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Horizon Scanning in Foresight – Why Horizon Scanning is only a part of the game

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Abstract

Foresight and Horizon Scanning are often regarded as identical concepts with identical models and purposes. But they can be completely different activities, both in and for any kind of prospective activity as well as for strategy purposes. Scanning is no debate and no strategy building. Whereas Foresight is more process-oriented and always includes a Horizon Scanning phase, Horizon Scanning is rather found at the beginning of any forward-looking activity and can be an automatized stand-alone approach for identifying "things to come" - which often means the identification of new science and technology and providing information about them. This paper wants to shed light on some of the confusions in Foresight and Horizon Scanning (HS) that often occur in organizations, among researchers and practitioners being thus of practical and scientific relevance for using an integrated model. The contribution is backed up by a study conducted for the European Commission (Cuhls et al., 2015) conducted to clarify for the Commission's Foresight department (A6) how the strategic intelligence part of a foresight, the Horizon Scanning, is intertwined with the sense-making part in similar projects in other parts of the world. The contribution thus starts with a broad definition of Foresight and of Horizon Scanning, explains findings from the study on objectives, methods used and relates the discussion to the EU standard "Foresight Cycle" derived from EFFLA. The conclusions are relevant for decision-making and strategy processes in the European Commission, for national foresight processes but also for company's and other users.

KEYWORDS

decision-making, foresight, foresight for strategies, forward-looking activities, horizon scanning, policy-making

1 | INTRODUCTION

The core function of Foresight and Horizon Scanning (HS) activities is to better anticipate future opportunities or threats, and to identify issues in the present that are of major importance for possible futures. Both activities open spaces of contestation, initiating debates concerning alternative futures to help organizations understand what is most relevant to their aspirations and concerns. However, there are important theoretical and practical differences between HS and Foresight that shape the mode of their application. Whereas Foresight is a more comprehensive set of activities that are process-oriented and inclusive of different stakeholders, Horizon

Scanning is viewed as a search for "signals" and is generally found at the beginning of any forward-looking activity. As such, Horizon Scanning often misses further sense-making and implementation activities. Recently, Horizon Scanning has become an automated stand-alone approach for identifying "things to come" - which often means gathering information about new science and technology, including upcoming socio-economic issues and small signals - but it stops at providing this information and does not necessarily involve participation. Foresight is meanwhile much broader and focuses on dialogue and discussion formats as well as the "classic research methods" similarly used in Horizon Scanning. Foresight is employed more often for generating strategies (often called "Strategic Foresight"), to advise policy or for the preparation of decision-making.

For practitioners, the idea that Foresight and Horizon Scanning (HS) are identical is understood as a theoretical issue, but for the clients and users of Foresight, this misperception leads to confusion and has increased the demand for clarification. This demand for clarification was reiterated at a debate in the European Forum for Forward-Looking Activities (EFFLA) and the Strategic Foresight Expert Group (SFRI) of the European Commission. Therefore, this is an endeavor to clearly differentiate between the two terms, and their methodological implications, for the benefit of both the foresight community and procurers of future-oriented research and activities. Differentiating between the terms seems to be just a theoretical aspect, but has large implications for the practical work in public Foresight activities (see for example projects like BOHEMIA (European Commission/European Union, 2018b) or RIBRI (Warnke et al., 2019), both contributing to the preparation of the new European Framework Programme "Horizon Europe". It can even have implications for Corporate Foresight (Rohrbeck & Schwarz, 2013; Rohrbeck et al., 2015, see also Rohrbeck et al., 2018; Sarpong & Meissner, 2018).

Horizon Scanning at the beginning of a forward-looking activity is applied for identifying "things to come," often new science and technology. This is not regarded as a strategy building activity, but can be a step towards strategy much as foresight is also only a "step in planning" (Coates, 1985).

Why look at Horizon Scanning? During the last years, activities under this name broadened in scope and in number of applications (Cuhls et al., 2015). Horizon Scanning is more and more automated, and some practitioners already fear that larger Foresight processes are not needed, anymore, because the "belief" in automation and its "prediction" capability (in fact extrapolation) is so overwhelming that providing this information is enough for many decision-makers. An overview of Horizon Scanning approaches (Cuhls et al., 2015) shows that this is definitely a wrong belief. Like in trend research, the findings remain vague and valuable for everyone, but cannot be utilized without activities that transfer this knowledge into actionable intelligence to the client.

Thus, I argue that further steps are needed to provide new information to develop a strategy by looking a) into the future and defining a target, and then 2) back from the future target. This is rather "Foresight for strategies", which starts with an open view and for which backcasting, roadmaps, and even visioning for defining the clear target can be applied. This is necessary to provide new information for filling a strategy with life. We can only call it "Strategic Foresight" if an objective is already existing (e.g. target or strategy fixed by a government) when the Foresight starts, and the Foresight is mainly used to fill the gaps, the steps on the way to achieve the target. Both are different ways of performing Foresight, both need Horizon Scanning but are not equivalent.

Foresight focuses on dialogue and discussion formats, general outlooks, and alternative scenarios as applied for generating visions, strategies, and policy- or decision-making. Foresight is utilized by public and private institutions and is an essential activity for strategy building. Often, Foresight is mixed with strategy-building, but it needs differentiating. Strategic Foresight is discussed by Slaughter in 1999 (p. 287), and has since evolved in its definition (Coates et al., 2010, Godet, 2000) and framework models (e.g. Gavetti & Menon, 2016). We can differentiate between the broad concept of Foresight as used in larger processes, e.g. in public policy contexts (like the European Commission) or in larger company's (general Corporate Foresight approaches, see Rohrbeck & Schwarz, 2013; Rohrbeck et al., 2015 or for an older approach Reger, 2001; Coates et al., 1994), and the more restricted term "Strategic Foresight". In using the term "Strategic Foresight", a pre-existing strategy is assumed, and a forward-looking process like target-setting can be initiated more quickly. Psychologically, having strategy first means already closing up the discussion of the long-term future, making it difficult in later phases to open up the participants' or foresight practitioner minds again for new ideas, different perspectives, addressing biases (see BMBF Foresight II, Zweck et al., 2015b, 2015c, 2015a), and for potential participation, e.g. of citizens in public.

Sometimes, Foresight is also confused with scenario work or scenario management in the sense of scenario planning or building scenarios. But even though there are many different approaches to scenarios, and they are often worked out to create strategies in organizations (a good example is Lehr et al., 2017), "scenarios" are rather seen as a "method" in this context (for some overviews see e.g. Börjeson et al., 2006; Bradfield et al., 2005; Fink & Siebe, 2016; Fink et al., 2004; Godet, 2000; Pillkahn, 2008; Postma & Liebl, 2005; Rowe et al., 2017; Shoemaker, Day, & Snyder, 2013, van Notten et al., 2003, Wright et al., 2017, 2013, but there are many others). For making strategic use of scenarios, see e.g. Lehr et al., 2017 or Fink & Siebe, 2016. We in our Competence Center, Business Unit "Foresight for Strategies," also have the experience from industry project examples, which unfortunately cannot be published.

The terminology around Foresight can be confusing for diverse clients in company's, ministries, associations, or the European Commission when discussing starting points, identifying project objectives, or discovering suitable methodology. To bring a bit more clarity into the different approaches, this paper sheds light on the differences between Horizon Scanning and Foresight, and how they might be complimentary, integrated, forward-looking processes. The conclusions are relevant for decision-making and strategy processes

in the European Commission, for national foresight processes but also for company's and other users.

The cause for discussing differences between or integration of Horizon Scanning and Foresight was a very practical one: Both, the European Commission and the German Environmental Agency (Umweltbundesamt, UBA) raised the question about Horizon Scanning and its applications at nearly the same time. Both institutions separated it from Foresight activities well knowing that there are overlaps in methods and application. In the political debate and the debate what is methodologically useful, it was therefore essential to differentiate and clarify the terminology so that the European Commission launched a project about "Models of Horizon Scanning" (Cuhls et al., 2015).

1.1 | What is Foresight?

The definitions of Foresight are manifold and continue to be the focus of intense discussion within the field (see Cuhls, 2003; Georghiou et al., 2008). One of the famous definitions that is still valid is the one used early by Ben Martin (1995a,b, base: Irvine & Martin, 1984) about the systematic view into the long-term future with implications for decisions and policies in the present. Martin's paper concentrated on Technology Foresight, and influenced the first generations of national foresight activities (Georghiou, 2001, Miles et al., 2008, p. 15, Miles et al., 2017, for generations also Yksel et al., 2017). In these views, (Technology) Foresight is closely linked to policy and decision-making processes with a focus on science, technology and innovation (STI). It is thus clear that foresight is not planning (Coates, 1985) but it can be used as a step in planning to provide information (weak signals in the sense of Ansoff, 1980). Others see foresight rather as a vision-producing process, e.g. the FOREN network used this definition: "Foresight is a systematic, participatory, future intelligence gathering and medium-to-long-term vision-building process aimed at present-day decisions and mobilising joint actions..." (FOREN Network, 2001, pp. 3–4). Foresight is also very similar to the French "la prospective" (Berger et al., 2008; Godet, 1994, 2000).

For our purposes, we define: "Foresight is the systematic debate of complex futures" (Cuhls, 2012) unifying the definitions mentioned above, and opening up contexts like open and exploratory futures, realistic/probable futures, and desirable/ preferred futures to better differentiate the term "visions". Foresight is thus.

- Structured: it is a systematic approach by applying methods of futures research, science-based, and based on new theories of futures research
- A debate: it includes interaction of relevant actors, active preparation for the future or different futures, and orientation towards shaping the future
- Complex: it includes the consideration of systemic interdependencies, takes a holistic view
- Futures is plural: it is an open view on different paths into the future with thinking in alternatives. We also envisage different types of futures, in futures research we differentiate between possible, probable and preferable futures, Voros even adds potential and plausible futures (Voros, 2003, p. 16–17).

Foresight takes the long- and medium-term view, and encourages us to learn about the impacts of our actions in the present. It is not prediction (Cuhls, 2012), but rather a "set of approaches to bringing longer-term considerations into decision-making, with the process of engaging informed stakeholders in analysis and dialogue being important alongside the formal products that can be codified and disseminated" (Miles, 2008, p. 37). Additionally, it is inclusive of policy-making approaches, participative approaches, and prospective approaches (coming from traditional forecasting) and many different methods therein (Cuhls, 2008; Popper, 2008).

The objectives of Foresight activities can be very different (Cuhls, 1998, 2003), but generally aim to open up discussions and debates broadly prior to strategy-formulation. Sometimes they are just opening up the way of thinking (Cairns & Wright, 2018; Cuhls, 2017; Heinonen et al., 2017; Inayatullah & Milojevic, 2015; Popp et al., 2016) while in other cases, Foresight activities are directly targeted towards goals. Objectives range from (Cuhls, 2012).

- Enlarging the choices of opportunities, setting priorities and assessing impacts and chances,
- Prospecting the impacts of current research and technology policy, or of societal and other developments,
- Ascertaining or even testing new needs, new demands and new possibilities as well as new ideas,
- Focusing selectively on looking at the economic, technological, social and ecological areas as well as to start monitoring and detailed research in these fields,
- Defining or starting the definition and formulation of desirable and undesirable futures
- Working out objectives (goals) for strategy processes and
- Starting and stimulating continuous discussion processes with motivating the participants.

Modern Foresight concepts, processes and approaches thus address the full cycle of policy with their different objectives (see Cuhls, 2012; Georghiou et al., 2008 and others) often overloading the expectations. Their major task is to stimulate futures thinking and as already Slaughter wrote in 1995, the purpose is to push the boundaries of human perception, to bring in long-term critical thinking, envision desired states, and formulate strategies to address any consequences of present action. Foresight's main purpose is to identify opportunities and avoid futures that are perceived as negative from the current point of view.

The European Forum for Forward-Looking Activities (EFFLA) came back to definition and procedural questions on behalf of the European Commission. A common understanding of Foresight was discussed in this expert group resulting in a set of Policy Briefs to inform the policy-making processes at European level. A foresight cycle model was developed which includes the steps shown in

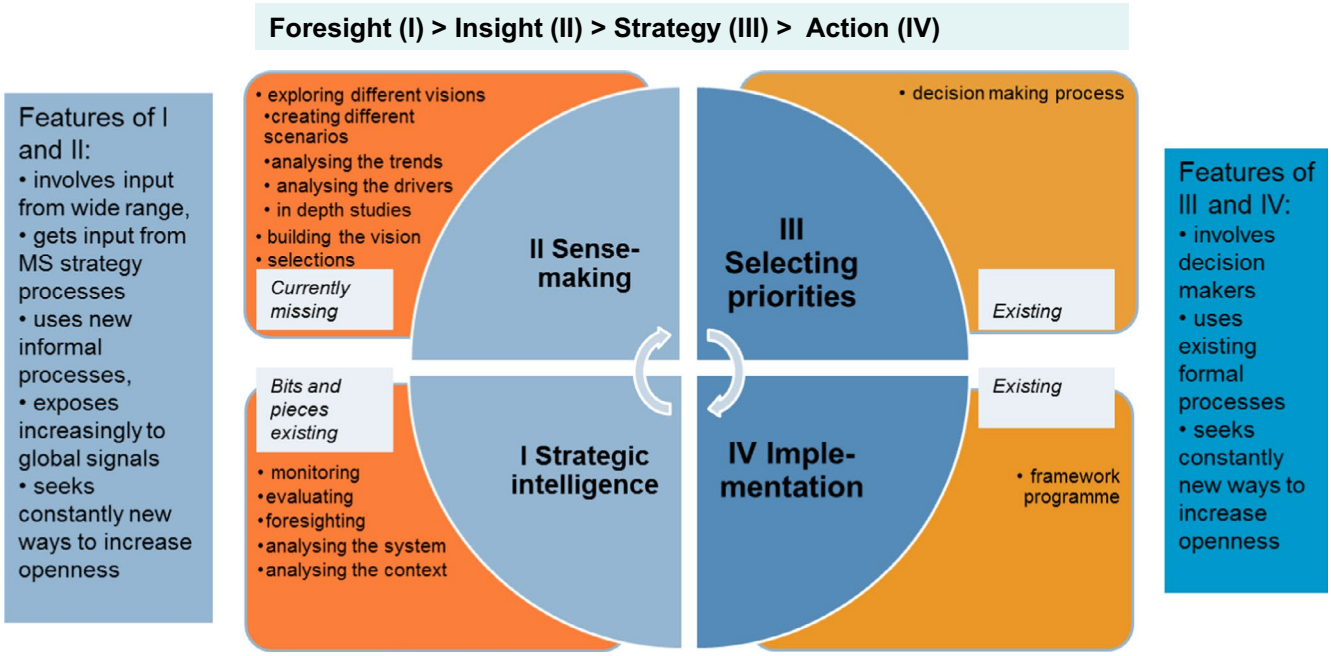

FIGURE 1 Foresight Cycle in policy-making (EFFLA Policy Brief no. 2, 2013 and Policy Brief no. 13, 2014)

Figure 1 (EFFLA, 2014a,2014b, 2014c,2013a,2013b).The process model comprises steps that are necessary from the point of view of policy-makers. The original model was provided by VTT and VINNOVA colleagues, who inductively derived it from their different practical project flows (a kind of descriptive model). It was adapted as the "standard" based on the experiences of several EFFLA members and their practical projects in mind, a kind of "best practice model" that can be used as a prescriptive model for the European Union Foresight. Experts in EFFLA represented the theorists and practitioners of Foresight in policy-making contexts in their respective countries with having a representation from nearly all EU countries. There is of course no evidence in the sense of a direct relation between the model used in the specific organization and "success" of the foresights in the countries where the model is used. In the joint understanding, the model turned out to be something like a "common way" of conducting Foresight independent of organizational requirements.

Step 1. Strategic Intelligence gathering is searching for "information about the future" making use of different perspectives. Information about the status quo is also needed as reference point for the "present," which is already difficult to determine and formulate (Figure 2). Phase 2. Sense-making means an assessment of the fit to the criteria or other requirements for the user of the foresight or the process itself. Sense-making is literally "making sense of the information" and tests the strategic fit of the information found. 3. Selecting priorities means a criteria- or discussion-based selection of the directions to follow. Phase 4 is the implementation, which means preparing the decision, the real "making of," or the designing of a new strategy. This model is an ideal model derived from experiences and real cases (there is no citable literature on such a model), and most practical Foresights on corporate or national level still miss parts of it.

2 | WHAT IS HORIZON SCANNING?

Horizon Scanning has an important role in forward-looking, prospective, or anticipatory activities: it serves to explore futures, "emerging issues," and signals of all kinds, and to evaluate the importance of "things to come." During the last few years, different "Models of Horizon Scanning" have been developed through testing new methodological combinations and establishing specific "Horizon Scanning" institutions. Horizon Scanning (HS) approaches mainly serve to enhance resilient policy-making, address policy makers' needs and concerns regarding new issues, to identify business opportunities by anticipating consumer and societal needs or to prepare society for less expected or rapid changes. The definition of Horizon Scanning used by the European Commission in the project on Horizon Scanning (Cuhls et al., 2015) is the following:

> Horizon Scanning is the systematic outlook to detect early signs of potentially important developments. These can be weak (or early) signals, trends, wild cards or other developments, persistent problems, risks and threats, including matters at the margins of current thinking that challenge past assumptions. Horizon Scanning can be completely explorative and open or be a limited search for information in a specific field based on the objectives of the respective projects or tasks. It seeks to determine what is constant, what may change, and what is constantly changing in the time horizon under analysis. A set of criteria is used in the searching and/ or filtering process. The time horizon can be short-, medium- or long-term.

Horizon Scanning is a large part of the *Strategic Intelligence* phase of the strategy process described in the different briefs of EFFLA (EFFLA, 2013a,2013b, 2014a,2014b,2014c, see Figures 1 and 2). Although it mainly refers to information gathering it is strongly linked to sense-making (phase 2, see Figures 2 and 3). Time frames (the "horizons") may differ according to the subject and purpose of the approach.

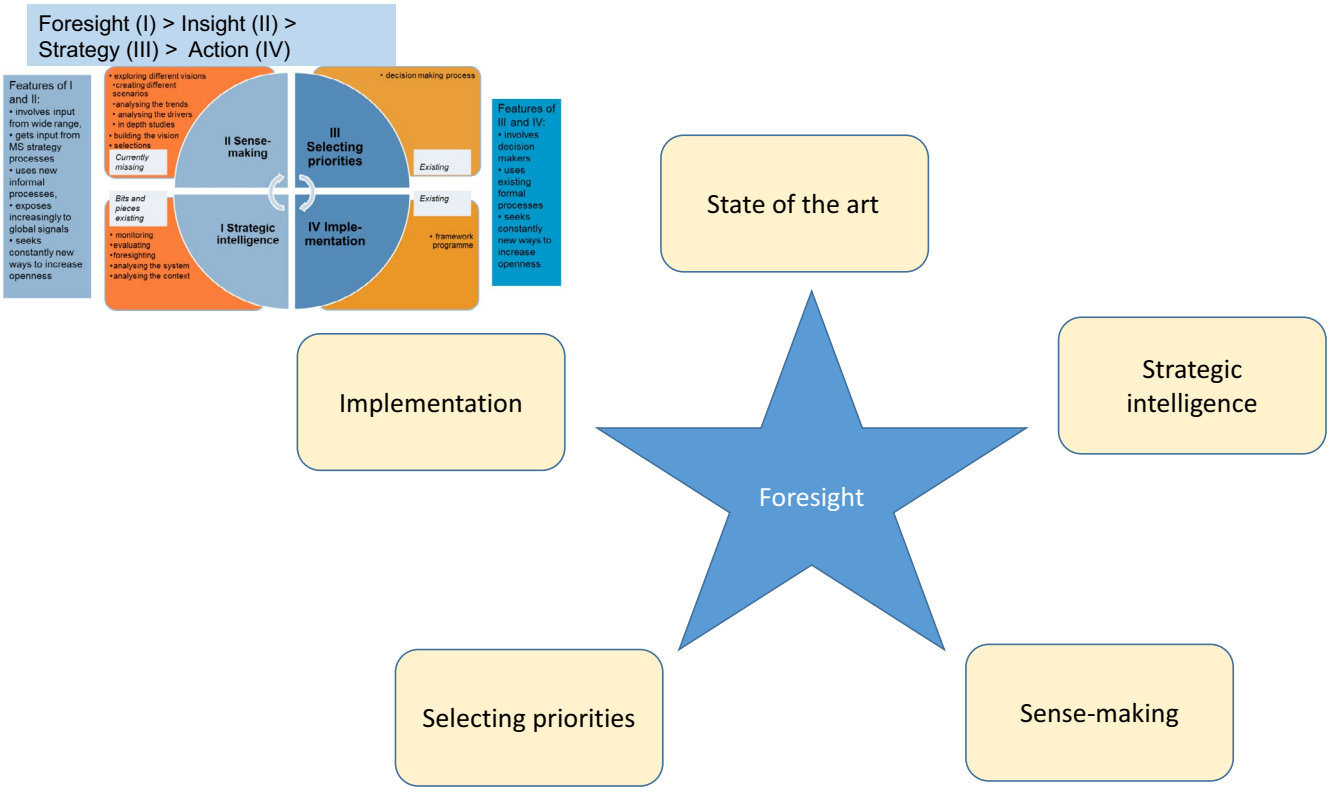

FIGURE 2 Foresight Cycle includes the State of the Art

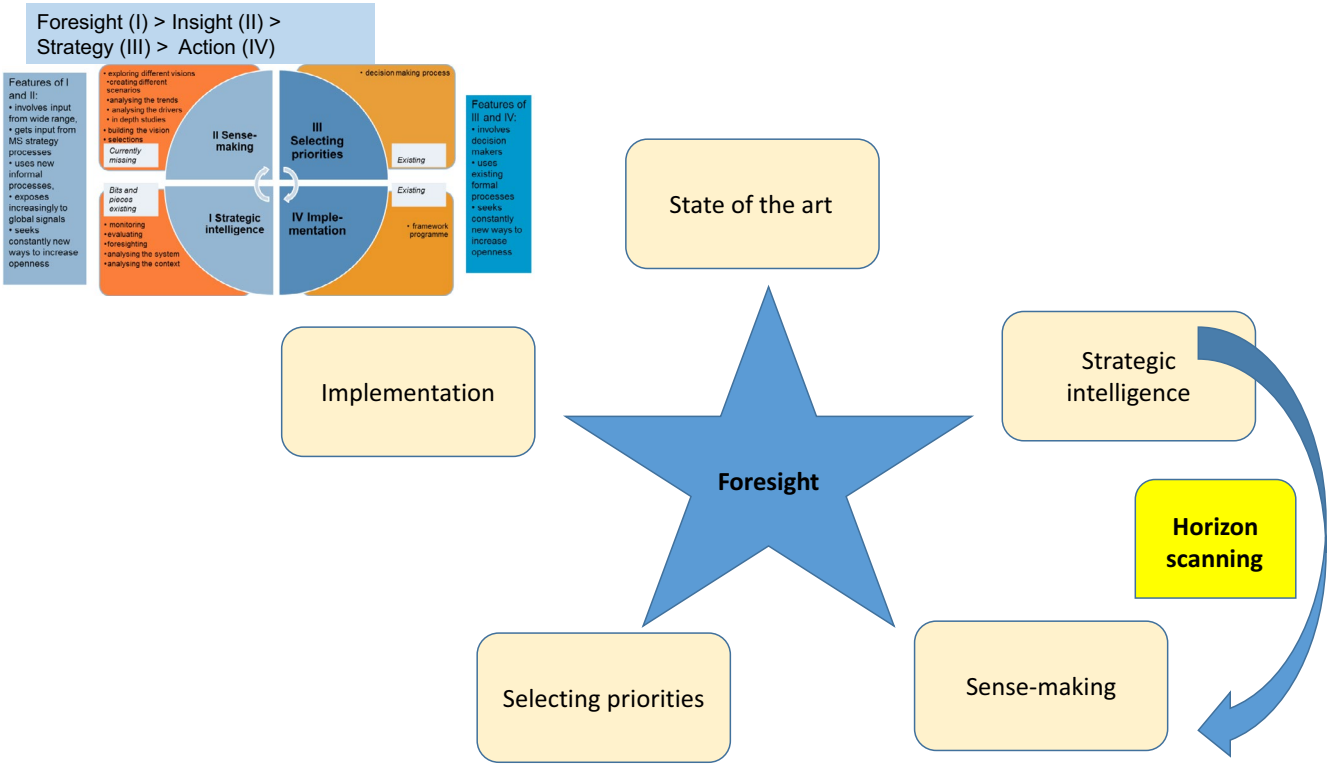

FIGURE 3 Horizon Scanning in the Foresight Cycle (according to EFFLA, 2013b,2014c and EFFLA, 2014a,2014b,2013a)

Horizon Scanning is often based on desk research, helping to see the big picture behind the issues to be examined. It can also be undertaken by small groups of experts who are at the forefront of the area of concern, share their perspectives and knowledge with each other so as to "scan" how new phenomena might influence the future. A solid "scan of the horizon" can provide the background to develop strategies for anticipating future developments and thereby "gain" lead time until things get urgent (Cuhls, 2019). It can also be a way to identify and pre-assess assumptions about the future to feed into a scenario development process. There is considerable experience with Horizon Scanning dispersed in different countries, organizations and institutions - some are more successful than others. Often, the results are under-exploited. New techniques are continuously experimented with.

3 | HORIZON SCANNING ACTIVITIES: AN ANALYSIS OF 27 INTERNATIONAL CASES

In a case study for the European Commission, we examined the ways Horizon Scanning is performed (Cuhls et al., 2015). The cases were chosen according to the preliminary definition of Horizon Scanning (see above), the accessibility of sources (reports, internal documents, internet pages, other material), the classification of being "successful" in relation to their purpose, and the availability of experts who could be interviewed as "insiders" wherever possible. Twenty-six practitioner interviews were conducted to gather detailed methodological information (for the questions see Annex), own experiences from Fraunhofer ISI, TNO and VTT were added. Gray literature, internal documents and insider knowledge were analyzed - the amount of data and the quality of reports differed between the cases. Table 1 gives an overview of the cases, and the additional literature list includes background material and further sources. This was regarded as sufficient for understanding the relation of Foresight and Horizon Scanning and to inductively include the findings into the mode Foresight praxis. The study was not intended to be an overall comparison of the different aims or features of the individual cases but to pick out relevant elements for performing qualitatively sufficient and impactful Horizon Scanning, for use in advising the European Commission.

The cases are neither exhaustive in themselves nor do they cover the totality of HS activities in the world, but they were considered to be representative for national level activities. A broad range of experiences was represented in the cases: from completely automated Horizon Scanning processes to open searches via scouts (people), from national large-scale foresight processes to small, company-specific and target-oriented searches. There were resource-intensive processes as well as very small-scale and resource-saving approaches. Some examples intentionally pursued participation and stakeholder involvement, while others focused on expert participation, on single, detailed issues or automatically generated reports (dossiers). The Horizon Scanning results of the specified cases were communicated in reports, dossiers, newsletters (regular or irregular), internet platforms, in peer dialogues, or a combination of different channels. All cases were processed between 2010 and 2015, and the interviews were all conducted in spring and summer 2015.

3.1 | Observations

The following findings summarize the results from the project's analysis.

1. Objectives - Horizon Scanning was performed for the following reasons
   - To provide a forum for monitoring, reviewing, and sharing information about future developments of any kind,
   - To give orientation, identify chances (e.g. for future emerging technologies), serve as an early warning system (e.g. emerging conflicts), and initiate dialogues.
   - To generate background information, evidence and scenarios for foresight projects. Horizon scanning forms an integral part of what is called *trend analysis*, and is typically implemented as one part of setting-the-scene or contextualizing activities within foresight projects.

Specific objectives of different Horizon Scanning cases were defined by the direction of the search that was performed, e.g. by key areas that are scanned, keywords searched for [1, 2, 4, 9, 12, 14, 15, 19, 20, 21][1], or even by the research or technology field they are supposed to serve [1, 2, 4, 5, 6, 9, 11, 12, 13, 14, 15, 21, 24, 25, 26, 27]. Some cases have Horizon Scanning integrated into a full Foresight process from the search of topics to priority-setting and recommendations (e.g. Japanese Foresight [12], German BMBF Foresight [15] or Policy Horizons Canada [6]), in the sense of Figures 1 and 2). Others are more focused on details [19, 20, 27], and have the objective of providing early warning, identification of new research and technology focuses ("hot topics," "hot spots") or broad information for policy-making (for more details, see Cuhls et al., 2015).

2. Scoping: Overview versus Sectoral. When the objective is to gain an overview of emerging issues and signals (open search or search over a lot of fields like in the OECD (Keenan, 2016 [18]), the German BMBF Foresight (Cuhls et al., 2009a, Zweck et al., 2015b, [15]), RAHS Singapore [1], and others) Horizon Scanning is often part of a full foresight process. In other cases, the search field is already limited (e.g. search in a technology field, in an area like in the UK Foresight [5], or for a very limited application, e.g. kitchen equipment for a company like Philips [20]).
3. Methods applied range from automated searches via keywords and their modifications [e.g. in 1, 3, 4, 7, 10, 12, 15, 21, 24] to open (explorative) scenario workshops [2, 12]. For a full combination of Horizon Scanning and scenario planning procedures, see e.g. Rowe et al., 2017. In the cases examined, the combination with scenarios (alternatives) was rarely found. Straightforward identification of issues and an assessment were more often the method of choice. A new combination of search and assessment was just tested in the European project "Radical Innovation Breakthrough

TABLE 1 Cases in Horizon Scanning Analyzed in 2015 (Cuhls et al., 2015, order according to the study). Please note: The order of presenting the activities was given by the starting list in the study. First, there are national horizon scanning activities, then international, corporate activities and the last ones were identified as interesting during the study

National HS activities (main focus)	Main Sources of information in 2015
1. Risk Assessment and Horizon Scanning Programme Office Singapore The RAHS program explores methods and tools that complement scenario planning in anticipating strategic issues with significant possible impact on Singapore. With the help of international partners as well as through experimentation, the RAHS Programme has developed processes that enabled agencies to collect, analyze, inform, model and monitor emerging strategic issues. These processes are supported by products that enable analysts to better perform their roles including the RAHS software platform which is specifically designed and developed with capabilities to support research and analysis using information extraction and visualization, modeling and survey tools. The RAHS team has been actively engaging government agencies, academic institutions and international partners through training, consultancy and joint projects. The projects generally explored emerging issues with the aim of enhancing strategic anticipation capabilities for the agencies.	Scanning documents and internet page; Main source: www.rahs.gov.sg
2. Australasian Joint Agencies Scanning Network, including the Australia and New Zealand Horizon Scanning Network (ANZHSN) The Australian Horizon Scanning Program is a collaborative Commonwealth and State initiative guided by the Health Policy Advisory Committee on Technology (Health-PACT). Health PACT is a subcommittee of the Australian Health Ministers Advisory Council (AHMAC), reporting directly to the Clinical, Technical and Ethical Principal Committee (CTEPC). HealthPACT comprises of representatives from all State and Territory health departments, the Australian Department of Health and Ageing, the Medical Services Advisory Committee (MSCAC), the New Zealand Ministry of Health and the New Zealand District Health Boards. It is the network, in which the Horizon Scanning is organized; with representatives from all different jurisdictions on the one hand, as an advisory committee, they are directly linked to the Ministry – and they are linked to own networks in the "regions"/ states of Australia. The AJASN was the first network that was in place for Horizon Scanning, the business model was fairly unique in terms of national scanning activities. The AJASN has adopted a fluid partnership approach, with individual members contributing a small fee each calendar year. The outputs include an online database, quarterly reports, and an annual report. Member organizations decide the level and nature of other contributions they will make to the network; these contributions vary according to their specific needs, workloads, and interests. Different agencies have taken different approaches suited to their individual culture and mission. AJASN activities and reports are used to inform broader position papers, annual reports, internal horizon scans, strategic planning activities, and individual policy, program and service delivery design and development processes. AJASN is also used by member organizations as a professional development opportunity (to improve strategic thinking).	Documents, interview; AJASN from Delany & Osborne (2013)
3. The Central Planning Bureau, The Netherlands The study was carried out by two of the Dutch planning bureaus. The planning bureaus are formally part of the government and have the task of carrying out policy-relevant research in various areas to inform policy-making. The study was based on a review of existing literature. Moreover, several internal workshops with employees of the two planning bureaus were held. The thematic scope of the scanning was very broad. An advisory group, composed of employees of several Dutch ministries, guided the development of the study. The study solely focused on trends that are supported by "hard" evidence provided in scientific literature.	Documents, direct insider knowledge, interview; reports in Dutch
4. Finland Future Watch, Tekes –, Finland Finland Future Watch was an embedded broad inter-ministry and inter-agency effort, "*Team Finland*", to coordinate horizontally Finnish policy instruments in support of business internationalization. Team Finland included major Finnish technology and business organizations and was lead by Tekes, the Finnish Funding Agency for Innovation. Finland Future Watch focussed to facilitate the internationalization of Finnish business, with particular emphasis on the fast growing small and medium-sized firms. This work consisted of (1) information and intelligence and (2) networking. By collecting information, undertaking targeted analysis, as well as knowledge diffusion and networking activities. Aim of the study was to lower the threshold for internationalization of business and to provide Finnish SMEs with business intelligence in direct support of their operation-al activities. The Future Watch part has a time horizon of 2–5 years.	Documents, direct insider knowledge, interview
5. Horizon Scanning Centre UK The Horizon Scanning Programme Team coordinates strategic horizon scanning work across departments, drawing on insights from experts in and outside government to challenge our thinking. The joint team brings together members of the Cabinet Office Analysis and Insight Team and the Government Office for Science. The team was created in March 2014, after the Cabinet Office's Horizon Scanning Secretariat merged with the Government Office of Science's Horizon Scanning Centre; combining the respective expertise and networks. This joint team helps the government to make informed decisions about the long-term. The techniques of horizon scanning help analyze whether the government is adequately prepared for potential opportunities and threats, and ensure that policies are resilient to future environments defined by social trends or new technologies. It can also help inform spending choices that will have ramifications for many years. It is also a contribution to open policy-making. The majority of government departments carry out horizon scanning research. The Horizon Scanning Programme Team's role is to join up this analysis and ensure it is refined by insight from experts within and outside government. The ultimate objective of the scanning team is to ensure that horizon scanning is embedded into policy making. Some formats are roundtable discussions on specific topics, taking part in "communities of interest" (these groups bring together a range of experts to explore how a particular issue might affect different areas of policy) and setting up the Horizon Scanning Private Sector Network, a network of private sector horizon scanning experts, drawn from a range of firms who either specialize in horizon scanning or include it as a fundamental component of their corporate strategic planning.	Description and Database of the Horizon Scanning Centre, interview

(Continues)

TABLE 1 (Continued)

National HS activities (main focus)	Main Sources of information in 2015
6. Policy Horizons Canada Policy Horizons Canada anticipates emerging policy challenges and opportunities in a rapidly changing and complex world. Through scanning and foresight they monitor and explore social, economic, environmental, and technological changes in Canada and around the world. They look at how these changes may come together in the future. Each year a theme or set of related topics is examined. The results of this work are communicated through *MetaScan*, foresight projects as well as other publications. These help federal organizations to take a holistic, longer-term approach while they are dealing with their short-term priorities. The starting point is always open on a meta level (Meta Scan). Then, an issue or single topic is chosen and dealt with in more detail in a dialogue-based foresight process that uses modern foresight tools to engage knowledgeable participants in exploring alternative plausible futures and their potential implications. This allows participants to explore the forces of change taking shape, e.g. in Asia and their potential implications for Canada in the areas of economy, energy, geo-strategic, and social issues.	Documents, study, interview, http://www.horizons.gc.ca/eng/content/current-projects
7. NOSEit, Executive Agency For Higher Education, Research, Development and Innovation Funding (UEFISCDI), Romania NOSEit is a project carried out centrally by the UEFISCDI team. UEFISCDI is developing a large social network called BrainRomania 3.0 for researchers and entrepreneurs through which the selected news from NOSEit can be directed towards the network peers segmented by their interests. The thematic approach is horizontal covering all areas of S&T emerging from the discourse of the sources as well as some societal changes. The system covers science and technology topics as well as behavioral change and service innovation. It is not directed towards specific policy sectors but at the whole STI system. However, STI policy as well as a wide range of sectoral policies (e.g. transport, agriculture, health) are potential users. The Horizon Scanning is carried out by a core group of seven researchers plus 17 master's students from a diverse range of disciplinary backgrounds with the following steps: *Human evaluation of news*: The scanning process is organized in a game like manner using a game like platform (TAGy). Through the game 17,000 current news are evaluated monthly by a group of 17 master's students with diverse disciplinary backgrounds who "play" TAGy in rotating pairs of extractors and assessors. Out of the evaluated news 2% are generically validated as weak signals, based on which 30 per month are selected as top weak signals. The group of evaluators functions on building a tacit knowledge, which is permanently monitored as convergence in the game. The selection behavior is continuously monitored to assess convergence and influence of attitudes e.g. stubbornness. The findings are stored in a structured repository. Filtering is possible according to several categories (source, data, 7 WS categories). *Machine supported structuring* - using a combination of NLP (Natural Language Processing) tools, the team clusters the whole repository, classifies the news by domains and sub-domains, checks the similarity of news and spots the primary sources. More features like semantic estimation of novelty are under development. The TOP 30 per month are distributed on Facebook through the NOSEit site.	Direct contacts, interview, material, https://www.facebook.com/NOSEit
8. **Department of Strategies and Economic Analysis at the Portuguese Environment Agency (APA, PT)** Three specific projects which have deployed Horizon Scanning activities are reported: (1) *Long-term Future of the Portuguese Economy* (2) *European environment — state and outlook* (3) the *DPP Horizon Scanning*, about horizon scanning at the former Department of Prospective Studies, Planning and International Relations (which was incorporated into APA as Department of Strategies and Economic Analysis). The objective of horizon scanning activities at APA is seen as to create background information, evidence and scenarios for foresight and strategic planning projects. Horizon scanning has been very useful to be applied when there is a specific need for it, when there is a gap in the traditional planning process, in the capacity to mobilize external information for decision-making. Then, the process of organization and/or reorganization of information with a strategic focus can take place by deploying horizon scanning. The activity may combine different approaches, such as search for weak signals, emergent issues, anticipatory signals, and interdependencies. It does not necessarily take for granted the consultation with public/users. The idea in Portugal was that horizon scanning is to be used in response to a need expressed by decision-makers (from public or private organizations) and utilizing own systems (combination of approaches). The work of horizon scanning/foresight experts is enriched with participation of different expertise. The *Long-term Future of the Portuguese Economy* was the outcome of the project "HybCO2 - Hybrid approaches to assess economic, environmental and technological impacts of long term low carbon scenarios: the Portuguese case", which was executed between 2010 and 2013. The aim of HybCO2 was to assess the implications of long-term carbon reduction scenarios through the development and comparison of two hybrid tools (the HYBGED model and the HYBTEP platform). Based on the scenarios exploring the possible socio-economic paths for Portugal up to the year 2050, the two tools were used to assess the cost effectiveness of the possibilities of greenhouse gas emissions reduction and its effects on prices, production and family income and on economic well-being. The research focused on the technological and behavioral changes necessary to reach a low carbon scenario in Portugal, including a carbon neutral scenario, and on the analysis and optimization of the political tools required to attain it.	Documents, interview, Alvarenga, A., Carvalho, P., Lobo, A., Rogado, C., Azevedo, F., Guerra, M. D., Rodrigues, S. 2011 *Long-term Future of the Portuguese Economy: A Scenario Building Process*. Lisboa: Ministério da Agricultura, do Mar, do Ambiente e do Ordenamento do Território, Departamento de Prospectiva e Planeamento e Relações Internacionais.
9. National Foresight of South Korea, Future Strategy Centre, S&T Policy Institute (South Korea) 1. There is a government funded research institute in social sciences, humanities and economy, which has different areas with an own institute each. They perform their own HS. 2. In science and engineering, the Ministry of Science and Future Planning and the National Information Agency (NIA) are both per law dedicated to HS. They perform mainly Big Data analysis, literature research, backcasting and some sentiment analysis. They are connected to the Singapore RAHS and try to adopt their system. 3. A third player is the Korea Institute of Science and Technology Information with an in-house build system. It uses mainly automatized HS, expert technology and has no connection to the other activities.	Documents, interview, Choi et al. (2014), Hwang et al. (2011), Schlossstein & Park (2006)

(Continues)

TABLE 1 (Continued)

National HS activities (main focus)	Main Sources of information in 2015
KISTI: there is an annual conference of Future technologies, in which the most important 100 technologies (priorities) for South Korea are identified and presented. Prior to this conference, candidates are identified (from literature, Scopus and other papers etc.), 200–300 of them are pre-selected and filtered via expert survey. The conference invites SMEs to discuss and learn about the priorities because they do not have the capacities to do Horizon Scanning on their own. During the processes mentioned above 1) in social sciences and humanities, the work is performed more narratively and in a top-down filtering way. In 2) S&T, there are clear filtering and priority-setting processes with criteria like the economic importance (always first), to expand the environmental assessment possibilities or to estimate how the world evolves and what impacts on Korea can be expected. Here, even Wild Cards are used. NIA and KISTI have software-supported tools to do HS	
10. Estonian Institute for Futures Studies Horizon scanning is understood broadly, it is embedded as an element in foresight projects and activities, and not implemented systemically as an independent activity. There is no dedicated programme on horizon scanning in Estonia, it is implemented as a part of other foresight processes and projects. One actor is the *Estonian Institute for Future Studies at Tallinn University.* The objective for horizon scanning is typically to create background information, evidence and scenarios for foresight projects. Horizon scanning forms an integral part of what is called *trend analysis*, and is typically implemented as one part setting-the-scene or contextualizing activities within foresight projects. At the early phase of foresight projects, a trend overview is gained in order to analyze and classify trends between continuing, changing and new trends. After this, cross-section analysis and scenario building are realized. HS is the first step in analyzing the broader landscape and in creating the context.	Documents, mainly: interview
11. Commissariat générale à la strategie et la prospective (CGSP, France) France Stratégie assists the government in determining the main directions for the future of the Nation and the medium- and long-term objectives for its economic, social, cultural and environmental development. It contributes, moreover, to the preparation of governmental reforms. The four missions are: 1. Evaluate public policies independently and exemplary 2. Anticipate developments of French society 3. Open debate with social partners, civil society, enterprises, specialists and academia 4. Suggest policies/reforms/orientation to the government In summer 2013, for example, President François Hollande asked France Stratégie to examine the prospects for France 10 years from now.	Documents, internet platform, newsletters, interview, e.g. FRANCE TEN YEARS FROM NOW. Priorities for the Coming Decade. report to the Presi-dent of the republic under the direction of Jean Pisani-Ferry, Head of France Stratégie 2014; or http://www.strategie.gouv.fr
12. National Institute for Science and Technology Policy, Japan, NISTEP: 1. Horizon Scanning project and 2. Foresight 9 Japan has a long tradition in Foresight and started separate Horizon activities complementary to the set of Foresight methods. Foresight is aimed to provide information for the next budget plans and the Basic Plan, to generate information about science, technology and society for the public. Japan has a full Foresight process directed towards implementation in the Japanese Basic Plan with four pillars: comprehensive Delphi survey, scenarios, bibliometric searches and societal survey. For the Delphi survey, expert committees work out topics, based on the previous Foresight and search for new ones. NISTEP is organizing the meetings, is doing the searches and adding information. NISTEP is responsible for the methodology, is performing the Delphi survey and the scenario work. The Japanese Foresight is thus thematically broad, in different technology fields and society and has a time horizon of 30 years ahead. Science Maps were for the first time developed in 2003 on demand of certain high-ranking experts and policy-makers. In 2003, the objective was to identify upcoming "Hot topics" and to find out rapidly-developing research areas, so-called "hot research areas". Science Maps are officially part of the science and technology foresight – but the link is rather vague. There is no explicit demand from the policy side. NISTEP accumulated a time series of maps (biannially), developed indicators at NISTEP and OECD, and measured the diversity of research with the emphasis on how to promote emerging fields as fast as possible.	Own documents and publications, original material (in Japanese and English), interview two responsible persons, Saka et al. (2010); NISTEP (2005a,2005 b,2005c,2005d, 2009, 2010a,2010b,2010c, 2010d, 2010e)
13. Strategic Futures Group, National Intelligence Council (USA) The National Intelligence Council (NIC) drafts Global Trends to promote an integrated Intelligence Enterprise by developing the National Intelligence Strategy, evaluating the Intelligence Community's strategic posture and progress, and enabling and integrating successful strategic planning and execution efforts. Other tasks are to promote and encourage community-wide long-range perspectives. Key tasks are to lead the IC Strategy development, integrate strategic direction, evaluate the IC Strategic Progress and promote IC Innovation. The National Intelligence Council (NIC), composed of some 18 senior analysts and national security policy experts, provides the U.S. intelligence community's judgments on crucial international issues. NIC members are appointed by the Director of National Intelligence and routinely support his office and the National Security Council. Congress occasionally requests that the NIC prepare specific estimates and other analytical products that may be used during consideration of legislation. It is the purpose of their regular report to describe the statutory provisions that authorize the NIC, provide a brief history of its work, and review its role within the federal government. The report focuses on congressional interaction with the NIC and describes various options for modifying congressional oversight.	Documents, internet pages; two interviews; www.gao.gov; http://www.dni.gov/index.php/about/organization/policy-strategy-who-we-are

(Continues)

TABLE 1 (Continued)

National HS activities (main focus)	Main Sources of information in 2015
14. Government Accountability Office (GAO) One role of the United States Government Accountability Office (GAO) is to inform the US Congress on single topics with future relevance, to prepare a strategic plan for serving the Congress (e.g. for fiscal years 2014–2019). "Our Mission is to support the Congress in meeting its constitutional responsibilities and to help improve the performance and ensure the accountability of the federal government for the benefit of the American people. We provide Congress with timely information that is objective, fact-based, nonpartisan, non-ideological, fair, and balanced." (www.gao.gov) The work of GAO is done at the request of congressional committees or subcommittees or is mandated by public laws or committee reports. GAO also undertakes research under the authority of the Comptroller General. We support congressional oversight by auditing agency operations to determine whether federal funds are being spent efficiently and effectively; investigating allegations of illegal and improper activities; reporting on how well government programs and policies are meeting their objectives; performing policy analyses and outlining options for congressional consideration; and issuing legal decisions and opinions, such as bid protest rulings and reports on agency rules. GAO advises Congress and the heads of executive agencies about ways to make government more efficient, effective, ethical, equitable and responsive." (www.gao.gov) Our work leads to laws and acts that improve government operations, saving the government and taxpayers billions of dollars.	Documents, interview 2 responsible persons
15. Federal Ministry of Education and Research - BMBF Foresight Cycle I and II, Germany BMBF Foresight Cycle I (official title: BMBF Foresight Process Cycle I (Foresight-Monitoring Konzeptionelle Weiterentwicklung und Umsetzung eines Foresight-Prozesses des Bundesministeriums für Bildung und Forschung) from 2007 to 2009 had the aims of: 1. Identifying new research and technology focuses, 2. Identifying (and deriving) areas of activity covering a range of research and innovation fields, 3. Analysing potential fields of technology and innovation in which strategic partnerships might be possible, 4. Deducing priority areas of research and development activity. For this, central and decentral searches determined what was looked for in detail. Accordingly, topic coordinators (2 or 3) were responsible for each topic field: to work out the topic in general and provide relevant information at the different steps of the process, to perform peer-to-peer interviews. An internal management group was responsible to coordinate the different activities and methods/ methodological interfaces. They also prepared the different conferences. The process as project was only dedicated to the "search phase" of the Foresight process – priority-setting and implementation was intended to be performed in the BMBF. The time horizon was 10–15 years and more in science. Innovation was excluded. It was mainly searched for topics with a longer time horizon. Topics already in the focus of BMBF were excluded/ sorted out. Starting point were the fields of the Hightech Strategy 2006 + Systems and Complexity Research (Future Fields), but the aim was to be open and identify interdisciplinary topics (New Future Fields), which were then clustered, summarized and described in a report. A combination of very different methodical elements was used: • Structured, focused interaction with experts (workshops and interviews) • An analysis of the innovation system, including a review of current strategic processes in the BMBF • Environmental scanning (literature research, conference analysis, scanning of relevant results) • Secondary analysis of current international foresight studies on research and technology • Analysis of the dynamic in scientific publications (bibliometrics) • A broad online survey of experts to provide a differentiated evaluation of relevance and the need for action (2,659 valid responses) • Two-stage personal survey of top international experts (Monitoring Panel) • Inventor-scouting (targeted surveying of young researchers) The results of all the methods were continuously adjusted. These scanning activities and research resulted in a structured and evaluated set of wide-ranging future fields and future topics in research and technology with long-term relevance that served for later "strategic dialogues" in the ministry. BMBF Foresight Process Cycle II (official name: Suchphase des neuen BMBF-Foresight-Prozesses (Zyklus II), 2012–2014: Starting point were trends in society – the hidden trends looked for by Fraunhofer ISI, the larger and obvious trends as well as social science topics by VDI. An update of the science and technology fields of the first cycle was performed by experts from both institutions. The time horizon was 2030. Especially open searches (internet, literature etc.), workshops with an open character, and interviews were performed. For the "hidden trends", so-called "antenna" (scouts or persons with specific experiences or needs) were interviewed. In an innovation seed workshop, the societal trends and technological developments were matched in order to be creative about new upcoming topics. In BMBF intranet, BMBF interested persons were able to comment the first drafts of the trend profiles and fields. In stories from the future 2030, narratives explained the context of the different findings.	Own documents, insider knowledge, ISI was manager in the first and partner in the second process BMBF Foresight I: Cuhls et al. (2009b,b); BMBF Foresight II: Zweck et al. (2015b)
other multinational approaches	

(Continues)

TABLE 1 (Continued)

National HS activities (main focus)	Main Sources of information in 2015
16. The iKnow project iKnow is one of six Blue Sky foresight research projects funded by the European Commissions Seventh Framework Programme for Research and Technology Development (FP7) under the Socio-economic Sciences and Humanities (SSH) theme operated by a large consortium. The project is aimed at interconnecting knowledge on issues and developments potentially shaking or shaping the future of science, technology and innovation (STI) in Europe and the world. There is a general consensus that the kinds of issues addressed by iKnow have often remained out of the policy radar and so far have received little attention in forward-looking activities: the identification and analysis of Wild Cards and Weak Signals (WIWE) and their effects on European and global science, technology and innovation (STI) policy. Platform-based, everybody could fill in and use the data. The types of issues mapped by the horizon scanning included new/emerging: trends, policies, practices, stakeholders, services, products, technologies, behaviors, attitudes, surprises (Wild Cards) and seeds of change (Weak Signals). One of the critiques in this platform-based approach was that signals were inserted, filtered, but again and again the same or similar signals that were already taken out were included again. The knowledge was not transferred, why the signals were taken out, which lead to additional work.	Data base, documents, interview; http://community.iknowfutures.eu
17. European Environment Agency (EEA) The European Environment Agency sees itself as an interface between science and policy-making: Which global trends are interesting and relevant for policy-making in the environmental area? With a network of more than 300 institutions in 39 European countries, the EEA "provides timely, reliable and relevant information to support sustainable development." Horizon Scanning is performed in megatrend studies and assessments as well as via EIONET, the European Environment Information and Observation Network. The Foresight and Sustainability Unit with its Integrated Environmental Assessments Program is responsible to gather data, information and derive visions from them to hand over the knowledge to policy-making. One of the frames is the 7th Environmental Action Program. The core group is cross-disciplinary, since 2007, they have an EEA Scientific Committee with scientists. The EU institutions are linked via an Advisory Goup and since 2009 via broad stakeholder consultations, a public call for evidence.	Documents, interview; Presentation by Jakil, A. Velkavrh-Pirc, A., Ribeiro, T.: Global Megatrends, EEA Global Megatrends Assessment 2015. Conference "Wicked Problems", June 2015, Turku; http://www.eionet.europa.eu/
18. OECD The whole OECD sees itself as a forward-looking institution so that there is bottom-up foresight and horizon scanning in every Directorate. Concerning the national levels, there is a committee structure. Every committee decides on themes and - according to the budget - is able to do formalized activities or scanning or searching, e.g. in particular fields like the production revolution. One of the programs dedicated to future is the International Futures Programme of the S&T Directorate. In the 1980s, OECD was centralized and produced all material on a CD ROM, which was in fact not largely used. Meanwhile the work is decentralized with some coordination in order not only to work in tacit way. There is the role of a coordinator for foresight who also brings together an international network of scientists and policy-makers (Global Foresight Network, GFN) for meetings with the purpose of regular mutual exchange. Horizon Scanning itself is free, defined by the clients, the demand and emerging issues. The time horizon also differs, for the countries reports it is close to the present. The Economic Outlook was the basis but the published outlooks broadened to a wide variety from education to innovation, quality of life etc.	Documents, interview; www.oecd.org
Private company's	
19. Kone, Finland Future looking studies and planning at Kone have roughly the following layers: • **Megatrends**. Company executive group, with the leadership of the CEO, has defined the *megatrends* that drive and impact Kone future business. Megatrends are generic and have been designed to structure broadly company planning processes, and to identify major issues for company future business. They do not directly impact or direct operative activities, which require more fine tuned future looking analysis. • **Macrotrends.** Macrotrends examine how, for example, urbanization really unfolds and impacts people and lifestyles in different places in the world. It's objective is to realize what kind of R&D, design, and services will be needed to implement Kone products in the future. This activity is implemented at the Design department of R&D department. • **Technology roadmaps**. These identify direction of strategic technologies and inform Kone R&D investments and activities. As a part of the activity, active technology scanning is carried out. This activity is implemented at the R&D department. • **Business intelligence.** Additionally, Kone collects business intelligence on various aspects of its future business, such as where new large-scale building projects are to be expected etc. A dedicated business intelligence team under the senior management is responsible for implementation. Macrotrends are the key vehicle of Horizon Scanning at Kone. Their objective is to create concrete intelligence on how people, communities and society are likely to use Kone products (elevators, escalators, etc), and to encompass how life style, demographics, urbanization, human expectations and so forth should be taken into consideration in developing and designing Kone products and services. Macrotrends are expected to help to advance our R&D processes.	Short document screening, interview

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TABLE 1 (Continued)

National HS activities (main focus)	Main Sources of information in 2015
20. Philips: Kitchen 2020 Project, The Netherlands KA2020 (Kitchen appliances) is an example of a specific scanning project to define an innovation roadmap for kitchen appliances. Based on this roadmap more concrete innovation projects could be defined. The results were mostly used by the two departments carrying out the project. Moreover, the results were used in the communication with (potential) clients and in collaborative projects with third parties. The study focused on the period until 2020. Instead of focusing on product categories the project focused on different themes (e.g. energy use, safety). The exact themes that were studied is confidential.	Documents, interview, internal project
Other approaches	
21. Shaping Tomorrow (e.g. as Horizon Scanning Service for EIRMA members) The Shaping Tomorrow Network consists of two partners as the core, 20 close associates, 100 people working virtually and 12,000 members of the network. There are no hierarchies and there is no organization. Policy-makers are the clients and it is directly worked with them by education and workshops on the spot. There are no limits in scope for the projects, no time limits, no content limits. The clients are the participants, first they are trained, then they work directly on the field/ issue chosen. Therefore, there is no focus on a special thematic issue. The client is defining what to look for and what the questions are. There is no limit in content outcome. Pure scanning is performed automatically. The results containing the generated information are provided directly in a well formatted and easy-to-use way. The software is programmed by the Shaping Tomorrow core partners. It reads 1. specified organizations, 2. People (futurists, bloggers etc.), 3. keywords and semantic search. The searches are text-mining-bases, semantic and multi-lingual. The software exports lists of information and ready-made presentations. Statements and indicators add to the list. The sources are secondary sources, existing in the web. Surveys are additionally performed. Workshops are also conducted with clients. The toolbox is available so that in selected areas additional primary data can be generated but the base are secondary sources. Instant scenarios are possible. Every customer gets an own platform on the web with private and public partition, where he can go on working alone, with his clients, internally, externally – as a collaborative environment (even with own design and logos).	Documents, database and newsletter, interview; www.shapingtomorrow.com
22. SESTI SESTI is a project funded by the European Commission, through the 7th Framework Programme for Research and Technological Development (FP7), 2008–2011, lead by TNO. The overall objective of the SESTI project was to contribute to the development of an effective trans-national system for the early identification of weak signals and emerging issues. The project had the following underlying objectives: • Develop methods and approaches for identifying "weak signals" and evaluate their usefulness to the policy community; • Create an efficient working tool to share information between the project consortium and the user community; • Track and analyze emerging issues on the "future of research", based on weak signals analysis; • Engage with the user community to provide them with an "active" stake in the project to ensure use of and long-term success; • Launch a discussion on emerging issues at EU and national level, as well as linking the actor communities including policy-makers, strategists and researchers; • Facilitate the use the project results at European and national level through selective involvement of relevant actors; Disseminate project results widely to potential users in policy, business and the research community. At first, a list of emerging issues was compiled through bottom-up scanning and issue-centric scanning (focus on the three topics cognitive enhancement, energy, healthcare). The following tools were used in this process: • Web-based search engines as Google, Google News, Timeline, Google Insight, and Bing • Expert review and survey • Visits to conferences and seminars • A special SESTI wiki to evoke contributions to the scanning process • Active use of blogging and micro-blogging (Twitter) • Text-mining The list of emerging issues was then discussed in three thematic workshops with experts and policy-makers. Moreover, another workshop focusing on foresight methodologies was conducted.	Internal documents, project contributions from TNO; http://sesti.info
23. JRC Horizon Scanning The first wave of horizon scanning at JRC was performed from 2011 to 2014, later a new approach was followed. It was financed by the EU/ JRC to make use of the knowledge of European scientists, especially those from the entire JRC, to identify weak signals and emerging issues. For this, in each institute, there was a responsible person ("correspondent") in charge of collecting the information. The findings were delivered to Brussels, where an editing board selected, discussed and fine-tuned the issues found. They edited the information into a "Bulletin", a kind of newsletter that was sent to all EC managers. It was also possible to subscribe for it from the "internal social network". The search was thus thematically open, focusing on all fields on the agenda of the European Commission and on policy issues.	Interview, newsletter

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TABLE 1 (Continued)

National HS activities (main focus)	Main Sources of information in 2015
24. Netherlands STT Horizon Scan 2050 Netherlands Study Centre for Technology Trends ("Stichting Toekomstbeeld der Techniek (STT)") was established in 1968 by the Netherlands Royal Institute of Engineers (KIVI). STT is an independent non-profit foundation, funded by financial contributions from the Dutch government and industry and science. The governing board consists of more than 50 high-level members from industry, science, society and government. STT carries out society-oriented technology foresight studies. For that purpose, STT facilitates a free space in which enthusiastic stakeholders, experts and creative minds from industry, society, science and government take part. There are often more than 100 participants per project. Young people from schools and universities are increasingly included in discussions. The participants create views on the future of technology in society. The STT Horizon Scan 2050 has four aims: • ***Inspiration.*** This study reconfirms what the future Grand Challenges are and it adds the richness of the Signals for Change. In this manner our imagination is stretched to the very limits (the Unknown Unknowns or UUs). Together this offers crucial inspiration for research, policy studies, innovation and societal debate. It also helps us identify specific domains where major developments will occur. The Netherlands, as many other countries, needs the competencies to deal with these developments in order to survive the future global competition. • ***Vision.*** The future is already in progress. Reflection on our society in 2050 allows us to create an image of future profitable business models. What will the developments identified in this book mean for our economy? Where will our future profits come from? And what will be the position of man in an economy dominated by robotics and interconnectivity? Do we have to pursue each and every technological possibility? There is an ethical issue involved here with far-reaching implications for our future social relationships. And what will all this mean for the Dutch so-called Top Sectors? How will entirely new innovation models alter these business sectors in 10 years time? In many business sectors human labor will be affected by increased automation and the rise of robotics. This not only requires a vision on the way society will earn its income, but also on how it will deal with social issues, such as the distribution of labor and income. • ***Risk analysis.*** The STT Horizon Scan 2050 links today's and tomorrow's Grand Challenges with the Signals for Change and potential Unknown Unknowns. This makes it an essential reference book for long-term risk analysis. • ***Innovation.*** Expert input suggests that social and ethical factors may be more important than mere technological developments in the future. An interesting perspective. Who will be global leader in social innovation in 2050? Reflection on the various directions and shapes the future may take allows us to start a broad societal debate about the changes that are or are not desirable and inevitable. It gives us insight into the space we will have to manoeuvre and offers us a chance to prepare for these changes. The confrontation between the six Grand Challenges and the fifty-seven Signals for Change addressed in this book, however, also serves to inspire the reader to think further.	Documents, interview, http://stt.nl/horizonscan-2050-2/ (website); http://stt.nl/wp/wp-content/uploads/2014/05/STT-80_Horizonscan-2050-metkaft.pdf (Dutch version); http://stt.nl/wp/wp-content/uploads/2014/09/STT-Horizonscan2050-defweb-03.pdf (English version)
25. Horizon Scanning at the Higher School of Economics (national Russian Foresight) The Ministry of Education and Science of the Russian Federation financed horizon scanning that is operated by the Higher School of Economics, a National Research University, Institute for Statistical Studies and Economics of Knowledge (HSE ISSEK). The scanning is part of a broader Foresight process: "A Foresight exercise for Russia's science and technology towards 2030 is due to be completed. It highlights specific ways to both revitalize traditional sectors and penetrate into new high-tech markets…" V. Putin, Presidential Address to the Federal Assembly of the Russian Federation, Dec. 2012. The Russian S&T Foresight is aimed at identifying the most promising areas of science and technology development in Russia towards 2030 to ensure the realization of the nation's competitive advantages. Objectives specific to the HS were to identify the global challenges, influences on Russia, risks and opportunities, general markets (not only hightech) and which S&T should be tackled in the future until 2030. HSE ISSEK organized the survey, the statistics and other methods that were performed. They were responsible for results and reports as well as other publications. The team consisted of 15–20 persons internally. From a database, they were able to select experts with the adequate knowledge for their methods and involved them in the process but also "used" them for the strategic scanning (2000 experts for online survey). 15–20 experts were in a very close advisory circle), 150 international experts. Results were presented at several events, to policy-makers and directly to V. Putin! A new fund for S&T projects was established and waited for the results and recommendations to prepare calls for projects/ programmes.	Documents, interview with our cooperation partners at HSE, official information from the International Advisory Board
26. Horizon Scanning, new process in the Federal Environmental Agency, Germany (UBA) "Horizon Scanning" and Trend Monitoring as an instrument used for the early detection and policy consultancy in environ-mental policy were a concept study and scan report the German UBA, Four people in Department I1.1 explicitly dealt with futures in four realms: system analysis, thinking in options, simulation and prognosis, and strategic foresight. Horizon Scanning counted among other strategic foresight activities at UBA, namely global megatrends, trend analysis, and wild card analysis. All these branches are interlinked. In a 3-year R&D project (UFOPLAN), a core concept for a Horizon Scanning system relating to ecological studies and policy was developed in the first phase. In a second phase, overarching socio-ecological trends and new events were identified and described; and the concept was tried in a concrete test case. The external contractors developed a concept for Horizon Scanning and tested a pilot application in co-operation with UBA. During the process, interim results have been used in-house; the final results were published. The intention was that Horizon Scanning shall identify new themes continuously. Top 10 themes may be selected and communicated, trend impact analysis studies may analyze prioritized developments in depth.	Report, interview; https://prezi.com/za186mq83p15/copy-of-zukunftsforschung-im-uba/

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TABLE 1 (Continued)

National HS activities (main focus)	Main Sources of information in 2015
27. Euroscan EuroScan International Network is the leading global collaborative network that collects and shares information on innovative technologies in healthcare in order to support decision-making and the adoption and use of effective, useful and safe health-related technologies. They described themselves as the principal global forum for the sharing and development of methods for the early identification and early assessment of new and emerging health-related technologies and predicting their potential impact on health services and existing technologies. EuroScan International Network is committed to work with a high level of transparency and professionalism, and in partnership with researchers, research centers, governments and international organizations to produce high quality information and effective early awareness and alert systems for our respective constituencies. They are also committed to support the development of existing and new not-for-profit public agencies working in the early awareness and alert field. EuroScan International Network VISION: EuroScan International Network will form the leading global network for public institutions working on the identification and early assessment of new and emerging technologies in healthcare to support decision-making and the adoption and use of innovative technologies to the benefit of patients and health services. EuroScan International Network GOALS: To establish a system to share skills and experience in Early Awareness and Alert activities. To strengthen activities for the development of methodological approaches to the identification, description and assessment of emerging technologies. The major aim is to improve the exchange of information about new and emerging health technologies and their potential impact on health services and existing health technologies, to increase the impact of EuroScan International Network's output, to identify relevant not-for-profit public partners in order to share the results of work with partners/members of the EuroScan International Network collaboration, and to advise not-for-profit organizations within public administrations who wish to consider the establishment of early awareness and alert activities.	Internet page, recommendation from Australia; http://euroscan.org.uk/about/

Inquirer" (RIBRI) (Warnke et al., 2019) where technical innovations, societal practices and "global value networks" were identified.

In automated Horizon Scanning, one major task is the definition of keywords. Often, the keywords are defined in a group (steering group, expert group, user group) or by those who perform the scanning. Although there is a discussion about direct pattern recognition in big data volumes for Horizon Scanning, in 2015, we could not (yet?) find any actual cases. Other "methods" found were desk research for identifying and reading relevant literature, qualitative methods, automated and semi-automated literature searches (different sources from complete internet to specific databases), bibliometrics, patent analysis, text mining, science map, conference scanning, expert opinion usage (single, interviews, surveys…), scenarios, storytelling, matrices etc. for structuring, platforms for exchange of information, and social media scans. Horizon scanning activities are rarely performed on the basis of only one single method, usually a number of steps using different methods and technique are performed sequentially or in parallel (more details in Cuhls et al., 2015).

In Romania [7], efforts were made by a research institution to maintain a "trend wiki". The trend wiki needs to be regularly updated, provides information on major trends that are likely to affect the organizations' future business opportunities (in company's or research institutions). A critical mass of input is necessary along with long lasting, continuous participation from motivated contributors. Otherwise, people just forget to contribute and reminders are often ignored. No case was found where the problem of how to keep people motivated was successfully resolved.

Pure scanning can be performed automatically by software. A professional provider of Horizon Scanning (Shaping Tomorrow [21]) uses software that searches and reads out 1. specified organizations, 2. people (futurists, bloggers etc.), 3. keywords and semantic search. The searches can be semantic and multi-lingual. The software exports lists of information and ready-made presentations. The approach is based on secondary sources existing on the web. The generation of "Instant Scenarios" is possible, but in most cases, a human touch is needed to narratively convey the results of the automated scanning. A good example of use of a software platform is in Romania [7], in the Human Evaluation of News by "playing" TAGy.

The most sophisticated automation system is supposed to be applied in Singapore [1]. If all components are used one can definitely call it a full Foresight circle (www.rahs.gov.sg) ranging from Environmental Scanning over Narrative Capture (patterns and perspectives) to Scenarios to Strategies even including Quantitative Modeling (Quiggin, 2007).

4. Process - All approaches analyzed consisted of three main types of activities that are organized hierarchically: *Signal collection*, *Sense-making*, and *Specific reports*[2] *and in focusing on specific reports. As discovered in both interviews and surveyed reports, a general procedure common to most cases is:*
   1. Define Scan field
   2. Characterize Scan field
   3. Select sources and methods
   4. Search Scan theme
   5. Search context
   6. Expert dialogue
   7. Preparation of Scan report
   8. Use of Scan report
5. Organization top-down or bottom-up?/ Regular or ad hoc? Foresight and also Horizon Scanning activities often include both top-down and bottom-up elements (SFRI paper Working Group 5, Cuhls et al., 2015). In Horizon Scanning, the question is how

far laypersons can be involved. Wikis are often fed with opinions from experts on a lower hierarchical level in the organization. On the other hand, there is often the request from the top management to find signals or explain an upcoming issue. Both can initiate Horizon Scanning projects, both are important to maintain the activity. In the case study, we found more top-down organization (clear hierarchies) for overviews (e.g. if the management needed an overview about upcoming topics for strategic reasons and positioning in the landscape). When specific topics were chosen for further detailed analysis, the activities were often more bottom-up, based on the opinions of external experts who were consulted, volunteers who contributed, and lower level management.

There are HS processes with regular output (e.g. newsletters), continuous and irregular outputs (platforms, wikis etc.) as well as ad hoc production of output (if the need is felt, scanning on request). If only information about searches, future issues, weak signals etc. is provided (possible in all output cases), the information is often just summarized in templates, in a newsletter or put on a platform by single persons or a dedicated department in the organization. There was no clear answer, which kind of organization might fit best to integrate Horizon Scanning, and the cases had different ways of integrating personnel from different departments or just finding pathways for the findings.

There are also examples without any formal "organization": They just provide a platform or work completely electronically with very limited manpower in the background [e.g. 21 or 1]. The content is sourced from volunteers' contributions or is generated automatically. In these cases, the scanning aims to provide information rather than knowledge creation, sense-making, or information assessment. In other cases [7], the information is spread via online platforms and all scanning activities are conducted virtually. In these organizations, it is even difficult to identify the "responsible person" or contact person [e.g. 11]. There is also the possibility of platforms without any coordination or strategy but just for collection [16, partly 27]. The platform is provided, and participants fill it with content and are able to use it. It is difficult to keep this organization running.

Horizon Scanning often searches for topics or themes that have to be described in sentences instead of just single keywords or short expressions, and therefore automated searches do not suffice, especially if societal issues are concerned. The procedures need much more coordination than isolated, automatic keywords searches or applied semantics offer. In some cases, we often found decentralized scouting systems in the case examples (e.g. scouts or specific experts in different locations or responsible for specific content, topic coordinators in the first German BMBF Foresight Cycle I, Cuhls et al., 2009b,b). In company's, we find HS in strategic divisions or within the R&D division and its management line that are usually responsible for high-level macro trend analysis and performing overviews, whereas more focused Horizon Scanning activities are mainly decentralized. Examples include the large Korean company's, the Chaebol, that have their own in-house systems and are well informed [9].

We also find HS on demand (overview or single issues) but only first attempts of Foresight on Demand[3]. When single issues are identified and analyzed in more detail, bottom-up attempts at organization and information flow are also common. Horizon Scanning is open to broader participation when a specific purpose is defined. Centralized, decentralized and embedded structures exist and may reflect organizational structures that are critical to the integration of HS results.

3.2 | Overlaps of Horizon Scanning and Foresight

Regarding scope, time horizon and the thematic focus, there is a huge overlap between the Horizon Scanning and Foresight projects. Even though Foresight focuses more on medium- and long-term views, the definitions of these terms shows high variation similar to Horizon scanning. In the cases looked at, the scope of the time horizon varies a lot: For some activities, the near future of 5 years is interesting [19, 20], for others, the very long-term (30 years and more) [9, 12, 15, 25]. In most HS cases, a longer time horizon coupled with incremental backcasting, becomes a methodological foundation. On the EC level, initial Horizon Scanning activities focussed on Grand Challenges (European Commission, 2011) and Signals for Change (European Foresight Platform, 2011).

The scope of target audience or userbase can be either very broad (e.g. in the Romanian case NoseIT the whole Facebook society) or very limited (a single ministry, the US Congress, the Russian President Putin or even single persons who demanded this information). The thematic focus often starts broadly or with a general overview on issues and signals, and becomes more narrow as the report presents detailed findings. In the ideal HS case, the objectives of the project guide the search (e.g. with criteria what and where to search), and define thus generally, which themes are looked at in more detail (detailed scanning). In our study, we discovered overviews starting broadly with a structure of economy, energy, geo-strategic and social issues[4], that investigated predefined fields (BMBF Foresight Cycle I, see Cuhls et al., 2009b,2009a [15]), previous Delphi surveys (Foresight Japan, e.g. NISTEP, 2010c, [12]), or the broader strategies of the government or other institutions [11, 14, 15, 25]. For company's, the initial search parameters and ultimate focus was often more narrow and aligned with the company's primary product or service (e.g. example kitchen equipment [20]).

In a few cases, efforts were made to organize broad participation using platforms, wikis, and other digital platforms to draw from crowd- or "swarm-intelligence." The interviews have shown considerable skepticism on such methods[5], though individual enthusiasm for participation in Foresight remains (Raford, 2015, EU project CIMULACT, see Hebáková et al., 2018, or European Commission workshop of the Strategic Foresight Expert Group, see Cuhls, 2017). Horizon Scanning workshops are rather small scale (20 persons, in some cases up to 60 persons working in groups), they are rarely the size of conference (100s of participants) or communities (1000s of participants). Foresight projects, on the other hand, can utilize either

scale of participation, and are often encouraged to organize both large- and small-scale workshops as well as broad surveys, often online.

3.3 | Intertwining Horizon Scanning and Foresight

To define their ultimate products, Foresight processes often need a filtering system based on criteria derived from the project's objectives and expected outputs. HS systems and processes, on the other hand, normally produce a focused report that lacks overarching sense-making or advisory statements. All Foresight activities include a Horizon Scanning process (often called *environmental scanning* or *outlook*), though the inverse is not necessarily true. In those Foresight processes, in which a full integration of HS is intended, the methods are closely interlinked, and data, information, and descriptions are transferred from one stage of the project to another via structured papers, template-like documents, via Scouts or coordinators.

Horizon Scanning has several steps, depending on objectives, expectations, resources and acceptance by the user. The following typical stepwise model is derived inductively from the findings (Figure 4 and the procedure derived from the interviews, see above). It is a "full model," not an "ideal model" of the process: If no overview is intended, the model starts with step 2. In practice, only very few actual Horizon Scanning projects include all steps or are completely integrated into a Foresight process so that all steps are covered.

Presently, automated processes are appropriate for collecting and scanning in HS systems, but expert judgment is still needed for filtering, sense-making, and synthesizing or combining material from different angles and perspectives. New methodological combinations using indicators for assessment (Linturi & Kuusi, 2018; Linturi et al., 2014; Warnke et al., 2019) and weighting (see also Garnett et al., 2016) are first attempts to close this gap but still face a lot of methodological challenges.

The model we derived from the observations is similar to the one presented by Voros (2003, 14–15). In EFFLA, it was developed with different vocabulary, and utilizes a cyclical model to indicate the continuous nature of the process through a mandated return to initial processes. Figure 5 shows how Horizon Scanning is integrated in the policy process of Foresight, in which the prospective and anticipatory phases are fully intertwined with the Horizon Scanning activities. The first process, making use of open Horizon Scanning, is dedicated to building new strategies through Foresight for Strategies (Foresight first), and can be followed by additional HS rounds once the strategy aims are clarified - as Strategic Foresight (Strategy first).

4 | IMPLICATIONS AND CONCLUSIONS FROM THE CASE ANALYSIS

Within the cases we analyzed, Horizon Scanning is viewed as being useful when there is a specific need for it, such as addressing a gap in planning processes, or for the mobilization of external information for decision-making. The activity may combine different approaches, such as the search for weak signals, emerging issues, anticipatory signals, and interdependencies. It does not necessarily include consultation with the public or the users. However, Horizon Scanning is most effective when deploying a HS specific process, used in response to expressed needs of decision-makers (from public or private organizations). Additionally, Horizon Scanning may be used to provoke attention towards a warning, a wild card, an interesting finding, an anomaly or a neglected but changed development, but it should be noted that in these cases attention often fades away quickly. Even if the user demanded information on specific topics: by the time it is available, the question has sometimes already been forgotten.

Many cases demonstrate the difficulty of installing a permanent HS activity for general future information that is actively used, and establishing continuous or regular HS activities to update knowledge and as strategy inputs. If HS is adopted as a regular agenda activity, strategists and stakeholders who need HS outputs as general information would be more effective and efficient at their work. They

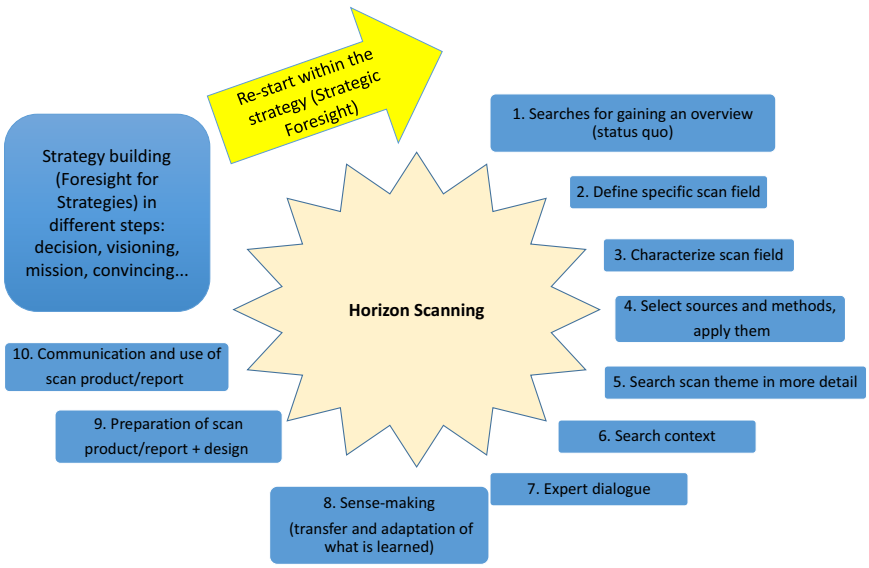

FIGURE 4 Steps of Horizon Scanning full model (not necessarily ideal model)

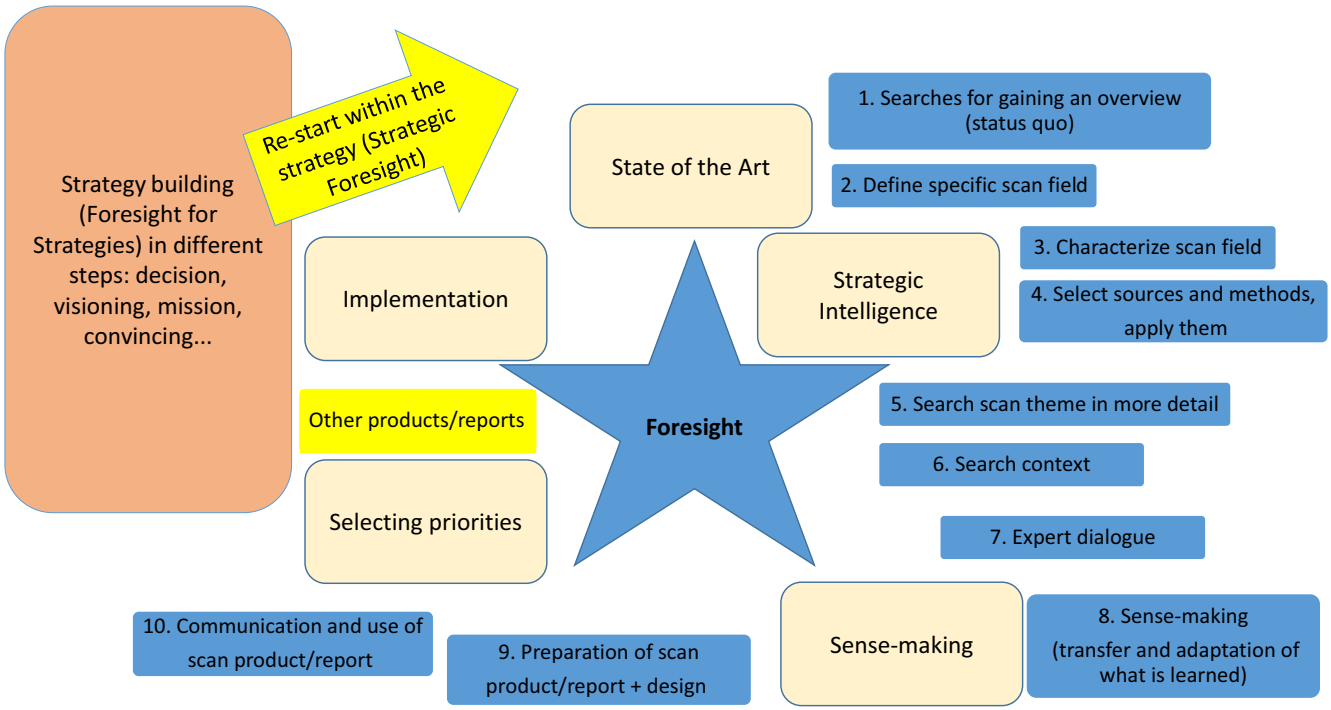

FIGURE 5 Steps of Horizon Scanning in a full Foresight process

would not need to fight every time for a new start and the commitment of the "colleagues."

The "optimal" choice of a model is thus dependent on project objectives and user needs within specific organizations. While the cases we analyzed did not consistently include all HS model steps, it can be observed that those cases that included more of the full cycle processes, and followed the procedures for making clear choices, were regarded by the interviewed researchers and organizers as more "successful," and often resulted in HS processes becoming more continuous. What "success" means is defined by the objectives or the hidden agendas. The interviewees also reflected on the statements of their sponsors or clients, the continued use of Horizon Scanning process, and client satisfaction with the project or procedure.

Stand-alone Horizon Scanning – contrary to full Foresight processes – often needs to concentrate on rather quick answers to a certain issue, but larger stand-alone Horizon Scanning procedures for overview purposes are possible. On the other hand, in full Foresight processes, Horizon Scanning is always among the initial phases of the project, and provides inputs to all further processes. The cases we analyzed demonstrate the consistency by which every project has "to go through this phase" in order to discover and adapt the relevant, project-specific findings.

One question that differentiates between the need for stand-alone Horizon Scanning or full-scale Foresight processes is the scope of the project. Does it have the goal of generating either general overviews about future issues and small signals (e.g. all important R&D-related topics and issues)? Or is the topic field already clearly defined, with HS being deployed to provide animating details about future projections (e.g. searching for the horizon in Nanotechnology or Biotechnology or for Nutrition...)? Figure 6 shows the range of possibilities. Left- and right-hand sides are the extreme poles, most Horizon Scanning activities are in the middle or combinations – adapted to the objectives. Foresight processes are more on the left-hand side, only limited sectoral ones are dense and quick.

A very simple lesson is that clear project objectives are essential for providing the Horizon Scanning system with the criteria it needs to be "successful." While this may sound trivial, it is difficult and often neglected at key initial stages in project design. Another lesson is that automated machine scanning alone is possible, but needs specific skills and does not provide intuitive inputs for sense-making processes. It is most productive when combined with a team of human translators. Here people, in many cases experts, are needed to assess HS results (sense-making), and transfer these from the information collection (strategic intelligence) to real knowledge. Finally, humans can effectively navigate the socialization of the findings (sense-making) that has to be organized and often needs some detours.

Horizon Scanning can be part of a full Foresight cycle but can also stand alone as just information gathering (strategic intelligence). Foresight thus can use automated methods in its Horizon Scanning phase, but it cannot be automated completely, as it is humans that stand at the heart of debates about the futures of institutions' or organizations' decisions, and the visions, priorities, and decisions that will take them there. The strategy-building component of a Foresight process in particular resists attempts at automation as it requires human-led discussion, structuring, priority-formulation and -setting, and decisions for strategies.

Learning from the different cases, we see that we have a huge variety of sources to exploit, a large and more and more robust toolset of methods to be combined, and a need for good people to

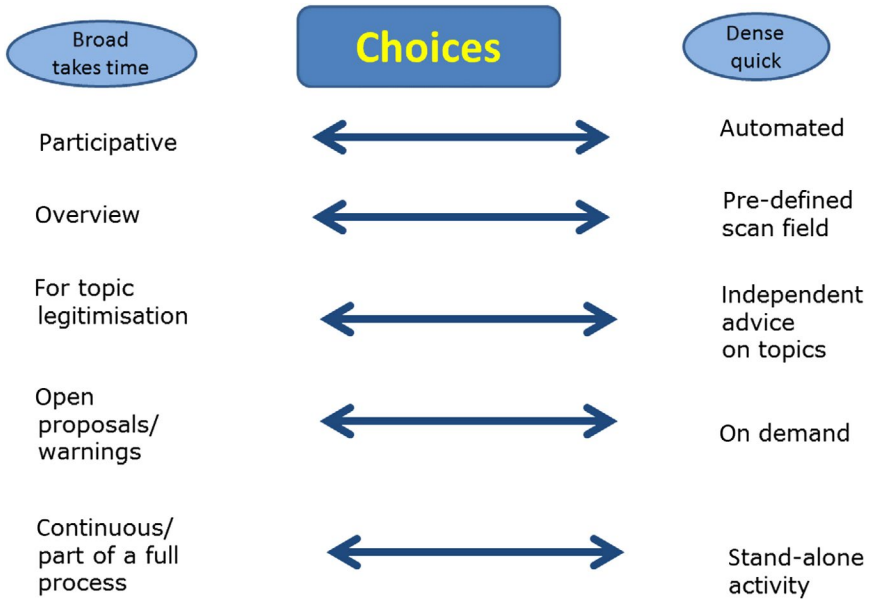

FIGURE 6 Operational choices when deciding for a Horizon Scanning model in a Foresight for strategies (derived from cases, own summary)

program software, to give input, and to asses and transfer knowledge. We also have the need to visualize results in an adequate way, but the core questions and challenges that remain are:

- How to gain attention at all in the flood of information? Specifically: How to gain attention of those stakeholders who should know about the signal - and who is that?
- How to keep motivation to participate or use results?
- What to do with results of HS?
- How to communicate HS?

In practical terms, there is still a long path ahead towards an integrated model. Even though theoretical models exist, the interests of people or policies change, and the attention and participation required demand new approaches to building intrinsic motivation. In the corporate setting, it has been argued that agile strategizing requires a movement from an issue-based strategy process to a continuous one that includes:

1. a kind of radar for key change drivers - horizon scanning,
2. a set of stable scenarios (need to be chosen from alternatives, desirable scenarios), and
3. alternative strategies derived from them, fitting into the landscape (Lehr et al., 2017; Rohrbeck et al., 2018, see also Figure 6).

That means regular, full-scale Foresight for strategies should become the standard, not the exception. To install continuous foresight processes within organizations commitment from all actors is required - from the top of the hierarchy to the bottom. This can only be achieved systematically, thus creating barriers for small and medium sized entities to establish such processes.

In summary, the major learning points from the examined cases are the following:

1. A clear organizational structure, addressing functions of coordination and brokerage with users, is needed for either Horizon Scanning as a single endeavor or within a comprehensive Foresight process.
2. Joining forces with others helps, and there are good experiences in associations, which provide results to their members.
3. More demand-driven Horizon Scanning and Foresight activities are required, including bottom-up work in order to learn about the applications and uses of generated forward-looking knowledge.
4. The implementation strategy for HS results should be considered from the project's inception, or the HS needs to be integrated into a comprehensive Foresight process.
5. Both continuous Foresight and stand-alone Horizon Scanning projects are necessary.
6. Involvement of human experts is necessary to transform information into actionable knowledge. As can be seen in the "debating the future(s)" component of comprehensive Foresight.
7. Sense-making and Horizon Scanning need to be separate steps, but both are necessary. Different stakeholders should be consulted for sense-making and assessments, which is a built in advantage of full Foresight processes.
8. An understanding of HS/ Foresight methods, their respective capabilities, and their utility within the organization is required.
9. A tool is only useful if users have the knowledge to exploit it and make sense of its products.
10. Potential users of HS need to know what is possible and should be integrated into both search and sense-making processes. Otherwise, a "not-invented-here" syndrome can appear.
11. Translation of the results into the users' language at the right point in time is necessary.
12. Horizon Scanning should include History Scanning as an experiment.

13. Experiments with short processes on demand in a given field of search are necessary to demonstrate quick successes.

Until now, many Foresight and Horizon Scanning activities have been performed in all parts of the world, and the European Commission has initiated larger strategic activities accordingly (e.g. European Commission/ European Union, 2018a, 2018b). There are some new methodological approaches under development, focusing on Horizon Scanning combined with indicators (e.g. the Finnish Technology Inquirer of 2014, 2016 and Linturi, Kuusi, 2018 or the European Commission's Radical Breakthrough Inquirer 2018 (RIBRI), see Warnke et al., 2019). They represent the state of the art in HS systems and processes, but many methods still need refinement, especially when automation is required. A wealth of information is available, and a problem of knowledge management has taken the foreground: The amount of information is very large, very diffuse by content, and often generated with unspecified user groups in mind. The task from now on is to make sure that the existing knowledge is exploited in a useful way, and gains the attention of important stakeholders.

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NOTES

[1] The number indicates the source project or project family as listed in Table 1. Only those are listed, in which we definitely found a statement on our hypotheses. In the others, it did not exist or was not mentioned in the interviews or it was not stated in documents.

[2] (summary from the Finland Future Watch [4]. Filtering takes place throughout the whole process: the pure search and collection (What to search for?), in the sense-making (How is it related to the objectives or the organization? What is useful in the specific case?)

[3] (performed in the SFRI expert group of the European Commission, currently, in summer 2018, there was a project call of the European Commission on "Foresight on Demand").

[4] e.g. a start similar to a STEEPV approach - Social, Technological, Economic, Environmental/Ecological, Political and Value-based issues or PEST or longer even PESTLE - Political, Economic, Sociological, Technological, Legal, Environmental

[5] mostly associated with the difficulty of motivating volunteers to keep feeding into such systems

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

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