



Scanning for Emerging Science and Technology Issues
The SESTI project is funded under the European FP7 and researches the application of weak signals and emerging issues for improving the anticipatory intelligence of the European Commission and the EU Member States on future developments and issues



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Background Paper for the SESTI Methodology Workshop 26th of October , Brussels

Scanning for early recognition of emerging issues; dealing with the unexpected, *An operational framework for the identification and assessment of new future developments*

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The project partners of the SESTI consortium are:

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- Dutch Ministry of Education, Science and Culture (MinOCW)
- JRC Institute for Prospective Technological Studies (JRC-IPTS)
- AIT Austrian Institute for Technology
- University of Manchester, Institute of Innovation Research (Mioir)
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Introduction

The SESTI project focuses on the new foresight approaches that can be used to identify “weak signals” and emerging issues in a systematic, efficient and effective way, it pursues their operationalisation by linking them in a meaningful way to policy processes.

The project aims therefore amongst others

- 1) To develop and evaluate different methods and approaches that can be used for the identification of “weak signals” to provide information for the policy community.
- 2) Set up a systematic monitoring approach for the identification of weak signals/emerging issues, including participation of stakeholders and the user community.
- 3) Development of a methodological framework that can be used in policy oriented initiatives on weak signals, leading to more synchronized approaches on national and European level. In this way, information on “weak signals” can be shared more easily.
- 4) Creating an efficient working tool to share information within the consortium but also for knowledge transfer to the wider community.
- 5) Identification and analysis of prioritized emerging issues on the “future of research”, that on one hand are not visible on the policy RADAR and have low probability, but on the other hand have high potential impact on occurrence.
- 6) Facilitating public (external) participating in the project, involving the user community to provide them with an ‘active’ stake in the project to ensure use of output and long-term success of the project.
- 7) Raise discussion on emerging issues at different levels, EU / national, as well as linking the actor communities comprising policy-makers, strategists and researchers at these levels.
- 8) Facilitate the use of the outcomes of the project at European and national level through involvement of relevant national and European actors.
- 9) Wide dissemination of project results (both on the future of research and “weak signals”) to potential users in policy, business and the research community.

This report gives a reflection of the internal discussions of the project team on the concepts and methodological approach to prepare the execution of the different work packages. It is the intention of the project partners to revise this report after completion of the project in the form of a scientific publication.

Background

Today, foresight and other forward looking activities are often used to initiate discussions in policy circles in order to better anticipate future opportunities and threats. These activities often are quite effective to clarify issues that are developing at present they are less effective in identifying emerging issues that are not yet on the policy radar. Recently certain events have had highly disruptive consequences for our society, but were not sufficiently recognized in the policy arena (e.g. credit crisis, 9-11). This highlights a growing need within the policy arena for the capacity/competencies and tools to identify these issues upfront. This would enable policymakers to anticipate these issues, and to take more proactive action in order to reduce negative impacts and/or enhance positive societal impact. This notion has become increasingly important, as the lack of anticipation leaves the policy arena with limited means of preventive measures. As prevention is almost always more efficient and more effective and safer than “cure” (or repair), the need for a *scanning mechanism* for early recognition to identify precursors of possible high impact societal changes is becoming more and more important. So the question is if there are ways to identify these *emerging issues* at an early stage, are there *early warning* that can predict these potential disruptive events? Such scanning activities should serve the purpose of getting prepared for possible changes. Events that seem to occur suddenly may actually (have) announce(d) themselves some time before. If these signs would have been detected and (correctly) interpreted, more time for preparation would have been available.

The SESTI project focuses on the development of a scanning *process* where the different concepts are combined in an integrated approach. Core to the SESTI approach is the aim of identifying emerging issues that can be of relevance to policymakers. The approach starts with the integration of the concept of early warning signals for the gradual identification of the emerging of issues.

This working paper to the SESTI project is aimed at making the concept *scanning for early recognition of emerging issues* more operational. The paper will be a key input for the SESTI Methodology Workshop which will be held on October 26, 2010. The Methodology Workshop will discuss scanning methodologies, the ways of integrating scanning into the policy arena and finally the SESTI scanning approach, which will be demonstrated in two Policy Workshops in late November 2010 with focus on Energy and Health sectors.

Overview of Scanning Concepts

The purpose of scanning for early recognition of emerging issues is not to produce a broad systematic overview of possible important issues, but to identify topics that are not yet on the policy RADAR and can have major impact on our society. Signals and related potential emerging issues are to be evaluated if they are important enough to be discussed by policymakers in a systematic way. Scanning for early recognition of emerging issues serves to attain different but complementary objectives, namely:

- To enhance resilient policy-making and address policy makers' needs and concerns regarding new issues they will encounter
- To identify business opportunities by anticipating consumer and societal needs
- To prepare society on less expected or rapid changes

In order to address these objectives through the Methodology Workshop, in this background paper we first provide a section on terminological clarification. Brief definitions of the following scanning concept will be given: Weak Signals, Physical and Social Early Warning Signals, Wild Cards, Hypes, Future Trends, Emerging Issues and Discourse.

Early warning signals¹

Early warning signals are the first important indications of a change. These may be understood as advanced, somewhat noisy and generally socially situated indicators of change in trends and systems that constitute raw informational material for enabling anticipatory action. Many times these signals are difficult to spot because they are indicating an unknown, unexpected or rare change which makes it hard to distinguish them as relevant. Therefore they are usually referred to as "faint" or "weak" signals. The benefits of early warning signals can be seen when assessing their significance in an organization or a field concerned and analyzing how the phenomena reflected by the early warning signals should be reacted on. There remains some confusion about the definition of early warning signals and related terminologies as faint or weak signals. Sometimes these terminologies are referred to as future oriented information, sometimes more like emerging issues. Hiltunen (2007) has tried to clarify the confusion about the weak signal definitions, by combining signal, issue and interpretation in the concept of the "future sign", which more holistically describes how these signals relate to change. Citing from Igor Ansoff, Hiltunen (2007)² provides a definition of weak signals as: "warnings (external or internal), events and developments that are still too incomplete to permit an accurate estimation of their impact and/or to determine their complete responses". Early warning signals are meaningful as long as they are evaluated in the context of both their emergence and their evolution as a part of a pattern along with other early warning signals. They do not exist in isolation.

¹ This section draws upon: Saritas, O. and Smith, J. (2010). The Big Picture – Trends, Drivers, Wild Cards, Discontinuities and Weak Signals, **Futures**, Accepted for publication.

² Hiltunen, E. (2007). "Weak Signals". Presentation given at the Finland Futures Research Centre. Available at: <http://www.slideshare.net/whatdiscover/weak-signals> (last visited on: March 14, 2009).

Physical and Social early warning signals³

In many human activities early detection of change is important either to grasp opportunities or to react adequately to upcoming threats. Therefore in many areas there is a need for signs that warn us for emerging changes for better and for worse which we call early warning signals. Usually these signs find their basis in experience or historical analysis of previous changes. The historical analysis tries to identify which abnormalities preceded the past event and applies correlative knowledge to diagnose future events. For instance, we can see in medicine that physicians learn to recognize early stages of skin cancer on basis of structure and color of skin before the disease really develops. Their knowledge to foresee this development is purely based on collective accumulated experience which is transmitted by education and training. Someone driving a car is alerted on strange noises that may disrupt the engine of his car. He recognizes these disturbing sounds either by education or by experience (with sound of ‘healthy, normal functioning’ and ‘disturbed’ engines). Airplanes have to stay on the ground if their skin shows microscopic cracks, since it was discovered through air crash investigations that these cracks are in fact precursors of sudden loss of strength of airplane skins. Besides these ‘Physical (observable) early weak signals’, we can also mention ‘Societal early warning signals’, which are produced by humans and therefore largely subjective and usually contain meaning or language. In many cases they are meant to be communicated, translated and interpreted even with the purpose to influence the future discourse. These signals may contain a rational factual basis coming from scientific communities, but they may also be signifying strong interests or emotions at the same time. These interests and emotional charges of signals are important aspects of their prospective significance. The societal signals may therefore be seen as intended or not intended precursors of self-denying or self-fulfilling prophecies.

Wild Cards and potential wild cards⁴

Wild cards involve relatively high impact but somewhat low probability events and situations that carry a lot of conditionality. They really are unlikely but if there is even a remote possibility, then that contingency needs to be accounted for. The following description provides perhaps the most relevant definition for purposes of the current paper: ‘Wild cards and shocks are those surprise events and situations which can happen but usually have a low probability of doing so - but if they do their impact is very high’. These situations tend to alter the fundamentals, and create new trajectories which can then create a new basis for additional challenges and opportunities that most stakeholders may not have previously considered or prepared for (Saritas and Smith 2010, p.6). Wild cards may be introduced into anticipatory decision-making activity in order to increase the ability of social groups to adapt to surprises arising in turbulent business or social environments. Such sudden and unique incidents might constitute turning points in the evolution of a certain business –social trend or system. Wild cards on one side refer to events that happened and on the other hand to phenomena that may happen in future which we could refer at as potential wild cards. The following can be given as Wild Card examples that happened: The French revolution, World War I and II, the Chernobyl accident, the Asian Tsunami, the falloff the Berlin wall or 9-11. (Potential) wild cards may be caused by physical events or phenomena that are already in the universe but out of our present sight (like an enormous solar flare, or asteroid impacts, earthquakes, pandemics or alien life) others may be caused by humans (Nuclear accident, terrorist attack, climate change etc)

Trends

³ This section draws upon Van Rij (2011), V. Building resilience, using horizon scanning, wild cards and early signals, ined Maria Giaoutzi

⁴ This section draws upon: Saritas, O. and Smith, J. (2010). The Big Picture – Trends, Drivers, Wild Cards, Discontinuities and Weak Signals, **Futures**, *Accepted for publication*. and Van Rij (2011), V. Building resilience, using horizon scanning, wild cards and early signals, ined Maria Giaoutzi

A trend can be defined as a general direction of development. Trends can be obtained through the extrapolation of historical data to the future by using statistical/mathematical models. Some examples are national economic developments (e.g. GDP), consumer preferences, jobs growth. However, the concept of trends is also used within the domain of fashion. Design trends are also already very visible, but are likely not to last that long and often coincide with business cycles. However things that may have looked like “mere fashion trends” in the beginning, e.g. “ecological living”, can develop into longer lasting trends. Essential to these trends is that they are extrapolation of historical data to future developments. Usually they are based on statistical information and are as such relatively predictable and predetermined.

Besides these currently visible trends it may be possible to observe developments that could become a future trend. From the view point of early recognition, it is worth considering how to identify possible emerging trends where there is little or no historical and current evidence. Organic food or alternative medicine that once started as ‘fringe choices’, for example, have already gained economic relevance and are not considered at something “exotic” anymore and thus can be considered as a historical example for the development of a trend. In this regard, these observations could be seen as early warning signals. Press releases or journal articles that for instance speak of coupling biological nerves to computer technology or medical strategies for healthy aging may not be defined as ‘early warning signals’ since their observation can rather be interpreted as a sign for a new trend direction (towards the further development of already existing cybernetic and neuro-technologies or the growing scientific interest in anti aging.

Hypes

The term ***hype*** generally refers to over-enthusiasm, excessive publicity around a certain topic, excessive advertising or making exaggerated claims⁵. In today’s world, hypes are common as the internet and television provides efficient and effective tools to create hypes. The US analyst firm Gartner coined the term ‘hype cycle’ to describe the ‘peak of expectations’ in regard to (information) technologies. In this phase “a frenzy of publicity typically generates over-enthusiasm and unrealistic expectations. There may be some successful applications of a technology, but there are typically more failures”⁶. After this phase of exaggerated expectation comes the “trough of disillusionment” where people realise that their expectation cannot be met. Many people may lose their interest, companies are failing and some even abandon this path. But through this phase, the more realistic and useful applications are beginning to crystallise if there is a promising core behind the technology. Hypes have been found, for example, in information technology, nanotechnology and stem cell research. It can be difficult to keep hypes (‘hot air’) and emerging issues (really relevant developments with high impact) apart and alpha and beta errors (regarding a hype as relevant or wrongly dismissing an important development as over-exaggeration) could occur. Although it is challenging, a relevant core can be found behind many hypes. Taking “Second Life” as an example, although this platform was not able to deliver what it has promised (or what people expected of it), the idea of using virtual 3D representations has lived on and is becoming increasingly interesting in many contexts ranging from education, research and training over web-based meeting facilities to movie-making.

Emerging and potential emerging issues

The concept of “emerging issues” is an often used phrase, but is not well defined in a conceptual way. The concept is often used to express the focus of “think-thanks”, like the Institute for Emerging Issues. In the UK, horizon scanning focuses on identification of possible relevant issues for policy and R&D agenda setting, while the Netherlands horizon scans searches for potential promising and threatening issues for the Netherlands

⁵ <http://www.thefreedictionary.com/hype>

⁶ <http://www.gartner.com/pages/story.php.id.8795.s.8.jsp>

society (opportunities and threats) that need further investigation. The Danish scan that has been executed by the OECD describes issues that seem to be emerging for the R&D agenda setting.

In most scanning activities there seems to be a focus on issues that may become important but that are either on the brink of emerging or that may emerge in the coming decades and needs attention of society, policymakers or research. Usually these issues are formulated on the basis of “searches in different sources” and “expert interviews”, which delivers not only proposals on potential emerging issues but also on additional signals that are considered to be indicative for the start or development of their emerging. In the context of this project we will consider an article that contains a description for new potential emerging issues also as an early warning signal, but one that should be dealt differently than the signals that are connected to the potential emerging issues as indicators for its emergence.

Discourse

Early warning signals, (potential) wild cards, trends, hypes and (potential) emerging issues all will influence the discourse on the future in a different way. “Hypes” for instance have the tendency to influence the discourse strongly as well as “strong trends”, “issue that have already emerged” and “wild cards that already happened”. While “early warning signals” as well as “potential wild cards” and “potential emerging issues” have to fight for attention in the discourse. Discourse tells something about the level on which the topic is discussed within the community, whereas this characteristic of discourse has different aspects.

The first aspect is the severity of controversy on the topic, ranging from a certain level of shared agreement around the topic to strong opposition in various parts of the community/communities being knowledgeable about the specific observation. Usually, this also tells something about the uncertainty around the topic. It can be the result of external uncertainty (unpredictability) due to the early stage of the discussion itself. A second aspect of the discourse is the sheer size of the part of the target community actively involved. If only a part of the community is involved in the discourse or the community is small, it can implicate that the observation has not yet attracted broad attention and is likely to be still early warning. But also the reverse may happen where only the ideas based on what may happen in the far future are taken into the discourse and lead to immediate action. One example is the discussion and legislation around human (reproductive) cloning. Although successful whole human cloning (not only tissues or single organs/organ parts) is currently considered to be extremely challenging and very improbable to be successfully achieved within the short- to mid-term, most nations have already declared human cloning as unlawful, at least the reproductive variant.

Characteristics of concepts⁷

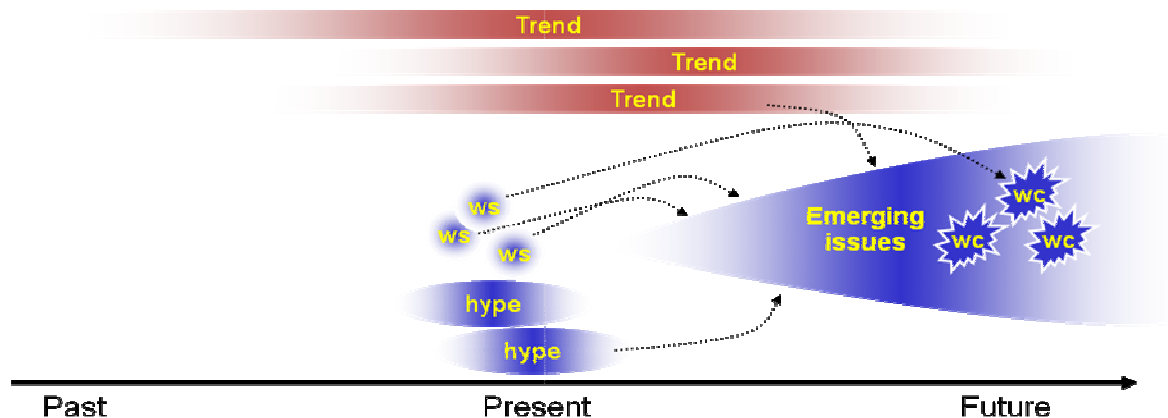
In the previous sections, some of the frequently used scanning concepts have been described. number of conceptual different topics are described. Below are some of the common characteristics of those concepts, which shape our scanning approach and tools and techniques we use:

- **Relative-abnormality.**
This characteristic relates to the novelty, or unexpected nature of the topic, making it an early warning. Central is its deviation from prevailing wisdom.
- **Impact**
As the process of early warning scanning is about anticipating future developments, the (potential) impact of the topic on different value domains is of importance.

⁷ Mainly drawn from Van Rij, V., *Horizonscanning: monitoring plausible and desirable futures*, Knowledge democracy page 227-240, edited by Roel J in 't Veld, Springer 2010

- **Changeability/criticality**
Anticipation also implies that we can change the impact by human action either by prevention or by altering impacts
- **Uncertainty/plausibility versus probability.**
The emerging of the potential wild cards and issues related to early warning signals is often very uncertain but usually plausible to a certain degree
- **Desirability**
The impact of potential wild card and emerging issues has desirable and undesirable aspects for different groups and seen from different value perspectives
- **Chronological position**
Early warning scanning is a process in which the various described concepts can be a part. The question is at what chronological position the concept is located. Early warning signals precede the new trends and hypes, potential wild cards and emerging issues.
- **Communication/Level of granulation /authority /timing**
The importance of a potential issue, trend or hype is dependant on the way the audience will integrate this in the discourse and take this into account in decisions.
- **Complexity**
The interaction of all future trends, hypes, (potential) emerging issues and early warnings highlights the inherent complexity of these concepts.

Finally, to highlight the relationships between different scanning concepts, they can be placed on a timeline and illustrated as follows:



Now we will look at some of the tools and techniques used for scanning.

Tools and techniques for Scanning

A list of tools and techniques can be given to conduct a scanning activity. Amongst them, below we will describe:

- Manual scanning
- Wiki
- Surveys
- Text mining
- Twitter
- Conferences

Manual scanning

Many horizon-scans as performed by many countries and large companies are based on searches for future issues that may impact their policies. Usually these potential impact rich issues are searched for by professional scanners assisted by expert panels that review articles in different sources like scientific journals, news papers, policy papers, reports, statistical data books etc. We refer to this approach as manual scanning. The emergence and still ongoing immense growth of information that is put on the internet has eased the work of manual scanners enormously not only because of the fact that many of the old sources (like printed journals and news papers) have become available in a digital and searchable format but also because of the fact that new sources have become available like weblogs, you tube and Wikipedia. Although the manual scanning delivers very useful information and is very useful to pinpoint and monitor emerging issues through weak and stronger signals it may miss the so called unknown unknowns, although individual scanners may stumble over them while they are scanning, so unusual findings will usually not be put aside but taken into the results. Examples are some puzzling findings in physics which all may lead to paradigm shifts that may have an enormous impact on energy and or transport, other are news articles on the concept of nuclear mixed fission-fusion energy plants that may be used to burn up the nuclear arms weapon arsenal, or article on the growing search for scarce minerals that are needed for fuel cells etc. The manual scanning focuses on the focus domains of the SESTI project (see the paragraph: Focus) and started with heuristic frameworks on the selected domains (see appendix) . It is clear that for more in depth analysis of signals especially of metadata (answering questions like origin of signals and development of reading audience etc) automatic tools may be much more suitable.

Wiki

Looking at the large success of Wikipedia, it is considered that WIKI can be a useful tool for gathering scanning input. The information provided through wiki is usually rich and lengthy. However, this sometimes makes the analysis more complex and challenging. Some of the major platforms, where scanning practitioners contribute frequently are:

<http://singularityhub.com/>

<http://hplussmagazine.com>

<http://www.acceleratingfuture.com/>

<http://nextbigfuture.com/>

<http://www.eurekaalert.org>

<http://www.wfs.org/futurist.htm>

<http://www.kurzweilAI.net>

<http://www.thoughtware.tv/> (video platform for science and technology related content)

Wikipedia works well as an encyclopaedia where the user knows what s/he is searching for and is convenient because of the hyperlinks that lead to pages that explain other terms (e.g. if searching for “hydrogen” on Wikipedia, one also gets a link that explains what is meant by “atomic weight”) one does not really know beforehand. However, this may be problematic for the purpose of scanning, as most of the scanning data emerges from unknowns, rather than knowns.

Surveys

Surveys are the tools which can be used to elicit information from a wide variety of respondents who cannot be present physically at a particular place at particular time. It is valuable in terms of collecting diverse opinions and keeping the respondents anonymous so that they can state their ideas freely. An application of survey for the purpose of scanning was the Big Picture Survey - BPS (Saritas and Smith, 2010), This Big Picture Survey (BPS) was designed primarily to collect a set of future oriented trends, drivers of change, weak signals, wild cards and discontinuities from around the world. It was been structured to allow the Future-oriented Technology Analysis (FTA) 2008 Seville Conference attendees, mainly the organizers and practitioners of Foresight, an opportunity to contribute to a value-adding Foresight knowledge base regarding the directions and catalysts that are prompting our global future and its various contingencies and uncertainties. The originators of this survey used the responses to lead a plenary discussion at the 2008 FTA Conference, by providing some basic profile information without any attribution of responses to individuals. The BPS methodology was straightforward: An open-ended survey with compilation, grouping responses, and a general analysis of the five areas. We were more interested in the distribution of responses than individual response patterns. For this purpose, looking at the survey results a STEEP (Social-Cultural, Science & Technology, Energy, Ecology and Economy, and Geo-Politics) framework was suggested to map the five areas consistently. This allowed seeing the general patterns of preferences while still capturing the respondents’ narratives.

Text mining

Text mining is an approach to analyse large datasets, like reports, social networks and patents. The basic point of departure is that the analysis of these large datasets can not be done manually, but need sophisticated software to (help) analyse the information. Many commercial tools are already on the market such as well known examples like Lexus Nexus and SPSS.

However, traditional text mining is not directly suitable for the identification of weak signals. The core principle of text mining is that relations can be found between two words or phrases in a text, based on semantic correlation or statistical correlation. So the aim is to search for correlations between two entities with a high score. This is contradictory to the fundamental character of weak signals, being a signal that is just surfacing and does not yet have a high occurrence in text. Also here, the baseline is of crucial importance. The weak signals collected with an automatic process should be processed further to derive the emerging issues.

There are however two aspects of text mining to be considered. The first aspect is that the text mining software today cannot be seen as a fully automated system; where without any interference with experts results are generated. The large lists of outcomes need to be processed and an expert needs to fine tune the underlying procedure (e.g. by adapting the search heuristics by changing the graphs). As the expert involvement is of importance, this initiates a second aspect. The involvement comes with a bias in the final results. As experts have their historical unconscious heuristic search filter, the outcomes will be coloured by this expert filter.

Twitter

Twitter is a rather new kind of “short messaging” or “micro blogging” service where people can post short messages no longer than 140 characters onto an internet platform. In order to use this service, people need to register and they can “subscribe” to other users by “following” them, meaning that they automatically receive their messages upon their login. Twitter also facilitates the use of Lists, in which a category of experts can be clustered. This functionality is available for the individual users to set up, but can be seen and used by other users as well. There also exist search functions on twitter to search for specific topics and users and there are many tools and software applications (e.g. for advanced searches, conditional searches, filtering, statistics and archiving) available that can help with searches, filtering and archiving twitter messages.

A major advantage of Twitter is that it is fast and information appears on Twitter often before it is reported in conventional standard news formats (e.g. TV, radio, print). Information about new developments but also societal happenings (e.g. demonstrations, riots etc.) can be obtained timely and even in “real time” (e.g. in regard to the demonstrations in Iran). This can enable faster and timelier assessments and thus earlier detection of events, changes and possible weak signals. A major disadvantage is that most users of twitter have other objectives than providing information useful for science and research about emerging developments. Therefore it is challenging to filter out noise (e.g. personal and irrelevant messages, spam, advertisement and topics that are irrelevant, e.g. about celebrities etc.).

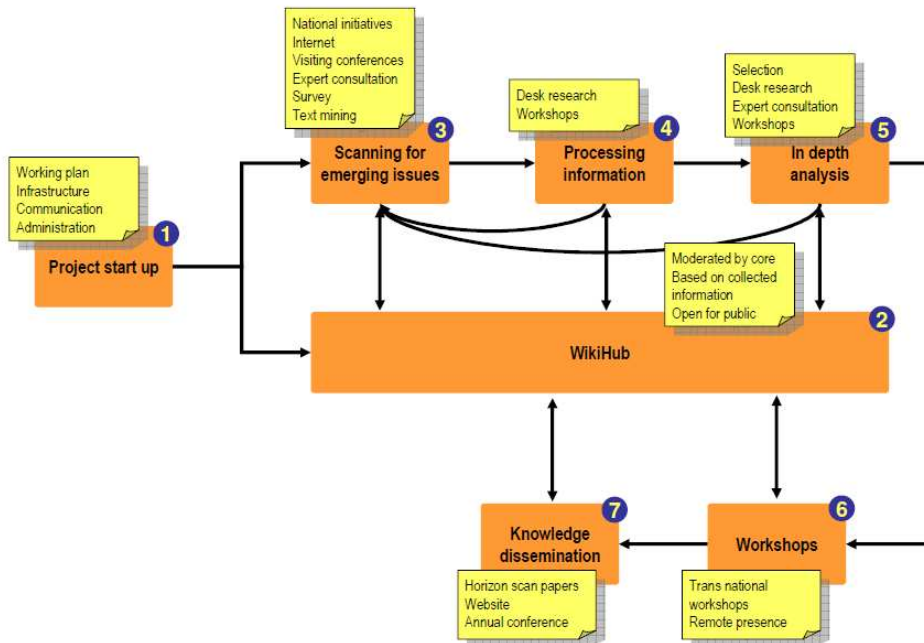
Conferences

Scanning team members attend events like conferences, workshops, meetings exhibitions that could yield information relevant for identifying weak signals and new developments in society, science and technology in addition to the manual and automatic scanning. The reason for the visits is mainly to develop insight in the running issues in the focus areas of the scanning. This is necessary to enable scanners to make the distinction between potentially emerging issues and their weak signals and already known issues. However, conferences may not be primarily interesting for getting to know new weak signals as this information can be even obtained earlier and in easier ways but consortium experts. Conferences are useful more for getting first-hand experience with the audience and the different knowledge levels of people and how they deal with the information being presented. Thus the observation of the audience and an assessment of their reaction might be even more focussed on at the next conferences.

Some of these tools and techniques have been used in the earlier stages of the SESTI project and some others will be used in the near future. More detailed information on the SESTI scanning approach will be given after the description of commonly used tools and techniques.

SESTI approach for Scanning

The SESTI project is organised along the following packages

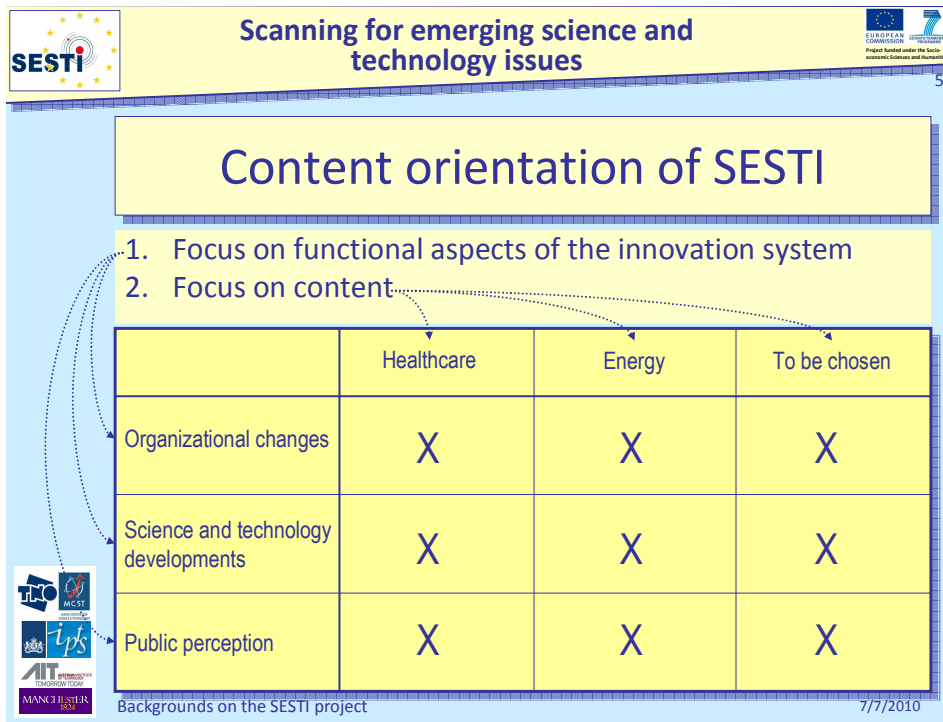


The scanning for emerging issues in SESTI is restricted to issues that are relevant for Policy makers in Science and Technology as well as policymakers that use or are dependent from Science and Technology. According to the SESTI proposal priority should be given to:

- Topics that are not currently addressed by EU policy or FP7 or are addressed in a limited way.
- Topics with a long-term orientation (2030) and having no “owner” in the European Policy arena.
- Topics that have relative low probability and potentially high impact (wild cards).

Focus

Throughout the project, the scoping discussions we held within the SESTI team lead to the following Focus of the scanning:



Scanning for emerging science and technology issues

Content orientation of SESTI

1. Focus on functional aspects of the innovation system
2. Focus on content

	Healthcare	Energy	To be chosen
Organizational changes	X	X	X
Science and technology developments	X	X	X
Public perception	X	X	X

Backgrounds on the SESTI project

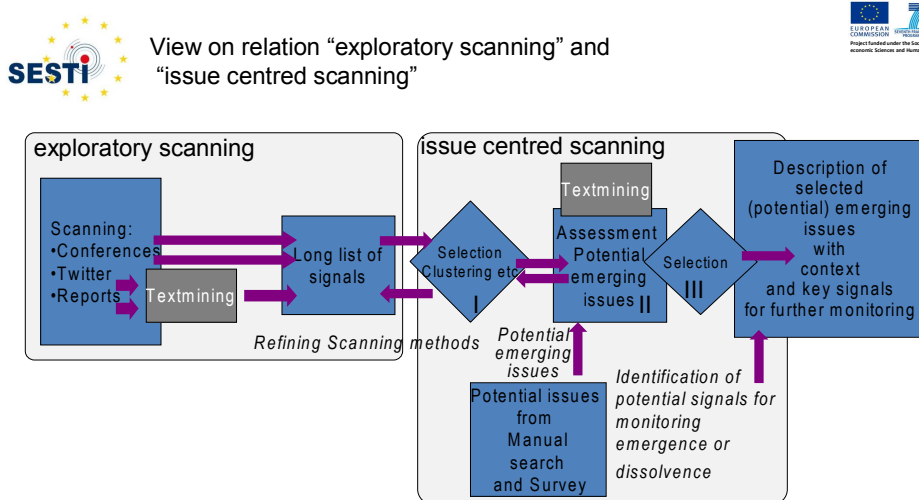
7/7/2010

In a pilot scanning exercise the topic of cognitive enhancement was chosen as third content focus. The results of the pilot scanning efforts will be discussed in the policy workshops to be held in late November 2010.

During the project different methods are used to obtain weak signals and potential emerging issues including manual scanning based on the experiences of national horizon scans, a specialised functionality in the wiki that called for contribution of weak signals by experts, twitter analysis, text-mining and conferences. At the end of the project a survey will be held to elaborate and validate results of the scanning. The experience we have gained so far with the use of these tools and techniques have been reported and discussed extensively in the earlier project reports.

Exploratory and Issue centred approach

During the project two major approaches to identify new emerging issues were followed , one concentrated on a wide variety of data from different “signal” sources (exploratory scanning) , while the other approach concentrated more on descriptions of potential issues form a variety of sources (issue centred approach) . In the first approach the assumption is that new emerging issues could be identified by processing the different signals, while in the issue centred approach the descriptions of potential issues are used to identify potential additional signals that could either confirm or deny the “real” emerging of the issue . Both approaches will be used to identify several main “emerging issues” for the selected focus areas that will be discussed with field experts and policy makers in these areas



Appendix

Search map Energy: wild cards, issues and weak signals

Key question in the search for potential Issues concerning Energy Policy and Research and Innovation agenda (Science & Technology)

- **(production)** Can we expect any increased success or failure in the development of one or more of the existing **energy sources**⁸ (whole specter C-fuels to renewable and nuclear fission and fusion)? What kind of signals may predict this?
- Can we expect new unknown **energy sources** and what kind of signals may introduce these (wild cards)
- **(conversion)** Success or failure in efficiency conversion from source to carriers or between carriers⁹, or from carriers to end use. Development of new carriers?? Again which signals could lead to their detection
- **(transport and distribution of energy)** Revolutionary efficiency gain in carriers and in energy distribution systems
- **(storage)** Revolutionary development in energy storage (micro, meso- and macro)
- **(saving)** Revolutionary development in saving energy use¹⁰ (transport, industry, households etc)

Key question in the search for potential Issues concerning Energy Policy and Research and Innovation agenda (Public perception – risks - Society)

- **(production)** changes in public perceptions on safety and desirability of **energy sources** (caused by new risk analysis or energy disasters terrorism et etc)
- **(consumption)** Sudden increase or decrease of energy use (less transport, demand for less energy products, vegetarian life style etc)
- **(transport and distribution of energy)** changes in public perceptions on safety and desirability of energy **carriers** caused by new risk analysis or energy disasters , terrorism etc
- **(storage)** changes in public perceptions on safety and desirability of energy storage caused by new risk analysis or energy disasters etc
- **(saving)** enormous changes or trends in energy saving behavior

Key question in the search for potential Issues concerning Energy policy and Research (Organizational changes)

- **(production)** change in geopolitical or economical settings though which availability of **sources** changes suddenly (may be caused by wild cards as conflicts or war, nationalization and privatization etc))
 - **(transport and distribution of energy)** idem for **carriers** , but also grid configuration
 - **(storage)** idem
 - **(saving)** altered policies on saving , market regulation, limitation of energy use etc
-
- **(context) wild card** the climate change theories all were proven to be wrong or can we catch this under public perception)

⁸ See next page for the further division of this item

⁹ See next page for the further division of this item

¹⁰ See next page for the further division of this item

Energy sources:

Coal
Oil
Gas
Methyl hydrates
Geothermal
Wave and tides
Solar direct
Solar indirect wind
Solar indirect biomass
Nuclear Fission
Nuclear Fusion (ICF)
Nuclear Fusion (ITER)
New unknown?

Carriers

Coal
Oil
Gas – all different types
Hydrogen
Methyl hydrates
Warmth
Electricity
Light
New unknown?

Conversions

Between sources and carriers and between carriers

End use

Heating cooling houses, buildings
Heating, cooling and processing in Industry & agriculture
Light in Agriculture industry and houses
Transport of people and goods
Construction buildings and infrastructures

Search map Health: wild cards, issues and weak signals

Key question in the search for potential Issues concerning Health Policy and Research and Innovation agenda Suspected Issues Health (S&T)

- **(new emerging diseases)** Discoveries of unknown diseases¹¹ or of health effects with unknown causes (increase of allergy, suicides, decrease of fertility etc) appear
- **Increase health threatening physical environment (radiation, dust etc)**
- **(increase in diseases)** Discoveries of increase or decrease of numbers of patients with known diseases and or health problems (pandemics (like Aids SARS) , obesitas, home accidents)
- **(prevention¹²)** New knowledge leading to increased success of prevention of main diseases and negative health effects (enhancement of general immunology, cancer immunity etc)
- **(cures¹³, healing)** New potential successful healing of existing main diseases
- **(cures and care¹⁴, measures, improving quality of life or life extension)** Success in ways to improve life conditions of people with diseases

Key question in the search for potential Issues concerning Health Policy and Research and Innovation agenda (Public perception – risks - Society)

- **(new emerging diseases, increase diseases)** changes in public perceptions on effectiveness of cures for main diseases , lack in confidence of health care
- **(prevention)** Increase health threatening behaviour or social interaction. Lacking attention for health in education, stress in work, altered sex relationships, family conditions , poverty, use of drugs, etc)
- **(consumption)** Sudden increase or decrease of health care consumption (due to aging or other developments in society, war , disasters etc)
- **(high costs)** Costs become to high, health care tourism, decrease of health care workers, immigration of health consumers etc

Key question in the search for potential Issues concerning Health Policy and Research and Innovation agenda (Organizational changes)

- **(health care system and costs)** changes in public versus private health care
- **(prevention and care and cure)** misbalance in investment in different activities in health care *for instance too much detection and no cure, or too little prevention)
- **(production)** Too many or too little of health care workers , physicians (also in different niches)
- **(economy)** financial crisis etc

-
- **(context) wild card** : what if it comes out that cancer diagnostics increase cancer mortality, early diagnosis success for diagnosis but failure for mortality
 - **context) wild card** : the magic bullet, one treatment makes us almost invulnerable for diseases
 - **context) wild card** : the magic life elixir beyond our human life limit

¹¹ See next page for the further division of this item

¹² See next page for the further division of this item

¹³ See next page for the further division of this item

¹⁴ See next page for the further division of this item

Diseases:

Genetic deficiencies (xxx)
Behavioral diseases (xxxx)
Infectious diseases (xxxx)
Others cancer, cardiovascular, etc
Environmental threats
(Water, food, biosphere, build, environment, climate, radiation)
Psycho sociological environment

Diagnostics

Chemical
Physical
Biotechnological
Unknown

Prevention

Education, communication,
Environmental & labour policies
Behavioural influence
Self diagnostics
Identification causes
Vaccination
Immune enhancement
Food Vitamins and minerals
Unknown

Cure

Genetic
Pharmaceuticals
Stem cells
Engineering
Psychological
Physiological

Care

Pharmaceutical
Human - psychological
Mechanical
Etc

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