Intelligence: Environmental and Horizon Scanning

5

5.1 Introduction

The Intelligence phase of ForSTI begins with a comprehensive understanding and scanning exercise, which provides input for the overall activity. The aim is to attain a reasonably comprehensive view of situations involved in the STEEPV systems and their future directions of development. This provides a shared understanding and mutual appreciation of situations, issues, and influencing factors as systems within their own contexts by uncovering uncertainties about the values and preferences of actors and stakeholders, and clarifying the goals of the entire ForSTI activity. In this way, the Intelligence phase offers a mind-set for understanding how systems work and behave, and what their emerging characteristics are. The goal is not necessarily to bring about a convergence of views, but, at least a partial convergence is likely to emerge from this process in practice.

In ForSTI, scanning exercises can be carried out at two levels. The first one is scanning the wider context of influencing factors, which may be mentioned as "Environmental Scanning". A STEEPV framework can be used for this purpose. The second one is "Horizon Scanning", which is concerned with what could plausibly unfold in the future in the form of trends, drivers of change, weak signals of emerging developments, wild cards/shocks/surprises and discontinuities (Saritas and Smith 2011).

All scanning activities may be undertaken by using various quantitative and qualitative ForSTI methods, such as brainstorming, workshops, review of existing literature and studies or through the bibliometric and semantic analysis of large amounts of data and information. The outcomes of the process should enable a better understanding of the focal object and ForSTI 'context'. This can support the identification and scoping of the main areas of the activity (i.e. establishing the main boundaries of the ForSTI). Furthermore, this should clarify such aspects of the 'content' of ForSTI as the themes, topics or sectors to be focused on. The context and content of the activity will help to design a 'process' for ForSTI with the selection and combination of methods and tools. In this chapter, we will first begin

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by introducing Environmental Scanning, and will then focus on the more future-oriented Horizon Scanning activity.

5.2 Environmental Scanning

We define Environmental Scanning (ES) as:

> the systematic identification, monitoring and examination of issues of relevance to the topic of concern.

ES does not just consider the natural environment. It can include two types of contexts, in which ForSTI is embedded. These are illustrated as external and internal contexts in Fig. 5.1.

The external context consists of a set of interrelated and interdependent systems, which, in practical terms, can be explained with the STEEPV acronym (Box 5.1).

Box 5.1: STEEPV Acronym

STEEPV is one of a family of classification systems that are often used in horizon-scanning. Loveridge (2002) explains the emergence of the concept and ways of using it. STEEPV acronym stands for the categories: Social, Technological, Economic, Environmental, Political and Values.[1] The aim of such a list of categories is very simple: it is to encourage users to think through a range of factors—they could be trends to examine, driving forces underlying trends, weak signals of emerging developments, possible wild cards or impacts of trends. We use such lists not because they represent a deep ontology of how the world is constructed, but simply in order to avoid getting trapped by just considering one or other set of factors as if these were the only important ones. Examples of the issues to be considered under each category are given below:

Social	Ways of life (e.g. use of leisure time, family living patterns) demographics (population growth and age structure), social inclusion and cohesion (fragmentation of lifestyles, levels of (in)equality, educational trends, conflict across age groups or subcultures).
Technological	Rates of technological progress, pace of diffusion of innovations, problems and risks associated with technology (including security problems). Technologies that might affect health,* life expectancy, interpersonal communication, personal security.
Economic	Levels and distribution of economic growth, booms and busts, industrial structure (e.g. growth/decline of particular industries), pensions and wages,* competition and competitiveness, markets and financial issues.

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[1] Other systems include PESTLE, where the L is Legal; TEEPSE; where the E is Ethical.

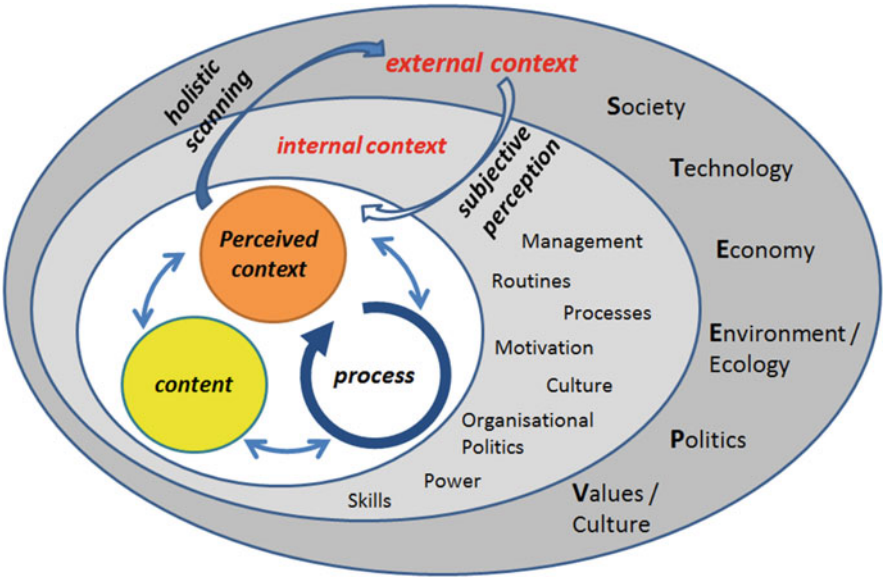

Fig. 5.1 Contexts of ForSTI for environmental scanning. *Source*: Saritas (2006)

Box 5.1 (continued)

Environmental	Pressures connected with sustainability and climate change in general; more localised environmental issues (including pollution, resource depletion, and associated biodiversity, health and safety concerns).
Political	Dominant political viewpoints or parties, political (in)stability, role of governments and quangos in regulation, political pressure and lobbying by non-state actors (e.g. pressure groups).
Values	Attitudes to health/ill-health*, to working life (e.g. entrepreneurialism, lifelong careers, mobility across jobs, countries, etc.), deference to authority, identity in relation to leisure, culture, political values, etc.

*These and several other examples reflect the focal topic of the exercise from which these example instructions are drawn—it was related to individual careers in health services

In some cases the practitioners of ForSTI may hesitate where a particular trend or development may fit within STEEPV categories. For example, the topic of 'sustainability' can be considered under environmental, economic or social category. What is important to know is that the aim is not to come up with a perfect classification system under STEEPV, but to capture as widely as possible issues in the course of discussions, and to address them during the ForSTI activity, whichever category they may fall under.

The aim of scanning the STEEPV systems is to develop a view of where important developments are taking place, what trends need to be watched, and who the key players are and might be. Methods used here are very varied: they include systematic analysis of media (nowadays this most critically means the Internet), perhaps using content analysis tools (to indicate emerging social attitudes and political movements), review of reports from financial analysts and specialised consultancies (to suggest emerging markets or business models); examination of specialised databases (e.g. patent or bibliometric data, to give warning of developments in science and technology). It is possible to become too tied to specific methods and data sources, so that alternatives—especially paradigm-challenging ones—may be neglected. Many organisations routinely engage in such scanning. It may include the business, political, or technology environment, for example, "Competitive Intelligence" is one flavour of ES used by firms to examine their competitors. The activity is most often conducted in a "one-off" fashion, when a new activity is being planned. This may save costs, but reduces learning opportunities.

The internal context is also an important element of the scanning activity. It usually functions as a filter when the external contexts are considered. For instance, organisational goals, worldviews, motivations, politics, behaviours, skills and competences are important determinants for interacting with the external world. This gives a subjective characteristic of the scanning and ForSTI activity. Although the ForSTI exercise aims at developing visions, ideas and innovations to present to the external context, it has also benefits for the advancement of the internal context. For instance, one of the key impacts of the ForSTI, "behavioural additionality" introduced by Georghiou (2002), takes place in the inner context, where practices, routines, and organisational and individual behaviours change substantially following the exercise. The concept of behavioural additionality will be touched once again in the evaluation chapter of the book.

The ES scanning activity provides a useful input for ForSTI right from the beginning of the activity. First of all, the ES links ForSTI into its aforementioned contexts. In this way it helps ForSTI to understand systems' behaviour and recognises critical issues, and impedes the flow of information amongst the key stakeholders and decision makers. Three important inputs to ForSTI can be derived from the further examination of the ForSTI's context (Saritas 2006):

1. A rich understanding of existing systems, their history and possible futures
2. Analysis of different stakeholder perspectives and their social relations in the system which can affect and be affected by the process
3. Examination of formal and informal networks and procedures, which can be in favour or in conflict with other systems

Analysing the contexts of ForSTI in the course of ES helps to build the content of the activity, where content represents the subject areas taken into consideration such as technologies, themes or other topics, which may generate the biggest socio-economic and environmental impacts, and therefore, are worthy of focusing in the exercise. Content for ForSTI can be defined in a more open-minded, creative and flexible way, at least at the outset. In the long-term future, the boundaries of many phenomena are liable to be redefined. We need to be able to take this into account,

rather than limiting our appraisal to what we know now. To give a simple example: assuming that "homes" involve only houses and apartments in the USA failed to take into account the large numbers of people living in mobile homes (currently estimated to be almost 7 million); the implications for housing, urban development, education, medicine and social welfare are enormous.

During the ES process, ForSTI will explore a range of important and uncertain issues (like demographic change, socio-cultural evolution, technological advancements, environmental issues, or political transformations). In most cases, the ES with the use of STEEPV analysis can be an ideal first step for planning future scenarios. A more detailed description of the process of working with STEEPV systems is given in Chap. 7 of the book.

Moreover, the ES activity also helps to develop a proper methodological approach for ForSTI, which may be customised in line with the specific context and content of the activity.

Following a good understanding of the contextual factors affecting the future of the key areas of focus in ForSTI through an ES, a more future-oriented intelligence gathering exercise can begin with a Horizon Scanning activity, as described in the following section.

5.3 Horizon Scanning

For ForSTI activities, we can define Horizon Scanning as:

> *The systematic identification and examination of emerging issues (including emerging developments in established issues) that are of relevance to the topic of concern* (i.e. the focal object and content of the study)[2]

Some of the terms used in this definition are elaborated in Fig. 5.2.

Horizon Scanning (HS) is often confused with Environmental Scanning (ES), but as explained above, as a broader term ES looks into the contexts (or environments) of ForSTI topics, while HS, which can be considered as a subset of ES, is concerned with future-oriented 'emerging' trends, issues and uncertainties in the topic of concern. While the issues stressed in HS are especially those involving novel and emergent features, ES may be very short-term in focus. Thus, for instance, in corporate environments the focus may be on what competitors and regulators are doing or preparing to do next, how markets are responding to their activities, what they are stressing in press releases, and the like. Well-informed managers naturally monitor many key issues on an ongoing basis, and large

[2]We have derived this from a UK Foresight formulation of HS as: "the systematic examination of potential threats, opportunities and likely future developments including but not restricted to those at the margins of current thinking and planning. Horizon scanning may explore novel and unexpected issues as well as persistent issues or trends" (dating from at least 2004, this is reproduced often, e.g. Government Office for Science 2011).

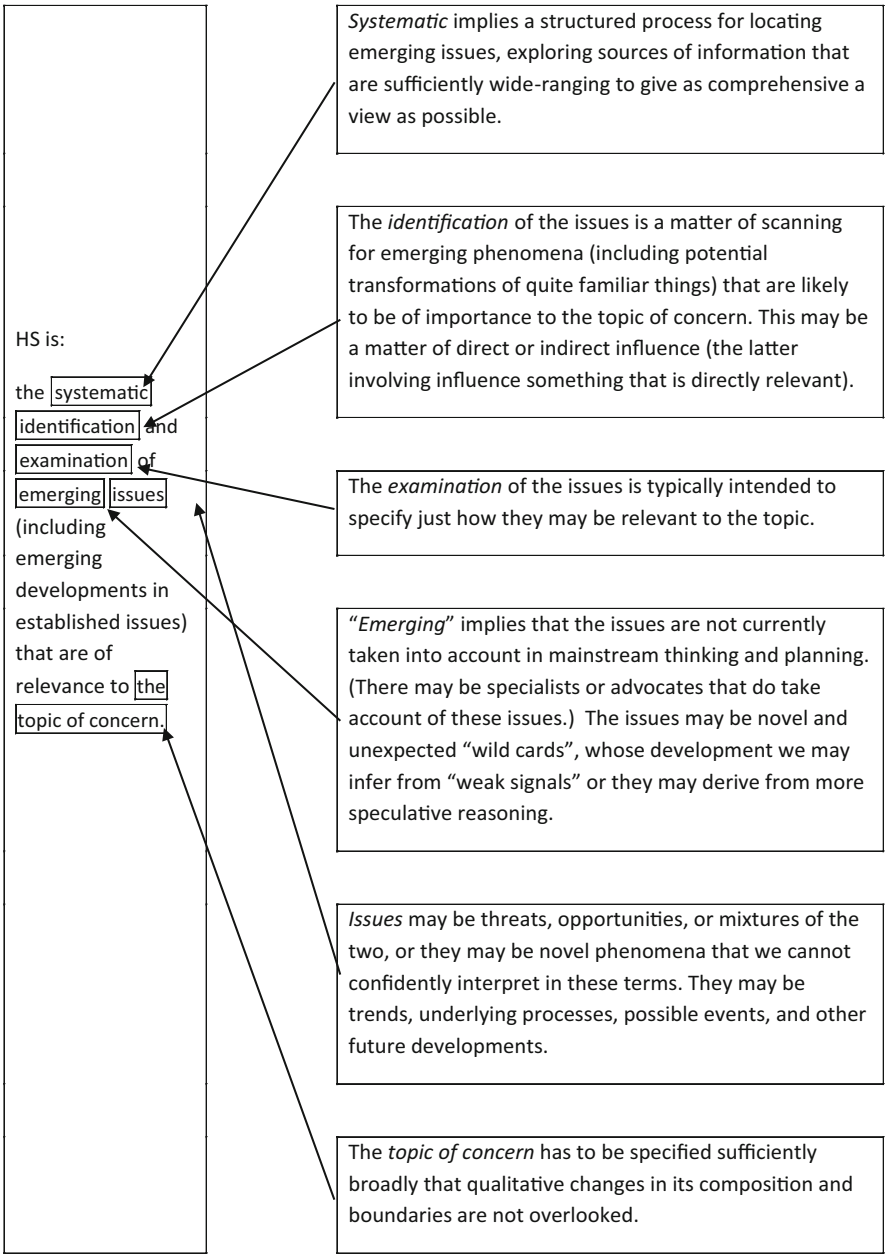

Fig. 5.2 Unpicking a definition of horizon scanning

organisations will often have several departments that feed relevant information they have picked up to senior managers.

The specific focus of HS will tend to be on changes that are evidently underway or the subject of controversy or speculation. Often these are matters that are entering into immediate and short-term decision-making, and that are the topic of discussion within the organisation and its networks. This is not to say that HS is always about obscure, unrecognised topics. It is often the case that there has been considerable discussion of future contingencies—for instance, the likelihood of a future pandemic of highly fatal strain of influenza. Organisations and individuals charged with risk management and resilience are often focused on such phenomena, and they may occasionally surface in the mass media. They will typically only enter into ES when the threats in question start to become manifest, or when the organisations in the environment of our scanner are engaging in activities connected with the risk.

Regarding the scope, the HS activities are typically concerned with:

- Trends
- Drivers of change
- Weak Signals of emerging developments
- Wild Cards/Surprises/Shocks
- Discontinuities

These will be elaborated in the next sections.

5.3.1 Trends

The starting point for scanning is usually to identify the key trends which are presently evident in the broad sense of being both discernible and (usually are) somewhat gradual forces, factors and patterns that are pervasively causing change in society generally. The speed of change may be deemed comparatively slow or fast depending upon one's vantage point, but the important aspect of a trend is its pervasiveness (Saritas and Smith 2011). Box 5.2 gives a few examples of Trends.

Box 5.2: Examples of Trends

- Demographic change observed in the form of ageing population observed mainly in Western societies, whereas increasing population in other parts of the world such as Africa and India
- Increasing concerns for energy efficiency and renewable and sustainable resources for energy generation
- Trends towards mobile devices with the integration of higher number of functions and services, with lighter and faster devices

Saritas and Smith define other concepts related to trends, including "Mega-trends", "Potential trends", and "Branching trends".

Mega-trends typically extend over generations of human life and describe complex and systemic interactions between many factors. For instance, as a mega-trend climate change has been observed for a long time prior to human existence.

Potential trends are the ones which stem from innovations, projects, beliefs or actions that have the potential to grow and eventually go mainstream in the future. For instance, alternative medicine remained an outcast from modern medicine. However, currently, it has links with business and has achieved a degree of respectability in some circles and even in the marketplace.

Branching trends represent a group of trends, which are linked to each other as branches and twigs. For example, a well-documented movement toward equality between men and women might represent a branch trend. The trend toward reducing differences in the relationship between the salaries of men and women in the Western world could form a twig on that branch (cf. Saritas and Smith 2011).

A recent report by WEF (2016), entitled "*Global Risks Report 2016*" introduces the concept of "Global trends", which is defined as: "*a long-term pattern that is currently taking place and that could contribute to amplifying global risks and/or altering the relationship between them*" (p. 6). Among the examples of the global trends are: changing landscape of international governance, climate change, environmental degradation, and rising global mobility.

5.3.2 Drivers

In HS we are usually looking for things that might change the situation, or change the way in which it is developing. The term 'Drivers' (or Drivers of Change) simply refers to the major influences on a phenomenon, especially the major forces that underpin trends. Though in wide use among managers and policymakers, the terminology of 'drivers' is one that is resisted by many social researchers. They regard it as an unscientific term, as perhaps implying a one-way, linear causality that cannot exist in reality. The point may be expressed in different ways, but one point of view is that social affairs should be understood as emergent from systems, in which there are multiple variables linked together in a complex web of feedback loops. Others may stress the reflexive nature of social activity (human beings can gain awareness of what they are doing, why, and what the possible consequences are; they can conceptualise and communicate this to others; and this can lead to new patterns of behaviour).

In contrast to these sophisticated points of view—which are often counter-posed to each other as quite different approaches to social understanding—the notion of drivers is much more of a lay, everyday concept. On the basis of a review of the ForSTI literature, where the idea is often invoked, we can say that:

- Drivers are major factors that are known, or believed, to be shaping or influencing our topic of concern, or to be liable to do so in the future.
- Drivers are the forces underlying the trends (e.g. investment in bioscience R&D). Some commentators will see trends as more the outcome of the action of drivers, which are then seen as longer-term factors whose dynamic interplay moves trends in one direction or another. Events, in turn, are the outcomes of trends—an event may be purely statistical (we now have more than 50 % of the population in this category, for example), or phenomena that mark step changes of one sort or another (e.g. the introduction of a new policy in response to a trend).
- Drivers may influence our topic of concern directly or indirectly. Some drivers are outcomes of other drivers. For example, improved nutrition, public health, and treatments of common diseases, are among the factors that are leading to a growth in the elderly population, which is a major driver of increasing demand for healthcare related to this population's needs.
- Some drivers are relatively predictable (bar major wild cards); we can anticipate, for example continuing decrease in the cost and increase in the power of much information technology; we can forecast the age structure of the population into the next decade or so with some confidence. Others are much more uncertain, for example major policy changes may result from quite small swings in electoral behaviour, or even from complex trade-offs in a governing coalition.
- There can also be uncertainties to do with the actual effect a driver is liable to have on our topic of concern. This may be because the emergent issue is too novel to properly assess; because we believe it will interact with other drivers to produce different outcomes; because we do not know what the reaction to a development will be.
- Drivers may be internal to our own organisation (e.g. ageing and turn-over of the workforce), or external to it (e.g. factors restricting the immigration of workers with particular skills or capabilities).
- The sorts of influence that drivers may have can also be very varied. A driver may increase, decrease, or qualitatively change a variable we are interested in; it may set limits or thresholds to change; it may indeed inhibit change.

Some ForSTI practitioners have attempted to sharpen the terminology by drawing new distinctions and introducing new formulations. For instance, van der Heijden (2005), from the perspective of strategic management, differentiates between the Factors in the Contextual Environment (which we survey and appreciate, since our ability to influence them is limited), Driving Forces from the contextual environment that influence (a) the Transactional Environment where our organisation interacts' with others (and here there is scope for influence and co-design of developments) and (b) the Actor (organisation) itself, where we have the opportunity of controlling choices. Such a framework can be helpful in classifying and organising different drivers, though it is more common to use one of the all-purpose frameworks such as STEEPV, which will be further elaborated in Chap. 7 of the book. Some examples of drivers are presented in Box 5.3.

Box 5.3: Examples of Drivers

- Climate policies and resource practices are the drivers of carbon credits, taxes and footprint accounting
- Resource restrictions and political instability in the Middle East and North Africa drive scores of people to immigrate illegally through dangerous ways
- Information and Communication Technologies and the Internet have been the main drivers for electronic commerce

5.3.3 Weak Signals

Weak Signals are the first important indications of an emerging future change associated with society, technologies, innovations or other domains. They may be first signs of future trends, paradigm shifts, drivers or discontinuities yet to materialise. There may still be uncertainties whether the signals can be accepted as an evidence, as there may be some faulty signals—either due to an error in the signal detection process, or mistakes in data. This may not be known immediately. Even if it is emerging, there may still be uncertainties about the direction of future change and the extent of impacts it may have on our systems. The main benefit of analysing Weak Signals can be observed when their impacts on society and organisations are assessed, and strategies and policies are developed. An example of Weak Signals from the past is the first mention of the climate change, which was made in the 1970s. However, not much has been done until recently. Further examples of Weak Signals can be found in Box 5.4.

Box 5.4: Examples of Weak Signals

- Virtual second lives of people dominate the real first life. People have double personalities as who they are in reality and who they would like to be virtually. Social differences in real life like age, sex, race, language, religion blur in the second life
- The use of digital currencies will be widespread across the globe resulting with faster commercial transactions and more stable markets—though only after economic and security issues are addressed!
- Legislation, justice and execution functions of governments are implemented through ‘crowdsourcing’ resulting with the abolishment of the traditional parliamentary systems and elections with real time public participation

5.3.4 Wild Cards

Wild Cards—which can be what are referred as Black Swans (Taleb 2007)[3]—represent those unexpected/surprising/shocking events and developments, which are generally believed to have low probability of occurrence, but would substantially impact the human condition once they occur (Petersen 2000). Consider our present world: many of its key aspects have been shaped massively by events that would not have been predicted a few decades ago, from the emergence of AIDS to 911 and the conflicts that accompanied it. We can be fairly confident that much of the world of the 2040s, for example, will be similarly shaped by unpredictable and uncertain wild cards, which may originate either from the factors out of our control (such as natural disasters like earthquakes, and asteroid impacts) or human-controlled factors (such as nuclear disasters, pandemics, terrorist attacks). Box 5.5 presents Wild Card examples with their associated trends in which they may exist.

Box 5.5: Examples of Wild Cards

- Due to rapid technological developments, humans will lag behind in computation, production, and service provision, and will look for ways to slow down or stop technological development
- Extraction of precious raw materials, like gold, from extra-terrestrial reserves collapses the global economic system
- Due to increasing use of electronic health systems and mobile devices, 'digital viruses' become more serious medical threats than conventional 'organic' viruses

Wild cards may also be introduced into ForSTI in order to increase the ability of practitioners to adapt the future-oriented ideas to surprises, which may arise in turbulent environments. For instance, Wild Cards can be introduced into the process of scenario planning for the 'wind tunnelling' of alternative scenarios under unexpected circumstances.[4]

[3]There are several differences between the two concepts, though both have high impacts. Wild Cards are (supposedly) unexpected when they happen, but they can simply be events that are seen as having a low probability of occurring (at least within a specific time period). Black Swans are phenomena that were not previously seen as possible—e.g. it was long assumed that all swans were white.

[4]The wind tunnelling concept will be elaborated further in Chap. 7.

5.3.5 Discontinuities

Discontinuities are rapid and significant shifts in trajectories, or the forces behind these. Some of them may originate from wild cards, but many are less surprising. Indeed, some are widely anticipated, for example, the displacement of analogue media by digital ones was long expected—the main uncertainties concerned how soon and how fast this will happen. In the ForSTI field, 'technological discontinuities' are particularly important.

The introduction of the advanced Information and Communication Technologies, and the Internet has created major discontinuities in our lives. They have already resulted in major changes in the ways societies and personal relations organised as well as the ways products or services are produced, delivered and used, such as in finance, education and trading. While creating new opportunities, discontinuities may also pose threats for instance for those who use inflexible technologies, or even for elderly citizens, who may not be able to stay up to date with technological developments and may be isolated from the rest of the society. Some more future-oriented example discontinuities can be found in Box 5.6.

Box 5.6: Examples of Discontinuities

- Electronic communication and social networking tools like Google, Wiki, Facebook, YouTube and similar innovations create the ways for transformations in personal relations and business practices
- Additive manufacturing and 3D printing will transform production processes, such that existing production and logistics infrastructures and practices will need to be redesigned
- Lightweight and durable building materials using nanotechnologies may substantially change heavy, lengthy and dirty construction work

The terminology presented in HS above features a number of concepts that are frequently confused with each other. In fact, it may not be very important whether they are called or classified under one or the other, as long as they are captured and considered in ForSTI exercises. However, in order to help with the clarification of the HS terminology, the following example on demographic change is given in Box 5.7—though it may still be subject to discussion!

Box 5.7: An Example for Comparing HS Terminology

- **Trend:** Ageing population
- **Driver:** Declining reproduction rate, longer life spans of individuals through better medication, diet and lifestyles
- **Weak Signal:** Social, economic and structural tensions due to lesser opportunities for younger people: rise of intergenerational conflicts of various kinds
- **Discontinuity:** Elderly become more influential in politics and decision making, with many older people active in civic affairs and campaigning
- **Wild Card:** Unlike the present, cosmetic surgery is undertaken to look older and wise!

There are some other concepts, which can be considered as closely associated with HS. For instance the 'Global Risks' concept can be considered somewhat closer to the Wild Cards concept. As defined by WEF (2016): "*A global risk is an uncertain event or condition that, if it occurs, can cause significant negative impact for several countries or industries within the next 10 years*" (p. 6). Among the global risks mentioned are: failure of climate change mitigation and adaptation, profound social instatibility, and interstate conflict.

Following the description of the HS concepts and terminology, Box 5.8 presents an example of HS in the health field, where HS activities are often undertaken—not always accompanied by other ForSTI approaches. HS seems to be particularly prevalent in the health area for a number of reasons. One is simply that new medical treatments are continuously emerging, and it is important to be able to anticipate and assess these if they are to be introduced effectively into practice. On the other hand, training of medical staff is problematic: there are often shortages of skilled staff, and the skills required change as medical practice does. There are also trends and discontinuities in the pattern of ill-health in the population which have to be taken into account in planning.

Box 5.8: Horizon Scanning in Health: UK Example

HS in the heath/medical fields of one sort or another has a long history, but it was given a considerable boost by the UK Government's TFP. From the 1990s on, this programme has evolved through several stages, notably from undertaking a wide analysis of practically all sectors of the economy and areas of promising technologies, to a more focused approach where a succession of studies examine either important areas of technology development (e.g. "detection and identification of infectious diseases"), or specific social problems (e.g. obesity) where there is scope for the application of STI along with other policy interventions. A common The aim is to help coordinate different departments of government whose activities of would otherwise proceed in a piecemeal fashion and quite possibly undermine each other.

Confronting pressures of their own, and needing to deal with unpredictable change in society and technology, several departments of the UK government became active in HS activities. Sometimes these conformed to the restricted definition of HS discussed above, sometimes they involved broader futures and ForSTI activity (the "Horizon Scanning" label was probably applied because "Foresight" was identified with a specific department's Programme). While departments have their own specific interests and requirements, there was inevitably some duplication, and an effort to centralise HS was made by creating the Horizon Scanning Centre (HSC) in 2005. Hosted by Foresight, the HSC was intended to feed futures work into departments across government, and to encourage cross departmental activity at Permanent Secretary level to develop scenarios for use by government.

As an example of cross departmental use, the Department of Health (DH) and Department of Work and Pensions (DWP), asked the Foresight Horizon Scanning Centre to help them explore how trends might interact in the future to affect people aged over-50. A set of scenarios was created suggesting four possible future worlds together with a fifth scenario, setting out a preferred future for an ageing population. The three elements of this vision were: a more inclusive, 'age-neutral' society where people of all ages are valued for different types of social and economic contributions; full realisation of the potential of the over-50s population to contribute to society; and alignment of the provision of public services and support with need. The scenarios have been used by policy makers to test potential interventions. The project's outputs supported the futures work for the Foresight project "Mental Capital and Wellbeing", and were used in the analytic report published by the departments sponsoring the project.

More generally, the term Horizon Scanning is widely used in the UK health system, with a wide range of organisations engaged in HS activities, especially with respect to the impact, regulatory processes and application of new medicines and technologies. The organisations include, at the national level, UK Medicines Information, the National Horizon Scanning Centre (NHSC),

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Box 5.8 (continued)
National Prescribing Centre, Scottish Medicines Consortium, All Wales Medicines Strategy Group. Horizon scanning is, however, an integral part of some of the more science-based areas of policy development and is also part of the role of the Department of Health's Scientific Advisory Committees.

The NHSC's definition of HS, which has been adopted by the Department of Health, is well in line with our own understanding of the term (see Fig. 5.2).

In 2007, the Department of Health (DH) set up a specialist Horizon Scanning Unit (HSU) and Network to provide support to embed horizon scanning capabilities in order to improve the robustness of their evidence base and policies, within the Divisions of the DH. The HSU operates an internal DH's intranet as a corporate resource to share scanning information, contacts and methodology. Specifically the HSU is intended to:

- Promote a shared understanding of horizon scanning within the Department
- Improve capability and engagement across the organization, and with stakeholders
- Explore and share good practice with stakeholders in using horizon scanning to inform strategy and policy
- Share relevant findings from horizon scanning in OGDs, Select Committees etc. and Foresight with staff and stakeholders (including SACs)
- Promote the use of a wider spectrum of scientific and industry expertise in horizon scanning
- Work with industry on scenario planning
- Commit funds to act on the outcomes of horizon scanning as appropriate

Horizon scanning via HSU operates across government departments and at different levels of the Department, for example collaboration with the National Horizon Scanning Centre (see below); as part of the NIHR Health Technology Assessment (HTA) Programme ; and participation in ForSTI projects such as brain science, addiction and drugs, tackling obesity, infectious diseases, mental capital and well-being.

The NIHR funds a National Horizon Scanning Centre (NHSC) at the University of Birmingham. This has a relatively short-term focus, dealing with advances in technology and medical practice up to 3 years before launch in the English National Health Service. Data are derived from focused routine scanning of literature and internet resources; from a specialty-based work programme, liaising with the Royal Colleges and other specialty professional organisations to identify gaps in awareness, prioritise technologies in that specialty; and from in-depth scanning of patient pathways, usually at the request of, and in collaboration with, national decision making bodies.

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Box 5.8 (continued)
Important advances to examine in more depth are selected, and further work then develops briefings on these topics. The NHSC seeks to provide intelligence about such developments, describing the technology and patient group concerned, knowledge on clinical effectiveness, unit costs and alternatives, and the clinical, service and financial impact, as far as possible.

A high level committee (the Futures Group) of the Health and Safety Executive (HSE), a national independent watchdog for work-related health, safety and illness,) oversees its own HS system, and ensures that relevant information and advice is fed into strategic thinking and planning. The HSE set up a "futures team" at its Health & Safety Laboratory (HSL) to gather and analyse information on trends and developments across a wide range of subjects and disciplines. External contractors, including HSL, provide in-depth studies of emerging issues. The team calls on a variety of sources, including the considerable numbers of skilled policy and frontline operational and technical staff in HSE who are able to identify emerging issues and evaluate their likely impact. External input is also obtained through formal and informal networks and the website. In addition to the usual approach of deploying experts (or "expert generalists") to prepare a detailed study of the subjects being scanned, the HSE has also commissioned a scenario study, and engaged stakeholders in discussing these scenarios.

Although the terms used, time scales involved, precise remits and target audiences may differ, essentially similar processes are undertaken across many parts of the health system—only a sample of the whole spectrum of activities has been provided above. Expertise is shared amongst individuals and expert groups undertaking horizon scanning for different organisations.

These, and many other HS activities, use a mixture of consultation and engagement of wider or narrower pools of stakeholders, with more in-depth dedicated analysis from a small team, typically producing reports that can be widely circulated to provide decision-makers with critical intelligence. Consultation and workshops can be valuable in providing stakeholders with richer understanding of the issues and underlying dynamics than is likely to be achieved simply by circulating a report. Furthermore, this is an important opportunity for developing cross-departmental and cross-specialism coordination. Different parts of the policy and practitioner systems can share their understandings and objectives, in dialogue that makes it possible to clarify the meaning of the terminology used, the sources of evidence behind professional opinions, and the like. The horizon scanners, too, can learn more about who knows what, and about the types of information and ways of presenting results that are most effective for sponsors and other stakeholders.

Many of these HS approaches explore just a few years ahead. But workforce planning necessarily takes us into the longer-term, since it can take much longer

(continued)

Box 5.8 (continued)
than this to train professional and medical staff, and they will be in place for much longer still. Though there are frameworks for modelling the longer-term development of supply and demand for the HSC workforce, we have not located a great deal of longer-term systematic HS here. The Centre for Workforce Intelligence (CfWI) is now placing a great deal of emphasis on this theme.

ES and HS activities can be undertaken by using various qualitative and quantitative methods or a combination of them. The most frequently used methods range from reviewing of available sources for Scanning and creative and thought-provoking brainstorming exercises to surveys. Furthermore, more sophisticated applications of trend monitoring based on Big Data, bibliometric and semantic analyses, and network analysis are increasingly used for the purpose of scanning. We describe these methods in the following sections with examples.

5.4 Tools for Environmental and Horizon Scanning

5.4.1 Reviewing

First, the most straightforward way of undertaking Scanning is to review the outputs of other sources, which are engaged in similar efforts. Some sources with wide-ranging interests are listed in Box 5.9.

Box 5.9: A Selection of Sources on Horizon Scanning, Wild Cards, and Related Techniques[5]

- European Commission—Futurium: https://ec.europa.eu/futurium/en
- Shaping Tomorrow: http://www.shapingtomorrow.com/
- Millennium Project—State of the Future: http://www.millennium-project.org/
- The OSI Foresight Programme's Horizon Scanning site, as well as containing a large number of HSC-related topics, presents a guide to HS (https://www.gov.uk/government/publications/futures-toolkit-for-policy-makers-and-analysts). Many of the reports of Foresight are also highly HS-relevant—for example projects that have undertaken detailed analysis of future developments around Drugs, Cognitive Systems, Obesity, Mental Capital (https://www.gov.uk/government/collections/foresight-projects).

(continued)

[5] All webpages were accessed on: 14.01.2016.

Box 5.9 (continued)

- Many other countries have undertaken ForSTI Programmes, and some documentation about European experiences was made available from The EU FORSOCIETY network, which also published a good overview of HS practice (https://www.era-learn.eu/network-information/networks/forsociety).[6]
- There are several journals seeking to bring more rigour and documentation to the field, including *Foresight* (http://www.emeraldinsight.com/loi/fs), *Futures* (http://www.journals.elsevier.com/futures/), *Technological Forecasting and Social Change* (http://www.journals.elsevier.com/technological-forecasting-and-social-change/), *Foresight and STI Governance* (http://foresight-journal.hse.ru/en/).
- There are several organisations of futurists and foresighters, with the UK hosting The Foresight Network (http://shapingtomorrowmain.ning.com/) which brings together many individuals in a social network, and which has several active and relevant discussion groups. Several groups link people working on health, and on HS. The organisation behind this network has produced some extensive documentation on futures methods, including HS: see Chap. 4 of their Practical Foresight Guide (http://www.shapingtomorrow.com/media-centre/pf-ch04.pdf).
- There are (at least) two active global membership groups: the World Futures Society (www.wfs.org), and the World Futures Studies Federation (http://www.wfsf.org/).
- Two Foresight guides that are available online provide documentation on tools and methods, with many links to relevant information and expertise. These are Practical Guide to Regional Foresight in the United Kingdom (http://foresight.jrc.ec.europa.eu/documents/eur20128en.pdf) and The Handbook of Knowledge Society Foresight (http://www.eurofound.europa.eu/sites/default/files/ef_files/pubdocs/2003/50/en/1/ef0350en.pdf). An overview of TF methods and practice around the world has been produced by Georghiou et al. (2008).
- World Economic Forum (WEF)—Global Challenges (http://www.weforum.org/global-challenges). Global Competritiveness and Risks Team of WEF publishes regular Global Risks reports (the latest report is available at: http://www3.weforum.org/docs/Media/TheGlobalRisksReport2016.pdf)
- ARUP—Drivers of Change (http://www.driversofchange.com/)

[6] At the time of writing unpleasant cybersquatters seem to have taken over the Forsociety website, but a report on the experience is available in an academic journal, it is to be hoped that the extensive documentation of (especially UK and Dutch) HS will become available again shortly.

5.4.2 Brainstorming for Scanning

Brainstorming was introduced in Chap. 4 as a technique that is widely used to generate ideas from groups of people. In Scanning, it is done in a workshop setting, often using a STEEPV or similar framework is used for ES. Similarly, a template can be created to identify Trends, Drivers of Change, Weak Signals, Wild Cards and Discontinuities for the purpose of HS. The Scanning activity can be undertaken in a few hours or longer in the availability of time and other resources. As a reference, below we give a list of tasks for a STEEPV activity, which can be accomplished in a couple of hours in a workshop (Box 5.10). The duration and activities can be tailored to suit the contents of the activity and resources available.

Box 5.10: Tasks for STEEPV Brainstorming to Identify Drivers of Change

TASK 1

TASK 1A: STEEPV Brainstorming

Time allocated: ~45 minutes

The **Brainstorming** activity is undertaken as described in Box 4.1. A number of drivers are discussed under each STEEPV categories, which are then discussed in the next task "working with the outputs".

TASK 1B: Working with the Outputs of STEEPV Brainstorming

Time allocated: ~15 minutes

The task now is for each break-out group to work through its suggestions. The aim is to come up with the top three or four MOST IMPORTANT drivers under each of your STEEPV drivers, and to write these down very briefly (a few words per driver) in large and legible text, onto a set of flip charts (one S chart, one T chart, and so on). You may well discover that several of the ideas that have been generated are very similar or closely related, so it may make sense to group them together under a new heading, so form any such groups if they apply to drivers that you think are important. Select your top drivers for each STEEPV area by group discussion: try to reach a consensus; if this is very difficult, then a vote may be in order (for example, concerning which of two drivers should stay on the list and which go).

Your rapporteur should have a set of flip charts, each containing a list of drivers under an individual STEEPV heading, on which they can report to other groups by the end of this task. It is convenient if each set of drivers has a succinct label!

TASK 2

TASK 2A: STEEPV Brainstorming Reporting Back

Time allocated: ~25 minutes

Put the flip charts up on to a wall, or set of stands, so they are clearly visible.

Rapporteurs: Each rapporteur should report back to the plenary group on the set of drivers that they consider most important in influencing their topic area. Try to make a strong case for these being important drivers.

Make brief presentations—5 minutes at the absolute maximum. Discussion at this point should be mainly a matter of clarification and points of information. It is just possible that some items from some groups will be seen as highly relevant to the others.

TASK 2B: STEEPV Voting—Importance

Time allocated: ~15 minutes

Each participant is allocated three post-it notes.

Each participant: The task now is to use these as "votes" to nominate which of the drivers you believe to be most important in shaping the pattern of development of your topic.

You vote by sticking the post-its next to those drivers that you consider most important. You can put all three cards against one topic if you think this is overwhelmingly critical, or distribute them in some other way.

(Please record these votes. This is useful material for later analysis and a final report.)

TASK 2C: Top STEEPV Items

Time allocated: ~5 minutes

This is a job for rapporteurs!

Rapporteurs: The task now is to write the top five or six drivers from each of the two topics down onto flip charts. Choose drivers which have most votes. If there is a tie for the fifth or sixth item, then you can allow two items in. If there is a clear concentration of votes, so that (say) only four items get the vast majority of votes, then you can just use these and need not bother with trying to get up to five or six.

TASK 2D: STEEPV Voting—Uncertainty

Time allocated: ~15 minutes

Each participant is allocated ten post-it notes. You may not use them all!

The task now is to use these as "votes" on the single flip chart representing you groups' most important drivers for in shaping the pattern of development

(continued)

of your topic. But this time we are not voting on importance, instead the task is to indicate how UNCERTAIN you are about the development of each driver and/or its impact on the topic you are examining.

Each participant: You vote by sticking post-its next to drivers that you consider uncertain.

IF you are very confident about what will happen and what its effects are liable to be, then stick NO post-its by the driver.

IF you are slightly uncertain about what will happen and what its effects are liable to be, then stick ONE post-it by the driver.

IF you are moderately uncertain about what will happen and what its effects are liable to be, then stick TWO post-its by the driver.

IF you are moderately uncertain about what will happen and what its effects are liable to be, then stick up to THREE post-its by the driver.

If you have run out of post-its before you have finished, then you will have to choose how to distribute them so as to best capture your feelings about the uncertainties!

It may be that the result of this exercise will be a mass of stickers all over the place, or that there will be a clear concentration of voting in particular places.

Please record these votes—this is useful material for later analysis and a final report.

5.4.3 Surveys

Information for Scanning may be generated by surveying large amount of experts and stakeholders, which has proved to be a useful instrument for collecting ideas as to important topics to be included in ForSTI. A typical survey of this sort is the *Trends and Issues* survey, which was used in the initial stages of the UK TFP in the 1990s. This asked experts to suggest up to four important ideas in each of the topics in the area of interest: trends, driving forces, market opportunities, and technological requirements. The rich information elicited was open-ended and thus difficult to analyse, but provoked many ideas; it formed one source of several later Delphi questions (see Chap. 6).

Various other types of survey are currently used for a range of scanning purposes. For instance, the Millennium Project frequently undertakes real-time Delphi surveys to collect judgements from a wide pool of experts across the globe.[7] This is an electronic and web-based survey and is implemented on real-time basis. Another example is the TechCast survey, which is undertaken for the purpose of pooling collective intelligence of global experts to forecast the most

[7] http://www.millennium-project.org/millennium/RTD-general.html (Last visited on: May 19, 2015).

important technology breakthroughs, social trends, and wild cards for business and government.[8] The Big Picture Survey designed by Saritas and Smith (2011) was completed by many of the participants of the 4th Future-oriented Technology Analysis (FTA) conference. This survey generated a list of novel Trends, Drivers, Wild Cards, Weak Signals and Discontinuities, which were analysed and discussed in innovative ways by using network analysis (Nugroho and Saritas 2009; Saritas and Nugroho 2012). The use of surveys in ForSTI will be elaborated further in Chap. 6 of the book.

5.4.4 Big Data, Bibliometrics and Semantic Analysis

We live in an age of 'information overload'. New (or supposedly new) concepts, inventions, knowledge, technologies and innovations are introduced in an ever increasing number of scientific and non-scientific media. For instance, there are more than 20 million publications in the Medline database and this figure is topped up with 40,000 further publications per month. This is far beyond an individual's capacity to absorb, analyse and use. How to manage such an overload is the key question of "data science", a field that has attracted researchers from fields such as physics, computer science, genomics and economics, and which finds applications in health, science, and transport among other areas.

Big Data Analysis, bibliometrics, scientometrics, text analysis, technology mining, semantic analysis; these are among the terms frequently used to point to various ways of handling large amounts of data and information so as to reduce the effort involved in obtaining useful information. These methods help in detecting key trends and patterns of activity; they may signal developments that are important for thinking about future prospects. Definitions for some of these terms are given below (Box 5.11) to highlight the distinctions and overlaps between them—as a rapidly evolving field, the terminology is still being discussed in the literature extensively.

Box 5.11: Data Analysis Terms Defined

Big Data Analysis	Inventing and investigating new methods and algorithms capable of detecting useful patterns or correlations present in big chunks of data (p. 1).[9]
Bibliometrics	The application of quantitative analysis to measure publications and scientific output. Commonly used interchangeably with Scientometrics[10]

(continued)

[8] http://www.techcastglobal.com/web/guest/whatwedo (Last visited on: May 19, 2015).

[9] http://www.itu.int/dms_pub/itu-t/oth/23/01/T230100002200001PDFE.pdf

[10] http://thomsonreuters.com/products/ip-science/04_030/using-bibliometrics-a-guide-to-evaluating-research-performance-with-citation-data.pdf

Box 5.11 (continued)

Scientometrics	A mathematical and statistical analysis of science, technology and innovation with the aim of understanding scientific citations, mapping scientific fields, generating networks and measuring the impact of authors, articles, journals and institutions and generating indicators for policy and management (Leydesdorff and Milojevic 2015)
Data mining	The computational process of discovering patterns in large data sets involving methods at the intersection of artificial intelligence, machine learning, statistics and database systems[11]
Text mining	A systematic analysis of content in natural language text to determine the objective or meaning of communication
Technology mining	Technology mining refers to text mining of STI information. It makes exploitation of text databases for deriving knowledge about emerging technologies (Porter and Cunningham 2004)
Semantic analysis	The process of relating syntactic structures, from the levels of phrases, clauses, sentences and paragraphs to the level of writing as a whole, to their language-independent meanings. An associated concept "*Latent Semantic Analysis*" is defined as a theory and method for extracting and representing the contextual-usage meaning of words by statistical computations applied to a large corpus of text[12]

Many of the above-mentioned terms are used interchangeably in the literature (particularly bibliometrics and scientometrics). One source of variation across approaches relates whether they are analysing structured data (like Web of Science, Scopus or Patent Databases); semi-structured data (like Twitter, Facebook or other social networking data); or unstructured data (blogs, newspaper articles or any other open-ended data which can be found electronically). Whereas structured data can be analysed by using quantitative analysis and statistics, unstructured data is usually dealt with via semantic analysis and linguistic tools. Text mining is considered to be the application of Data mining to text (Thuraisingham 1999). A few other terms used in the literature include Infometrics, Webometrics, and Web scraping, and others will no doubt arise. Whatever type and source of data are used in ForSTI, the common objective is to generate future-oriented intelligence through exploratory analysis of data for research and investigation.

Figure 5.3 provides an illustration of how different source of data can be used for gaining intelligence on the different phases of technological development and STI evolution. This is an important point. While the analysis of publications can provide information on current research and development work, with potential future technologies, products and services; patent analysis generates information on already available and more near market technologies and applications to emerge

[11] http://en.wikipedia.org/wiki/Data_mining#cite_note-acm-2

[12] http://lsa.colorado.edu/whatis.html

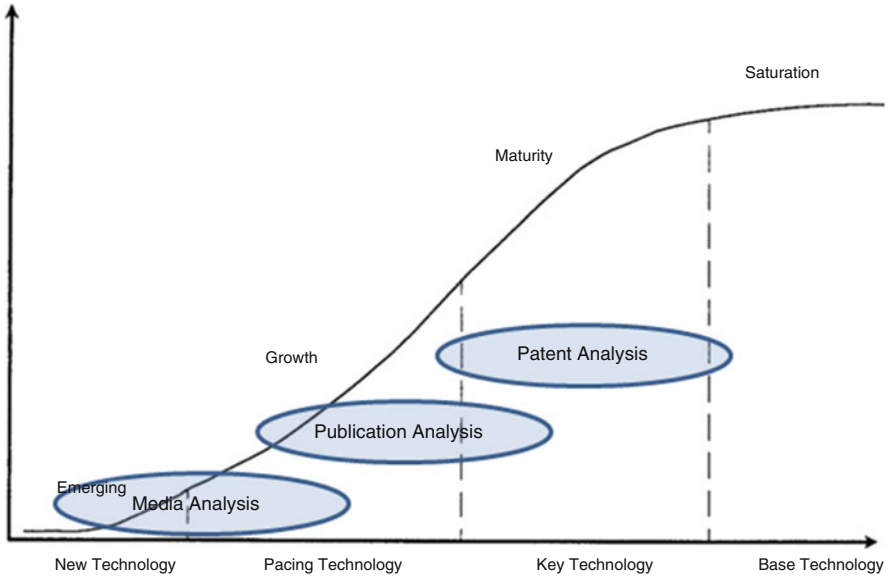

Fig. 5.3 The use of data sources across technology life cycle

in a shorter time horizon. Similarly, information from media, academic and business conferences, blogs, fora, and even data from CCTVs, sensors and satellites can be used to gain intelligence for different purposes and time periods.

For ForSTI activities, the analytical techniques can be used for:

1. Detecting futures
   a. Gathering intelligence on emerging technologies and socio-economic trends, which drive social and economic growth, and address Grand Challenges
   b. Identifying Weak Signals of possible future developments
   c. Early warning of Wild Cards, Shocks and Surprises
2. Responding futures
   a. Top countries, institutions and companies, funding organisations, potential collaborators and key people
   b. With implications on National STI policy and Corporate R&D strategy

Analysing more data in shorter spaces of time may help to reveal unknown information and can lead to better, more strategic and faster decisions. Thus, the analyses will:

- Increase the lead time for stakeholders to plan and address potential disruptions in the STI areas identified
- Provide early indications of potential emerging trends and disruptive technologies in those areas; and

- Enabling policy and strategy makers with tools for prioritising potential opportunities and threats; and allocating resources to increase the ability to capitalise on, protect against or mitigate the impacts of Grand Challenges, Wild Cards and related potential disruptions

Increasing number of applications and software are being launched for advanced data analytics. For instance, the Vantage Point is a text mining tool for discovering knowledge in search results from publication and patent databases.[13] Functions for data cleaning, natural language processing and principal components decomposition help to reduce complexity and locate meaningful patterns and clusters. After generating results though the analysis, it is often useful to generate visualisations for the interpretation and communication of data. Programs like VOSviewer[14] are able to create maps with various clustering algorithms. Network analysis and visualisation software, such as NetDraw[15] can demonstrate the inter-relationships between key terms, authors, institutions and other entities used in the analysis.

Quantitative data analytics methods can be combined with qualitative methods used in ForSTI exercises. Experts are frequently engaged in the scoping phase of the analysis, for instance, for the identification of the terms to be used in the publication and patent analysis; as well in the subsequent stages of the analysis such as for the interpretation of the interim and final results. (The interpretation of data reduction and mapping techniques usually requires expert judgement, since the purely technical algorithms used to choose, for example, the number of dimensions to be considered, have no understanding of the meaningfulness of the results.)

It should be remembered that the data analytics for the purpose of horizon scanning is usually carried out in the early stages of ForSTI exercises to provide input for the intelligence phase of activity. Therefore, the tools and approaches presented above can be combined with the other quantitative and qualitative methods throughout the study. Saritas and Burmaoglu (2016) present a ForSTI process where a patent-based bibliometric analysis is combined with other methods like scenarios, roadmaps and strategies in research looking in the future energy generation, transfer and storage technologies for the defence sector. Box 5.12 gives an example of how publication data can help us to understand trends in the use of ForSTI methods.

[13] https://www.thevantagepoint.com/

[14] http://www.vosviewer.com/

[15] https://sites.google.com/site/netdrawsoftware/home

Box 5.12: Identification of the Trends in the Use of ForSTI Methods Through a Scientometric Analysis

Saritas and Burmaoglu (2015) reviewed the evolution of the use of ForSTI methods through a scientometric analysis in the Web of Science (WoS) database. The use of "Foresight" as a search term in WoS generated 2659 publications from 1991 to present. The analysis revealed 4424 keywords/phrases initially. Following several rounds of data cleaning and fuzzy clustering through the use of the Vantage Point software, 68 ForSTI methods were identified in total. Figure 5.4 illustrates the occurrence of methods in publications across time, and thus shows the trends in the use of ForSTI methods and their integration.

As the figure illustrates, the number of ForSTI methods has increased dramatically in recent years. In the early 1990s, only a few ForSTI methods were referred in research and publications. However, the number of methods has increased to reach over 30. The variety of quantitative and qualitative methods used at present is noteworthy. The analysis reveals that key ForSTI methods—including scenarios, Delphi, forecasting and roadmapping—remain the key methods; while new methods are increasingly integrated with them such as bibliometric analysis, system dynamics, and network analysis. Various visualisations and other analyses are presented by Saritas and Burmaoglu (2015).

The approach described above to analyse the trends in the use of ForSTI methods can be applied, using different sources of data, to the analysis of socio-economic and technology trends in broader contexts.

Saritas and Burmaoglu (2016) outline a research methodology, which presents a way of integrating bibliometric analysis of patents with scenarios and strategic roadmaps with the case on the energy requirement of future military operations.

Tools such as bibliometric analysis can also be used at the evaluation (Impact) phase of the ForSTI process, for instance, to understand the impact generated by the Foresight exercise in various publications and other media across time.

5.4.5 Network Analysis

Network Analysis has attracted an increasing attention in recent years, largely because of its ability to reveal relationships and links that make up various social processes (Carrington et al. 2005). Within STI studies, this method has been proved useful to understand clusters of actors (e.g. Allen et al. 2007; Lee and Song 2007) and hot topics (Nugroho and Saritas 2009), collaboration practices (for instance Levy and Muller 2007; Roth et al. 2008; Tuire and Erno 2001) and diffusion across networks (among others, Cowan and Jonard 2001; Hussler and Ronde 2007). Network Analysis focuses on relations among a set of phenomena (e.g. actors and

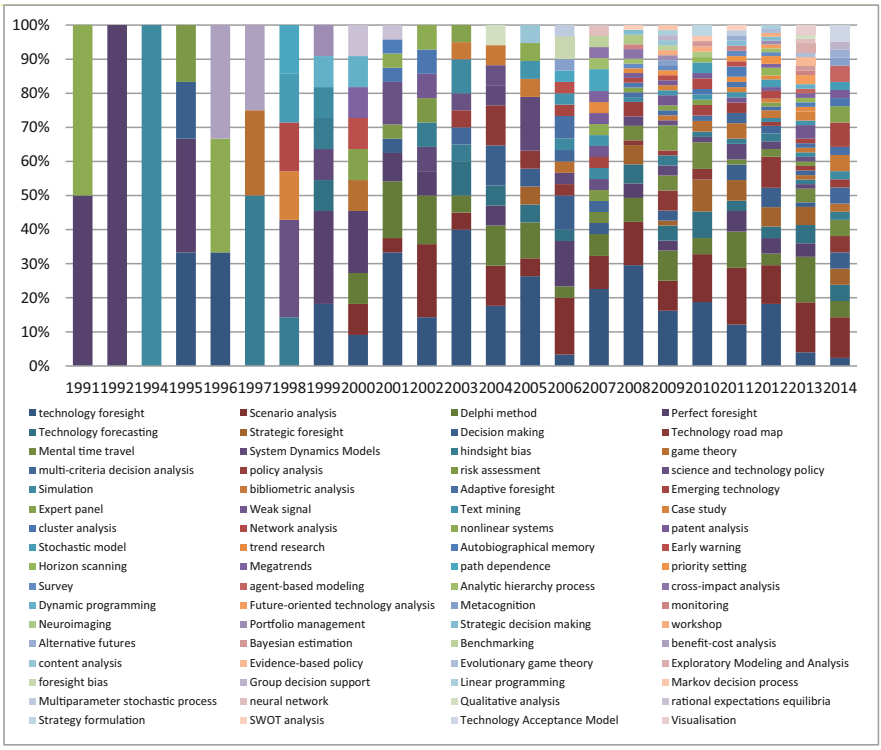

Fig. 5.4 Trends in the use of ForSTI methods

events where the number of connections can be assessed from various data sources—such as co-occurrence in newspaper stories, authorship of patents or publications, and so on).

Network Analysis includes techniques for data collection, statistical analysis, and visualisation, among others, that can be applied simultaneously to both the whole system of relations and parts of the system. The ability to capture the structure of the whole, or parts, of interacting system might be what makes Network Analysis particularly interesting for researchers working on organisations or systems approach (Kilduff and Tsai 2003), which makes it attractive to apply Network Analysis with ForSTI as a systemic activity (Saritas 2006).

Nugroho and Saritas (2009) propose two ways of incorporating network analysis in ForSTI:

- First, through the inclusion of network analysis into the formal methods of ForSTI
- Second, by conceptual incorporation of network perspective in ForSTI's phases

The first way to incorporate Network Analysis in ForSTI is via a straightforward use of it as a methodological tool for the purpose of analysing ForSTI data. In the ForSTI exercises data can be of any form: experts' opinion, statistics, survey responses, among many others, which are processed using certain methods. The contributions of Network Analysis in ForSTI can go beyond the ES and HS in the Intelligence phase, to cover the entire process of ForSTI:

- In the Initiation phase, Network Analysis could help to draw the boundaries of the exercise and to decide what topics/issues are crucial and how different topics/issues relate to each other.
- In the Interaction phase, Network Analysis could be used to map key actors. Further it can also help analyse the actors' positions in the network and map the importance of their affiliations relative to others. If the data is collected over time (panel/longitudinal), network dynamics analysis will be able to identify the shifting role of the actors.
- In the Intelligence phase, Network Analysis can be used to illustrate the systemic relationships between the outputs of ES (i.e. STEEPV factors) and HS (Trends, Drivers, Weak Signals, Wild Cards and Discontinuities). For instance, Fig. 5.5 illustrates the links between the trends identified by Saritas and Smith (2011) through the Big Picture Survey (Nugroho and Saritas 2009). The links based on the co-occurrence data in the figure clearly illustrates, for instance, the links

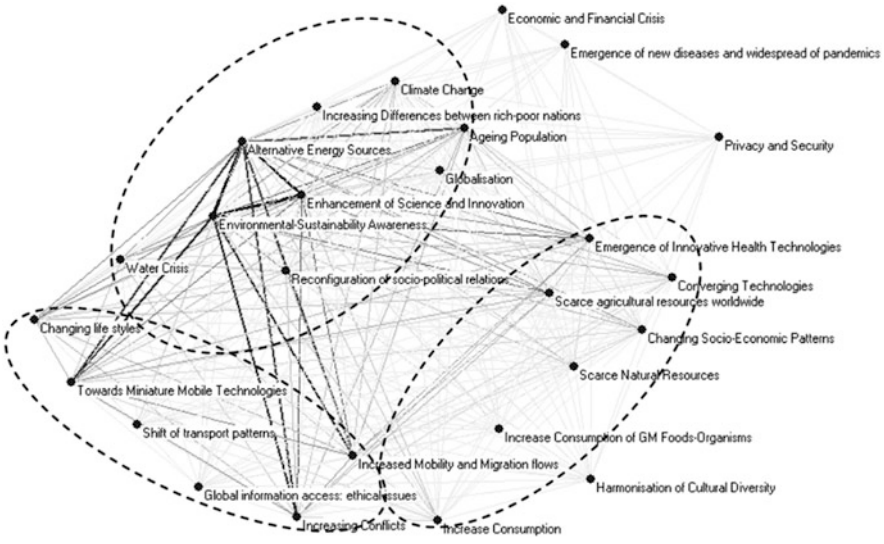

Fig. 5.5 Network of trends. *Source*: Nugroho and Saritas (2009)

between three trends: Environmental and Sustainability Awareness, Alternative Energy Sources and Enhancement of Science and Innovation.

- In the Imagination phase, which focuses on the development of alternative scenarios and models of the future, Saritas and Nugroho (2012) present the "Evolutionary Scenario" approach by analysing a series of networks based on HS data in different time horizons (i.e. every 5–10 years starting from the present into next 20 years and beyond). Thus they are able to explain the process of evolution from the present state into the future.
- In the Integration phase, network analysis can illustrate the central, broker and peripheral factors (for instance, based on network centrality measures), actors, organisations and institutions, and can help to determine the priorities and critical success factors, which might help for appraisals and vision building.
- In the Interpretation phase, network analysis can be used to build understanding of the structure upon which the ForSTI exercise is based. Further, as already elaborated earlier in this section, Network Analysis can help model, analyse and select important actors (and further, issues) and inform the transformation agenda.
- In the Intervention phase, network perspective can contribute to set up more effective collaboration and interdisciplinary actions.
- Finally, in the Impact phase, network analysis could be used in the evaluation of the whole process of ForSTI, particularly by examining the networks of actors and activities, and their relationships.

5.5 Conclusions

- Different data and information sources may be telling us about quite different things, all of which we should be attending to at first (even if some are later discounted from the further analysis). We can think of a life-cycle of ideas about what is on the horizon:
  - At first there may only be very "Weak Signals" as discussion about a possible driver or outcome of change is restricted to a few radical thinkers—they may be visionary scientists and engineers, artists and Science Fiction authors, avant-garde figures in social movements, etc. Some of these ideas may prove ill-founded or too far over any planning horizon (the events considered may be too far off, as would be the case, perhaps, of large-scale space colonisation or "downloading" human consciousness into information technology systems; or they may simply be so disruptive and uncontrollable with present knowledge that they will render our planning irrelevant, as would be the case with some major natural disasters or political catastrophes—such as a supervolcano or large-scale nuclear conflict). But many important developments have begun life as such apparently wild ideas.
  - Gradually, some of these ideas will be picked up and disseminated more widely. They may be manifest in ForSTI studies, in newspapers and popular media, and the like. They are deployed by management gurus and other

public figures who want to stay ahead of the game and cultivate an image of being forward-looking. Often at this stage there is a proliferation of new terminology to describe the phenomena, and there is increasing articulation of views about its meaning and implications. Striking examples or harbingers of the phenomenon bring it to public attention.
– Finally, the issue becomes the standard fare of policy reports and official documents. A few ways of describing and conceptualising the issue have been forged into a mainstream narrative of what the drivers of change are. The issue has become a matter of common sense and received wisdom, and people have quite possibly forgotten that it was once a wild idea.

It will be important to avoid restricting Scanning just to the issues that are already the topic of much discussion and debate. When we are using a longer-term time horizon, then some things that currently seem quite outrageous may well become everyday phenomena.

There are no panaceas for solving problems in complex policy environments. Scanning is only one input into the process of informing policy; like other inputs, it is subject to human fallibility and the very partial knowledge we have about many STI developments. This is particularly likely to be the case if Scanning is not being carried out in a systematic way; if there has not been enough effort to provide those responsible for Scanning with adequate skills, time and other resources, access to data and key informants, and so on. The Scanning function needs to be effectively scoped and related to other elements of the planning process, not to be taken as a stand-alone activity. This will help assist the Scanning team in asking the right questions and providing answers that can be used effectively.

Scanning is only as good as our ability to detect important signals, trends, and drivers. It may be worth applying different worldviews to the topic of concern, and thinking about what sort of factors might be seen as major influences by, for example, a believer in "tech-fixes", a techno-sceptic, an environmentalist, feminist, radical socialist, libertarian, and so on. What would be stressed from different scholarly disciplines or practitioner professions?

In addition to weaknesses in the Scanning activity itself, there can be problems in the way it is used in the planning process (We will not venture to discuss ways in which the planning process itself may fail to be properly implemented or used). It will be important to present the results of Scanning in ways that are meaningful and cogent to the intended audience, and if possible, to involve key decision makers in the HS activity that they can provide intelligence as to how to do this—and gain intelligence about the significance and scope of the Scanning itself.

Scanning exercises often feed into scenario development and analysis. One very good reason for this is that often the drivers and factors identified in HS activities are the ones, which are highly uncertain. We do not know whether a certain development will or will not occur in our timeframe (e.g. will medical treatments that effectively prevent the further progress of Alzheimer's Disease be developed?); we may not know how far it happens or what stage of development it may have attained (will these treatments be in wide use, what is their cost?); we may be

uncertain of their implications or effects (will there be a requirement for substantial retraining of patients who have not exercised cognitive skills for a period of time, will the treatment require new skills among staff?); we may be uncertain about interactions with other drivers (will the treatment be working in a context where other age-related conditions are also being tackled effectively, or not?).

Given the many uncertainties we confront, it is inappropriate to make a single forecast—we have no real basis for estimating a most likely future, and we can be fairly sure that Business as Usual will not prevail. Scenarios are used as one way of confronting such uncertainties.

Overall, Scanning is one of the most frequently used methods in ForSTI. HS of various sorts is typically used alongside scenario building, trend analysis, Delphi and other expert consultations. HS is often a preliminary step in a ForSTI exercise and mainly used in the Intelligence stage of the activity in an effort to see what are the major forces liable to shape the topic of concern, before launching more detailed studies of specific themes.