon scan (see Figure 1) has tended to be used as part of a client-oriented project approach, where the starting point is a client (for example, a government department) reflecting on its strategic direction or policy. Part of the HSC engagement with the client will be an analysis of scan data (and data from other specialist sources) relevant to the client's policy domain. Depending on the issues encountered in this analysis, workshops may be organised with different stakeholders, providing a broad range of inputs to the policy and creating relevant new networks that cross not only policy domains but also scientific disciplines. The involvement of client departments and their own future analysis is considered to be mutually advantageous: such contacts have been encouraged by the formation of a network of future analysts (FAN club). In this way, the future-oriented approach is disseminated through the whole of the government system, as well as the scientific community and society.

In the Netherlands the approach used can be described as the cluster approach (see Figure 2). This started with the assembling of clusters of issues with potentially impact-rich interactions. Clusters were developed in creative sessions with a wide variety of stakeholders. After completion, clusters that cover a variety of policy domains and scientific disciplines were forwarded to some essay writers. Essays and cluster descriptions are seen as a potential input to further, more focused foresight and the formulation of recommendations for research and policy. Next to this, a more client-oriented 'scan proof' approach was developed and implemented for some clients on the regional level. Furthermore, it was expected that publication of the issue lists on the horizon scan website would have the effect of raising public awareness of the issue.

In Denmark, the scan issues were used as input for the selection of prioritised research themes in a four-year cycle of research funding (see Figure 3). The scan data were used alongside the outcome of a public internet 'hearing' process that delivered an additional input of 366 proposals from the general
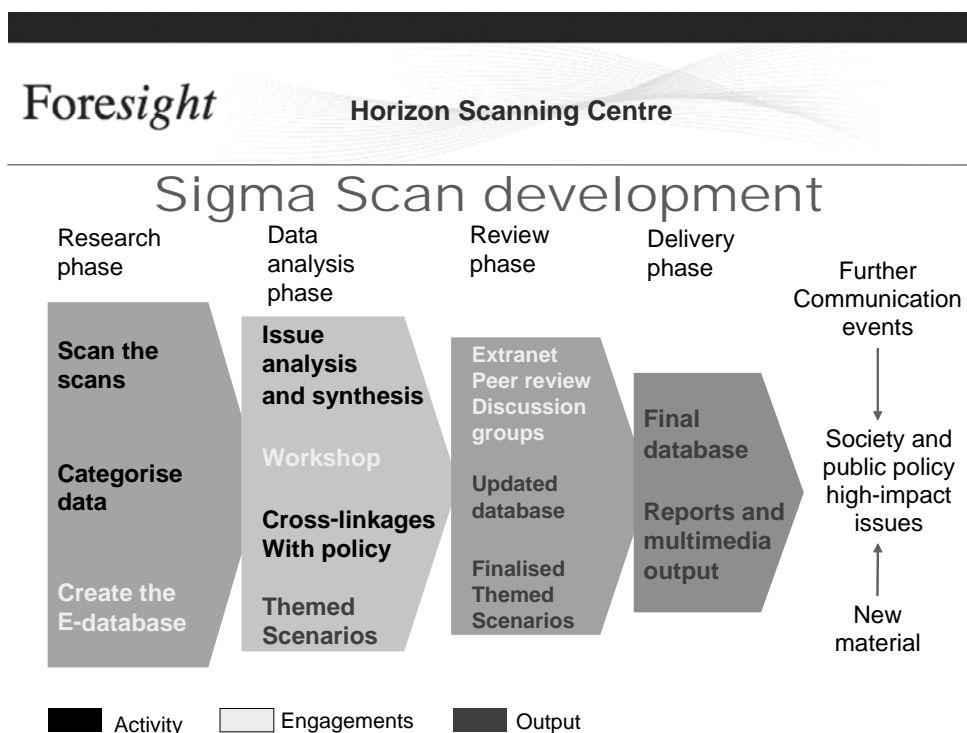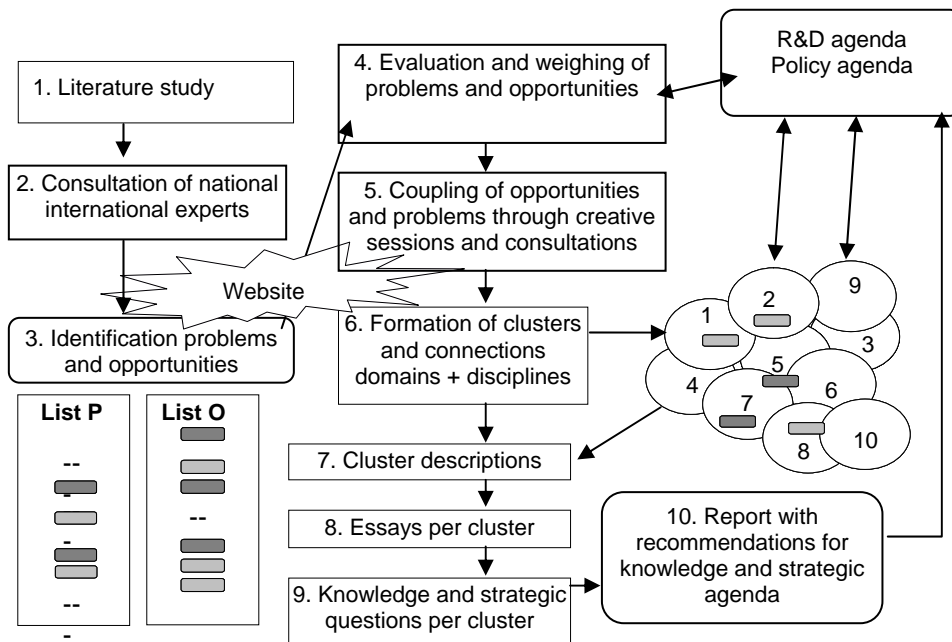

Figure 1. Schematic design of UK horizon scan

Figure 2. Design of the Netherlands horizon scan
Source: Allun Rhydderch

public, companies, researchers, universities and organisations. Preselection of prioritised themes took place within an expert group that delivered input for a workshop with a user panel, consisting of representatives from trade and industry, the public sector and civil society. The final selection of themes was made by a stakeholder workshop.

Premises and values for identifying and filtering issues

All horizon scans are based on broad and intensive literature surveys (including foresight, future studies and even science fiction) and panel groups.

Horizon scanning seeks to identify what in the Netherlands scan are described as potential PTOs and in the UK horizon scan are called issues. Horizon scanning is different from trend scanning (Rollwagen *et al*., 2007) in that it does not solely focus on

Figure 3. Design of the Danish OECD–DAST horizon scan
Source: Morton Wied

trends, but also on potential breakthroughs, analysis of risks, uncertainties and unexpected events that are considered as potentially disruptive in the future.

Issue (or PTO) selection is therefore based on likelihood and estimated impact on the future of our society. Every effort is made to avoid the influence of personal values and preferences and 'group think'. In all scans the issues were categorised to achieve a degree of comprehensiveness and to cover all policy domains and science disciplines. In all horizon scans, organisations and individuals were allowed to make contributions.

The focus of the UK scan is on 'public policy' (not explicitly government policy, although government is the main intended client). The UK effort has focused on drafting the issue papers in such a way that they present a balanced synthesis of the sources scanned (and referenced), so that any values (and biases) contained within the issue papers reflect those of the sources. The number of sources cited per issue paper (generally more than ten), and their diversity, are intended to reduce the risk of one strong viewpoint dominating.

The goal is to provide a reasonably objective basis for the necessary political process (consideration of options, consultation and debate) that will lead to implementable policies (policies that achieve government's goals while meeting society's expectations). In this way, the scans are positioned as part of the policy evidence base.

The Danish scan focused on the policy domains of all ministries and therefore implicitly took in all the values incorporated in the policies and services for which they are responsible. In the Netherlands scan, explicit attention was given to the sustainability of society in the light of different sets of shared societal values for which the government will be held

responsible, whatever its political constitution. Issues were selected on the basis of indications in the literature of either positive and/or negative impact on these values. This was also done for issues where authors had (very) different opinions.

These sets of shared values[14] are:

- biological dimension: quality of life, ecological quality (survival, health, longevity of (future) citizens, health of ecosystems);
- social dimension;
- economic financial dimension: economic quality (basis for other dimensions but also welfare creation, luxury, leisure, distribution of wealth) social quality (social cohesion in the present and in the future, eliminating poverty, mental health of (future) citizens);
- governmental dimension: juridical and democratic quality (rule and policy basis to realise other dimensions, constitutional state, equality of rights, sustain democracy, human rights);
- cultural, ethical and intellectual dimension: cultural, ethical and intellectual quality, stimulate cultural development and cultural expression as long as it does not interfere with other dimensions, increasing the intellectual level in service of the other dimensions;
- self-realization of (future) citizens (freedom of individuals and of religious and cultural expression); and
- stability of international relations (peaceful coexistence with the rest of the world).

Positioning of the scans

The UK HSC was established in 2005 with a central function to use horizon scanning and future thinking to inform the policies of (all) departments. It operates under the government's chief scientific adviser. Its goals are to:

- inform departmental and cross-departmental decision-making;
- support horizon scanning carried out by others inside government; and
- identify the implications of emerging S&T and enable others to act on them.

COS was the umbrella organisation of the so-called sector councils for R&D that were established by Dutch law during the 1980s to provide strategic knowledge questions for departmental policies in a number of policy domains (environment, agriculture, health, developmental policy and technology) and to establish the interface between policy, research and society. An important tool of these sector councils was participative foresight that developed over time and was used to influence decision-makers in government, research and society in a future-oriented setting. COS had the task of facilitating cross-departmental foresight and identifying

cross-cutting departmental themes; the horizon scan started in 2004 to guide this search in a systematic way. In 2007 the Netherlands government decided to abandon the system of 'sector councils' and to create new provisions within all ministries (so-called knowledge chambers). The horizon scanning task will be maintained and has been provisionally reallocated to the newly formed Knowledge Directorate of the Ministry of Education, Culture and Science.

DASTI is an agency of the Danish Ministry of Science, Technology and Innovation that aims to promote research and innovation of a high international standard for the benefit of Danish society, facilitating development in economic, cultural and social respects. The horizon scan was mandated by the Danish parliament in 2006 to feed directly into the research agenda setting. Since this research agenda setting has a long cyclic character it has not yet been announced when another round will be organised.

Impact

Although there are many unresolved methodological difficulties in assessing the impact of foresight (Barre and Keenan, 2006), also due to more general problems around the interaction of scientific advice, government and society (De Wit, 2005) it is clear that horizon scanning is seen as a valued but also vulnerable learning process (DEFRA, 2006) which seems to be embedded in important decision-making processes in at least three European countries.

For the OECD–DASTI horizon scan it was clear from the beginning that the results of the scan would be used as an important input for the process of prioritising new research themes for the Danish four-year cycle of the research funding councils, which is acknowledged in the research 2015 document (Danish Ministry of Science, Technology and Innovation, 2008) that sets the stage for research prioritisation in Denmark for the coming four years in a clear relationship to the challenges facing Danish society in the future. In addition to this we may assume that the process which contained many experts and stakeholders will also have indirect impacts among this group.

Within the Netherlands the preliminary results of the horizon scan (COS) were also used as input for the strategic planning and prioritising of research by the National Funding Agency (see Netherlands Organization for Scientific Research, 2006). The process involved many stakeholders who have been influenced by the discussions and issues that were selected. After the report was published the horizon scan team was approached by a number of organisations and regional and local communities that asked for help and/or cooperation in the area of horizon scanning and development of future strategies. There was also some attention in the press, especially on the topic of robotics which was pushed forward as a typical cluster where no main stakeholder could be found. The report contained recommendations for

specific foresight activities which still have to be executed. The disappearance of the COS and reallocation of the horizon scanning task creates a new situation that should lead to a more effective positioning of the horizon scanning task.

The UK horizon scan has a more continuous character due to its recognised central task and its strong networking capacity in the UK government and futures community, which is strongly supported by the so-called FAN club that the HSC established to support horizon scanning activities in government and elsewhere. Here also, the processes involve many people and institutions that are certainly influenced by the future-oriented project work and the material provided by the scans. The launch of the scan data was well covered by the UK and some international press. Several departments are now initiating their own horizon scanning projects.

Joint database

A joint database has been established containing 430 issues of which 159 are from the Netherlands horizon scan, 125 from the Danish scan and 146 from the UK scan. The distribution of the issues over the different categories in each scan is shown in Table 3.

Analysis of the joint data

Although all scans covered all STEEP domains, the Netherlands scan contained significantly fewer issues in the societal domain and the Danish in the S&T domain than the others. In all scans we can observe that the level of abstraction (or granularity) that was used to describe the issues differed slightly between the scans. Despite this, the data can quite easily be compared at the revised subcategory level. This comparison led to the conclusion that the scans contained many similar issues that were closely related that were taken up in all three scans (or at least in two). Some issues only figured in one scan sometimes because they were specific to the country undertaking the scan.

The main conclusion is that the joint scan offers additional material that could be used by each national scan. It is expected that widening the cooperation may reveal more issues of high impact that are overlooked in the scans that are now combined, especially if data can be incorporated from scans developed by countries on the other side of the world, at different stages of economic development or with contrasting political (and geopolitical) systems. Such different perspectives may contribute enormously to understanding our own place in the future.

Further development of the joint horizon scan

On the basis of the experience of the pilot joint horizon scan and discussions within the established network of interested organisations and interviews with representatives of different directorates of the EC, a proposal for further development of the joint horizon scan has been developed within the ForSociety Network (van Rij, 2008). This proposal suggests developing a network of countries and EC-level organisations that have performed horizon scanning (or similar activities) in the past or are planning to carry out horizon scanning (or similar activities) in the future. The function of this network will be the exchange of experience and know-how, but also to combine or link all scan data in one central database that will be used to develop proposals for joint foresight on common themes (through EC and other projects), provide feedback on the national scans, and lead to the joint development of methodologies for using and carrying out the scans.

Discussion and conclusion

All three scans delivered issue lists which overlapped considerably but which were also complementary. This means that cooperation might be rewarding to improve the scanning images for each country but also that the shared scan data provide a common basis for further joint foresight to develop joint research programs and even policies.

Overall we conclude that horizon scanning as performed in the three cooperating countries is a powerful tool which can be used for different purposes such as R&D agenda setting and the development of more resilient policies. It provides a rich source of

Table 3.

Category	% of issues in Sigma (UK horizon)*	% of issues in OECD–DASTI (DK-horizon)	% of issues in COS (NL-horizon)	% of issues in all scans
Society	18.5	22.4	**7.5**	15.6
S&T	16.4	**8.8**	15.1	13.7
Economy/finance	21.2	21.6	18.9	20.5
Environment/ecology	13.7	15.2	23.3	17.7
Politics/public services	30.1	32.0	35.2	32.6
Total number of issues	146	125	159	430

Note: * in addition to the Sigma Scan the UK HSC also executed the Delta Scan, which contains about 100 S&T issues, the comparison shows that the Dutch scan somehow seems to fall short on issues from the society domain

weak signals and wild cards that may be used to assess the robustness of results that may come from other forward-looking tools as planning, scenarios and quantitative modelling. Therefore, horizon scanning is highly complementary to these tools.

The fact that the horizon scans considered here were developed for different purposes illustrates their versatility as a policy- and research-informing tool. To complement their increasingly acknowledged role in persuading policy and research teams to think more broadly, openly and strategically, it would now be helpful to establish clearer guidelines for their application, including a robust methodology so that their effectiveness could be properly evaluated. The purpose of such guidelines would not be to limit their use to one particular context, but to clearly distinguish the different ways in which horizon scanning in relation to other tools might be used in different contexts, and what it can (and cannot) deliver in each case.

Cooperation

The use of joint scan data at the European level could offer a useful way of addressing the complex challenges the world and Europe are facing, and merits further attention which hopefully will be provided by projects such as the Far Horizon project that was recently approved by the EC and which will focus on the use of scan data to address particular challenges that were indicated in the EC's World 2025 exercise (Fauroult, 2009).

At the same time, the content of the joint scan could be progressively enhanced by a network of European (and non-European) countries that regularly perform horizon scanning, and countries and organisations that contribute relevant data and expertise. This network would then be available to policy groups within the EC (and other international groups), who might wish to use it to inform their strategic decision-making processes.

The network should not only deliver a joint scan base to serve national and EC policy and research, but could also serve as a platform for exchanging experience and addressing methodological questions relevant to horizon scanning such as the role of values (prevention of biases), the identification and significance of faint or weak signals and wild cards, how to deal with complexity, the learning function of horizon scanning, stakeholder participation and how to increase impact. The EC recently approved different blue sky projects that focus on these questions like the Citizen Visions on Science, Technology and Innovation project that focuses on the involvement of civilians through horizon scanning driven public debate (CIVISTI),[15] the Searching Emerging Science and Technology project (SESTI)[16] and the I-KNOW project that both focus more on new methodologies to identify and interpret weak signals and wild cards. We can glimpse the methodological questions that need to be answered in the sections below.

Weak signals, wild cards and stakeholder involvement

In all scans questions arose regarding the ways in which stakeholder (or public) involvement in the initial phase could be improved. In the UK scan and the Netherlands, thought was also given to the way in which the number of entirely new issues and weak signals could be increased. New approaches were therefore being considered to boost stakeholder and public involvement, by for example the use of blogs and Wikipedia-like structures, and web-bots for information gathering these approaches will play an important role in the blue sky projects that have already been mentioned in this paper.

Supporting evidence and issue description

Another common question concerned the high level of aggregation of the issues in the descriptions in the scan highlights the danger of superficiality. In the UK horizon scan expert essays were written to provide more depth. In future, the way forward may be to link the broad national scan with more in-depth departmental scans from other ministries or agencies. By connecting these more specific scans with more global scans, a complete picture could be established which may provide users with a broad strategic context at the top level, but also allow them to 'drill down' into more depth and evidence base where needed.

Finally, the handling of science issues in the scans requires a careful approach. This should balance the need for scientific scrutiny, making sure that existing scientific evidence is not overlooked or contradicted, with the need to point to potential future scientific developments for which by definition little (or no) authoritative evidence is yet available. The successful approach to this taken by the UK's Delta Scan was to seek the views of 250 leading scientists and members of the S&T community through an online Delphi-like survey facilitated by a wiki. It is important that, for the scans in general, differences of opinion (controversies even) are presented in the scans, along with the evidence each side draws on to make its case, rather than seeking to choose one view over another or to simply include views on which a consensus can be reached.

Complexity

It is clear that the issues identified in the horizon scans are very different in nature: they describe events or trends that are desirable or undesirable, likely to happen or unlikely to happen, possible to influence or inevitable. Furthermore, almost all issues may interact in a very complex way. The outcome of a scan therefore is almost as complex as the reality it reflects upon, its meaning lies much more in opening up minds and evoking important questions around the future than in providing clear-cut

answers (Medina Vasquez, 2006). Therefore the outcomes were always discussed in stakeholder and expert meetings either with regard to a specific policy need of a department (UK), or a research funding scheme (as in Denmark) or to identify new cross-cutting questions that need further forward-looking attention with other methods and transdisciplinary approaches (clusters of issues, as in the Netherlands).

Alerting function

The fact that some of the scan issues published in 2005 (e.g. risk of a financial crisis caused by poor lending practices and worldwide lack of governmental financial control)[17] became reality within a very short time frame highlights the value of referring to individual scan issues, even before they have been considered in combination with other issues in a group context. This alerting aspect makes it particular interesting to identify faint or weak signals for strong impact developments to come.

Embeddedness

In the UK the horizon scan is embedded in the strategic function of government and closely connected to the national foresight programme. In the Netherlands the function started in connection to the foresight function, while in Denmark it was a single exercise that may be repeated in the next planning cycle for the research agenda. It is recommended that horizon scanning is embedded and closely related to strategic functions and other forward-looking functions in which the horizon scan may be used as an indicator and scoping device for specific strategic forward looking activities (as scenario building, technology assessment and other foresight). By repeating the scanning on a regular basis more insight can be gained on the impact of these activities since it will give us a picture of what has changed in (our perception of) future issues over a period of time.

We can conclude with an example of an analysis by the joint scan. The growing energy demand and uncertainty in energy supply is not only related to the scarcity of some of these resources, but also to the widely assumed connection to climate change, the future technological possibilities and scientific breakthroughs (which all may lead to better ways for saving, transporting and producing energy using all thinkable resources), to our potential to change our way of living (behaviour) and to the geopolitical developments (energy demand of developing giant economies and tensions about distribution of scarce resources). This issue not only requires a transdisciplinary approach, but it also requires a policy that transcends several policy areas and the borders of countries. Joint horizon scanning could be used as a tool: to clarify the picture of the most relevant relationships in a shared process (with the involvement of

decision-makers) on a much earlier moment than usual when problems have accumulated this picture can be used to scope further (foresight) activities to align key stakeholders and to prepare the joint research, innovation programmes and common policies that will be required.

Notes

1. See <http://www.eranet-forsociety.net/ForSociety/index.html>, last accessed 1 June 2009.
2. This exercise was executed by a team of representatives from: the Danish Agency for Science Technology and Innovation (DASTI), the UK Horizon Scanning Centre, the Commissie van Overleg Sectorraden voor Onderzoek en Ontwikkeling (COS), the Malta Council for Science and Technology (MCST) and PREST (University of Manchester, UK).
3. The comparison is based on the given documentation, which was more limited for the Danish scan due to the fact that the Danish scan had a limited purpose.
4. Australia and New Zealand Horizon Scanning Network (health technology scan). Available at <http://www.horizonscanning.gov.au/>, last accessed 1 June 2009.
5. Canadian Agency for Drugs and Technologies in Health, Environmental Scanning Service. Available at <http://www.cadth.ca/index.php/en/hta/programs/horizon-scanning>, last accessed 1 February 2010.
6. UK HSC. Available at <http://www.foresight.gov.uk/Horizon%20Scanning%20Centre/index.asp>, last accessed 1 June 2009.
7. At the end of 2009 these scans were merged into one scan, which has kept the name Sigma Scan. <http://www.sigmascan.org/Live/>, last accessed 1 February 2010.
8. Netherlands Horizon Scan. Available at <http://www.horizonscan.nl/>, last accessed 1 June 2009.
9. Creative system disruption: towards a research strategy beyond Lisbon, Key Technologies Expert Group. Available at <ftp://ftp.cordis.europa.eu/pub/foresight/docs/key-technologies-report.pdf>, last accessed 1 June 2009. More information can be found at: <http://cordis.europa.eu/foresight/kte_expert_group_2005.htm>, last accessed 1 February 2010.
10. The European Information Network on New and Changing Health Technologies. Available at <http://www.euroscan.bham.ac.uk/index.htm>, last accessed 1 June 2009. (Now replaced by <http://www.euroscan.org.uk/>, last accessed 1 February 2010.)
11. UK Sima Scan. Available at <http://www.sigmascan.org>, last accessed 1 June 2009.
12. UK Delta Scan. Available at <http://www.deltascan.org/>, last accessed 1 June 2009.
13. It should be clear these categories are not entirely distinct. Many issues could still be placed under two and sometimes more categories.
14. It should be clear that the pursuit of all these values may create tensions because issues may cause very high positive impact on one or more of these values but at the same time very negative impact on one or more of the others.
15. See <http://www.civisti.org/>, last accessed 1 February 2010.
16. See <http://www.sesti.info/sesti/en/consortium-info>, last accessed 1 February 2010.
17. See threats number 67 and 65 on page 101/102 of the Netherlands Horizon scan report (In't Veld *et al.*, 2007). These issues were also published on the Dutch horizon scan website at the end of 2005.

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