European Commission

Report of the Expert Group 'Strategic Foresight for R&I Policy in Horizon 2020'

Background Papers

Research and Innovation

EUROPEAN COMMISSION

Directorate-General for Research and Innovation
Directorate A — Policy Development and Coordination
Unit A3 — Horizon 2020 Policy

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2017 Directorate-General for Research and Innovation EN

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Luxembourg: Publications Office of the European Union, 2017.

PDF ISBN 978-92-79-68543-9 doi: 10.2777/768916 KI-01-17-428-EN-N

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Preface

This compilation contains the nine background papers that have been drafted by members of the European Commission's Expert Group 'Strategic Foresight for R&I Policy in Horizon 2020' (SFRI) between June 2015 and November 2016. All papers have been finally endorsed by the entire group. They are the basis for the group's final report entitled 'Strategic Foresight in EU R&I Policy: Wider Use – More Impact'.

Background Paper 1

Forward-looking Rapid Response (FRR) as a support for R&I policy-making

Authors: Marguerite Grandjean (editor), Robby Berloznik, Blaz Golob, Luis Valadares Tavares

1. The need for a Forward-looking Rapid Response mechanism

1.1 Background

The concept of rapid response relates to providing timely intelligence and resources for addressing urgent (or fast emerging) threats, risks and opportunities. Foresight is an open, anticipatory and participatory process aimed at distilling relevant knowledge on future trends, disruptions and emerging developments into effective and realistic policy options. Over the years, a range of tools has been developed, including horizon scanning, scenario development, Delphi and visioning among others, to explore such future developments in a systematic manner.

Over the years, and as evidenced by long-standing practices in many Member States of the EU, foresight has become increasingly embedded in the policy process to the extent that it dovetails with other policy support tools. This has meant that foresight has been useful as a tool tailored to the policy context and its needs, helping respond to the challenges of an increasingly dynamic policy environment.

However, the policy context has changed. Policy makers are increasingly faced by sudden events sparked by social and other media which may quickly turn a relatively calm policy area into a disruptive arena requiring fast but calculated and effective policy responses. In this context, most foresight activities tend to be too slow in providing the required forward-looking inputs to policy making in a timely fashion, while new questions are arising quickly and unexpectedly. **For this reason, new tools are needed that can handle this demand for quicker inputs, while drawing on the best available foresight knowledge.**

The forward-looking dimension of policy challenges has become increasingly acute in the following cases in particular:

- Opportunities and risks facing a particular sector or domain that arise suddenly or require urgent attention in order to be factored quickly into current policy design.

- A policy issue or concern (relating to a scientific, technology, industry and/or societal domain, political pressures) which reaches a point where paradigm change or transition is urgently required.

- A decision taken quickly now which has significant long-term repercussions on policy programming and design.

Against this backdrop, Forward-looking Rapid Response is aimed at offering European policy makers with timely and effective support in addressing decisions related to urgent crisis situations and emerging risks, as well as windows of opportunities for resolving ongoing policy challenges and concerns.

Forward-looking activities range from the exploratory to the more normative which cater for particular client needs. Forward-looking Rapid Response (FRR) falls in the latter category. While foresight usually entails a systematic process over several months, the speed of emergent policy needs requires a trade-off between more lengthy reflection processes and prompt intelligence-gathering and sense-making. This is what FRR aims to offer. It does not claim to replicate the in-depth quality of longer-term reflection, study and consultation. Instead, according to the time windows available, it can adjust to provide the response required, when it is required (i.e. within a 10-day to six-month timeframe, with the best resources and intelligence available at the time.

1.2 FRR definition & characteristics

Forward-looking Rapid Response can be defined as a process that enables a network of relevant external experts to provide forward-oriented input in a short timeframe to the European Commission (EC), more particularly to DG RTD, with two aims: (i) to provide input to a high-stake

policy issue that has emerged as a priority and that requires urgent responses; and (ii) to help validate and complement research priorities of DG RTD services.

A 'short' timeframe would typically vary between 10 days to six months, depending on the nature and urgency of the Commission's needs. The three FRR pilots conducted by the SFRI expert group, on scientific advice, migration, and security, have typically required three months. One can expect faster responses once FRR processes become more rooted within DG RTD, particularly if experts are asked in advance to set aside time for a very fast response.

Beneficiaries of FRR may include:

- decision-makers within DG RTD and beyond;
- research staff in thematic Directorates within DG RTD who are in charge of producing the content side of Work Programmes, Strategic Programmes, and the next Framework Programme, as well as other R&I documents;
- as well as other stakeholders such as the RTD Foresight Correspondence Network.

1.3 The added value of forward-looking rapid response

Forward-oriented perspectives and tools provide value in high-impact policy development, research programming, and general sense-making[1]. The aim of approaches and tools used in the artful discipline of foresight is to provide knowledge and out-of-the-box thinking to the issues at stake. Foresight thus enables policy-makers and policy advisors to look forward into potential consequences for Europe of upcoming developments in the scientific-technological as well as the societal realms, and to highlight **implications these developments may raise** for European policy decision. As an interdisciplinary approach, it also helps point out linkages and **connections**. And finally, by looking beyond what is obvious, foresight considers **surprises**, provoking thought and highlighting non-business-as-usual possibilities.

In practice, in the R&I context, an FFR mechanism offers:

- **Input in a short timescale, in order to fit within decision-making urgencies**. These can be either political urgencies such as sudden event outbreaks, or procedural urgencies such as deadlines on a thematic input.
- **Input to context-specific demands that may emerge in framing R&I priorities**. Value added comes with a deep understanding of the political or research context in which the request emerges as well as a focus on asking the right questions.
- **A validation process for the questions that are planned to be addressed in R&I programmes and policies.** By reformulating the questions asked or supplementing them with broader perspectives, FRR proposes a valid frame to those issues, providing a means of qualifying *ex ante* the domain-specific expert research that is then done by advising groups or EC staff.

1.4 Methodology

FRR may use a range of available foresight methods for producing content and facilitating collective reflections. Horizon scanning, trend selection, weak signal identification, or rapid scenario building, may be used in order to frame or collect knowledge.

In order to ensure that high-quality foresight input can be delivered in a timely fashion, the following approaches can be used:

- The drawing on and scanning of existing sources (e.g. data-mining and advanced analytics of existing FS databases);

- The application of rapid data collection techniques, such as online enquiries, social media analysis and workshops;

[1] EFFLA.'Policy Brief 11.Sense-Making for DG Research and Innovation (DG RTD).' DG RTD: 2014.

- A long-developed ability to synthesise a broad spectrum of knowledge, and to connect it to current policy agendas.

2. Literature and experience review of FRRs inside and outside EU policy-making bodies

The need for rapid-response consultation at the EC is not entirely new, and has been expressed by experts. For example, writing about the general public consultations undertaken for FP7, Dan Andrée points out that one of the problems that arose was the lack of 'more targeted/systematic (and possibly more useful) processes' that would complement broad, open consultations.[2]

However, the need for it was reinvigorated three years ago by EFFLA, in the context of 'sense-making' for Horizon 2020 and European research science and innovation policies. Upon recommending to use sense-making during the preparation of European research strategies, EFFLA mentions that 'A need … may arise [in any sense-making task] for in-depth investigation of specific topics. Often a study of 3-4 weeks duration is sufficient, but without this the ongoing work may be based on assumptions which, either now or going forward, may be unfounded.'[3] Although effective expert consultation mechanisms are in place, such as advisory groups for Work Programmes, the specific, in-depth expertise provided by these groups is not always a good fit for policy-tailored inputs. Moreover, the time required to provide high-quality research may exceed the window open for timely evidence-based decision-making.

However, in practice, there are few instances of experimentation in the EU context with rapid response mechanisms by external experts in general to our knowledge, and none involving foresight in particular.

As regards FP-preparation processes in particular, it seems that the main ways that the EC has resorted to external consultation (for FP7 and H2020) have been (i) large-scale *formal public consultations*, (ii) *formal advisory groups* (High Level Groups, European Research Area Boards, expert groups) and (iii) '*informal consultations* … more *targeted* at the interested scientific and technical community and not necessarily open, or at least not widely publicised.'[4]

A rapid response mechanism using external input has been experimented with in the past at the Joint Research Centre's Institute for Prospective Technological Studies (IPTS), although it was not geared specifically towards FP preparation.

Rapid response systems of knowledge production have been proposed or experimented in other domains such as health or policy-making. Foresight companies such as Shaping Tomorrow and TechCast also have experience in gathering input in a rapid and standardized way from a network of experts.

A Forward-looking Rapid Response at ESTO

The European Science & Technology Observatory (ESTO) 'was the first project of the Joint Research Centre's Institute for Prospective Technological Studies (IPTS) based in Seville, Spain. It was set up in an attempt to "create a platform of experts engaged in monitoring and analysing scientific and technological developments and their relation and interaction with society.'[5]

ESTO relied on an external network of research institutes and related experts which ESTO staff resorted to when the European Commission asked specific, content-related questions. It was considered quite revolutionary at the time, especially given the lack of a collaborative culture within EU institutions. A specific process was developed, involving a multi-step workflow, which enabled iterations between the experts and the Commission.

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[2] Dan Andrée (Swedish Ministry for Education and Research). 'Priority-setting in the European Research Framework Programmes.' VINNOVA (Swedish Governmental Agency for Innovation Systems): 2009. (p. 51)

[3] EFFLA.'Policy Brief 11.Sense-Making for DG Research and Innovation (DG RTD).' DG RTD: 2014. (p. 4)

[4] Dan Andrée (Swedish Ministry for Education and Research). 'Priority-setting in the European Research Framework Programmes.' VINNOVA (Swedish Governmental Agency for Innovation Systems): 2009. (p. 35)

[5] https://en.wikipedia.org/wiki/European_Science_and_Technology_Observatory

What was key was the form given to the expert network. It consisted of different disciplinary networks, organized in a concentric way with different levels of direct access from IPTS and different functions. Experts within the first circle were addressed first. When they did not feel able to answer the questions, they could redirect their questions to further circles. Alternatively, depending on the access level, a member of the IPTS staff could ask a Circle 1 expert, and turn to Circle 2 if that expert could not give an answer.

One issue was the incentive system to encourage participation, whose design resulted in a level of competition among the partner organisations in the network to deliver content to the Commission.

RAR: Rapid Assessment and Response

RAR is a methodology originally developed by the WHO and widely used in the public health field (drug use, epidemics, tobacco use…). According to the WHO, "it is a means for undertaking a comprehensive assessment of a public health issue, including the characteristics of the health problem, population groups affected, settings and contexts, health and risk behaviours, and social consequences. It identifies existing resources and opportunities for intervention, and helps plan, develop, and implement interventions."[6]

Although RARs are not as rapid as our timeline (they take several weeks), it is interesting to keep in mind the key aspects of the methodology. The idea of RAR is to resort to social sciences methods to acquire a view of what is going on in a particular area. There is no fixed process. Rather, each time, the RAR team must define an objective and determine a course of action (including methodologies) that is best suited to the objective (realism principle). RAR includes both diagnosis and intervention.

Usually, after reviewing secondary data, surveys and interviews are conducted on the field. From this knowledge base, a practical plan of action is then deployed. There is a focus on documenting the process and its results so that it can be used for subsequent studies and interventions.

RRR: Rapid Realist Review[7]

RRR was developed by a group of health researchers in North America 'as a tool for applying a realist approach to a knowledge synthesis process in order to produce a product that is useful to policy makers in responding to time-sensitive and/or emerging issues, while preserving the core elements of realist methodology.' 'They have emerged in response to the incompatibility between information needs of policy makers and the time requirements to complete systematic reviews. Rapid reviews provide a way to generate similar types of knowledge synthesis as more comprehensive systematic reviews do, but in a much shorter time period. While some have questioned the validity of rapid reviews, there remains a need to achieve a balance between comprehensiveness and timeliness for many policy-relevant decisions.'

'All aspects of an RRR are guided by both a local reference group, and a group of content experts. Involvement of knowledge users and external experts ensures both the usability of the review products, as well as their links to current practice. … RRRs have proven useful in providing evidence for and making explicit what is known on a given topic, as well as articulating where knowledge gaps may exist. From the RRRs completed to date, findings broadly adhere to four (often overlapping) classifications:

- guiding rules for policy-making;
- knowledge quantification (i.e., the amount of literature available that identifies context, mechanisms, and outcomes for a given topic);
- understanding tensions/ paradoxes in the evidence base;
- reinforcing or refuting beliefs and decisions taken.'[8]

[6] http://www.who.int/hiv/pub/prev_care/en/youngpeoplerar.pdf

[7] http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3844485/pdf/1748-5908-8-103.pdf

[8] http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3844485/pdf/1748-5908-8-103.pdf

3. FRR in practice: pilot experiments for DG RTD

In responding to ad-hoc demands in a timely way, it is not recommended to accommodate all requests through a one-size-fits-all process (although the generic guidelines outlined below in Part 4 are necessary to address ways of recruiting and managing a relevant FRR expert circle and coordinating their contributions). **Experimentations are essential to test out the process in real conditions.**

SFRI has conducted two pilot experiments and one co-creation workshop, in which two 'mock' experiments were run. This section outlines the observations and lessons learned.

3.1 Pilot 1: Foresight for Scientific Advice (July-September 2015)

In early July 2015, the Commission sent to the SFRI Chair a reflection paper on 'The Use of Foresight for Scientific Advice', along with three related questions (presented below). The objective of the Commission was to receive rapid input from the SFRI group on a Commission priority. The Chair was tasked with providing a consolidated response with a deadline set at the end of August.

Two of the three questions addressed specific sections of the note. They asked for additional examples and whether the examples already given were still relevant. The last question was broader, asking for general advice on the topic of the paper (foresight for scientific advice).

The Questions

1. Could you please verify and correct or complete where necessary section 3 "Approaches to foresight for government". Are the examples still pertinent or do you know of any significant changes?

2. Could you please verify and correct or complete where necessary section 4 "Examples for the use of foresight by scientific advisory structures". Do you know any other important examples from national administrations or international organisations which can give insight into ways in which foresight can be used for scientific advice?

3. Based on your knowledge and experience what ways of organising the use of foresight in scientific advice would increase the chances that foresight is actually taken into account for policy-making (i.e. how could foresight be effectively used for scientific advice?)?

Please feel free to add any other comment you would find important to improve the document!

After the three Chairs convened in a Skype meeting and decided how to proceed, the Chair circulated the request to the SFRI members, with a deadline for input set one week later. By the end of July, the Chair drafted a preliminary response which was sent to the two Vice-Chairs and to the Commission for comments.

By 20 August, the Commission sent written comments to the Chair. The Chair and the Commission met up shortly afterwards to discuss the draft response. The meeting allowed for further clarification of the request for rapid response.

Based on the results of this meeting, by the end of August the Chair sent to SFRI members a request for additional input (good practice examples), again with a one-week deadline.

Five days later, in early September, the Chair submitted a final rapid response paper. This 6-page paper stated that "the relationship between foresight and scientific advice cannot be regarded as the former simply feeding into the latter. Due to the inherent future- and action-orientation, scientific input rather feeds into foresight and afterwards these results frame new scientific advice procedures." The major benefit of foresight for scientific advice is therefore to provide a reframing of problem definitions, based on sound scientific input, in order to support the formal advice

practice. It does so by 'embedding advice in a context of pluralistic world views, stakeholder participation and open planning, by exploring multiple future states.'

3.2 Pilot 2: The Migration Issue in a Forward-looking Perspective – Migration in relation with research, education, technology and innovation (September-December 2015)

During an SFRI plenary meeting, in late September 2015, an informal need for urgent expert input on the issue of migrations was raised.

Ten days later, in early October, the SFRI Chair communicated the request by email to SFRI members. The request was to share ideas on the relationship between migration and research, education, technology, and innovation. It was requested that the input should be brief and concise, and provided within a week.

Experts then exchanged their input by email, looking at the issue from different angles, expressing novel ideas, and synthesizing the ideas already provided.

Five days after the deadline (20 October), the three Chairs met to discuss the streams of input that emerged out of the email exchanges.

In this rapid response, SFRI experts opted for a rather informal approach, due to the particular high-emergency context of the 'migration crisis' that was going on at the time. Therefore, the group's input was sent directly via email to the head of unit who formulated the request, including a summary of the conclusions along with a mindmap displaying the issues that SFRI experts considered relevant for the current and next framework programs. Experts also recommended a feasibility study for a multidisciplinary research program exploring the drivers for migration and the mechanisms involved.

During the next SFRI plenary meeting, in December 2015, upon request by SFRI members, the Commission confirmed that some of the ideas provided in the email exchanges had been taken into account.

3.3 Pilot 3: Security Aspects in Future R&I Policy: Instability and Resilience (April-June 2016)

On the SFRI plenary of 15 March 2016, a request was formulated for a forward-looking rapid response on security. The scope of the request was to focus on how the new security landscape will impact on the EU research and innovation policy.

A dedicated Task Force of 6 people was appointed within the SFRI group, responsible for coordinating the production and delivery of the answer as well as ensuring the communication and interaction with the Commission services. The deadline for submitting the answer to the request was set at 30 June 2016.

A workplan was agreed by 22 March 2016.

The Task Force worked on the RR paper over the months of April and May. On 10 June 2016, they circulated a first draft to the other SFRI experts for input. Experts reacted by email and the draft was also discussed collectively at the SFRI plenary of 21 June 2016.

The final paper, made available by 7 July 2016, contains 20 pages and include a number of key recommendations. These outline the policy consequences of a 'changing security landscape', both for European and R&I policy in general and specifically for Horizon 2020 and FP9. The paper puts a strong focus on security end-users, both in its framing of the security problem and in the policy priorities it highlights. It is recommended that security be framed as 'societal security', addressing the full range of security dimensions (which are depicted in a summary table). Different areas of research and policy should be bridged to address interconnected threats, risks and opportunities. Specific attention should be given to the interrelatedness of security dimensions, social innovation solutions, and the potential of participatory processes in early detection of emerging risks.

Along with policy recommendations and reframing of security questions, the paper provides high-quality content on potential alternative futures for security. This foresight content includes a review of scenario literature on different security topics; an outline of 'structural features of the new security landscape in flux'; and a more specific outline of threats, risks and opportunities at present, in the short term and in the longer run.

This work on security challenges in a forward-looking manner was used as an input for a lunchtime discussion session organized by DG RTD for Commission staff to launch the World Economic Forum Report on Global Risks. The WEF Report provides an important analysis of key emerging risks at global level based on different stakeholder views including young people. The SFRI contribution, in contrast, focused on proactive responses, societal security, research priorities and the need to focus on opportunities in this respect. The presentation by DG Home outlined their approach to security and the ten projects underway and the constraints of working within the rules of H2020, in particular its time horizon. In the two rounds of question and answer, the discussion included the involvement of young people and local communities, how to address externalities, and how to exploit FP results.

3.4 Additional experiment: FRR workshop at the Commission (27 October 2015)

The SFRI Working Group 4, in charge of designing the FRR process, organized a workshop with stakeholders within the Commission interested about forward-looking rapid response. The objective was to co-create an FRR tool with them, in order to engage them in the process and to have information on what would be most useful to them.

The workshop was designed to be interactive, and the attendees were divided into two groups to go through a mock FRR process each focusing on a distinct topic: 'The future of the food processing industry' and 'Future of automotive systems/testing automobiles'.

The workshop confirmed the need for decision-makers to benefit from a FRR that can provide quick answers to various issues.

It also allowed for a collective design of the best way to provide value through FRR. Several key issues were raised:

- The first specification of a rapid-response request should be the intended end-goal of the request. What are the targeted outcomes and impacts?
- The RR mechanism should be dynamic and flexible and adjust itself to the target audience and the type of question.
- The data flow of the FRR can be either top-down (request from the Commission) or bottom-up (initiative from the experts).
- Motivating the experts is a key aspect of an effective network and of success in data collection.
- The timescales of FRR could be flexible and flow from 10-14 days in the short term to a longer scale of a few months.
- Validation and quality control of the data need to be ensured.

In conclusion, the question of the sustainability of the FRR after the SFRI mandate was raised: How will this mechanism continue to be operated and by whom?

4. Guiding principles towards an effective FRR for DG RTD

The section below outlines a number of **guiding principles to frame the feasibility and quality of the FRR offer.** They draw from recent pilot experiments conducted with the SFRI group, as well as literature reviews and evaluations of advisory groups and platforms set up to assist in FP7 and H2020 preparation and implementation.

4.1 Process flexibility

Because FRR responds to EC demands as they emerge, it has to ensure high flexibility. Therefore a range of possibilities in terms of timing, the origins of the request, output format, and network nature and management can be offered.

4.1.1 Flexibility in timing

The timeframe to provide a response is defined on an *ad hoc* basis, based on the particular context of each request.

Based on the pilots, it is advisable that a minimum of 10 days is allowed for providing a response. This provides sufficient time for convening experts and gathering input, a minimum delay of 10 days is required. Timelines can vary up to several months, depending on the magnitude and nature of the request and the flexibility of the client.

Although the timeframe can be short, it does not necessarily have to be on the go. When there is the possibility of anticipating a request for urgent response, preparatory arrangements can be put in place. For example, **experts can be asked well in advance to make themselves available to dedicate one month to collecting the latest information**. This means that pre-call notice of a rapid response request would be issued in advance, e.g. six months ago, while the actual rapid response occurs later.

4.1.2 Flexibility in output format

As outlined in section 1 above, the role of FRR is to provide highly contextualized framing and validation of questions raised for R&I priorities.

Validation and framing may take diverse shapes, depending on what brings the highest added value. Here are three possible types of cases:

- Case 1: **A revised question** could be a deliverable *per se.* The request may be issued as one or several questions, which the rapid response service reframes so as to include surprising insights, contextualisation, literature review, and other inputs.

- Case 2: **Layers of responses** may be considered for different audiences: one level with one question or one graph, another level with 10 pages, a third level with 100 pages…

- Case 3: **A list of relevant information or creative suggestions** (e.g. weak signals, unnoted historical perspectives, or out-of-the-box ideas) can be useful.

The means used to collect expert input should reflect the nature of the output needed. Software tools such as decision-support, crowdsourcing, survey, or gaming tools may be useful to facilitate rapid collection of large amounts of data or opinions. For more in-depth knowledge, expert writing may be the best option.

Whatever its form, **the output needs to be concrete and policy-oriented**, i.e. linked to policy and political realities.

4.1.3 Origins of the request

The Request is the demand that is formulated for the experts to answer. Requests may originate:

- '**Top-down**' from the EC: The main goal of the FRR in this case is to provide timely input to emerging R&I demands that the EC has identified.

- **'Bottom-up'** from the experts: Because of their field work, experts may be aware of incoming crises or opportunities which the Commission may not. Therefore, experts may start an FRR to raise attention about such topics, without waiting for a formal EC rapid response request.

4.1.4 Flexibility in response mechanisms

Depending on the nature of the request, the response mechanisms may need to take different forms:

- **The official network** set up specifically for the FRR (in our case, the SFRI group) receives the request first, and assesses if it is fit to provide appropriate framing and validation or if it needs further input.

- For some broad requests or, alternatively, very topic-specific requests, the core FRR group may not be in a position to provide a definitive and in-depth response but rather recommends how this can be obtained. Thus they can call upon **external contributions**. Ultimately, with practice, this may lead to the constitution of further expert circles that are more distant to the core FRR yet can be mobilized when needed.

- Different types of experts may also be involved: academics, entrepreneurs, innovators, inventors, civil society representatives, activists.

Management of the expert network may also take varying forms:

- **Collective call**: some issues require wide group reflection to sift through complexity or source for data outside the network. In these cases, the request may generate a call to all network members for input.

- **Individual call**: for other topics, in-depth expertise in particular areas may be required. The request may then lead to a call to a smaller number of specific individuals within the network to respond.

4.2 Context & formulation of the FRR request

4.2.1 Context of the request

Contextualization of the rapid response request is the key value of a FRR.

It is important that **the client provides an overview of the context** within which the rapid response request emerged. Context includes two levels:

- **The origin** of the request: Who initiated the request? For what purpose?

- **The destination** of the output: Who is the audience? How will it be used?

Context specification also enables Member State experts to take European specificities into account, at the geographic scale and logical level. As Dan Andrée explained, inputs to European consultations can be 'too detailed' while 'very few inputs address aspects such as European Added Value, creating critical mass, tackling fragmentation etc.'[9]

4.2.2 Request formulation

The appropriate formulation of a request is an important step in the process, as it influences both the quality of the output and the motivation of experts.

In order to ensure that rapid responses are as close as possible to the specific demand, **regular iterations between experts and the Commission are necessary.** This is part of the feedback process of the workflow outlined below. Iterations concern at first the request formulation *per se*, so that it can activate appropriate responses and tacit knowledge among experts. Then, iterations address the content of the responses.

Given the time constraint, **the formulation of the questions should make sure to be aimed at eliciting the greatest value from the experts**. This requires thinking beforehand about the expected input. What value are the experts expected to bring to the issue at hand? What input cannot be collected without these experts?

Clarifying the terms used and for what purpose is also important to avoid raising questions among experts that cost time and efficiency.

4.3 Quality review

The rapid response offer requires a balance between quality and urgency. Yet, given the networked nature of the process and the difference in requests, overarching quality standards are not relevant. **Quality needs vary depending on the destination and the urgency of the request.**

However, it may be useful to define 'basic' quality standards in order to both ensure the legitimacy of the process, as well as provide guarantees to experts. Such standards may eventually be defined through a 'minimum viable quality' threshold.

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[9] Dan Andrée (Swedish Ministry for Education and Research). 'Priority-setting in the European Research Framework Programmes.' VINNOVA (Swedish Governmental Agency for Innovation Systems): 2009. (p. 35)

4.4 Workflow organization

A task force is required as an intermediary point-of-contact between the EC and the expert network, in order to collect and synthesize answers and to interact with the EC along the process.

In practice, this task force takes the form of a team of two to six people responsible for choosing the best option among a range of possibilities (see 'Process Flexibility' part above), hands in hands with the Commission. **This includes**:

- Receiving the EC request and qualifying its characteristics, often during a first meeting with the EC
- Choosing which experts to convene within the core FRR group
- Contacting those experts and inviting them to respond
- Together with the experts, outlining a workplan to organize collection of information and collective work
- Coordinating the input of the network while checking in with the EC
- Synthesizing the input
- Coordinating with the EC over the final output
- Following up with the expert network to communicate how the rapid response was used.

Frequent feedback between the task force and the EC along the RR project is essential, even in a short timeframe. This helps prevent the expert group from going in the wrong direction. It also allows the EC to provide additional updates or requests during the course of the project.

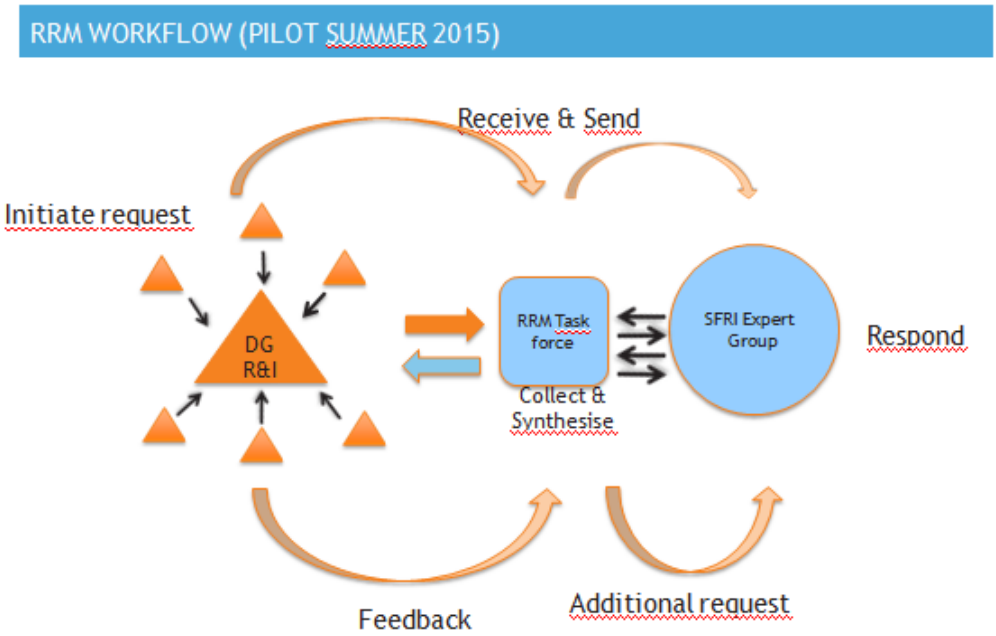

Fig. 1.Workflow for a Rapid Response Mechanism as used for SFRI's pilot experiment in Summer 2015.

4.5 Links with existing expert structures preparing research programmes

Many forward-looking activities have been conducted within EU policy-making bodies and Member States. Different units work at preparing research programmes. **The FRR should work in collaboration with these groups**. This can take several forms:

- Validated questions could be provided to Advisory Groups and other expert groups as a tool for calibration of their activities.

- The FRR could then be seen as a tool to navigate between active research groups, be they internal or external, and political or procedural needs coming from EC officials.

- European foresight networks, such as the Foresight Correspondents, and foresight units in different EU policy-making bodies, should be called upon when needed.

4.6 Supporting structures: network governance & management

Convening a group of experts to provide robust, synthetic input in a very short timeframe is a challenging exercise, albeit a valuable one. Some of the challenges posed include expert availability and motivation on short notice, the depth and quality of input that can be provided, and the required individual and collective working modes.

However, methods and good practices do exist to mobilize a network of knowledge providers (in our case 'foresight producers') in a way that is relevant and timely.

4.6.1 Triggering and coordinating input from the expert network

One of the most challenging parts of the process that emerged during SFRI's pilot experimentations is the coordination work of the Task Force. **How to motivate the network members to deliver very high value added within a tight time constraint?** Our pilot experience has shown that even when the network has been set up specifically for an FRR, the short timeframe still poses a coordination challenge.

In order to facilitate the delivery of input, it is important to qualify the Request in order to **characterize what will be required from the experts**. Such qualification can be made formally (through a template) or informally but in any case it should include:

- Presentation & Roles of the task force

- The formal request for input + Context information

- Definition of the nature of the input needed from experts:

    - Question reframing

    - Literature resources

    - Specific data and/or links between data that reveal interesting convergences

    - Fresh ideas: policy ideas or more general visions

- Timeframe

- Type of expertise needed

- Suggestion of a working method (to be realigned with the experts once committed)

Assessing individual experts' skills and preferences should also be used to facilitate rapid coordination for high-value output. One possibility may be to collect data from individual members susceptible of working on an FRR about how they prefer to work, including their main foresight and data-collection skills, their expertise areas, the resources they master, and their preferred way of communication for collective work.

When in-depth collective reflection is needed, a working culture with appropriate collective intelligence methods should ensure effective collaboration. Collective intelligence and network management are not natural, particularly in the EU context which has been said to suffer from a general 'weakness of the culture of cooperation across sectors and categories of actors.'[10] The quality of the bonds formed within the expert group (including the task force) and collective intelligence mechanisms can be used to create the appropriate working mode to produce

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[10] Dan Andrée (Swedish Ministry for Education and Research). 'Priority-setting in the European Research Framework Programmes.' VINNOVA (Swedish Governmental Agency for Innovation Systems): 2009. (p. 38)

a rapid yet relevant output in limited time. This includes face-to-face bonding, knowledge exchange, responsibility/accountability mechanisms, and motivation.

4.6.2 Expert motivation and compensation

Rapid response requires finding ways to **incentivize and motivate the experts** to work under tight time constraints. Compensation is only one part of the issue. The relevance and importance of their contribution within the context of the request, as well as the formulation of the request, are an important way to attract experts, as seen above. EFFLA pointed out in its Policy Brief 11 that 'the DG RTD is not currently able to let contracts within any reasonable timescale. This needs to be fixed as part of creating a foresight culture.'[11]

4.6.3 Expert responsibility

Because high value-added comes in close relationship with political decisions, experts may voice concerns over the responsibility associated with their input. The liability issues that emerge in scientific advice are not applicable here given the more qualitative nature of the input. However, basic guarantees need to be given to experts.

4.6.4 Beyond the SFRI Expert Group

SFRI has acted as a pilot group for forward-looking rapid response. With the project coming to an end in Autumn 2016, it is important to consider what will happen beyond the lifetime of the SFRI expert group. On what network could an FRR mechanism rely?

Different foresight and expert networks exist within the EC, and one of the working groups within SFRI was tasked with reflecting in particular on 'a flexible and informal European network of foresight experts for research, science and innovation policy to address the Commission's need for strategic intelligence and sense-making.' An FRR mechanism could be based on one or parts of these networks, with dedicated working processes.

A network of foresight experts does not mean a network of experts for every issue at stake. More than specific in-depth expertise, the promise of a foresight network is its unique knowledge, experience and attitude about embedding emergent, sometimes contested knowledge into public deliberation, participation and politics.

[11] EFFLA Policy Brief 11, p. 4.

Background Paper 2

Rapid-Response on 'The use of foresight in scientific advice'

1. Introduction

In this quick response we provide the European Commission (DG RTD) with a first analysis and response to the draft paper of July 15th on "The use of foresight in scientific advice", based on written remarks made by the members of SFRI. We propose, considering the relevance of the paper, that SFRI will contribute with a more detailed response to the further debates on this matter in September. We immediately installed a working group and asked directly all SFRI members to give a first response to the questions concerning the concept paper of DG RTD/A6. This resulted in several, sometimes detailed, responses in a very short period of time. Building on these inputs, the working group prepared this response, which is simultaneously presented to DG RTD/A6 and all the members of SFRI. After a discussion on a draft of this paper with RTD we took up the suggestion to ask the members of SFRI to come up with examples which, very specifically, illustrate the relationship between foresight projects and scientific advice. This extra inquiry gave some delay in the delivery of the report.

2. Foresight

In order to answer the question how foresight can contribute to scientific advice in the EU and in the Member States we want to shed light on some essential characteristics, which frame the relationship between foresight and scientific advice. Scientific advice comes in many different forms, and it serves a broad variety of goals. Foresight is not of use in all these regards, but – due to its specific characteristics – is pertinent to some types of scientific advice.

We want to emphasise the following characteristics of foresight:

- the action-oriented nature of foresight
- its participatory character through involving a variety of experts and stakeholders
- foresight explores never one but always several futures and preferably in an open deliberative process
- there is a particular relationship between foresight, planning and design, which goes beyond scientific deductive reasoning as such
- foresight is from the very beginning systematically and methodologically connected with meanings, values, interests and pluralistic, comprehensive views in society.

Normally, scientific advice is expected to present the current scientific state of the art. It is therefore just one of the building blocks for an exploration of possible futures through interaction amongst citizens, experts and stakeholders, as common in foresight. The purpose of foresight is to create a process in society, amongst stakeholders, politicians and policy-makers, and to confront them with well-underpinned and possible (multiple) futures in a pluralistic society. The foresight process itself is as much important as the written reports entailing conclusions and recommendations.

Of course, the toolbox for foresight contains instruments, which are also used in some types of scientific advice. In fact, foresight takes the best possible scientific understanding of the present – and the path leading to the present, that is, the near past – as its starting point. Similarly, regulatory processes and permanent advisory bodies to some extent lean on participatory procedures to improve the quality of their work by extending the knowledge pool, on which they draw. Most of the examples our members refer to, deal with this kind of activities or to separate foresight procedures which had a broad direct effect on policymakers, on societal actors and on political decision making.

Foresight is institutionalised in very different ways in the Member States. Although specific and independent research organisations, with a central mission of future analyses, exist in some countries, this is not a very widespread model. Other independent organisations, which rely heavily on the foresight toolbox, are Parliamentary Technology Assessment institutes. Ministerial departments and their research institutes, especially in the field of health, infrastructure/ planning,

science, innovation and agriculture, organise sometimes regularly, sometimes infrequently foresight activities as do their institutes dealing with regulatory affairs.

Against this backdrop, it is not the function of foresight to deliver sound scientific evidence or sound scientific reasoning to underpin one specific position in policy and politics, but rather it investigates possible future perspectives (multiple future states) of both a normative and an exploratory nature, and it does so by involving a range of stakeholders.

In describing the contribution of foresight to scientific advice we better take a broader scope and consider how horizon scanning and prospective analyses can be taken into account in some form of 'enlightened' and future-oriented advice to policy-making.

3. Scientific advice

We propose to focus on formal scientific advice, which means that the advice practice is embedded in governmental institutional arrangements, procedures and processes.

We consider the division, referred to in the draft paper, between Committees, CSA's and Academies not as a fruitful representation of the major arrangements in the EU and the Member States. We want to emphasise that the position (function) of CSA exists in just a few Member States and that the role of Academies in scientific advice is not prominent. Most strategic issues in Member States are covered by specialised bodies rather than by general-purpose advisory bodies. If Academies are involved, they cover predominantly scientific advice on strategic issues in science policy, and even though there may be a tendency to strengthen the position of scientists in evidence-based policy-making processes, it is questionable whether the Academies can justifiable claim to speak for the diverse entirety of scientific branches and streams

Moreover, scientific advice is provided through many other types of channels than these three. They range from dedicated bodies with a clear mandate to advise governmental bodies to research organisations and individual researchers responding to specific requests for advice through scientific studies and evaluations. The bulk of scientific advice is coming from specialised councils, specialised committees and specialised institutes. Much more attention should be given to the research institutes which are specialised for regulatory affairs and specific policy areas, which have a formal advisory function in, to our knowledge, every member state, for instance in the fields of environment, nature management, infrastructure, public health, economics, societal and demographical developments, foreign affairs, defence, forensic and public order issues.

We also want to draw attention to the hybridisation of scientific advice. Many councils and committees are populated not only by academic scientists but by all kind of experts coming from R&D departments of companies, NGOs, the judiciary, inspections and so on. Hybridisation we find also in terms of organisational forms with bodies like TA institutes, think tanks and commercial expert consultancy organisations playing an increasingly important role. Clearly, experts working for these types of organisations do not belong to the scientific communities of the academia. These bodies are equipped for performing investigations and studies and for delivering well-grounded advice in a formally ordered setting, very often on politically hot issues.

We therefore suggest taking a much broader notion of scientific advice as the starting point for achieving a better understanding of the relationship of foresight and scientific advice. Neither conceptually, nor empirically in light of practices in Member States, it is justified to restrict scientific advice to committees, CSAs and Academies. If we want to explore the landscape of scientific advice, our suggestion is to take a broad, impartial scope and take very little for granted.

3.1 The relationship between foresight and scientific advice

The major contributions foresight can deliver to scientific advice are:

1) Trust building concerning those policy issues, which have a highly conflicting character and are surrounded by uncertainty. Especially in those cases where there is no political consensus on aims and thus scientific advice on the proportionality of aims and means is not the proper question. Foresight establishes a dynamic connection among stakeholders, policy-makers and politicians on values, interests and disruptive societal change, which makes it possible to deliberate on multiple futures embedded in alternative value sets and interests in a transparent and systematic way.

2) Exploring future trends and early warning signals, as well as confronting stakeholders with future disruptive change, multiple futures and problem definitions in a strategic and policy design context.

3) Framing problem definitions and thus supporting the formal advice practice. This is particularly important with regard to framings that may substantially change in the future and which should thus not be taken for granted. In other words, foresight can help scrutinise problem framings from a future-oriented perspective.

4) Contributing to, and advising on, long-term planning activities of government and other bodies. This refers in particular to the planning and implementation stage of government policy.

Examples of the way FS contributes directly and in a well organised manner to scientific advice bodies are not prominent, and this has a lot to do with the nature of foresight. The impact of a foresight procedure is first and for all awareness amongst media, stakeholders and politicians and it gives later on rise to very often a manifold of studies, debates and parliamentary hearings amongst experts. What starts as a first step to awareness of future developments appears later on to contain an agenda for many stakeholders for taking up new steps in an (international) knowledge landscape. Taking this into consideration we mention the areas where foresight can contribute more directly to scientific advice

1. Foresight procedures on emerging scientific and technological developments, initiated by government or coming from other bodies, which frame the issues at stake and which are followed up by a scientific advice procedure through one of the specialised advisory bodies. Here cooperation with scientific advice bodies could be strengthened.

2. Research institutes, for instance on health and environment, which organise foresight procedures followed up by a formal advice. Every now and then a subsequent round of advice is asked from another specialised body. So the state institute for public health organises a foresight and comes up with a frame. The government subsequently asks another body, for instance a health council to advice on specific questions derived from that foresight. The Rathenau Instituut for example reported after a TA/Foresight procedure about synthetic biology and directly afterwards the ministry of education, science and culture asked a specific piece of scientific advice of the Dutch Royal Academy of Arts and Science.

3. Foresight procedures organised by science policy organisations like academies or university organisations e.g. on the future of universities, which are subsequently connected with advice to the government.[12]

3.2 Analysis of scientific advice landscape in the EU and the Member States

The members of the FRSI gave suggestions and comments on the inventory in the draft paper. We think that an internet survey needs completion by other means in order to get a representative and informative picture. To illustrate the need for other actions we refer to the text about The Netherlands, which lacks important scientific advisory bodies, as well as the very important so-called planning institutes and other institutes for regulatory sciences. As for science and innovation policy it also fails mentioning important advisory bodies. The role of foresight, however, is most prominent in these planning institutes, the institutes for regulatory sciences, some well-equipped councils and in hybrid organisations.

4. Key points

1) A broad(er) understanding of scientific advice is important to understand the contribution of foresight to scientific advice.

2) A foresight process is different from a scientific project in a very fundamental way, in particular in being future- and action-oriented, participatory and value-related. (Foresight, of course, among others sources of knowledge, relies on the results of scientific projects and uses several scientific methods.)

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[12] The extra inquiry amongst the members revealed some nice examples of foresight which had a strong impact on policy making and political decision making. An example which might be a model for the Commission is the FP7 foresight on manufacturing technologies which later on was followed by High level expert groups who tailored visions and came up with advice. We already referred to the synthetic biology case in The Netherlands where a Technology Assessment was followed up by a formal advice delivered by the Dutch Academy of arts and sciences, we refer to Flanders where a foresight resulted in long standing priority setting in research programming, in the UK where a foresight on flood and coastal protection resulted in a concrete governmental action program and to the Czech Republic where a foresight procedure also resulted in an action program on research activities. In most of these cases however the impact was directly without scientific advice by a third party.

3) Commonly, a foresight process might give rise to subsequent scientific advice by specialised bodies, every now and then more than once on different issues, which are identified by the foresight process.

4) The relationship between foresight and scientific advice cannot, therefore, be regarded as the former simply feeding into the latter. Due to the inherent future-orientation, scientific input rather feeds into foresight and afterwards these results frame new scientific advice procedures. The major benefit of foresight for scientific advice is embedding advice in a context of pluralistic world views, stakeholder participation and open planning by building and exploring multiple future states and problem definitions in situations of radical change.

5) If these general points of departure are accepted, the SFRI EG offers to deepen its work on better conceptualising and empirically underpinning the relationship between foresight and scientific advice.

DG Research and Innovation is advised to complement the current survey by other means in order to make it possible to define the role of foresight in relation to much more specified scientific advice practices.

Background Paper 3

Rapid-Response on 'Security aspects in future R&I policy'

Key recommendations

- The changing security landscape calls for a change in perspective from technological fixes or other security responses, towards a perspective that aims at embedding security deeply in society, in order to address the root causes of security challenges - the notion of 'societal security' can be used more effectively to denote this change in perspective. Specifically European policy responses could address the full range of security dimensions, including economic and societal dimensions in a coherent, integrated way, focusing on opportunities inherent to societal security and social innovation.

- Insights from the ongoing security programme in Horizon 2020 indicate that the current setup for strategic programming is not flexible enough to meet the dynamic nature of the security challenge. Sudden crises and emergence of new threats, risks and opportunities require an enabling framework which is more conducive to changes in research themes and approaches. A further complicating aspect to be factored in is the need to anticipate the types of innovative products and processes which ongoing security research gives rise to and how to ensure effective take-up. The current setup is too rigid to cope with these needs and requires a rethinking.

- The long-term shift in the security landscape indicates that FP9 in particular needs to shape up to new, more effective ways of addressing the security challenge. The inter-connectedness of security threats, risks and opportunities highlight the need for a comprehensive joined-up policy approach, to address converging security themes, and to bridge the gap between different areas of research and related policy. Factoring in security externalities and ways of prioritizing these is a key policy concern. The early detection of emerging security threats, risks and opportunities is critical and requires state-of-the-art and secure infrastructures integrating and manipulating multiple datasets.

- Horizon 2020/FP9 needs to make space for piloting more bottom-up approaches and thereby tackle more deep-rooted causes of security risks. The opportunities for societal regeneration and revival of trust in state institutions and practices is key in the drive to developing more secure societies. The discussion of threats, risks and opportunities highlights the need for developing a good balance between reactive and proactive approaches to the security challenge. Investing in security innovation projects highlights the potential of this area for the economy and society, through the development of new economic and business models as well as helping to project a more positive outlook among communities. These types of social innovation projects in the security area, especially those involving local communities and young people, could prove highly effective in countering the challenge. There are examples of ongoing initiatives at local level which could be supported through top-up funding and used for replicability to other localities throughout Europe. There are opportunities here to link to the smart cities and circular economy initiatives underway in H2020 as well as the smart specialization drive by DG Regio using structural funds. In this respect a combination of demand and supply side approaches could be adapted. There also needs to be more effective means for incentivizing the use of relevant results of existing initiatives as well as completed and ongoing FP projects.

- The design of security research and innovation programmes can be rendered more effective by being aware of and factoring in different time frames. Our current response to security in Horizon 2020 focuses primarily on addressing our perception of current threats, risks and opportunities. This may result in a rather narrow set of priorities which reduces the robustness of the approach. The forward look at the security landscape indicates a complexity of trends and drivers and there are indications of emerging scenarios which go beyond mere extrapolation of current trends and drivers over time. There is a need to better structure the response to these challenges by distinguishing between current, short to medium-term and long-term security concerns and needs. Different approaches are needed to ensure a more comprehensive and time differentiated approach.

In summary, in Horizon 2020 (H2020) and FP9, security requires a dedicated approach as follows:

- It is recommended that a comprehensive, joined up approach to security is developed due to the interconnectedness of threats and risks and the opportunities inherent to societal security.

- The planning and programming cycle needs to be more flexible, dynamic and anticipatory, allowing quick shifts to address new and emerging threats, risks and opportunities.

- This calls for more participatory processes involving end users in co-design of security solutions and sufficient space for piloting bottom-up approaches involving communities, local groups and young people.

- A strong emphasis on risk- and threat-identification systems with early detection and prevention is needed.

- The focus on effective end products is of particular importance in this strategic priority sector and could be incentivized through different measures including top-up funds for high quality replicable solutions as well as ongoing local community initiatives.

1. Introduction

The main objective of this pilot rapid response is to provide recommendations for future R&I policy responses in the area of security. The following questions have been addressed:

- Is security more effectively addressed in the next Framework Programme (FP) as a self-standing theme (challenge) or as a cross-cutting issue affecting all R&I priorities? Or both?

- Does security require supply-side vs demand-side R&I policy responses (depending on whether the emphasis is on risks, threats or opportunities)? And what is the importance and shape of risk- and threat-identification systems?

- Is it a technical R&D question or a question of perception of citizens and behaviour? What is the role of foresight in addressing this issue?

The following approach has been followed:

- To extract key trends and drivers of the future security landscape drawing on ongoing and completed projects (EU funded FORCE project FOResight Coordination for Europe)

- To reflect on the challenge of addressing different perspectives and understandings of the notion of security as an area of research, as a policy imperative and from the individual and societal perspective

- To develop an overview of the context and dynamics of the new and changing security landscape and how this will impact on EU research and innovation policy

- To trace links between threats, risks, opportunities and to focus on policy responses for societal security

- To outline a set of structured policy responses in the short, medium and long-term

2. The changing security landscape – a new paradigm?

Security is a manifold, complex and controversial area - including social, political, as well as economic and cultural challenges – drawing on several areas of science, from ICT, mathematics, physics and engineering to life sciences and socio-economic sciences and humanities.

Security refers to actions and measures for safeguarding the integrity and functioning of socio-technological practices and the (technological) systems involved there. Security can be understood as (i) preventing harm to citizens and the environment and providing for the safety of citizens and the environment; and as (ii) ensuring the well-functioning of the state. Considering these aspects the range of security challenges currently extends to:

- Natural disasters such as earthquakes, climate and extreme weather events, flood, hunger, disease outbreaks etc., which disintegrate or render obsolete or ineffective current systems, processes and practices at local, national, regional and international level for addressing these challenges.

- Intended hostile attacks in order to destroy the integrity of a state or group of states, and to undermine state sovereignty, political stability and democracy and the system of governance.

- Socio-technological practices which are in decline and are likely to collapse, entailing major risks for the functioning of society and economy; including the financial system, unproductive research practices, fossil energy systems etc.

- New and upcoming socio-technical systems and practices which raise new security challenges and call for a rethinking of traditional policy responses, for instance cyber-security, non-lethal weapons for public order, drones for intelligence and war weaponry, health care and new vaccination programs, molecular biology on infectious diseases or brain function, social engineering etc. The role of technology assessment and foresight is particularly important in this area.

- Misuse of practices (for example intelligence practices, ICT etc.) by external actors (political opponents, dissidents, powerful economic players outside the country), internal actors or government. Snowden and NSA are good examples of the blurred interface between use and misuse and the governance challenge this presents.

- The single and increasingly collective knock-on effects of the security challenges outlined above are having serious and lasting impacts on society and societal security. The result is an increasingly disintegrated, angry and agonistic society where distrust is cultivated and radical change comes forward in the field of human rights, nationalism, anti-globalism, the rule of law, representation in democracy, religious fights, migration, demography and what have you more.

- The knock-on effects of geopolitical distortions, ongoing disruption of global markets, financial and economic instability and resource shortages, highlight the fragility of the global economic system and individual livelihood and quality of life.

The security landscape reflects a high level of change and complexity and it is on a steep pathway of further change in the future. The urgency and policy relevance of security nowadays is expected to increase and become explosive mostly through the knock-on effects of the totality and conflation of the challenges outlined above. The legitimacy of the state and its institutional arrangements are at stake, including the legitimacy relating to welfare, safety, justice and public order. The magnitude and scale of the security challenge has reached unprecedented levels in recent months due to the confluence of a number of destabilizing factors which are exposing serious vulnerabilities in societal security. The onset of climate change has become more evident as extreme weather events are on a sharp increase. The conflict in the Middle East and the Mediterranean spring has led to mass migration into Europe, creating local tensions and pressures and sparking extreme political reactions. This has escalated further in recent months with the ongoing imminent threat of terrorist attacks in Europe using a dangerous combination of tactics including mass violence, cyber-attacks, lone wolf attacks and the threat of bio warfare. This fast changing high risk security landscape calls for new approaches in designing policy responses. A new kind of flexibility is needed and solutions which are holistic and tackle the root causes of the challenge systematically.

The new paradigm reflects the need for a new emphasis in security R&I policy on social innovation rather than technological fixes. Whereas R&I policy was in the past predominantly conducted based on industrial policy rationales, the re-positioning of security as a societal challenge requires a tighter embedding of European R&I policy in the security field. In other words, R&I policy rationales have to be tightly embedded in security policy rationales. There is a need for different types of research infrastructures to address more volatile security threats. The current approach of planning two- or even seven-year programmes is too constraining for addressing effectively a highly dynamic challenge. This requires that the planning and programming of security research is flexible, responsive to change and forward-looking.

The question is how can foresight contribute in describing a new paradigm for research and innovation policy to address this emerging and fast changing security landscape? The next section explores what can be expected in the future security landscape and the nature of the security challenge faced.

3. Structural features of the new security landscape in flux

The emerging security landscape has a number of alarming new features as distinct from the old landscape and is on a trajectory to embrace further change as current trends and drivers merge /confront each other. Threats and risks have become more prevalent, imminent and interconnected. The table below is an attempt to map and distinguish between different elements of the security challenge (terrorist attacks, cyber-attacks, climate change, migration), since each requires dedicated policy response(s). However, what is clear from recent security incidents is that the real concern relates to the way that these features are becoming more inter-connected and spiraling out of control. This is due to the fact that, as discussed earlier, a security incident/breach has multiple knock-on effects on societal security, revealing and amplifying existing vulnerabilities and fueling further instability and insecurity. There is also a concern that these vulnerabilities, including community tensions, are being deliberately exploited together, in a tactical way, by those responsible for perpetrating these attacks.

Current vulnerabilities in societal security have indeed become more apparent in the emerging security landscape, as terrorist attacks exploit poor migrant communities in Europe and mass migration, and combine the use of new technologies, cyber-attacks and social media to target critical infrastructures. The security challenge faced is thus complex and embedded in our society and calls for innovative approaches for developing effective solutions to a range of threats and risks in totality.

Table 1: Comparing the current and future security landscape

Current and Emerging Security Landscape	**Future Security Landscape**
1. Terrorist attacks (new level of sophistication, scale and imminence) - Sudden and increased incidence of coordinated cross-border hostile attacks on critical infrastructure and soft targets in the West and ongoing prevalent threat of further attacks (links to local communities, returned fighters, criminals) - Staging of multiple location attacks - Lone wolf attacks and guerilla tactics – stabbings, suicide bombers	More of the same? An extrapolation and conflation of current trends and drivers? What could change in 30 years from now? Use of big data and profiling to apprehend potential terrorists even before any suspicious behaviour - civil liberties and trust challenge
2. Cyber-attacks (new level of sophistication, scale and imminence) - Growth of new technologies and internet of things is creating new access points for hackers to target. All online devices are a target. - Change in the scale and quality of cyber-attacks: increase in terms of countries and industries targeted and they are more finely targeted to hit weakest link. Increased attacks on industrial control systems and increased business disruption - Increased involvement of governments - The capability of cybercriminals equals and often exceeds that of some nation states and they exploit different national legal frameworks	Enhanced cyber economic, military, financial insecurity - risks for corporate and government assets Economic espionage Governments become more intrusive to keep check on security breaches Increased infrastructure attacks expected due to increasing connectivity of operational technology systems, increased remote monitoring and diagnostics, legacy infrastructure, and more prevalent ICS malware. Internet enabled smart devices at risk and

	malware apps Arms race could kill off a technology trajectory seen to be vulnerable after mass failure e.g. contactless or smart phone
3. Climate change-extreme weather-(flooding-drought) -water shortages nexus. Biodiversity-Pests-Farming-food-health allergies. Cause of conflicts. Migration. New diseases in different regions because of climate change.	Climate change induced massive migration-impact on health-tourism – increased violence – new spread of diseases Climate change – the power balance could shift even more to the North with geopolitical consequences (e.g. Siberia) or could become attractive to China and create potential for conflicts
4.Prolonged chronic economic and financial crises- zero-growth economy- increased inequalities – robots replace humans	Disruption in economic and financial structures/shifting ownership/ resource constraints D0-It-Yourself economy Shared economy
5.Mass displacement of people and disconnection - migrants, refugees, - criminals/terrorists - rural-urban-city, centre/periphery closed communities	Entrenched Nomad culture - constantly on the move/opportunism
6.Crisis of systems (pension, health, labour, social) Work-life imbalance-higher proportion of self-employed, informal economy, contract-based work, retirement/pensions crisis, automation/unemployment	Large-scale automation-machines in control Jobs change - portfolio careers more common
7.Health crises – pandemics, rise of mental health diseases, growth of antimicrobial resistance, bio-terrorism	Epidemics, but advanced gene technology etc may make medicine even more about access than capability to cure
8.Religious and political extremism	Possible post religion reaction against government in countries where religion based government has failed, e.g. Iran

The key questions are - based on the complex dynamics of threats, risks and societal impacts outlined above - what fundamental structural change is the new security landscape posing, and what does it mean for the way we can address security issues.

– The main structural features which can be identified, relate to:

- The incidence of security events carries a low level of probability but there is a high and imminent risk of such events (e.g. lone wolf attacks) worldwide which needs to be addressed.

- The global geopolitical scenario is fraught with permanent and persistent threats which were already present during the Cold War, but are re-emerging now.

- Security events do not happen in a vacuum but in an increasingly borderless, interconnected political, economic and social environment, with domino effects as a consequence of globalization and ICT.

- The geographical scale of threats has become an important factor as borders have become more porous and multi-location coordinated attacks are becoming more frequent.

- The acceleration in the emergence of new threats, in particular hybrid threats, is leading to a general proliferation of threats.

The implications of this shift to a new security landscape include:

- Instability in systems at all levels

- Inability to anticipate long-term impacts

- Loss of public confidence and difficult to restore trust in governance system and services

- The economic costs and drop in revenue

- The growing burden on the military and police institutions

- Increased vulnerability of migrants, refugees and displaced persons

- Growing tensions escalating to conflict in mixed race/religion communities

- Borderless security concerns and threats

- Threat to European way of life and the EU 'project'

How will these structural changes feature in the future security landscape?

The features of the future security landscape as outlined above are still rather sketchy and are mainly based on an extrapolation, intensification and conflation of current and emerging trends and drivers. However it is envisaged that the future security landscape will entail more coordinated and combined use of different means for manipulating and exploiting marginalized and vulnerable groups and countries and related infrastructures. The response to such attacks (potential and real) needs to be equally coordinated, across a range of policy domains. The next section outlines a number of key trends and drivers which are shaping the future security landscape drawn from various forward-looking studies.

4. Forward Look at the security landscape

The section identifies the main trends and drivers of the future security landscape. Each topic is briefly explained followed by several supporting foresight results from previous security foresight projects. These results are based on content taken from project's FORCE IDSS[1]. Each topic briefly described supporting result from recent security projects such as trend, scenario, threat, risk, wildcard, etc.

I. The Future of work and social unrest among the younger generations

This is a topic which has already been debated recently in many forums relating to the significant mega trend of human workers replacement by robots and AI. If this trend will continue the results (mass unemployment) could be disastrous. There are several possible scenarios that can be developed here taking into account the differing characteristics of

[1] http://www.force-europe.eu/en/

younger generations, possible changes in the economic system including several possible solutions, such as the basic income idea.

References:

- Scenario: Large-scale automation of work (Global Strategic Trends 2045, 2014): *'Potentially, machines could carry out all manufacturing and agricultural tasks; repair themselves; as well as clean, cook and tidy. However, many people may initially struggle to achieve a sense of purpose and social status without work, with possible rises in cases of depression.'*

- Wildcard: Shift from materialistic to post-materialistic value worlds (Global Europe 2050, 2012): '*Many of the younger generation show critics against the economic growth and they will follow post materialistic values.'*

- Recommendation: Shifting ownership (Deep Shift Technology Tipping Points and Societal Impact, 2015): *'People are now more concerned with paying for access than with ownership, which has deep consequences for individuals, business, society and the economy. In a society where short-term and zero-hour contracts are increasing, this could lead to an agile but fragile workforce.'*

- Think millennials have it tough? For 'Generation K', life is even harsher (The Guardian, 19 March 2016[2]): *'Their feelings about government are similarly negative. Only one in 10 of this generation says they trust the government to do the right thing. This is half the percentage of millennials who feel this way. Generation K doesn't feel that politicians care about ordinary people, and believes that the rules of the game are rigged.'*

II. Escalation of threats/attacks in current security landscape combined with other threats such as climate change (leading to drought and water shortage) and migration

Climate change and migration are in themselves not new topics to the security sector. In recent years, however, it has become more apparent that migration is strongly impacted by climate change, and that the results of more rapid climate change are already noticeable. Future scenarios could envision significant increase in migrants due to drastic climate change, lack of employment, epidemic, etc.

References:

Driver and trend: Migration trends to 2045 (Global Strategic Trends 2045, 2014): *'Migration is*

- *likely to increase, with people moving within, and outside, their country of origin to seek work or to escape the effects of climate change.'*

- Scenario: Multiple messes (FORESEC, 2009): *'Armed conflicts and mass migration in EU's wider neighborhood, caused by environmental degradation and struggle for resources - Violent radicalization within the EU in immigrant populations and social groups hit hard by the weak economy.'*

- Wildcard: Catastrophic climate change (Global Strategic Trends 2045, 2014): *'Severe food shortages could lead to sudden mass migration of populations across national borders, triggering widespread social unrest.'*

- How Climate Change is Driving Migration (World Economic Forum, 10 December 2015[3]): *"Four principal pathways through which environmental change affects movements of people: longer term drying trends; rising sea levels and glacier melt; increased frequency and magnitude of weather-related natural hazards; and competition over scarce natural resources."*

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[2] http://www.theguardian.com/world/2016/mar/19/think-millennials-have-it-tough-for-generation-k-life-is-even-harsher

[3] https://www.weforum.org/agenda/2015/12/how-climate-change-is-driving-migration

III. Decentralization induced by new technologies

Decentralization may have a positive impact on societal security as the last result in the following list shows. There are several trends and technologies that support decentralization, such as the blockchain, peer-to-peer economy and the sharing economy. These driving forces can be more effectively addressed as part of a societal security policy.

References:

- Technology: Bitcoin and the blockchain (Deep Shift Technology Tipping Points and Societal Impact, 2015*): 'Blockchain, a way of keeping track of trusted transactions in a distributed fashion. Disintermediation of financial institutions, as new services and value exchanges are created directly on the blockchain - An explosion in tradable assets, as all kinds of value exchange can be hosted on the blockchain.'*

- Technology: The sharing economy (Deep Shift Technology Tipping Points and Societal Impact, 2015): *'Better environmental outcomes (less production and fewer assets required) - More personal services available - Increased ability to live off cash flow (with less need for savings to be able to afford use of assets) - Better asset utilization - Less opportunity for long-term abuse of trust because of direct and public feedback loops.'*

- Driver, trend: Peer-to-Peer economy (Foresight and Optimization in Horizon 2020, 2014): *'Do-it-yourself technologies such as 3D printing and replicators will boost the peer-to-peer economy and sharing economy further. Furthermore, people are likely to start using personal currencies to pay for their peer-to-peers transactions, giving rise to distributed currencies based on peer-to-peer reputational mechanisms.'*

- Toward alternative decentralized infrastructures (DEV '15, 2015[4]): *'This paper proposes a potential way to increase infrastructure resilience by supporting the creation of alternative, decentralized infrastructures (ADIs) composed of small-scale, heterogeneous systems and processes.'*

IV. Complexity introduced by the impacts of combining hyper-connectivity and technologies such as AI, IoT and drones

Hyper-connectivity may cause severe damages to society when IoT is fully deployed because it introduces complexities that are not completely understood today. It is a fertile ground for hackers and terrorists. Foresight methods in complex situations need to be upgraded since cause and effect relationships are not always clear.

References:

- Technology: The Internet of and for Things (Deep Shift Technology Tipping Points and Societal Impact, 2015): *'Consequences of a potential Digital Pearl Harbor (i.e. digital hackers or terrorists paralysing infrastructure, leading to no food, fuel and power for weeks).'*

- Threat: Internet of Things (IoT) (Worldwide Threat Assessment of the US Intelligence Community, 2016): *'In the future, intelligence services might use the ioT for identification, surveillance, monitoring, location tracking, and targeting for recruitment, or to gain access to networks or user credentials.'*

- Threat: Artificial Intelligence (AI) (Worldwide Threat Assessment of the US Intelligence Community, 2016): *'Implications of broader AI deployment include increased vulnerability to cyber-attack, difficulty in ascertaining attribution, facilitation of advances in foreign weapon and intelligence systems, the risk of accidents and related liability issues, and unemployment.'*

- Wildcard: Terrorists or a mistake cause a major bioattack over the next few decades (Techcast): 'Altering something as fundamental as the DNA code also may pose unintended side effects in ecosystems and humans. Worse, it can be deliberately misused to do harm.'

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[4] http://dl.acm.org/citation.cfm?id=2830648

- Weak signal: Robot Swarm Intelligence (iKNOW, 2011): '*Enhanced research on robot swarm intelligence might soon allow robots to communicate and build a system. Cooperation is organized, selfdynamic, and selfcontained by intelligent robots. Such capabilities are already demonstrated in certain military R&D.'*

V. Quantum computing & cryptography

The NSA has recently warned that quantum computers will neutralize current best encryption practices - this indeed is a paradigm shift.

References:

- Threat: Quantum computing makes encryption impossible (Global Strategic Trends 2045, 2014): *'Quantum computing could make all codes 'crackable' and genuine encryption impossible, as a quantum computer could theoretically try every possible combination of codes simultaneously to unlock a system*.'

- Will Quantum computers threaten modern cryptography? (Tripwire, September 14, 2015[5]): *'The strength of the current cryptographic algorithms rely on complex mathematical problems, such as integer factorization and elliptic curve discrete logarithm problem. These problems can be solved using large-scale quantum computers and therefore can easily crack conventional algorithms.'*

VI. Growing inequality and the shift from pure capitalism towards new economic systems

The growing income inequality and the rising share of the top 1 % income earners is already a well- known fact. This is a volatile situation if ignored. Some recent studies claim that this is a result of the current economic systems. Future scenarios could envisage the 'end of capitalism and the beginning of postcapitalism…'.

References:

- Scenario: The end of capitalism has begun (The Guardian, 17 July 2015[6]): *'As with the end of feudalism 500 years ago, capitalism's replacement by postcapitalism will be accelerated by external shocks and shaped by the emergence of a new kind of human being. And it has started.'*

- Recommendation: Mitigating inequality in the European Union (ESPAS, 2014): '*Growing inequalities will increasingly affect the European Union's cohesion and undermine its economic strength. So far, the European Union has not succeeded in reintegrating the low-skilled workers and other social groups most affected by globalization.'*

VII. New Geopolitical Order with implications on science

VIII. Completely 'free' world without borders and a world government

Every person is able to live where he or she wants. A world government exists. People commit to this government because it is directly elected and based on trust. Everything is transparent, security events and incidences are directly communicated to the police. Nothing is hidden anymore. Companies, even multinationals pay world taxes which are used to pay a 'police force'. Armies are forbidden.

References:

- Tucker, Patrick. Naked Future: What Happens in a World That Anticipates Your Every Move ?

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[5] http://www.tripwire.com/state-of-security/featured/will-quantum-computers-threaten-modern-cryptography/

[6] http://www.theguardian.com/books/2015/jul/17/postcapitalism-end-of-capitalism-begun

- Eggars, Dave. The circle (novel of our time)

- UN Sustainable Development Goals with first global regulatory character…

IX. Chaotic diffusion of new ideas in social networks

The diffusion of information in social media is difficult to predict although there are already many studies attempting to do that. The danger of such a situation is that some ideas may spread very fast causing unwanted effects as the following items suggest.

References:

- Wildcards: Empowered Internet users take the political power from the old political parties (iKNOW, 2011): *'Empowered internet users form new types of social movements that utilise the wisdom of crowds and flash social media. Finally they form strong political groups that demand direct power to vast number of societal issues.'*

- Driver: E-action and the future of democracy (Global Europe 2050, 2012): *'Global e-action groups and virtual protests are already with us, and will thrive in the future. This would not necessarily changing anything - although at least in the recent wave of popular revolts in the Maghreb and Mashreq countries social networks on Internet played a key role.'*

- A new kind of weather: social media now play a key role in collective action (The Economist, March 26th 2016[7]): *'The spread of information on social media is typically "spiky", with some posts suddenly becoming extremely popular whereas others never take off, regardless of the topic. Politics in the age of social media is better described by chaos theory than by conventional social science.*'

X. Stress and mental disorders cause strange behaviour in masses

- People can be convinced to join IS/brown movement in Germany/… because people are not able to listen, anymore. Direct attacks in the public because of stress.

XI. Different demographic changes – explosion of population numbers versus aging and shrinking societies

Unprecedented youth bulges and demographic changes which lead to instability in certain regions and instabilities even in societies that seem to be very stable, e.g. masses of younger and middle-age people invade countries that are already shrinking, in an uncontrolled way. Adaptation and integration is impossible. Borders are ignored.

Having explored different aspects of the future security landscape, the next section distinguishes between current threats and risks and vulnerabilities and how these impact on societal resilience.

[7] http://www.economist.com/news/special-report/21695192-social-media-now-play-key-role-collective-action-new-kind-weather

Background Paper 4

Forward-looking activities and strategic programming: a practical guide for designing the next Framework Programme

Authors: Attila Havas (editor), Jennifer Cassingena-Harper, Augusta Maria Paci, Ahti Salo, Matthias Weber

1. Introduction

1.1 The main purpose and the intended users of the guide

Day-to-day decisions guided by long-term, strategic thinking tend to lead to more targeted (ideally also more favourable) outcomes than *ad hoc* ones. This principle has influenced the 'strategic turn' in science, technology and innovation (STI) policies over the past ten years. It applies *a fortiori* to those decisions that seek to promote research, technological development and innovation (RTDI) activities as many of these might have major long-term consequences and quite a few of them take considerable time to bear fruits.

There are various approaches to forward-looking activities (FLA) and a number of handbooks present and explain the available methods. This Guide is aimed at assisting the design and implementation of future RTDI Framework Programme(s) (FP) of the European Union. It provides guidance to policy-shapers[1] and policy-makers to (i) navigate in a complex world characterised by inherently complex challenges; and (ii) understand how various types of FLA can be of help in this navigation and steering task.

It explicates the qualitative differences between main types of future challenges EU policies are facing, each requiring a different approach (and set of methods):

- Inertia: how to recognise and address lock-in to vested interests, which could be manifested in various ways, e.g. lock-in to outdated industries, technologies, modes of work? How to capitalise on emerging opportunities? How to create awareness of the need for change? A more general type of inertia can be described by the 'boiling frog' metaphor: how to identify slow developments that suddenly turn into rapid changes with huge impacts (e.g. climate change)?
- Crisis: how to handle a crisis in the short- to medium-term with rapid responses? How to manage the knock-on effects of a crisis, for example a security crisis leading to political, economic and social crises? How to handle an enduring crisis?
- Transition: how to govern a paradigm shift and prepare for challenges that are arising in the longer term via exploring multiple futures, mobilising stakeholders, devising a shared vision, that is, working towards building a consensus on a favourable future and the path advancing in that direction?

This Guide focuses on the main tasks of preparing an RTDI FP: where to put our money, and why? As for 'where to put our money', the usual thinking is to identify thematic RTDI priorities. Besides that, this Guide also highlights the importance and added value of relying on strategic intelligence when making decisions on large-scale research infrastructures and stresses the need to think strategically about possible new RTDI practices and structural requirements for successful RTDI activities.

It provides guidance as to how various FLA approaches can contribute to achieving the above tasks. Its primary users, therefore, are:

- EC DG Research and Innovation (R&I) staff, with a special emphasis on the Foresight unit, the foresight correspondents' network, as well as the strategy and evaluation units;
- other EC DGs in charge of policy domains relevant in view of the supposed mission-oriented character of the next RTDI FP.

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[1] Policy-shapers are mainly those civil servants – occasionally in co-operation with external experts – who provide advice to policy-makers.

The Guide is also intended to provide useful background reading for those experts and other stakeholders who participate in the various 'modules' of forward-looking activities to be conducted when designing and implementing the next RTDI FP.

1.2 Various approaches to the future

There are several quantitative and qualitative methods used for forward-looking activities, including forecasting – based on trend analysis and the identification of major drivers via STEEPV or PESTLE[2] –, simulation, Delphi surveys, horizon scanning, SWOT analysis, as well as building a vision, a single normative future,[3] a fully-fledged scenario,[4] or multiple futures and fully-fledged scenarios.

These methods can be used in various ways and settings: (i) either for pure academic purposes or as decision-preparatory tools; (ii) during participatory processes or in smaller, usually shorter, projects, only involving experts; (iii) some of them are suitable for considering multiple futures, while others try to predict a single future; and (iv) FLA projects can focus on *S&T developments* or take a broader, *systemic view*.[5]

A specific report by the SFRI Expert Group on the so-called 'Rapid Response Mechanism' discusses in detail a certain type of expert-based method to provide policy advice (see Background paper 1).

Foresight is a distinctive approach compared to other types of forward-looking activities: it not only facilitates thinking about and debating the future, but also helps shaping the future. It can also have a structuring effect by bringing together different communities of practice, for different or combined purposes: to explore areas of consensus and disagreement, issues of transparency and trust, as well as means of creating policy synergies and orchestration.

A given foresight process relies on a bespoke set of tools and methods to identify and assess in a systematic and transparent way those societal, technological, economic, environmental and policy factors and trends that are likely to affect competitiveness, wealth creation and quality of life. Foresight processes are (i) action-oriented (as opposed to pure academic analyses); (ii) participatory (by involving researchers, business people, policy-makers and various representatives of citizen groups, NGOs, as opposed to projects only relying on experts); and (iii) consider multiple futures (as opposed to a single future).

Foresight is practiced in many domains and at different levels from sectoral, local, regional, to national ones, and occasionally for world regions, too. Foresight programmes can – and indeed, should – take many different forms, varying in their specific aims, thematic coverage, geographic scope, focus, methods and time horizons.

A separate SFRI report elaborates on a frame devised specifically for selecting RTDI FP priorities in an inclusive, bottom-up way (see Background paper 6).

This Guide covers both foresight processes (participatory FLA) and expert-based FLA projects and considers which approach is more suitable for a certain task during the various planning and implementation phases of RTDI FPs.

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[2] STEEPV stands for social, technological, economic, environmental, political, and value-driven issues or factors, while PESTLE is a shorthand for political, economic, social [socio-cultural], technological, legal, and environmental issues or factors.

[3] A 'future' is a detailed description of a particular situation (outcome of important developments with its major features and interrelationships) in the future. While a 'vision' is usually kept fairly short (just 2-3 sentences) and mainly used for uniting and mobilising people to accomplish what is stated in a vision, a 'future' is more detailed, analytical, and neutral. From a different angle, a vision is normative, while a future is descriptive (a tool for exploration).

[4] A fully-fledged scenario or path scenario contains a future, as well as the path leading to that future, that is, the major decisions and steps to be taken to reach that particular future.

[5] A more detailed explanation on the distinction between S&T vs. systemic views, illustrated with real-life examples, is offered in the Annex to this paper.

1.3 Why to use FLA when devising the next Framework Programme?

Unless FLA is strongly embedded in the decision-making systems, there is a rather high likelihood that early warnings on the coming threats are ignored, or weak signals of emerging opportunities are overlooked. Indeed, the 2008-2009 global financial and economic crisis hit hard the entire world, and particularly so the European Union. In spite of abundant analyses pointing to several factors piling up to threaten overall security (especially influx of refugees due to failed states, civil wars and other conflicts, climate, water, and food safety, as well as societal and cultural tensions) the EU has not been well-prepared to weather these threats.

Most foresight processes go beyond exploring possible futures; they also contribute to building consensus on a desirable future that can be summarised in a shared vision. These visions and – associated to them – more operational roadmaps can be powerful instruments to assemble key players in a certain domain around a shared agenda to shape the future by following a desired direction. Uncertainty about the ambitions of major actors can be reduced substantially, and thus investment decisions can be made in a less 'alien' environment. Moreover, once participants arrive at a shared vision, they can expect that all of them would take steps to achieve that chosen future, and thus in essence align their future actions to the jointly identified favourable future.

Transparent, systematic decision-preparatory processes can also reduce the influence of vested interests, and thus diminish the chances that public money is misappropriated, and the overall decision-making process is captured, by a small group of strong players.

Neither foresight processes nor other types of FLA projects offer 'ready-to-implement' solutions. Multiple futures, shared visions and roadmaps need to be interpreted by decision-makers and translated into various types of decisions, e.g. regulations, structural changes, and support actions. This 'translation' is a separate, and non-trivial, task, to be performed by experienced experts. It could be useful to organise this 'translation' as an iterative process with some of the major contributors of a particular FLA project.

1.4 Foresight and scientific advice

Scientific advice is assumed to present the current state of scientific knowledge. It is therefore just one of the building blocks for an exploration of possible futures through interaction amongst citizens, experts and stakeholders – and having these interactions in the centre is a distinctive feature of foresight processes. Thus, the foresight process itself is as much important as the written reports entailing analyses, futures, a shared vision, roadmaps and recommendations.

A foresight process is fundamentally different from a scientific project: it is future- and action-oriented, participatory and considers values explicitly. Apart from others sources of knowledge, foresight processes rely on the results of scientific projects and use appropriate scientific methods. In turn, a foresight process may give rise to subsequent scientific advice by specialised bodies on different issues, identified by the foresight process.

1.5 How to use this guide?

The Guide proposes suitable methods from the 'toolbox' of prospective analyses with comments on their relevance in view of the various tasks required to devise and implement the next RTDI FP. Yet, it is neither meant to be a collection of ground-breaking new FLA methods, nor a blueprint for the 'one and only' FLA approach. It is designed as a navigation tool to help exploring the potential of various FLA approaches for policy-making purposes.

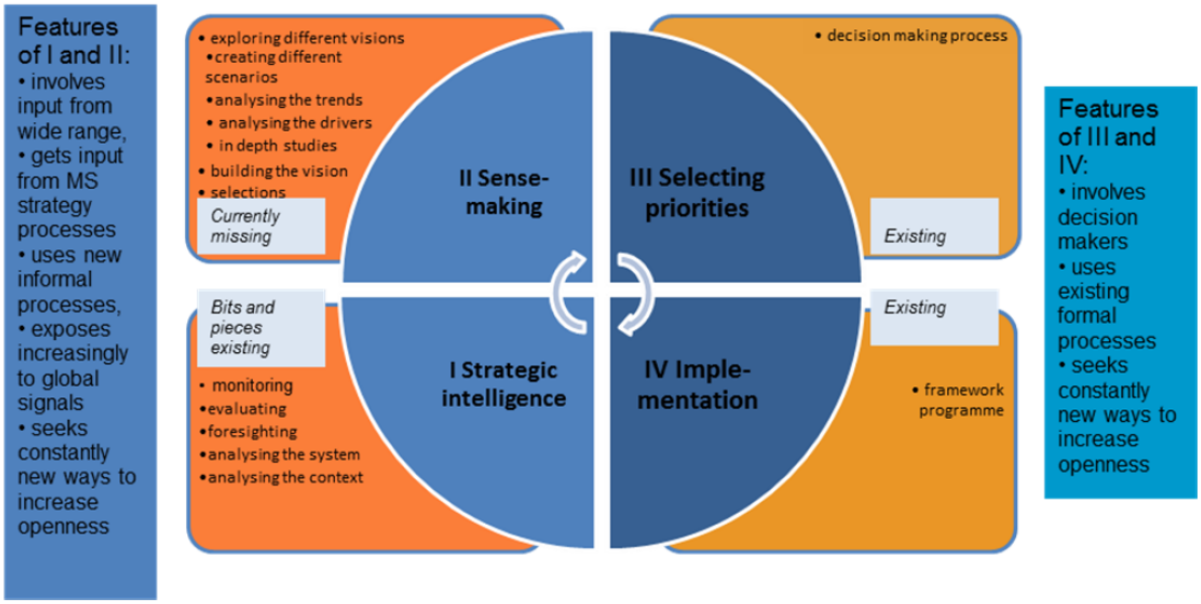
2. Approaches to strategic programming in RTDI FPs

2.1 What FLA methods can be used to underpin the planning tasks of the next FP and its implementation: pros and cons

This section follows a functional approach: it (a) identifies those tasks and steps during the planning and implementation processes of the next FP when foresight and other types of FLA seem to be relevant, leaning on the 'four-phase model' suggested by EFFLA (Figure 1), and (b) discusses the main features of those foresight and other FLA approaches that can support the completion of a given task during the planning and implementation of the next FP. The main pros and cons of these approaches and tools are also highlighted.

The EFFLA has argued that 'while there are numerous forward-looking activities at EU and Member State levels, these activities are uncoordinated and their results have a very limited impact on the actual preparation of policies and policy measures' (EFFLA Policy Brief No. 2). This observation is further elaborated against the backdrop of a four-phase model of a future EU strategic process.

Figure 1: Elements of a future EU strategic process



Source: How to design a European foresight process that contributes to a European challenge driven R&I strategy process, EFLA Policy Brief N° 2

While there are several forward-looking methods available to underpin the first phase of Strategic Intelligence, the crucial sense-making phase largely lacks any systematic underpinning by forward-looking tools. These first two phases are also rather informal in nature, while the latter two phases obey to highly formalised decision-making procedures between the Commission, Council and Parliament, involving also formal consultation processes with other stakeholders. These, however, could also benefit from a more regular use of forward-looking methods.

The remainder of this section presents the relevant approaches and methods for the 'I Strategic intelligence' and 'II Sense-making' phases, on the hand (these two phases are the major steps in the overall design of the next FP), and those for the 'IV Implementation' phase, on the other (understood as planning the work programmes and selecting the implementation tools of the next FP). 'Foresight-inspired assessment methods' (or other forms of ex-ante impact assessment) assisting 'III Selecting priorities' are also discussed.

I 'Strategic intelligence' phase

In this phase, future developments are explored and assessed, using a broad range of tools and methods that are often difficult to reconcile with each other in terms of underlying assumptions and form of results. At the same time, this diversity of strategic intelligence findings mirrors the diversity of perspectives on the future. They are thus a rich source to draw upon, and the relevant methods can be categorised as follows:

- **System analysis** at different levels, capturing the current situation and recent changes at different levels of aggregation (sectors, regions, countries, the EU as a whole, etc.), using a broad range of statistical, economic, econometric, scientometric and qualitative methods, underpinned by appropriate data.
- **Horizon scanning** of new and emerging developments (in an automated or semi-automated way, or by people; see Cuhls et al., 2015).
- Analysis of **driving forces** for various innovation ecosystems that are relevant when designing the next FP (e.g. using PESTLE, STEEPV, SWOT or similar frameworks).
- **Trend analysis** for the context of the next FP (e.g. exploring major trends outside the EU that would give rise to those challenges and opportunities that should be addressed by FP

policy tools [i.e. research projects, networking activities at various levels, international co-operation and exchange programmes, etc.).

- Exploration of the **interaction of different trends and driving forces**, either by way of qualitative scenario techniques or quantitative simulation models. This may include forecasting future developments of relevance to the context for the next FP (e.g. demographic trends or climate change).
- **Assessment** tools (e.g. Delphi survey, TA, Future Surveys) to assess the significance or timeframe of emerging trends and developments.
- Different **workshop formats** (e.g. Future Workshops) to make tacit knowledge of persons (experts, laymen) explicit. The most often used tools include creativity methods together with methods to open up futures thinking (Cuhls and Daheim (eds), 2017).

II 'Sense-making' phase

The sense-making phase is crucial as its main objective is to draw the diversity of insights from the 'Strategic intelligence' phase together around a specific issue or task (such as developing a new RTDI Framework Programme). While many individual inputs from the 'Strategic intelligence' phase are already available, it is a major task to integrate these building blocks into a common framework. In 2015, an EC expert group coined the notion of 'concurrent design foresight' as a framework to capitalise on this broad range of forward-looking activities across Commission Services (Köhler et al., 2015). The appropriate methods used at this stage include:

- **SWOT-type analyses** to relate different trends and driving forces to the current situation of a given organisation and its strategic ambitions; i.e. here the European Commission's next FP.
- Conceptualized and moderated **workshop formats** to assess and discuss EU matters directly relevant to FP issues.
- Building and exploring **multiple futures**, and positioning the future role of an organisation and its actions in those futures.
- Devising a so-called **path scenario** specifying the steps needed to reach a desired future (or a set of path scenarios leading to different futures, if such an approach has benefits for the policy-making processes).

This second phase should end up with clear indications as to the way ahead, the goals to be pursued and the pathways to realise them.

III 'Decision-making/Selection of priorities'

The selection of priorities does not start in this phase, given that it is already an integral, but somewhat implicit, element of the sense-making phase. However, this third phase moves from implicit and informal priority setting to the stage of formal decision-making. In recent years, impact assessment has acquired an important role in this phase to underpin decisions. The following methods support the selection of priorities:

- Development of **options for action** along the path scenario, taking into account the Commission's own ambitions, as well as the possible roles of other key actors related to RTDI activities. This element is particularly important to anticipate possible conflicts and/ or synergies between the actions to be taken by different agents along the paths. Options for action may also be assessed against the backdrop of different futures and path scenarios in order to identify robust and flexible options in view of high uncertainty of how the future may unfold.
- **Scenario-based impact assessment** would give the current 'standard' policy impact assessment practices a more systematic and longer-term forward-looking twist. Combining foresight methods and impact assessment could be of relevance as a means of interaction and communication between the Commission, the Parliament and the Council, i.e. the main bodies involved in formal decision-making.
- Defining a **set of criteria**, applying them to the issues under discussion and according to the criteria, facilitated discussions and selections can contribute to priority setting.
- At the end of this phase stands **the legal decision about the Framework Programme**. This is a fundamental decision about main directions to follow and instruments to be applied. Further priority setting actually takes place at lower levels of abstraction, and often in the course of the implementation of the Framework Programme. The identification

of options and scenario-based impact assessment are the methodological approaches to be pursued also at these levels.

IV 'Implementation' phase

In this phase (a) the time horizon is much shorter; (b) there is no need to identify and explore multiple futures; and (c) probably a lower degree of participation is required. However, as part of a multi-year research programme, there is a continuous need for adaptation in terms of specifying strategic and annual work programmes. Thus, an expert-driven approach, focussed on strategic programming, and probably supported by a set of quantitative techniques, seems to be more relevant in this phase. As this adaptation and specification task is an essential part of the European Commission's work, the relevant tools should be identified jointly with those EC staff members (e.g. the foresight correspondents) who have been involved in planning FP strategic and work programmes. In essence, the same methods could be applied here as in phases 1 and 2, but taking into account the more limited room for manoeuver and the more targeted nature of the tasks to be performed.

Finally, it should be stressed that *a particular tool can be used in different ways*, depending on (a) the issues tackled by the tool, (b) the experts/ participants involved, and (c) the interpretation of the results, especially the major observations and policy conclusions obtained by using a certain method, especially when a set of foresight and other FLA tools are mobilised,[6] together with other strategy- or policy-preparatory tools. In other words, there is *no strict, one-to-one match between a certain tool and a given task*.

2.2 FLA on research infrastructures

Research infrastructures are very important investments in the RTDI landscape, with significant and long-term impacts in terms of enabling research, measurement and testing activities, as well as training scientists and engineers, thus conditioning future trajectories of S&T-type knowledge generation. Typically, RIs provide either the basis for conducting major experimental, measurement and testing activities (e.g. testing materials, imaging), or crucial and standardised research material (e.g. information from databases, biobank and –models, etc.). Depending on the nature of the services provided, research infrastructures can be organised in different ways: apart from traditional large-scale and centralised facilities, distributed, multi-site infrastructures also exist. The latter model is quite common, for instance, for virtual databases.

This Guide is only concerned with RIs of EU-level relevance. Most of these are also key instruments in bilateral and multilateral S&T co-operations, occasionally involving partners beyond the EU, too.

2.2.1 Why foresight for preparing RI investment decisions?

Decisions on building new RIs and upgrading existing ones pose complex challenges, involving large-scale investments. There is a wide range of stakeholders, with their different, and sometimes even conflicting, interests; while a lot is at stake in terms of future S&T capabilities, with their consequences on socially, environmentally, and economically sustainable development. Strategic choices must be made, with significant immediate financial repercussions, and potentially huge long-term implications. The constraints are severe, the opinions might significantly differ, and no evidence exists in a strict sense. For these reasons a participatory process, that is, foresight seem to be more appropriate to prepare these decisions as opposed to a project drawing exclusively on experts.

Typically, suggestions to upgrade existing research infrastructure and build new RIs significantly exceed available funds. It is thus necessary to thoroughly compare different options as part of **setting STI policy priorities.** Foresight processes can assist making these decisions in several ways by providing forward-looking ex-ante impact assessment.

Apart from this portfolio perspective, foresight can also be useful at the level of individual research infrastructures in order to provide the basis for **long-term strategic planning** (e.g. in the form of multiple scenarios). It is necessary to anticipate the mode(s) of use(s), the type and needs of users ('external' researchers, businesses, 'citizen scientists', patient

[6] Some tools 'naturally' lean on other ones, e.g. scientometrics and patent analyses can provide important inputs for PESTLE, STEEPV, SWOT and trend analyses. That also means that the results of these and other quantitative tools should be interpreted and assessed by those who conduct these analyses.

groups, NGOs, …), the operational requirements of RIs, but also the skills and knowledge required to operate an RI (together with non-negligible repercussions in terms of funding for continuous re-training of staff), which are all likely to change in the future. Foresight can help looking into these issues.

This 'foresight-inspired' ex-ante impact assessment requires a reasonably solid knowledge of the future dynamics of the research and innovation domains concerned. On these grounds, foresight can (i) reduce technological, economic or social uncertainties by identifying multiple futures and various policy options; (ii) make better informed decisions by bringing together different communities of practice with their complementary knowledge and experience; and (iii) obtain public support by improving transparency.

For EU-level research infrastructures in particular, there are also important **STI policy issues** that could be tackled by drawing on foresight:

- There are strong scientific arguments to build new RIs and/or upgrade existing ones, but the costs of these investments can be astronomical, and thus not all these proposals can be implemented. Choices need to be made about the location of research infrastructures, raising issues of competition between Member States. Informed choices are to be made, through a transparent process, taking into account multiple criteria.
- The financial decisions and STI policy priorities of the countries that jointly invest in, and then operate, major international RIs need to be aligned (often at a rather extensive time horizon); appropriate governance structures are to be set up, preserving open access based on well-designed and transparent criteria; and political negotiations on site selection should be concluded. Therefore, a transparent process, taking into account multiple criteria is needed to underpin these decisions, too.
- Given the importance of RIs – in terms of scientific achievements, socio-economic impacts, and funding requirements – several types of important stakeholders need to be involved when strategic decisions are to be made on RIs. Beyond scientists and managers of RIs, and policy-makers, these include users and potential users, as well as citizens in many cases.

2.2.2 Emerging developments to be taken into account when planning RI investment decisions

Foresight for research infrastructures should not be a regarded as a one-off activity. The role of, and opportunities for, RIs need to be regularly revisited in line with evolving user needs (which can be termed as 'demand pull') and new S&T opportunities ('supply push'). This requires a proper, thorough dialogue and understanding between the co-producers and users of knowledge, including businesses, policy-makers, and researchers working for publicly financed research organisations (including universities), as well as the representatives of the civil society.

From the demand side, for instance, new directions in RTDI activities might require RI with significantly enhanced or brand new capabilities, in order to analyse scientific phenomena much faster, with higher precision (perhaps even using smaller quantities of samples) or at a qualitatively different level (e.g. in physics: atomic vs. sub-atomic levels; in life sciences: organs, tissues, cells; in vivo imaging as opposed to 'dead' tissues or cells), process and store larger amounts of data, cater for new modelling approaches (in all fields of science), or collect data in extreme circumstances (outer space, deep explorations, extreme weather conditions, …).

Other new requirements for research infrastructures are expected to arise from changing RTDI practices, which may alter the role and model for research infrastructures in quite fundamental ways. If, as we can currently observe, new digital technologies enable a broader range of actors to contribute to research endeavours, RIs need to be much more open and less exclusive than in the past. Similarly, RIs may need to cater for more distributed RTDI practices in the digital era.[7] In view of the need to tackle grand challenges, a new request is likely to arise: RIs will need to provide tools to enable upscaling in interaction with users (e.g. Innovation Labs or demonstration platforms in security research).

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[7] See, for instance, the futures prepared in the Research and Innovation Futures 2030 RIF project (http://www.rif2030.eu), especially the 'Open Research Platforms' or the individualistic 'Researchers' Choice' futures, both suggesting a growing demand for a novel generation of RI to pilot new solutions.

Similarly, on the supply side, new scientific and technological achievements could open up new avenues for RTDI activities (qualitatively better imaging, observation and measurement of previously undetected phenomena, new biological models,…).

Anticipating these and other emerging or future developments is crucial keeping the scientific, organisational and operational conditions of RI in the European Union at a level that is in tune with the advancement of the content and practices of scientific enquiry.

2.2.3 Implications for foresight methods

There is a significant overlap between conducting foresight to identify major research themes and that to deal with RI issues, as RIs should serve research on vital themes, but important differences, too, e.g. modes to develop, operate and manage RIs.

- The overall foresight approach and methods suitable for RI will differ depending on the type of RI, as well as the type of policy issue/ challenge they are supposed to address.
- Given the costs and the far-reaching consequences of RIs, a systemic FLA is more suitable than a narrow S&T approach (with the exception of specific planning tasks). Further, given the likely changes concerning the role of RIs, a foresight process is likely to be more appropriate, involving allthe interested stakeholder, compared to an expert-based project, relying only on the usual suspects of large PROs. In brief, transparency is a crucial in these decision-preparatory processes.

A JPI model seems to be suitable also for RIs, because it foresees two levels at which foresight is brought into the planning cycle: i) decisions about RIs in the first place (portfolio level); and ii) decisions about the strategic research agendas of individual RIs.

- At the first level, that is, portfolios of RIs, the four phases of the EFFLA model apply as well
  - Strategic intelligence to identify major needs for RIs
  - Sense-making to provide the basis for informed decisions, by relating possible RI options to potential uses, scientific opportunities, etc.
  - Decision-making as a formal process
  - Implementation of decisions.

- At a second level of individual research agendas, RIs pose more continuous need for foresight, but in essence the four phases still apply
  - Revisiting changing requirements and new S&I opportunities, strategic intelligence is needed in order to provide the necessary background knowledge on future and emerging developments in S&T as well as on potential uses
  - Sense-making would relate this knowledge to the further strategic orientation; and thus close interaction with users is needed
  - Decision-making as a formal process
  - Implementation of decisions.

2.3 FLA on RTDI practices and structural requirements for successful RTDI activities

There is a broad array of alternative FLA approaches, which differ in terms of (i) their purpose, scope, and objectives; (ii) units of analysis; (iii) methods for capturing and communicating future-oriented information; and (iv) ways of engaging experts and other stakeholders as active participants. The relevance and suitability of these approaches depends on how RTDI processes create impact in different application domains. For instance, in the development of new transportation systems, these impacts are not sudden as they are shaped by regulation and enabled through significant infrastructure investments, while in other domains (such as mobile gaming), the pace of change may be much faster due to fewer constraints on the diffusion of (technological, organisational, marketing, financial and business model) innovations.

Whatever the case, the impacts of RTDI activities are shaped not only by advances in S&T: rather, these impacts are contingent on the emergence and evolution of the broader techno-economic systems, in which new knowledge and ideas are exploited. In consequence, especially in domains, in which such systemic interdependencies are strong, it is pertinent to

broaden the scope of FLA with the aim of fostering a better understanding of how desired development paths of the innovation ecosystem can be best promoted.

There are many dimensions along which the scope of the FLA activities can be broadened from a comparatively narrow S&T focus. These include changes in the legal framework and regulation; the possibility of subsidies and other economic incentives that favour some technological options over others; the use of public procurement policies as a vehicle for fostering innovation; the viability and acceptability of alternative business models; shifting consumer preferences; advances in standardisation; protection of intellectual property rights; and shifting societal needs or a focus on quality of life for citizens, among others. More often than not, these dimensions are interdependent. For instance, rapid advances in ICT and the increasing digitalisation have provoked transformative and disruptive changes in many industrial and service sectors, based on the abilities of building, linking and analysing big data sets. These abilities build not only on advances in areas such as machine learning and computational algorithms, but also on much improved access to data, often enabled by regulations that foster openness in the collection, dissemination and utilisation of data.

The need for FLA projects with an explicit focus on these systemic aspects is illustrated by some recently heightened characteristics of innovation processes.

'Open' and other modes of RTDI activities: The strong involvement of multiple stakeholder groups (both as users and producers of new solutions) is becoming increasingly important, as illustrated by the rapidly growing sharing and platform economy, which has manifested itself in exceptionally fast and transformative changes. Indeed, the platform ecosystems established by companies like AirBnB and Uber have captured significant markets from incumbent service providers. These disruptive changes in ecosystems can occur very quickly if the underpinning technologies, chosen business models, and prevailing regulatory framework conditions enable strong network effects, which make the emerging ecosystem even more attractive. Even here, it is important to recognise that the chances of building a successful ecosystem still depend on the regulatory framework conditions, suggesting that FLA should not be restricted to the 'mere' S&T content of instruments such as RTDI programmes. Rather, these activities should explore to what extent changes in regulation or other actions may be called for and inform policy-shapers and policy-makers accordingly. From the viewpoint of companies that seek to build such ecosystems, it may be vital to pursue exceptionally rapid and even explosive growth, recognising that otherwise there is a chance that rivalling approaches gain first-mover advantages that cannot be erased later on. For policy-makers – both at EU and national levels – it is an important opportunity to position themselves among the 'facilitators' or brokers in the system.

Thus, an increasingly important activity in seeking to boost the performance of innovation ecosystems may be that of identifying and articulating problems which can be tackled by combining different competences systemically from various disciplines (e.g., the US DARPA programme). At best, the articulation of such problems may serve as a fertile ground for an ex ante analysis of the conditions in the presence of which such problems can be solved (and, if not, such an analysis may suggest avenues for how these conditions should be adapted and adjusted to provide a more fertile ground for innovation). Even public procurement may have a renewed role, partly because the rapid attainment of strong network effects can be decisive for business successes. Specifically, if RTDI programmes, combined with other policy instruments such as public procurement, contribute to the creation of new businesses, which benefit from network effects, these businesses are likely to achieve a stronger position in conquering markets more globally.

Business-academia collaboration: A defining property of systemic innovations is that they constitute novel solutions, which have been built by orchestrating collaboration among many participants who typically represent several communities, most notably businesses, research institutes and universities. Often, these solutions are based on proprietary RTDI results, which provide a source of enduring competitive advantages (e.g., Apple's iOS). When pursuing such solutions within RTDI instruments such as the FPs, the very identification and characterisation of such overarching problems (e.g., 'grand challenges') can suggest useful 'units of analysis', around which FLA can be structured in order to give shape for alternative solutions. Here, there may be an inherent tension between the pressures to provide solutions quickly and the relatively long delays in having outcomes and impacts of instruments such as the FP. Hence, it may be fruitful to analyse such problems especially in view of what advances in generic core S&T competences are needed, apart from possible 'architectural' innovations which can arise by combining existing competences through novel business models (e.g., platforms à la Uber).

Policy governance structures and practices might also need to be reconsidered partly in response to the needs and opportunities of emerging innovation ecosystems, and partly to enable them as active co-shapers of these systemic changes.

The recognition of the *systemic nature* of ecosystem evolution has important *implications for the design and implementation of FLA projects/ foresight processes*:

- *Inclusiveness of participants*: By design, the FLA project should be sufficiently inclusive to ensure that the relevant sources of expertise are possessed by the set of experts and other stakeholders who are engaged as participants. Thus, depending on the context, the pool of participants can become quite large, particularly when there are many interfaces to underpinning technologies and application domains and when S&T advances from one discipline may need to be contrasted with rivalling ones from different disciplines. In other words, in these cases a foresight process seems to be the appropriate type of FLA.
- *Attention to communication support and structuring of networks*: Extending the set of participants requires extra efforts and astute methods to maintain effective communication. Moreover, all participants should acquire sufficient general knowledge of the topics covered by a particular FLA project. That also means participatory processes can be important in raising the participants' awareness of how the innovation ecosystem can be expected to evolve. Against this backdrop, a foresight process need not be seen as an activity, which merely 'collects' factual statements about the relevant S&T trends and developments: rather, it can help participants understand ecosystem level issues and allow them to better navigate amidst such issues. There can be important process benefits as well, for instance through the creation of new networks, and the extension, reshaping and strengthening of existing ones. Thus, one of the very functions of foresight in these cases is its contribution to generating and shaping networks.
- *Awareness of and tolerance for uncertainties*: The growing number of interdependencies and associated uncertainties at the ecosystem level implies that it is harder to 'get it right', because these uncertainties, when taken together, may give rise to unexpected developments that shift odds either in favour of, or against, some technological options. In particular, instead of seeking to portray multiple futures erroneously as if one of them would actually materialise, it is pertinent to raise the participants' awareness of these uncertainties and to explore how various options would be affected by such uncertainties. In seeking to foster such awareness, precedence should be given to compelling representations, which are tangible and visual enough to capture the participants' imagination.
- *Problem-focused experimentation*: In many cases, users are one of the richest sources of ideas for transformative innovations. It is telling that many industrial companies have enjoyed important successes by organising intensive 'hackathon' like events that have allowed them to tap into creative potential of in-house and external developers. Indeed, this mode of development suggests that the well-established mode of running large-scale RTDI projects is increasingly being complemented by intensive, more 'ad hoc', activities, in which existing core competences are leveraged competitively by multi-disciplinary teams in order to experiment with new solutions.
- *Speed, adaptability and flexibility*: The pace of adopting innovations has speeded up, and hence the rate of adoption has become an increasingly important determinant of success. Accordingly, the phases of research, technology development, and commercialisation need to be pursued partly in parallel and even contemporaneously, with the aim of expediting the process and ensuring that the results will reach the markets as quickly as possible. This trend has another important implication. Innovations resulting from RTDI activities will have to compete with rivalling offerings that are developed more quickly than before, and hence it is necessary to offer enough flexibility to ensure that existing development paths can be adjusted in response to changes in this competition. This, in turn, suggests that instead of organising FLA infrequently and on a broad scale it may be necessary to invest in pursuing FLA more frequently or even on a continuous basis, possibly with a somewhat narrower and more contextual focus,[8] with the remit of ensuring that the STI policy instruments themselves have the forward-looking and horizon-scanning activities to support sense-making.

[8] The current round of the British foresight programme is a point in case.

3. Designing an FLA project to underpin the design and implementation of the next FP

This section outlines the process, which underpins the design and implementation of the next FP. It identifies critical factors to be taken into consideration in the design and running of FLA projects. It is not meant to provide an 'ideal' blueprint for FLA projects because there is no such thing: an actual FLA project should be co-designed by the 'clients' – who pay for the project and intend to use its results, in this particular case the EC services – and FLA practitioners.

The effectiveness of any forward-looking activity is highly dependent on the careful scoping of the exercise through co-design with the main users of the results to identify the purpose, the right level of ambition, as well as the extent of consultation and consensus and the timing. These are all required to ensure that the project/process delivers the outputs that are needed.

Step 1: Address users' needs through a joint 'scoping'

Purpose, level of ambition and expectations

The very first decision to be made is to agree on the main purpose of an FLA project to underpin the next FP. Key questions to address include:

- Is there a need to amend, revise or completely overhaul the current concept formulation and strategic design of H2020 to make it relevant in the emerging context?
- Is the currently identified set of economic, societal and environmental challenges relevant to consider when planning the next FP? Is there a need consider new ones?
- Is there a need to explore a completely different approach in addressing a particular economic, societal or environmental challenge?
- Are all the relevant actors at each level involved in the design of an FP?
- Have the pros and cons of expert-based and participative approaches been considered thoroughly and systematically?
- What should be the balance between top-down and bottom-up initiatives (inclusive approach)?
- Is the programme sufficiently flexible to address the dynamic nature of the current challenges? Is a new timeline required?

Based on the agreed purpose(s), the dimensions of the exercise need to be further specified:

- What is the level of ambition, what is the scope? Is the FLA meant to address the overall concept and design of FP or is it to be focused on a particular challenge or sub-challenge?
- What is the level of analysis: single level vs. multi-level? A trivial example for the latter approach: FLA on the evolution of the EU and other world regions; the operation and performance of ERA (what type of ERA would 'fit' into what type of EU?), the main objectives and tools of the next FP (what type of FP would be congruent with what type of EU and ERA?).
- How radical is our remit/agenda: a paradigm shift vs. some moderate improvements on the current practices and structures (a modified 'business as usual')?
- What is the unit of analysis: RTDI activities (in a broad sense); a given economic sector or technology domain; a societal or environmental issue?
- Is it mainly focused on setting thematic priorities, modernising research infrastructure, or reshaping innovation systems (structures, rules of the game, and RTDI practices)?
- Is there a gap in horizontal, vertical and multi-level policy co-ordination? Do we need to reconsider who does what and how we work together?

These factors will determine the design and implementation of a given FLA project. The exercise could be structured to take into account the current status, which needs to be addressed and the four phases, discussed in Section 2.1, taking into account the planning, implementation, and operational tasks. Tables 1-3 outline how the approach and methods can be tailored to address the current status by distinguishing between different levels of FLA: is the project addressing the Framework Programme as a whole or is it addressing a specific

societal challenge or sub-challenge?[9] A combination of levels is also possible and this will add to the complexity of the exercise.

It is likely to be rather difficult to ascertain the current state of play – in other words, what sort of approach would be needed: fostering a major transition; overcoming inertia; or handling a crisis – at the start, and hence this may be clarified as an important task of scoping. Once that decision is made, the tools can be tailored accordingly for each of the four phases of strategic planning. Some notional examples are given for Phase 1 for each ideal type, that is, transition, inertia and crisis in Tables 1-3.

Table 1: Selective use of foresight methods: the next FP as a whole

Approach (why to launch FLA)	**Phase 1** **Strategic intelligence**	**Phase 2** **Sense-making**	**Phase 3** **Priority-setting**	**Phase 4** **Implementation**
Transition	Scanning at a systemic level, strategic change in similar programmes	Exploring different visions for achieving transition; creating different transition scenarios; clarifying the implications for the FP	Structured discussions with policy makers and experts in transition management	Defining transition pathways at a systemic level
Inertia	Scanning for alternative sources of intelligence, weak signals of change, different perspectives and approaches to business as usual	Exploring alternative visions and disruption scenarios Trend analysis and trend breaks	Structured discussions with policy makers, those resisting change, and 'agents provocateurs'	Defining disruption pathways at a systemic level
Crisis	Monitoring and foresighting, analysing the system, scanning	Exploring visions moving beyond coping mechanisms; in-depth studies; considering potential breakthroughs	Structured discussions with policy makers and experts in crisis management	Defining crisis management pathways at a systemic level

Source: Own compilation

[9] Challenges and sub-challenges are best defined when designing/ conducting an actual FLA project: what is perceived as a relevant societal, economic, or environmental challenge, and how to 'decompose' it into sub-challenges, that can be tackled operationally?

Table 2: Selective use of foresight methods at the level of a certain societal, economic or environmental challenge

Approach (why to launch FLA)	**Phase 1 Strategic intelligence**	**Phase 2 Sense-making**	**Phase 3 Priority-setting**	**Phase 4 Implementation**
Transition	Scanning for relevant intelligence relating to the particular challenge, and challenge undergoing transition	Exploring alternative transition scenarios for the challenge and for managing the transition	Structured discussions with policy makers, domain experts and experts in transition management	Defining transition pathways for the particular challenge and/or redefining the challenge
Inertia	Scanning for alternative sources of intelligence, weak signals of change, different perspectives and approaches	Exploring disruption scenarios for the challenge, trend breaks in the challenge	Structured discussions with policy makers, domain experts and those resisting change, and change agents	Defining disruption pathways at the challenge level
Crisis	Keeping on-going watch on developments in the challenge which is in crisis, scanning	Exploring scenarios for crisis management within the challenge	Structured discussions with policy makers, domain experts and experts in crisis management	Defining crisis management pathways at the challenge level; redefining the challenge

Source: Own compilation

Table 3: Selective use of foresight methods at the level of 'a given sub-challenge'

Approach (why to launch FLA)	**Phase 1 Strategic intelligence**	**Phase 2 Sense-making**	**Phase 3 Priority-setting**	**Phase 4 Implementation**
Transition	Scanning for relevant intelligence relating to the given sub-challenge and related sub-challenges/ undergoing transition	Exploring multiple transition scenarios for the sub-challenge and related sub-challenges	Structured discussions with policy-makers, domain experts and experts in transition management	Defining transition pathways for the sub-challenge and/or redefining the sub-challenges
Inertia	Scanning for alternative sources of intelligence, weak signals of change, different perspectives and approaches	Exploring disruption scenarios for the sub-challenge and related sub-challenges	Structured discussions with policy-makers, domain experts, those resisting change, and change agents	Defining disruption pathways at the sub-challenge level
Crisis	Keeping on-going watch on developments in the sector	Exploring scenarios for crisis management within the sub-challenge	Structured discussions with policy-makers, domain experts and experts in crisis management	Defining crisis management pathways at the sub-challenge level and related sub-challenges

Source: Own compilation

In moving from the design of an FLA project to conduct it, it is important to identify the success factors in light of the expected outputs, outcomes and impacts. Success factors (pre-conditions) include access to appropriate resources: high quality ingredients, that is, a

tailored set of tools and methods fit for purpose (Step 2); a team of 'chefs and assistants' combining expertise in the approach and methods selected and in the domain (Step 3); and a systematic approach for operationalising the exercise and ensuring it meets targeted outputs and impacts (Step 4).

Step 2: Selection of approach, methods, and tools

Instead of pretending that it is possible to give relevant answers to all conceivable types of cases, the most important questions are listed below, which need to be asked when planning an actual FLA project.

- In case a participatory approach is chosen, what methods, channels are suitable for the dialogues to be conducted during a foresight process (to reap process benefits and improve the quality of the analysis)?
- In case an expert-based approach is chosen, what methods are suitable for that type of FLA project?
- In either case, what level of methodological sophistication is appropriate by taking into account the
  - amount of time needed to use a certain method properly;
  - requirements from the participants and users in terms of skills and experience to use a certain method;
  - the need to hire facilitators, methodological experts, rapporteurs when using certain methods?
- What are the pre-conditions to use a certain method in an appropriate (thorough, rigorous) way?

Step 3: Recruiting the team and selecting experts and/or participants

The main purpose and orientation of the chosen type of FLA project (Rapid-Response-Mechanisms, expert-based or participatory process) gives a clear indication what sort of experts and/ or participants need to be selected. For example, when inertia is a key concern, it is necessary to involve experts and/ or other participants who provide relevant new – possibly heterodox – perspectives and ways of thinking.

It is also crucial to consider at the outset:

- what is expected from the participants;
- what methods are the most appropriate to collect nominations (e.g. nominations by stakeholder groups, including policy-making bodies, chambers of commerce and other business associations, professional associations, NGOs and CSOs; co-nomination by a set of initially selected participants; open calls);
- how to select from the pool of nominated participants;
- what methods and incentives are needed to make the participants active contributors?

Step 4: Planning the operational aspects

A detailed, but flexible project plan also needs to be devised, covering the following major aspects

- budgeting, timing, and milestones of the given FLA project;
- communication strategy
  - methods, means and channels to be used inside the EC, for politicians and other decision-makers at different levels of governance, various communities of practice, media, citizens, …)
  - clearly, and expert-based FLA project requires a different kind of communication strategy than a foresight process
- methods and resources needed for monitoring, self-evaluation and/or external evaluation of the project.

These aspects need to be adapted and tailored to each of the three types of cases outlined above, that is, inertia, transition and crisis.

Finally, the division of labour among the EC services (especially DG R&I and other policy DGs) on the one hand, and external FLA practitioners, on the other, will also depend on the main objectives and type of the chosen FLA.

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Annex

Benefits of foresight when planning the next FP

Foresight explores different possible futures. Thinking in terms of multiple futures is a necessary pre-condition for devising strategies to cope with unpredictable developments.

In a complex world, phenomena cannot be understood in an isolated manner, but must be seen in context, taking into account a range of different viewpoints. Foresight, given its participatory nature, and assisted by relevant methods, is a means to incorporate different perspectives when exploring possible futures and bring to the fore a range of relevant influences and impacts of the issue in question.

Beyond the systemic perspective developed and applied, the process itself can have systemic impacts: due to intense dialogues, existing networks of major actors are likely to be strengthened, new ones are created, a future-oriented way of thinking is reinforced, and the novel, participatory methods also re-shape the overall decision-making culture in the affected policy governance sub-systems, especially in the domains of education, industrial, and innovation policies.

Policy-making organisations tend to be organised along the lines of rigidly demarcated policy domains. This applies to sectoral policy fields, but even more so to science, technology and innovation policy, where organisational structures can hardly follow the fast-changing patterns of newly emerging fields. In such an environment it is very difficult to find a proper place for cross-cutting research domains or new modes of delimiting them (e.g. shifting from S&T-led to societal challenges-driven research and innovation projects). Foresight processes have the potential to change not only the framing of policy issues, but also to induce organisational innovations. That would be particularly relevant at regional and national levels, but could be applicable for the EC, too.

Foresight usually aims at identifying future issues that often cut across established areas of policy interest. By way of involving participants from different policy domains that are likely to be affected by these novel developments, a dialogue can be initiated across the boundaries of these fields; a dialogue that contributes to creating a shared perception of emerging challenges, and complementary, if not joint, strategies to address them. Policy co-ordination can be fostered both horizontally (i.e. across policy domains, or between parliament and government) and vertically (i.e. between ministries and executive agencies).

Different approaches to the same theme: Technology vs. systemic focus

FLA projects can focus on building strategic visions to guide *technological development* efforts. For example, the UK foresight project on 'Exploiting the Electromagnetic Spectrum' (EEMS), completed in 2004, identified four rapidly developing areas of this specific S&T domain, which should represent major economic activity for the coming 10-20 years and the UK can commercially exploit these results in an economically significant way: all-optical data handling; manufacturing with light; electromagnetics in the near field; and non-intrusive imaging. An action plan had been devised for each area by its own group, composed of people from business, academia, user communities, government and other agencies. A five-year review has established that the EEMS project had been largely successful in identifying S&T areas that would be important for businesses, and these were still relevant after five years. Many of the actions following the project had encouraged discussion of the importance of the four identified S&T areas, although the review has found it difficult to quantify the implications of these activities.

The series of Delphi surveys conducted in South Korea every 5 years since 1993 also focus on technology developments.

Other FLA projects aim at building visions for manufacturing by taking *a systemic view*. 'The Future of Manufacturing: A new era of opportunity and challenge for the UK', a foresight project completed in 2013, for example, considered several factors shaping the key future characteristics of manufacturing by looking out to 2050. These include *new business models*, e.g. the 'servitisation' of manufacturing; closer relationships with, and faster response to the needs of, customers; and extended value chains; major *market trends and opportunities*, *'onshoring' of production* back to the UK, and the increasing share of *foreign ownership*. The likely impacts of five pervasive and six secondary *technologies* are also spelt out, as well as the *features of future factories*; *environmental* trends; and *skills* requirements. Several types of *financial* gaps are also identified. The report thoroughly explores the policy implications of

all these factors and trends. It stresses the need to take an integrated view of value creation in manufacturing; follow a more targeted approach to supporting manufacturing based on systemic understanding of STI and industrial policies; and enhance government capability in evaluating and co-ordinating policy over the long term. The 2-year project has been a major effort: it has produced 37 background reports, and besides mobilising the major UK stakeholders it also involved some 300 industry and academic experts, business leaders and other stakeholders, from 25 countries, via organising workshops on three continents and using other means of consultations.

The most recent rounds of the Japanese national foresight programmes have shifted from an exclusive technological focus to a broader approach, considering e.g. market, health, environmental, skills and ownership issues, too, when presenting a plan for the 'Revitalisation of the Japanese Industry'.

The US National Academy of Engineering also published a major report in 2015 taking a broad view of manufacturing: 'Making Value for America: Embracing the Future of Manufacturing, Technology, and Work'. Unlike the UK foresight process, it is based on a work of a smaller group of experts: a committee established by the NAE, staff members and contributions by other individuals.

Background Paper 5

Outline for an effective foresight network in support of EU research and innovation policy

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1. Mandate

At the beginning of 2015 the SFRI-Strategic Foresight for Research and Innovation experts group has been created by the European Commission. One of the mandates given to SFRI is "to develop the outline for an effective foresight network (incl. horizon scanning) for the EC", which is taken by Working Group 3. This specific mandate is, in our understanding, interconnected with the other mandates addressing bottom-up and participatory foresight (WG5), rapid response mechanisms (WG4) and foresight guidelines for strategic programming (WG1 +WG2).

The connection with WG1 and WG2: An effective foresight network should be able to actively and sustainable generate and transfer knowledge (concepts, methods, skills, etc.) useful for the strategic programming of Research and Innovation. That is to say: generating and transferring knowledge to support medium and long term decision making.

The connection with WG4: An effective foresight network should be able to provide rapid responses to challenges (derived from contingent events, weak signals, trends) to be addressed in the short term but with a high strategic impact. That is to say: generating and transferring knowledge to support short term decision making concerning strategic issues.

The connection with WG5: An effective foresight network should be able to integrate participatory processes to actively involve stakeholders in the identification of Research and Innovation priorities while supporting policy-making. That is to say: doing all this within a framework of reference based on a bigger and more continuous connection with citizens and the social and economic fabric.

According with this background, we understand the following fundamentals for the new foresight network:

1. This is an explicit mandate from our client, the European Commission, asking us to set up the conceptual basis for a proper design of a new foresight network asked that will be effective, which means helpful to support decision making (through shaping relevant questions to decipher the challenges coming, and providing proper answers to manage them) in a changing and complex environment.

2. The design of this new foresight network, in order to be effective, should provide an operative framework able to generate both long term (proactive) and short term (contingent) knowledge-based support to decision making concerning strategic issues by, respectively, generating a foresight culture and delivering rapid responses when demanded. And this should be done through integrating participatory processes (bottom-up) in order to be more emphatic with societal needs and expectations.

3. Consequently, the new foresight network should be understood more as a professional intelligence unit linked to the EC – even open, flexible and independent – than as a conventional academic/research network (based on concrete temporary research projects or spontaneous involvement on voluntary basis). It should be a sustainable framework able both to provide concrete solutions to on-demand requirements concerning strategic issues, and to generate a foresight culture in the European area.

2. Summary

Networking plays a key role in change management dynamics (creating opportunities, leading with challenges, etc.) that is induced by Foresight as strategic tool for decision making. A Commission report of 2002 stated that 'intelligence-gathering and networking methods have to evolve'[1] while mentioning the need of a more participatory approach for a greater democratisation and legitimacy

[1] Keenan,M and Miles,I (2002) A Practical Guide to Regional Foresight – version 2 Brussels, EC, DG Research.

in political process: a bigger empathy coming from the European Commission, an institution traditionally set in public opinion as technocratic and far distant from citizens.

As stated in that report, decision-makers have to live with the fact that knowledge is distributed widely. More importantly, we could add that knowledge is diverse – and changing – but so are priorities and sensibilities. Assuming this would imply a change in the shaping of the challenges to be addressed by Foresight, moving from top-down to a bottom-up perspective: going for a more integrative and stakeholder-oriented model, which would probably lead to a more empathic model of policy-making.

In this sense, a more participatory Foresight and 'human centred' has been demanded to be built on the basis of the stakeholder´s user experience and expectancies[2], as the only way of connecting Foresight with the real needs of the social fabric and consequently contributing to the stimulation of social Innovation and Foresight Culture within both individuals and organizations.

Based on the fundamentals (see above) we are proposing an operational framework for a new European foresight network to improve the efficiency of foresight in the strategic management of change – the **Strategic foresight European Network for knowledge Transfer, INnovation and Effective decision making with Long term impacts (SENTINEL)** is an intelligence complex system proposed as tentative design for the new foresight network demanded.

The mission of SENTINEL is to provide the EC and other potential stakeholders of the European area (national, regional or local governments; companies; NGO's) with a system of vigilance to generate and evaluate future-oriented information and knowledge. Also it is to provide analysis, assessment and support in decision-making regarding strategic issues. This intelligence system is created and supported by the EC as an external/independent advisory group. At the same time, it is the tool the EC use to spread the Foresight Culture in the European area: a tool the EC makes available for the whole organizations in Europe.

This system has three different parts: the CORE GROUP, the THINK TANKS and the POOL.

The **CORE GROUP** is a small group of 10-15 professional futurists (researchers or practitioners) working full time (or in a continuous way: 1-3 years) for SENTINEL as experts/advisors. They contribute to the system with expertise and knowledge in the concrete area of Foresight. This group is formally constituted as experts group by the EC, who is providing a budget for it. The group is stable –**'solid'** – but renewable periodically.

The **THINK TANKS** are ad-hoc small groups of 5-10 experts working for a short period of time (from 1 week to 1 year) in the concrete challenge provided by the client (EC or any other organization of the POOL). Their task can be related either with consulting work (rapid response mechanism, strategic thinking…) or training (in-company or open). So they are temporary and contingent; '**semi-solid**'. They are created on-demand by the CORE GROUP, which is picking up them from the POOL.

The **POOL** is the virtual space (managed through an on-line platform) where a network of networks is framed. This POOL is built on the basis of previously existing networks: from the whole scientific networks (no matter the knowledge area) operating in ERA to other foresight networks (WFS, WFSF, EFN, etc.), to companies and governments; mainly EC. This is just a place to be for those –individuals and organizations- demanding foresight solutions (making questions) and those providing expertise and knowledge (delivering answers).

Such a system would not necessarily provide answers about all kind of contingent challenges, but would support future R&I policy development by getting factual, systemic based, value-sensitive and temporal information to underpin policy responses and actions based on foresight intelligence.

In order to set up the network we suggest the following steps:

1. To elaborate a shortlist with the 50 top futurists, the most influential people working in the European Area. It should include both researchers (theorists, methodologists, academics) and practitioners (consultants, managers, civil servants) with a continuous and relevant demonstrated career of at least 5 to 10 years in Foresight. This 'relevance' should be measured in terms of

[2] Bas, E., Guillo,M. (2015) Participatory Foresight for Social Innovation. FLUX-3D Method (Forward Looking User Experience), Technological Forecasting and Social Change, http://dx.doi.org/10.1016/j.techfore.2015.06.016.

meritocratic and objective criteria, and based both on the cumulate and potential impact of their work in Foresight. This shortlist of individuals should be the seed for articulating the Core Group.

2. To elaborate a shortlist of the top 100+ organizations currently producing future oriented information and committed with Foresight –as main activity- in the European Area, both in the public and private sectors. It should include institutional agencies, consulting companies, research institutes, foundations and/or existing professional networks explicitly connected with the production and analysis of futures knowledge. The prior efforts done for mapping Foresight in the European Area should be taken as basis while being properly updated. This shortlist of organizations would be the part of the ecosystem (POOL) sustainable providing those individuals to be addressed as CG members and/or to the contingent specific Think Tanks (TT), and/or contributing with sustainable knowledge generation regarding Foresight (methods and expertise) to the network.

3. To elaborate a list of the European Area's top 100+ organizations – both public and private - demanding future oriented information and/or interested in Foresight as a tool for supporting decision making and/or strategic management. Those organizations already using some kind of Foresight, either generated in-company or hired to an external consultancy, should be considered. And also those other organizations not using it still, but showing some kind of interest in Foresight culture and/or potentially interested due to its activity strategic nature. This list should be inclusive: institutional agencies/units from EU governments-any level (EC, national, regional, local), private companies-any sector, foundations, NGOs, etcetera should be represented. This shortlist of organizations would be the part of the ecosystem (POOL) were the network should be rooted: the organizational critical mass supporting and financing the whole network through providing specific projects and challenges.

4. To create/access a 360 degrees wide database of experts operating in the European Area, working top level in all areas concerning science, technology, innovation and management. This should be done on the basis of the already existing professional networks of excellence (e.g. the Horizon 2020 experts program), so maybe creating it would not be needed but only accessing –when needed- the available information. This database would be a tangential part of the ecosystem (POOL) but essential in terms of human capital and specific knowledge generation: the experts addressed to be part of every specific TT should be picked up from this database according with the particularities of the challenge provided by the demanding organization and the specifications and needs provided by the CG.

5. To create a comprehensive database of existing Foresight Networks operating at global level, including both the traditional and more integrative ones (WFS, WFSF, etc.) and the more recent and specialized professional outstanding networks. Additionally, formal/informal links for improving cooperation/interconnection among networks and integrating the new European Foresight Network within the 'global foresight fabric' would be fair. This should be the 'window to the world' of this new European Foresight Network: the way for making possible systematically accessing knowledge – both data and individuals - at global level when needed.

6. To create a virtual framework, a 'recipe' to put all the pieces within: the CG (set of top futurists leading the network project), the POOL: the Organizations (both those producing and demanding Foresight knowledge), and also the access to this wide database of experts and other existing Foresight networks at global level. This virtual framework could be a new one, or just an updated version of an existing one (e.g. EFP - the European Foresight Platform). Then, articulating the proper way of creating synergies among them, either applying to public calls and/or private contracts and initiatives. This virtual framework will provide an accessible and holistic view of the aforementioned ecosystem, and –at the same time would shape the network in an operative way.

7. Needless to mention that the natural environment to develop such a framework would be the European Commission, which is the only public institution in Europe able to facilitate, promote and assure the sustainability of this independent consultant excellence-based huge network. So, there should be some kind of formal link with the EC as main potential user and leading inspirer of this network.

3. The new European Foresight Network in context

Some institutional initiatives have been taken since the early 2000s to shape a futures community in the European area in order to develop a kind of framework at European level to promote the use of Foresight (and Futures Studies in general) under systematic and scientific-based parameters, as a key strategic tool for orienting decision-making processes (mainly regarding research and innovation) within both public and private organizations in order to improve their efficiency and competitiveness in a global context. A context featured by continuous change, increasing

complexity and uncertainty. A context where having a solid knowledge-based future approach is needed for reaching resilient socioeconomic development and welfare.

At least nine official prior projects/network programmes related with the European Commission should be considered here as a reference to be considered: EFP-Enlargement Futures Project (JRC/IPTS 2001), ESTO Network (JRC/IPTS, 2002), EFMN-European Foresight Monitoring Network (FP6, 2004-2008), the FOR-LEARN (FP6, 2005-2008), the EFP-European Foresight Platform (FP7, 2009-2012), ERAWATCH (JRC/IPTS, 2010-today) and RIM Plus (2010-today). Regarding global networking, two of these nine projects have tried to share futures knowledge and building bridges with other geographic and socio-cultural contexts: SELFRULE-Strategic European and Latin American Foresight for Research and University Learning Exchange (ALFA Programme, 2004-2007) and IFA-International Foresight Academy (Marie Curie FP7, 2012-2015).

Finally at least three outstanding private initiatives should be also considered: the European Futurists Conference Lucerne (2004-2012), which was a cutting-edge platform sponsored by business companies with relevant outcomes (e.g. inspired the European Journal of Futures Research and the FU-Berlin MA in Futures Studies), the Foresight Europe Network (FEN) that was created at UNESCO site on 24th of October 2014 by European Nodes of the Millennium project (EUMPI) and the European Regional Foresight College (ERFC).

Now, SFRI has the mandate of the Commission to develop the outline for a new 'effective' European foresight network; a collective brain articulated on the basis of a real community. In our opinion, this should be –because of the explicit request for effectiveness that we understand as a demand to 'connect with the Zeitgeist' - to design a network flexible enough to adapt itself to the flexible and complex and changing nature of these times we are living in, and those to come. A definitive initiative to consolidate Foresight within the policy-making routines of the Commission itself, but also to shape a solid, resilient, creative, integrative, globally connected and productive futures community in the European area.

At the time of shaping the new European foresight network we should take into account the unused extremely changing and complex nature of current Zeitgeist which could be defined as 'Liquid Times'[3]: as suggested, we are living in a historical time of radical transformations induced by exponential technology development where most of the structures and institutions traditionally framing contemporary world (politics, security, economy, demographics, education, social life and culture, etc.) are getting 'dissolved'. A time where dealing with emerging challenges will demand new approaches, coming from both organizations and individuals: more emphatic, open and flexible, and consequently more effective.

Effectiveness refers to doing the right things: it constantly measures if the actual output meets the desired output, so it focuses in achieving the goal and involves thinking long term[4]. So, this new community should become a 'liquid' -rapid, adaptive, flexible and empathic mechanism to provide strategic information for policy-making and strategic management in a changing and complex environment. Additionally this community should be able to create, articulate and promote a sort of 'Foresight Culture' in the European area, oriented to support systematic innovation and based on the extensive use of foresight within European organizations and society, in the coming years and –mainly- through the next Framework Programme.

4. Shaping the new European Foresight Network

If we roughly define a Network as a 'collective brain for a shared purpose', having an explicit mandate to develop the outline for a new 'effective' European foresight network, this challenge demands, apart from a description of the proposal (the WHAT: what it should be at conceptual level), an exact definition of the seminal purpose inspiring the new European foresight network (the WHY: Mission, Vision and Values) as a first step to create a working community (the WHO: People in it and Institutional arrangements) and to design an operational framework of reference (the HOW: Articulation, Structure, Resiliency, Working Mode, Budget, Conditions, Communication) as well as to define the expected schedule (the WHEN: Time Frame) and the physical site, if any (WHERE: Administrative Location). Let's deconstruct all these points according with the mandate of reaching effectiveness:

[3] Bauman, Zygmunt (2007), Liquid Times: Living in an Age of Uncertainty, Wiley.

[4] Sudit, Ephraim (1996) , Effectiveness, Quality and Efficiency: A Management Oriented Approach, Springer.

What

The mandate itself (to develop an outline for a new 'effective' European foresight network implicitly demands from SFRI to learn from prior initiatives mentioned before, paying attention to what should be improved-if any. This implies to rethink how a European foresight network should be designed as a whole (and this affects the operative structure, the financing and the linkages with other existing networks on Science and Technology, among others) in order to reach effectiveness.

We are proposing a Strategic foresight European Network for knowledge Transfer, INnovation and Effective decision making with Long term impacts (SENTINEL) as a tentative design of a complex intelligence system.

This new network should be 'liquid' somehow: even slightly structured, it should be flexible, adaptive, shaped in accordance with the concrete and contingent demands and challenges in society determined by social change (which obviously includes the whole social system: economy, ecosystem, technology, security, culture, politics). The network may be shaped as a community, driven by a central group linked to the Commission (it would be desirable to have an in-company assessing group formed by people familiar and sensitive with Foresight). A multilevel (country, region, local) platform where a selected group of researchers, policy-makers and business managers working with Foresight in different areas should merge looking for synergies, but also acting as a kind of social brain. A body able to jointly produce –not just share- knowledge and relevant information in an open, flexible, continuous and sustainable way: resiliency in the long term should be a main goal to be covered

In a few words, SENTINEL should work as an open innovation ecosystem: a dynamic, informal and flexible international network/community of thinkers, researchers managers and users of Foresight knowledge. SENTINEL will provide the EC with strategic intelligence and sense-making on various issues related to STI policy and, simultaneously, would contribute to creating a 'Foresight Culture' based on Innovation, Creativity and Participatory processes within the social fabric in Europe.

Why

We understand that the goal for this network would be stimulating a Foresight Culture for research and innovation policy development in the European area. This, consequently, means to build the basis for a resilient/sustainable network, which should last over a longer period to achieve this goal, while being flexible enough to adapt its nature and activities to the future demands without losing its effectiveness.

In order to be successful stimulating Foresight Culture the new network should be built on the basis of Empathy: a kind of sensibility with the sign(s) of times and the consequent ability to anticipate social change and to identify, understand and approach emerging new challenges in a proactive way. This actually may result in a way of building something that raises the consciousness and level of Foresight in Europe.

This would mean trying to be creative while approaching Foresight research and innovation – and also networking - without following blind routines based on rigid procedures that can be obsolete, inefficient, ineffective or simply inadequate. Reaching empathy would mean, in this context, accepting change, understanding complexity, questioning cumulate knowledge, integrating new methodologies, and rethinking the way of approaching futures research depending on the operative context (cultural, demographic, economic, etc.) in order to provide and/or articulate proper (efficient) responses to the challenges to come.

Who

SENTINEL is understood, as mentioned above, an open innovation ecosystem where all the potential members should merge in a kind of collective brain, a community able to create and share useful knowledge for strategic intelligence and decision-making. This entails the concurrence of many different actors/stakeholders as members: both individuals (policy makers, academicians, researchers, entrepreneurs and citizens) and organizations (public institutions, universities, research centres, business firms and NGO's).

Though SENTINEL is initiated and its constitution co-funded by the EC, institutional setup and management of the network is fairly independent and self-governed. The EC plays the key role in the initial phase, when the SENTINEL is structured and the Core Group is created. In the later stage the EC formulates needs for strategic intelligence and sense-making that are addressed to and processed by the Core Group. The EC thus benefits from existing foresight capacity that can rapidly and effectively respond to future needs of Europe.

Regarding the role of the individuals and organizations involved, the new network should be operative, integrative, representative and influential: open but excelling, integrative but selective, multidisciplinary but holistic, flexible but resilient, systematic but creative, independent but institutionally supported. A network not only devoted with the anticipation of possible futures and approaching concrete challenges but also committed with the consolidation of a 'Foresight Culture' with all the stakeholders involved. It is important not to assume that our current economic paradigm is the only possible economic paradigm or we will only be innovative in the sense of reproductive (trying to make changes in the current system) instead of being creative (for example proposing simultaneous, multiple systems).

We understand that the network should work in an integrative way, being emphatic with all the stakeholders potentially involved and/or interested in Foresight for research and innovation: public institutions, private organizations and civil society. At the same time, reaching empathy would imply paying attention to the change processes and complexity shaping the future: this is key to understand, foresee and satisfy the needs, demands and expectancies of those stakeholders.

At least those 3 types of potential members should be considered for SENTINEL: professional futurists (individuals) working either in private or public environments, organizations doing Foresight as main activity (research institutes, university departments/units, foundations, institutional agencies linked to governments-multilevel, consulting companies), and organizations demanding Foresight knowledge and/or advisory (information, tools/methods, training, research) to improve their strategic management and decision making. The aforementioned individuals and organizations would be active part of the POOL of experts and organizations supporting the network. A selected group of futurists and representatives of the organizations doing Foresight would be in charge of the CORE GROUP (CG), the management team of SENTINEL. This CG should be refreshed periodically, e.g. 50% every 2 years.

Additionally, as a complementary external circle, tangential but key, other existing networks should be close to the operative system of SENTINEL. Being linked to other existing Foresight networks worldwide would be strongly recommended to reinforce a global vision; accessing to existing thematic professional/scientific networks is considered essential for being sure of addressing concrete challenges with the needed knowledge. These networks would be somehow linked to the POOL for external, contingent, advisory.

How

Creating synergies is the key point: the network should aim collaborative efforts of policy makers, academicians, researchers, entrepreneurs and citizens – and their organizations – to anticipate possible futures, to formulate a shared vision and to approach effectively (and collectively) identified challenges. In such an ecosystem new ideas and knowledge emerge from a continuous interaction, knowledge exchange and feedback loops among individuals, which influence each other. These new ideas are therefore examined and understood within a broad context of possible future developments.

About the activities to be developed, the scanning work (multilevel, multidisciplinary) should be a central activity, but also the periodical dissemination of results (conferences, journals, etc.) and training alternatives (workshops, etc.) in a structured calendar: continuous interaction and mutual learning would be essential for moving from technocracy to empathy, and for the new network to be effective in stimulating a Foresight Culture. This functional approach should determine the whole articulation and operative processes of the new network.

In general, several types of outcomes might be expected from the network. First, the network will provide response to the EC's need for strategic intelligence and sense-making (through specific Think Tanks). Second, it can provide a response to the societal needs, bottom-up topics identified by the network itself (through specific Think Tanks). Third, the network can serve to raise awareness about foresight as a tool for strategic policy making (the aforementioned 'Foresight Culture'), through running specific Workshops, Courses and Seminars. Fourth, it will contribute to create and sharing cutting-edge knowledge and experiences and thus to improving quality of Foresight, through running specific Workshops, Courses and Seminars.

When

Since most of the SFRI members are experienced in the building and management of Foresight networks, as active members, the first steps could be done while SFRI is running, in 2016 (e.g. by suggesting a group of outstanding futurists for the Core Group).

Further developments would directly depend on three key points: the support of the European Commission, the will to participate of all the mentioned stakeholders, and the needed budget to drive it all and guarantee the sustainability of this project.

About funding, two different ways of funding might be envisioned for two different phases of the network operation:

1. Funding of the initial phase (3 – 4 years)

Funding of the management team (initial Core Group) to set up the network. Funding for piloting different tools for stimulating viability and sustainability of the ecosystem (e.g. fees for each EC request, co-funding of bottom-up generated inputs to EC's decision making, co-funding of mutual knowledge sharing, annual conferences, label of quality, …). Funding of the SENTINEL website

2. Funding of the sustainability phase (years 5+)

Maintenance cost of web based platform and administrative issues. Funding or co-funding of different tools that will be verified in the initial stage. Joint funding of bottom-up topics by interested members (e.g. as part of their broader projects)

Where

Even SENTINEL is understood as based on a Website, operating as a kind of an open social network with virtual means, it would be convenient to appoint a concrete physical place. There are two main options: a fixed site like Brussels (if SENTINEL is formally linked to an EC unit), or a travelling site e.g. the Organization (Foundation, Research Institute, University, etc.) where is based the individual leading the Core Group. Since the proposed is refreshing the CG every two years, the SENTINEL 'physical site' would be moving periodically. This could be something good both for the inner dynamics of the network itself, and for disseminating the 'Foresight Culture' across Europe: it's probable the SENTINEL itinerant sites organizing most of the meetings and activities (Workshops, Seminars, Courses, Plenary Meetings), which is also good to have a direct interaction with different regional realities, actors and potential stakeholders (and research/consultancy projects derived).

5. Going operational: the proposed framework

We are considering three different entities forming the Foresight Network: the CORE GROUP, the THINK TANKS and the POOL, with the following set-up:

Core Group

It would work as management team of the whole network. Those representatives (about 15) forming the CG should possess an international leadership role, relevant know how and expertise in Foresight, no matter what nationality, academic or professional background. The CG should be refreshed 50% every 2 years, following similar criteria of excellence followed for the EC experts groups. It would be 100% designed by the EC in the 1st phase and 50/50 by the EC and the POOL respectively in the following ones, in order to preserve the public interest of this initiative.

The role#1 of the CG is shaping the challenges to be addressed according to the explicit demands or potential interests coming from the POOL, considering the general interest demanded by the EC. This means implicitly acting as Scientific Committee when needed, supervising methods and procedures. The role#2 of the CG is building (directly picking experts from the extended network or making a specific call) and managing the ad-hoc Think Tanks (TT) and/or activities derived from the demands of the POOL, addressed previously as challenges. The CG also might design the research or activity, manage the whole process, disseminate the results and dissolve every TT when its mandate is finished. The role#3 of the CG is leading the network's communication, both internal (management of the platform, reporting the POOL and the European Commission periodically and/or under demand) and external: social media, agenda-setting, etc.

Think Tanks

The TT is a group of experts (in their respective/professional areas, not in Foresight) addressed to work jointly and temporarily in solving a pre-defined challenge considered of strategic relevance, in the terms and time period considered. The nature and composition of every TT would depend on the particularities of every concrete challenge, and will be determined by the CG, acting as Scientific Committee, by direct choice and/or specific call for applications.

Different types of challenges may be addressed and require different types of urgency, times, resources, etc.: VISIONS (normative issues; e.g. visions for Europe 2050), FACTS (short term analytics, e.g. Refugees crisis), TRENDS (mid-term analytics; e.g. Aging population) and WEAK SIGNALS (long term analytics; e.g. rise of Populism). There can be various TTs working simultaneously in different challenges under the supervision of the CG, depending on demand and available resources coming from the EC and the POOL. Some of those TTs may be further developments the previous work done by pre-existent TTs.

The main role of a TT is providing information and relevant insights, in a structured way (through a research/foresight process defined and managed by the CG) to solve the defined challenge. This could mean both to anticipate tentative future scenarios, identifying risks and opportunities, and proposing creative solutions in an experimental way.

The Pool

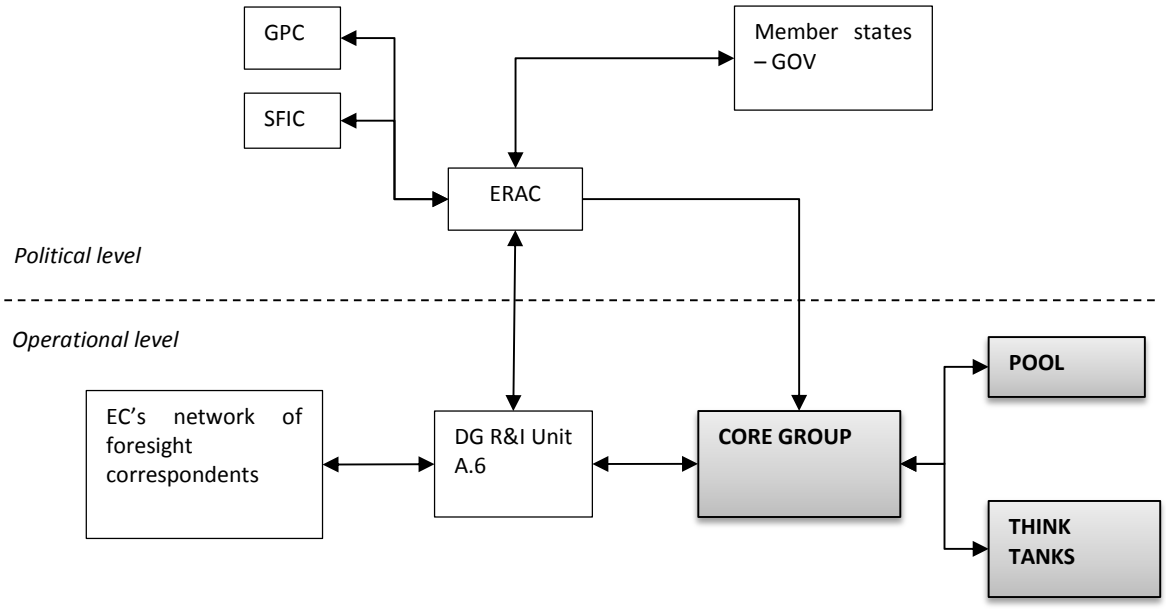
It´s a comprehensive group of European individuals and organizations committed with Foresight and/or Research and Innovation. The POOL is considered to be the basement of the network. Although being member is voluntary, it would be convenient to merge with other existing scientific and professional networks, becoming a kind of network of networks.

The role of the POOL is multiple and key: giving the network the needed credibility and support (also Funding) to be legitimated, inspiring the CG to shape the challenges and priorities agenda, and becoming the pantry nurturing both the CG and TTs.

Additionally, the POOL is responsible to assure the social impact of the innovation and foresight processes developed by the network. It´s the watchdog working to guarantee that the work done fits with the socioeconomic fabric´ expectancies and strategic needs: the guardian of empathy and efficiency.

Embedding SENTINEL in the European R&I governance structure

In order to strengthen the impact of the foresight activities on the EU R&I policy it is important to position SENTINEL in the established R&I governance structure at the European level. This section presents a proposal for integrating SENTINEL in the European R&I policy making that is consistent with the general scope and shape of the new network.



Political level

In this proposal the European Research Area and Innovation Committee (ERAC) shall be entrusted with the key initiating role with regards to sentinel. ERAC shall give a mandate to Core Group to manage the network and to serve as an 'engine' of the SENTINEL. Thanks to this mandate given by ERAC the new network will be first, embedded in the EU research and innovation policy making process and second, officially linked to R&I governance structures in member states. In addition,

outputs of the SENTINEL can be efficiently used by the ERAC High Level Group on Joint Programming (GPC) and the Strategic Forum for international S&T Cooperation (SFIC).

Operational level

The key operational role plays the EC. With regard to SENTINEL the EC shall in the first phase nominate members of the Core Group. Members of the CG shall be nominated based on their expertise, experiences and esteem in foresight, and their willingness and commitment to stimulate foresight culture in the European R&I policy. The EC should also absorb the outcomes coming from SENTINEL and together with linking them with the EC's network of foresight correspondents it should contribute to their integration into the policy-making process within the EC.

Annex

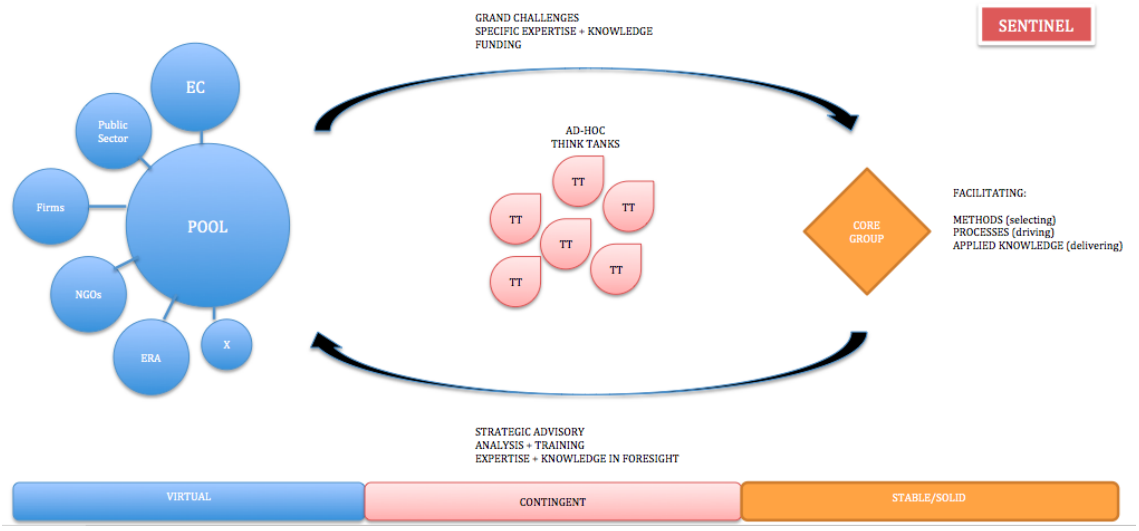
The new European foresight network in a view:

WHAT	***The Network*** **CONCEPT**	What it should be at conceptual level? **OPEN COMMUNITY/COLLECTIVE BRAIN OF STRATEGIC INTELIGENCE**
WHY	***Mission*** **IDENTITY**	What is the aim inspiring The Network?. **HELPING TO UNDERSTAND, FORESEE AND DRIVE SOCIAL CHANGE BY SUPPORTING A RAPID RESPONSE MECHANISM ON STRATEGIC ISSUES AND GENERATING INNOVATIVE FORESIGHT KNOWLEDGE FOR THE STAKEHOLDERS INVOLVED**
	Vision **IMPACT**	What The Network wants to become in the future?. **OPEN INNOVATION ECOSYSTEM BASED ON FORESIGHT CULTURE**
	Values **PHILOSOPHY**	What is the basement/roots of The Network?. **EXPERIMENTAL, INFORMAL, FLEXIBLE, INTERNATIONAL, MULTIDISCIPLINAR, INTEGRATIVE**
WHO	***People in it*** **HUMAN CAPITAL/KNOWLEDGE**	Who are the potential Members of The Network? **ORGANIZATIONS (BOTH PUBLIC AND PRIVATE) AND INDIVIDUALS COMMITTED WITH TO FUTURE ISSUES**
	Institutional Arrangements **LEGAL ENTITY**	How embedded/connected and to whom? **INDEPENDENT WITH A MANAGEMENT CORE (CORE GROUP) LINKED TO EC**
HOW	***Articulation*** **SHAPE**	Is it a Network, a Think Tank, etc.? **WIDE NETWORK OF NETWORKS (POOL OF EXPERTS) MANAGED BY AN CORE GROUP ON FORESIGHT WHERE AD-HOC THINK TANKS ARE**

		FORMED ON THE BASIS OF SPECIFIC NEEDS ADRESSED BY THE EC OR THE POOL ITSELF.
	Structure **SYSTEM**	Which elements and interactions? **CORE GROUP** **+AD-HOC THINK TANKS** **+COMPREHENSIVE POOL OF EXPERTS**
	Resiliency **SUSTAINABILITY**	How to guarantee efficiency in the long term? **TRANSPARENCY. VISIBILITY. COMMUNICATION (WEB-BASED PLATFORM?)**
	Working Mode **OUTPUT**	What production to be delivered? To whom? (Assessment/Research/Knowledge Transfer/Education) **-RESPONSE TO THE EC NEEDS FOR SI?AND SENSE-MAKING** **-RESPONSE TO SOCIETAL NEEDS IDENTIFYIED BY THE NET ITSELF** **-SPREADING/IMPROVING FORESIGHT FOR STRATEGIC POLICY MAKING** **-SHARING KNOWLEDGE AND EXPERIENCES** **-SPREADING INNOVATION CULTURE**
	Budget **FUNDING**	Who is paying The Thing? **CO-FOUNDING: EC, COUNTRIES, COMPANIES, FOUNDATIONS, etc.**
	Conditions **OPERATIONAL**	Partnerships? Impact Assessment? Working Modes internalised? **HORIZONTAL (SET OF PRIORITIES BY THE WHOLE ECOSYSTEM)** **TOP-DOWN (PROCESSES MANAGED BY THE CORE GROUP)** **BOTTOM-UP (GENERATION OF INFORMATION BY SELECTED REPRESENTATIVES OF THE POOL OF EXPERTS FORMING THE THINK TANKS)**
	Communication **CONNECTIONS**	Corporate Image? Media coverage? Relationships with other units/networks (regional and global) **NETWORK OF NETWORKS. CONNECTED WITH OTHER NETWORKS AND ORGANIZATIONS, BOTH PUBLIC AND PRIVATE**

WHEN	***Time Frame*** **CALENDAR**	When doing what? Step by step timing to afford challenges and concrete targets **INITIAL PHASE (STARTING AND CONSOLIDATION): 3-4 YEARS** **SUSTAINABILITY PHASE (YEARS 5+)**
WHERE	***Administrative Location*** **SITE**	Physical place? Fixed or itinerant? **ITINERANT? BRUSSELS?**

The SENTINEL intelligence system, as operative framework proposal for the new European foresight network, in a view:



Background Paper 6

A frame for selecting bottom-up topics

Authors: Kerstin Cuhls (editor), Robby Berloznik, Jennifer Cassingena-Harper, Natalie Dian, Michal Pazour, Tal Soffer

1. Introduction

This paper should contribute to the question how to prepare the next Framework Programmes ('FP9' and 'FP10').

There are still many uncertainties: What might the next Framework Programme look like? What is the policy (on research, development and innovation) behind? Is the next programme about instruments (e.g. funding) or more about topics? Is it demand-oriented? Or is it science and technology push-oriented? Is it similar to H2020 or experimental and new? How much money will be available? What does change after a BREXIT?

Based on these uncertainties, there are two assumptions: There will be a next Framework Programme and it is prepared now with a fixed timetable. The very next Framework Programme (i.e. 'FP10') is even more unclear and still some new features and instruments can be proposed for it. Therefore, we include some free thinking about this, too. The working group therefore took the freedom to reflect about the task in a broad way and sees two different time frames:

1) **urgent time frame** for the next two years (after 2015) to prepare the next framework programme (no. 9 or H2030).

2) **long-term** developments that lead to a new way of preparing a Framework Programme beyond the next (FP9) Framework Programme.

Tasks of a bottom-up system are:

- Generation of novel issues in a bottom-up fashion.
- Piloting working mode using some bottom-up topics in 2015: Regarding the piloting activities it was pointed out that the 'why and 'what' must be clear to show the benefit of those pilots. Looking at potential pilots at national level was proposed (while keeping in mind the limited geographical scope) as well as reflecting on citizens demands. These pilots should also serve to learn how the working methods ('bottom-up'; co-creation; rapid-response mechanism) of this expert group work.

It was particularly pointed out that SFRI should produce output that can 'surprise'/'provoke' the Commission by, e.g., turning around the assumptions behind the existing priorities, provide alternative solutions, and suggest also new methodologies for defining priorities. This output might be combined with pertinent questions. In this context, SFRI could also reflect on the conditions under which the involvement of citizens into priority-setting and policymaking should be sought.

This brief provides a preliminary set of guidelines for use in preparing future Framework Programmes:

- Developing a frame for selecting bottom-up topics
- Generating/co-creating novel issues in a bottom-up fashion
- Piloting working mode on some bottom-up topics

The brief revisits assumptions behind existing priorities and working modes and proposes new approaches/methodologies for defining priorities that aim at enhancing bottom-up approaches, including the involvement of citizens.

The first question we have to ask is: What is 'bottom-up'?

BOX 1: 'Bottom-up' approach

The term 'bottom-up' in this brief refers firstly to the deeper participation of a wide set of stakeholders from a range of policy and societal levels, representing diverse perspectives, needs and interests, in particular under-represented groups and those with limited/no access to policy design and shaping. Bottom-up foresight entails the engagement of a whole new range of actors for generating foresight knowledge and a new transfer way of this knowledge. The new actors who carry this knowledge (still implicitly) are e.g. young entrepreneurs, students, change agents, business angels and local activists. Bottom-up can also be referred to the engagement of different stakeholders, especially citizens, to raise trust and a sense of solidarity.

Secondly, bottom-up refers to the exploration of a broad range of information sources and scans, including alternatives and disruptions based on diverse levels of search for emerging trends and drivers. This entails a finer granularity of the future topics when finer, multiple filters are developed to serve as a frame for selecting bottom-up topics.

The means for implementing bottom-up foresight (as a systematic view of different actors) that people and new sources of information have become more accessible with the spread of social media and web-enabled interactive tools. The question is also where the bottom lies. However, the challenges of assessing and evaluating the data as well as extracting useful information from this mass of data to gain applicable results are big. Even the resources required for a comprehensive bottom-up approach are considerable.

2. Rationale

To date the use of foresight in FP5/6/7 and Horizon 2020 has focused primarily on top-down approaches (based on the ideas of high ranks, on request or based on 'experts'), including the use of expert groups to rethink a completely sectorial approach, or at programme level to define the work programme's specific topics, sometimes at project level in defining strategic research and innovation agendas.

Foresight activity has been encouraged at different levels in this system and to address different rationales including providing support for national, regional and local foresight exercises; and the organisation of EU level foresight to inform EU policies and promote the harmonisation of member state policies. During the accession phase of the EU-12, foresight was used as an instrument of transition to support the accession of new Member States with the aim of building R&I intensity, capacity and performance. EU-sponsored regional and city foresight addressed local territorial concerns as well as cross-border cooperation have had important impacts in influencing policy and action at different levels. These actions have resulted generally in increases in national R&I spending contributing to new actions and measures, at regional and city level, have enhanced governance processes and led to more effective regional and city programmes.

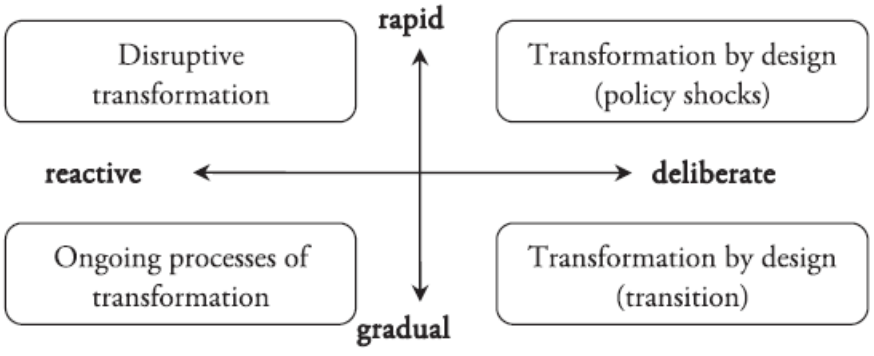


Figure 1: Identified types of transformation (Weber et al 2012, p. 155).

The EU drive to gear research and innovation to address grand societal challenges reflects a more ambitious commitment to bringing about societal transformations by design (Weber et al. 2012; Haegeman et al. 2012). In essence, this is a shift towards generating longer-term impacts in society, economy and governance processes. The use of foresight to address societal challenges is in itself highly challenging for those designing and implementing the exercise, since the process for generating such impacts is more complex and risky.

Weber et al. (2012) distinguish between four types of transformations or disruptions which foresight activity has to contend with in different ways. Figure 1 shows the difference between the primarily reactive approach to disruptive events and ongoing processes of transformation and the need to use Foresight (in the citation used here broader and thus called FTA) towards more deliberate, proactive approaches to transformation.

The Lund Conference (Lund Revisited. Tackling Societal Challenges)[1] in 2015 especially touched upon Social Challenges and ended with a revised declaration 'Europe must speed up solutions to tackle grand challenges through alignment, research, global cooperation and achieving impact'.

3. Change in paradigms

When society is talked about, society must also be involved in the procedure – regarded as an actor. This leads to a new thinking about participation and even democracy in general. But we have to go further:

Survival is the ultimate goal, described in today's terms as sustainability and resilience. In order to equitably make this huge change possible, all levels of society need to be involved or the changes will be too slow to save lives and traumata. Change on a regional level (EU) will have to be addressed not only by all the member countries, but also by all the peoples within those countries. Discussions on what sustainability and resilience mean to all citizens of EU countries must begin immediately. It involves also science and technology to create an awareness and is more democratic in taking into account more and different information as well as information sources.

Thus, in the long range, we have to consider new paradigms and a new 'mix' of people to address it and to think about it, even in Foresight processes. The combination should include age and gender aspects such as young people from the 'gamer generation', the second generation of the so-called 'digital natives' (Prensky 2007), 'Digital Immigrants' (Prensky 2001) as well as 'wise' and experienced persons as in education. The best results can be achieved in mixed groups including different fields of expertise. This does not only mean to work in social media surroundings, but especially in real life (labs) or working groups. Even here, a lot of social innovation is possible. It does not only mean making use of swarm intelligence.

This needs a culture, education and understanding shift: Paradigm differences can be large from jurisdiction to jurisdiction and within jurisdictions. For example, a move from the concept of 'growth' to sustainability can be difficult for those still trying to reach the same growth standards that other countries have already obtained. Identifying paradigm differences can be key to providing the scope and range of any scanning process we recommend. These also refer to cultural differences between nations and sometimes within nations in the way people look at things and behave. For example, the perception of privacy may be affected by cultural differences.

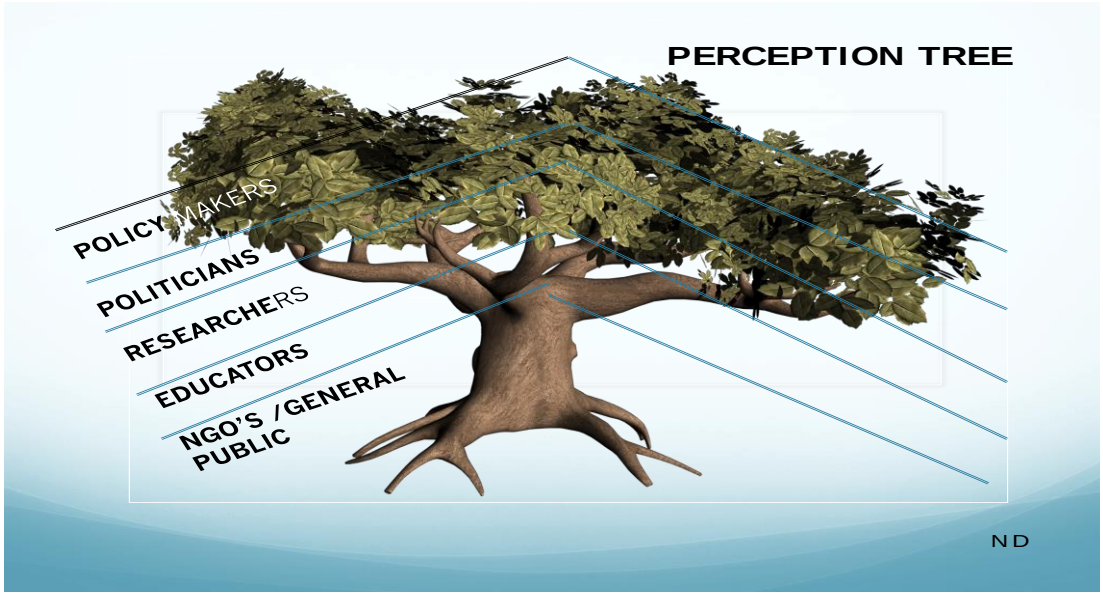


Figure 2: Perception Tree

[1] http://www.vr.se/download/18.2f2b4c214fabb87955150ea/1441703705896/lund-revisited-150908.pdf

There are a number of different change theories coming from change management backgrounds to behavioural sciences. Education or knowledge acquisition, formal or informal, is seen as having a large effect especially on systems. A structured scanning system might be seen as a new way to inform the whole organization as to the possibilities and their validity for the years 2015-2020 and beyond.

The so-called 'bottom-up' approach needs to be expanded to all those who will be influenced by any potential change, that includes the citizens most negatively and positively affected by the changes (induced by both humans and nature). Making the kind of change we need at this time in human history involves everyone on the perception tree (see Figure 2). Therefore, we need to include all levels, beginning with the bottom where the greatest numbers live.

4. Different application of information & knowledge management

Thoughts that go back to Greek hegemony can still be found today. In fact, many of them are blooming or are preparing to bloom at this writing. In order to understand the world as it is today it is important to look around at past precedents, what others are saying about the present and implications for the future. Everything from: visions of moving to another planet, to changing our approach to this planet, can be considered. We have already discussed the need to get information from all the levels of perception we have available to us. Now we need to lay guidelines for what we are searching (see Figure 3)

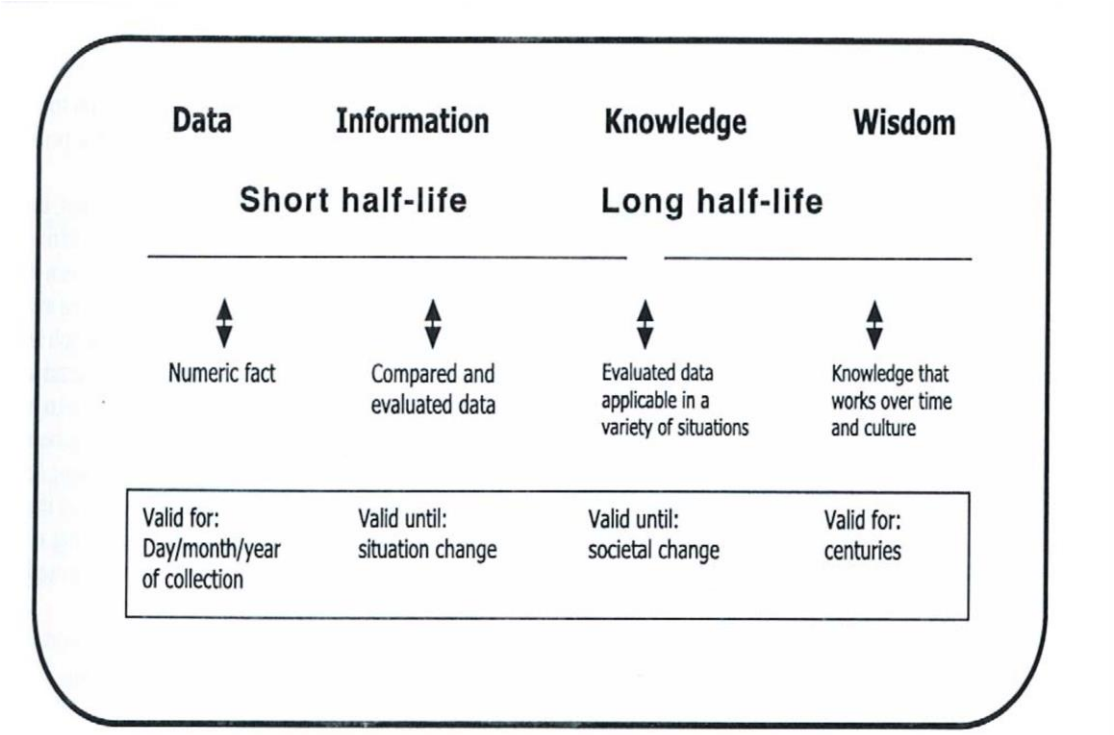


Figure 3: Types and qualities of Information

- Using short half-life or long half-life information (the relative lengths of time required for information to fall to being half descriptive of any subject or situation) provides a possible basis for identifying weak signals (in the sense of Kuusi et al. 2000 or Hiltunen 2008, but also Ansoff 1975; Curry and Hodgson 2008 or Holopainen and Toivonen 2012). It needs to be compared and evaluated over time to verify if a trend is forming or not. Criteria for information sources: quality of source, quantity of sources on the same subject.

- Knowledge, which implies patterns in the past that can have relevance for the future. Major changes in, for example, weather, major catastrophe, large societal change can invalidate knowledge.

- Social changes that are related to one another can indicate the adaptation of a social change. For example, the view that humankind is dependent upon natural resources and that they must be protected is related to animal rights thinking.

The current set of H2020 topics is partly set top-down (policies, policy-makers, lobbies, large majority groups, majority and mainstream thinking) **or** derived from former projects **or** have been defined through foresight processes whether through EC exercises or through at project level (JPIs e.g.). The proposed frame includes these, especially the not yet exploited topics.

If a system of information collection, broadly spread throughout the whole EU structure and at all levels of perception is set in place it could have a huge impact. Besides the information gathered, a system of collection could raise the awareness of the whole organization to the direction needed to fulfil EU goals. Even the member countries will benefit from a better understanding of EU decisions, the 'why', and budgets that are directed to them.

A structure behind any potential futures programme challenges and involves identifying our assumptions and articulating our values. To understand future possibilities we need to understand where we are in the present. The current values of EU decision makers will define the future based upon their values unless they are supported in rethinking what possible consequences their values will have in the future.

5. Objectives of a Framework Programme

In relation to a new paradigm, the next Framework Programmes may have a different objective and policy intention: Is it just about funding or more about moderating the funds? Is it important to define content or are there other ways of defining content (e.g. by the scientists and researchers themselves)? Do the instruments have to be changed? What are new instruments?

Within the foresight concept lays a general acceptance of systemic thinking. That means that objectives will not be a list, but a grouping of interrelated tasks that will need to occur simultaneously from bottom-up and top down. Disruptive events and the need for emergency relief from them will be grouped with activities identifying chances for the future, designed to be transformative. The overall goal of both levels of activity will be directly related to resilience (to be able to meet disruptive transformation) and sustainability (which will be met through transformation by design).

How can Foresight intelligence be used for the programme beyond Horizon 2020 mainly 'bottom-up' and involving 'knowledge stakeholders' such as academics and thought leaders? Who are the thought leaders? They can also be people who are knowledgeable on the specific matter but are not classified as 'experts' because they do not have high ranking functions in the system?

Making judgments about if and when bottom-up knowledge will be most useful needs experience. As new paradigm thinking becomes more integrated and what was bottom-up knowledge a number of years ago becomes generally accepted today, new insights will develop at those layers of society most affected by the changes, positive or negative.

6. Time and the next EU Framework Programme

Foresight is about the long range. But what does long-term mean? The scope of each foresight project must be declared. While this begins as an estimate, there are guidelines that can be applied. Since the mandate for this paper is Horizon 2020, and it is written in 2015, there are only five active years left for foresight application to prepare the next Framework Programme. Five years are a good strategic period for making sure that the goals set prior to 2020 have been adequately addressed. It is a time for deciding what is left undone and what new must be added. A suggested length for a complete foresight project is 25 years. This leaves room for determining possible and desired futures. Each goal will have its own timeline, perhaps under the 25 year mark and others over the 25 year mark. It is wise to be as honest as possible as to how long things might take. The research and innovation for sustainability and resilience within the whole EU might take much longer than the life times of those who are now living or those who are preparing the programmes. In that case, we do not speak of goals but of direction and systems creation.

For example, major development of positive and workable immigration procedures might take five years to develop, but dealing with the various causes for migration might take fifty years or more. It is wise to realize that all goals cannot be fulfilled within a democratic political mandate of say, four years.

On the other hand, for the next Framework Programme, there are already a lot of priorities pre-determined. They have to be considered, too. Thus, we propose to differentiate between the next Framework programme (FP9), the next five years – but then to consider a complete paradigm shift to adapt to or to prepare for the very next Framework Programme (FP10).

7. Definition of search field – criteria for selecting Framework Programme topics

7.1 Impact, criteria and indications

Bottom-up also refers to the process of generating topics as well as the selection process and the sources.

What are the interesting topics, issues, challenges or inputs that are part of a new Framework Programme? How can they be 'defined'? Which criteria do they need to fulfil? There are underlying values, predefined general policies and requirements they need to fulfil. There are research communities and groups, which have developed over time and have opinions and expectations regarding the programme's direction, aims and impacts, and topic orientation. Significant investments have been made in certain policy areas, marine, energy, environment based on long-term policy consultations and discussions. Is our aim to link to these processes, or to bypass them and focus on remaining different areas? Are we proposing a frame, which these communities can be encouraged to use?

In defining selection criteria, we may need to identify different levels, e.g. at the higher level, there are challenges and targets which have been set – does our frame come in to support cross-challenge approaches, cross-fertilization of ideas, cross-disciplinary approaches, forming new communities?

They have to be trans-formulated into the selection criteria. Maybe there are also different instruments for supporting R&D – the topics have to be chosen accordingly.

7.2 Messy values behind the criteria

There are many values and grades of those values and all values are relative. Much is written about values[2]. One way of dealing with values is to find subjects that all cultures must consider. All cultures find themselves placed upon the spectrums that have to do with human relationships. For example, all cultures have to define what is considered good and bad and the points in-between.

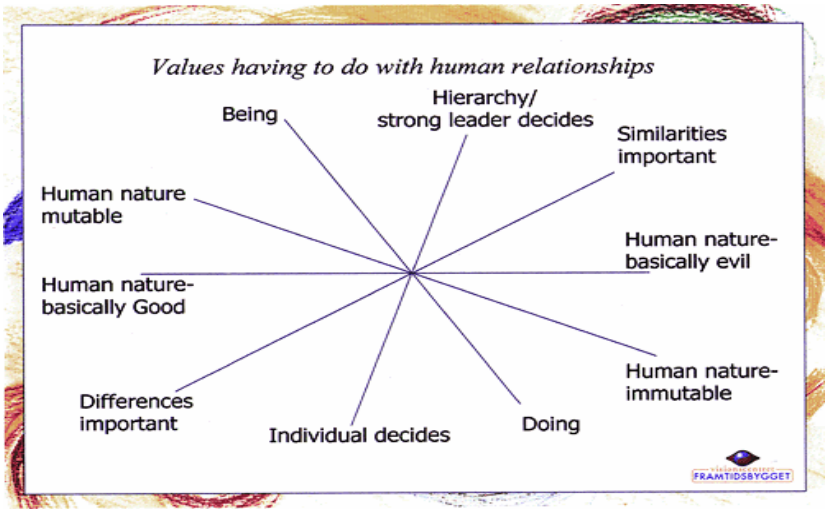


Figure 4: Values having to do with human relationships

[2] See also the Final Report of a Commission Study: The Impact of Changing Value Systems on EU Research and Innovation Policies: Signals, Drivers, Responses, Brussels 2015.

When looking at all the spectrums, certain viewpoints begin to show themselves. They form our paradigms (more on paradigms see below). Consider a circle including, hierarchy/ strong leader decides, similarities important, human nature basically evil, human nature, immutable and doing. Now consider a circle including being human nature mutable, human nature basically good, differences important and individual decides. Using the extremes, (which is very rarely the description of any individual) one can see two different worldviews based upon values.

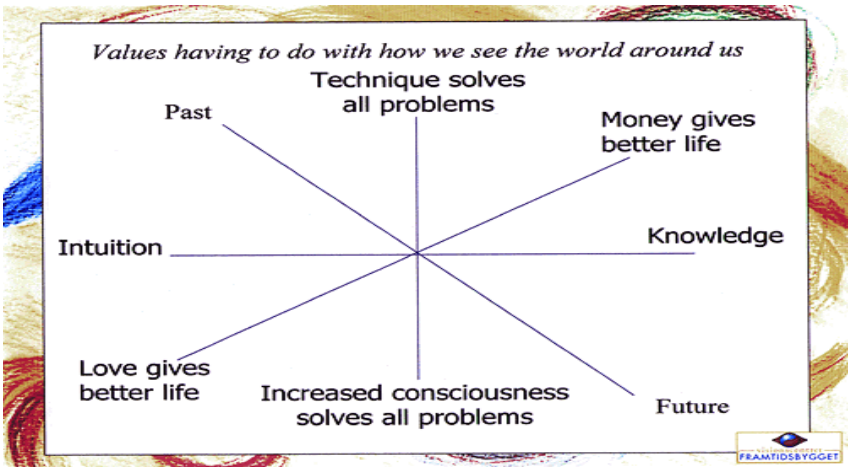


Figure 5: Values having to do with how we see the world around us

The two prevailing western and global dominating paradigms can be glimpsed in the chart 'Values having to do with how we see the world around us'. If a circle is drawn to include mastery over nature, past orientation, technique solves all problems, money gives better life, and knowledge; one finds a simplified view of one paradigm. If a circle is drawn to include intuition (probably better stated as wisdom and experience), love gives better life, increased consciousness solves problems and future orientation and subjection to nature; another paradigm can be perceived. Consciousness or awareness refers to consideration of more than only technical aspects contributing to a problem. Systemic/ holistic relationships do not exclude technique, but give equal value to all the ways we experience the natural and human world around us. Keep in mind that these are extremes and most behaviour will lie in the middle section of each spectrum, causing the paradigms take on more nuanced form.

8. What does a Framework Programme include? What is searched for?

A Framework Programme on RTDI (Research, Technology Development & Innovation) includes foresight tools – and to prepare it needs already first answers to challenges (knowing the demand side) and what it can provide (on the supply side). The Framework Programme also needs to be adapted to ongoing trends. What is a trend in this context? A trend is long-range and persistent; it effects many societal groups, grows slowly and is profound. In the Framework environment, trends are a sketch of what is happening in the present and clues to what might influence the future. Not to be confused with fads which are in contrast, a fad is short-term, 'in', effects particular societal groups, spread quickly and are superficial.

In addition, it is often talked about megatrends. A megatrend extends over many generations, and in cases of weather, megatrends can cover periods prior to human existence. They describe complex interactions with many factors and they often represent ways of human existence such as in hunting and gathering, agriculture, and industrial societies. The choice of trends for analysis is naturally influenced by the author's values. Often trends are explored and structured according to the driving fields Technology, Economy, Environment, Politics/Policy, Social and Ethical (called STEEP, STEEPV or TEEPSE).

Wild cards: Here you find signs of new trends from the categories social, technical, ecological, economic, political or demographic. Wild cards are potential future events with low likelihood of occurrence (at the point in time they are perceived by most people) but with high impact if they

occur. Decision makers, in an uncertain world, could challenge their conventional thinking and forcing themselves to think 'out of the box'[3].

Weak signals – are 'ambiguous events, often referred to as seeds of change, providing advance intelligence or hints about potentially important futures, including Wild Cards, challenges and opportunities. Weak Signals lie in the eye of the beholder and are generally influenced by the mental frameworks and subjective interpretations of individuals with limited information about emerging trends, developments or issues in a particular time and context. Their weakness is directly proportional to levels of uncertainty about their interpretations, importance and implications in the short-medium-to-long-term. Thus, Weak Signals are unclear observables warning us about the possibility of future game changing events.'[4]

Trend families: Very often, the chosen trends are members of a trend family. A parent trend, for example, collapsing nations, can be related to water availability, war, social and governmental collapse etc.

Geographical trend growth and **'bellwether' geographic sites**: There is also an attempt to follow the global spread of trends. Some places seem to lead development in one or a variety of areas and are looked to as the source of new trends. The Netherlands, in suing its own government may be considered a bellwether country for a peaceful, legal method to assure that government keeps to its agreements and goals when it comes to the environment.

But most topics for a new Framework programme and beyond need to be derived from the unspecific tacit knowledge that is not yet codified and can only be harvested from the heads of people, different persons, not only experts. We observe many new topics more indirectly – not directly from surveys but by asking the right questions, combining the right sources, adding literature and synthesizing in a way that the core/focus is touching upon something relevant.

9. General frame of bottom-up selection of topics

The general frame of bottom-up selection of topics builds up on the framework for a better integration of forward looking and strategy activities developed by EFFLA 2012. The EFFLA framework consists of four key elements of the strategic process:

I. Strategic intelligence

II. Sense-making

III. Selecting priorities

IV. Implementation

Our frame of bottom-up selection of topics elaborates mainly on the first two phases and discusses the role and involvement of different stakeholders because they are rather not involved in III and IV. Naturally, well-functioning bottom-up principles embedded in the first two phases influence also the two latter and more formal phases of the strategic process. Of course, evaluation processes for quality control are also necessary. Whereas the quality control in the bottom-up processes takes place via criteria and at every step, a full evaluation of implementation success can only be performed later, when the process has been finished.

Figure 6 shows the possibility to gain bottom-up input (knowledge, ideas, and proposals for topics) into the next Framework Programme. Maybe the shift towards open input will be more drastic and one has to come up with different ways of deriving issues and topics for it.

In figure 6, there are very different sources for inputs into the selection basis for topics, issues, new challenges, existing trends and signals of all kinds. Threats can also be regarded as a frame but are not a direct input in foresight (as this is about chances). A pre-selection takes place in open but moderated processes (e.g. workshops with clear concepts and involving a variety of people with different backgrounds). In order to let a broad range of persons with different values behind,

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[3] Steinmüller, Karlheinz. 'Thinking Out of the Box. Weak Signals and Wild Cards for European Regions', Futura no 2, 2007: 22-29.

[4] See Hiltunen 2009, citation above, and Hiltunen, E., Weak Signals in Organizational Futures Learning. http://epub.lib.aalto.fi/pdf/diss/a365.pdf, 14.4.2010.

different backgrounds and different opinions take part in the communication; a Delphi survey is intended to receive the opinions of these 'experts' on the pre-selected topics. The definition of 'expert' is broad here (see e.g. Cuhls 2000).

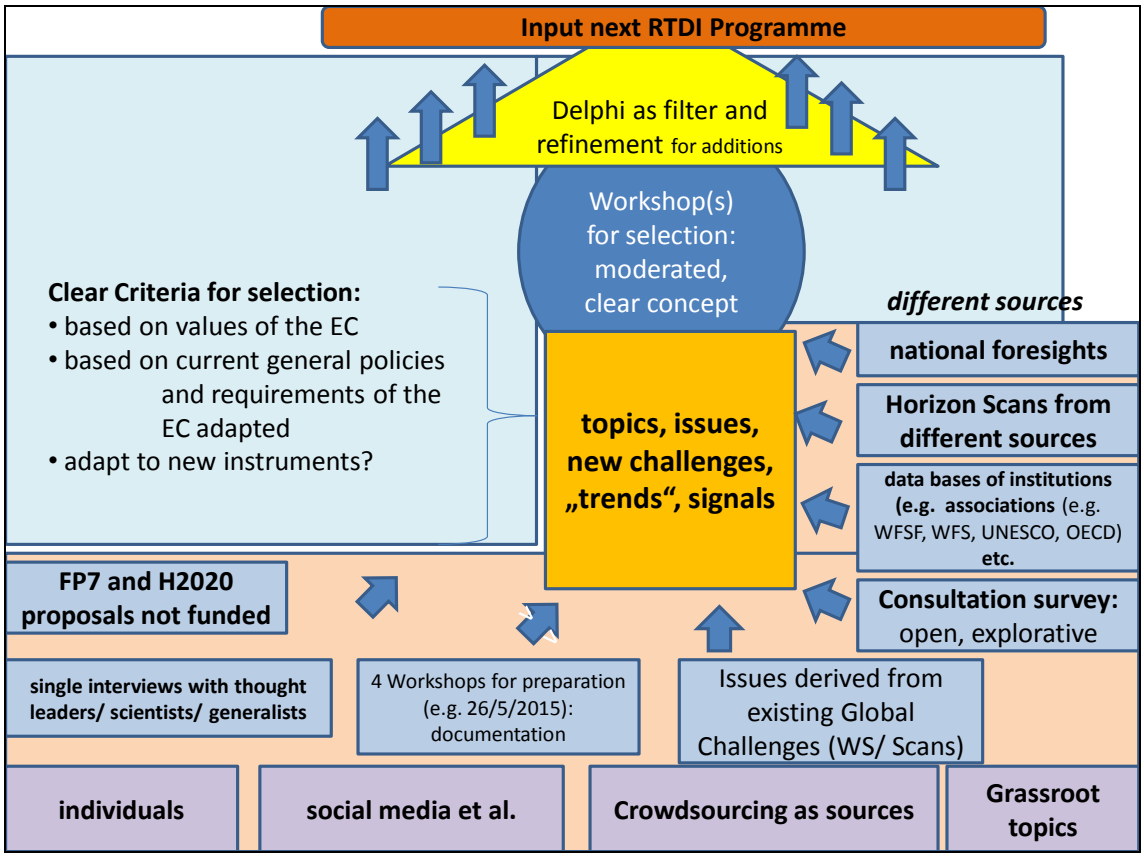

Figure 6: Frame for input process into a new Framework Programme

Although results from a Delphi survey (with classical 'experts' or a broader range of participants) can be examined statistically, the comments, arguments and explanations should be taken into account, too (the survey has to be designed accordingly). The analysis of the results needs to take into consideration the level of expertise. Thus the recipients can reflect the wisdom of the crowds and that of the experts. Not only traditional statistics and rankings should be considered for the selection phase, but especially the extremes and non-mainstream topics should be looked at that might contain interesting insights for selecting topics. In most Delphi surveys, it is looked for consensus or where a consensus can potentially be achieved, or where there are arguments for majorities, but also the minority opinion is worthwhile looking at.

The selection process and sense-making phase after the Delphi analysis gives room for fine-formulation of research questions that should be selected as candidates for integration into a new Framework Programme.

9.1 Scanning and first selection of topics for RTDI

According to the figure 6, above, different sources are used for the scanning and the first selection of issues and topics from bottom-up. Sources can be: Interviews and open discussions, material from grassroots groups, issues deriving from Global challenges that were already addressed but never really worked out, workshops of all kinds (e.g. creative ones, mental time travels), participatory platforms which involve the citizens such as crowdsourcing and social computing as well as databases of events that can be used to generate trends, patterns and activities. (e.g. European FuturICT[5], The Good Judgement Project where results of volunteer forecasting accuracies are measured against actual occurrence of events[6]).

[5] See http://www.futurict.eu/

[6] See http://www.goodjudgmentproject.com/

In addition, other well-known sources exist: Horizon scanning activities of all kinds, national foresight activities, databases and public consultations as well as the workshops that are just performed in the EC could be used. For example: the Global Europe 2050 project which adopted a full bottom-up process and used a highly participatory approach to scenario building that seeks to optimally combine visionary thinking with plausibility[7].

Actors of different social groups can be a source on their own. Just taking their ideas and opinions on board (regardless of a specific methodology) can already induce change and motivate these participants for action. A broad involvement of different stakeholders as well as formal explicit knowledge (internet searches, data bases) is needed here. This so-called Intelligence gathering phase is very open and only pre-selects broadly according to the set of criteria mentioned above (see section 7) and defined by the Commission as a prerequisite for a Framework Programme. The first filter is very open. As an example: also protesting citizens who sue their own government can be integrated, the critics and journalists who report on the phenomena, maybe the historians who have written about similar situations in earlier times, it could be the experts who were there in the challenging situations and experienced it. NGOs play a role in this 'bottom up' approach. Any sources that bring one to individuals most affected can be considered valuable.

9.2 Sense-making

The topics/issues/challenges that were found have to be adapted to the requirements of a European Framework Programme. This can only be done by:

- First selection via criteria
- Open discussions and consultations in workshops
- An open assessment by external experts, here with a Delphi survey (see tender Delphi)
- A selection according to the Delphi results + further discussions with external experts + selection in the EC

9.3 Paradigms – identify and negotiate

During the selection, but especially the sense-making phase one has to be aware of the existing paradigms. Paradigms allow each individual to frame an understanding of current issues, possible consequences and resulting future scenarios and visions (desirable scenarios). Possible, probable, desirable and undesirable future views are also influenced by the paradigms from which individuals gather and apply foresight intelligence and sense-making information. All scenarios have a different basis and different assumptions behind.

Understanding paradigms helps us to make more informed choices on trends and signs of the times. This has to be considered especially when the sense making and adaptation to the needs of a Framework Programme is discussed.

At this point in time we are caught between a weakening, but still dominate paradigm characterized by belief in market economics, individual responsibility, linear thinking and technology as the answer to most problems. The measurement of success in this paradigm is individual power evidenced by monetary accumulation and the monetary worth of possessions. But there are already trends showing us that this perception is losing ground (see e.g. German BMBF Foresight[8] cycle II 2015).

An upcoming different paradigm is characterized by a systemic approach: Some of the measures of success in this paradigm are the health and wellbeing of individuals, plants and animals surrounding them. Individuals within this worldview have a strong relation to nature and see the links between the health of the planet and their own health. The society or governmental entity, put into place by the people have a responsibility to take care of those who are unable to take care of themselves.

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[7] Global Europe 2050 (2012); available at https://ec.europa.eu/research/social-sciences/pdf/global-europe-2050-report_en.pdf

[8] See www.bmbf-foresight.de

10. Conclusion

The current challenges we are facing, namely ongoing, economic, financial and social crises, migration, natural and man-made disasters, are becoming more pressing and interconnected and require more robust, forward-looking solutions, and a mix of bottom up and top down policy and governance responses. In the long term, this entails exploring and introducing paradigm shifts and system disruption.

This requires policy makers to work simultaneously or in parallel on both short term and longer-term time horizons when undertaking foresight to inform policy. In the short-term, there are a number of practical problems which need to be addressed in order to ensure the effective use of bottom-up approaches in foresight and policy-making. These include socio-cultural and other contextual obstacles as well as constraints in terms of content, resources and competencies. The EU Commission can play an important role here in mobilising efforts to improve, on the hand, **practice** by providing the required tools, policy orientation and political championing; and **theory**, on the other, by promoting more research and innovation in this area.

The **longer-term** exercises raise more systemic than instrumental concerns and opportunities. They allow a major rethinking of current policy approaches, to explore a wider spectrum of information sources and scenarios, and the opportunity to bring in more bottom-up inputs and approaches. The longer-term exercises can serve as important feeds into the shorter-term exercises.

The longer-term exercises should allow bottom up approaches to be factored into the four main phases of strategic intelligence, sense making, selecting priorities and implementation. The tools are available for this to happen but often time and resources are constraints. It can also bring in provocations and alternative options for actions and activities in a framework programme when asking 'what if…?' They also provide an opportunity for the shorter-term exercises to be put into perspective, contextualised and to a certain extent evaluated. Especially different search instruments and scenario tools allow gaining insights from different perspectives, assumptions and people.

In addition to the outcomes of the bottom-up approaches resulting in the generation of collective intelligence across diverse disciplines and cultural contexts, also the process of engaging various stakeholders groups and citizens themselves creates an important basis for success of policies responding to current complex challenges. The participatory and co-creative bottom up processes enable creating common vision and goals, and stimulate joint endeavours to achieve these goals. And complexity of current challenges predetermines the need for active involvement of whole societies in addressing these challenges. On top of that, closer links between the societal visions, needs and concerns on one hand, and research and innovation activities on the other strengthen trust of the society in research, which is a prerequisite for sustainable funding of research and innovation activities.

Necessary steps to implement a bottom up approach thus need **providing the tools and resources**, e.g. development of a comprehensive strategic intelligence database; development of a toolkit providing guidelines and case studies of bottom-up approaches (local, regional, national, European), provision of different online and offline (workshop) fora where societal players discuss and debate; or scanning and extracting relevant information as part of sense making, to work out what level of change is desired/expected by society and in the long term.

There is also the necessity for **driving more systemic change**, e.g. rethinking the way grand challenges are being addressed in foresight processes to factor in bottom-up, disruptive approaches; transition policies co-designed by key players including citizens. FP research and innovation projects to allow experimentation, study and coordination/harmonisation of 'disruption' approaches; operative organisation in the system to bring in bottom-up ideas, developments, opinions and transforming them into policy language or mainstreaming bottom-up approaches through changes in the selection of FP projects.

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Background Paper 7

Workshop report 'Rapid Response Mechanism'

1. Background and purpose of the workshop

The overall objective of the workshop was to support the development of an effective 'rapid response' mechanism for the EC. More specifically, this workshop aimed at **the co-development of a 'rapid response' mechanism (RRM)** for strategic programming of research and in support of the next Framework Programme with experts (SFRI) and EC officials.

The workshop format was based on the work of two breakout groups that separately dealt with a set of questions that were aimed at facilitating a discussion for conceiving and optimising a RRM. Two topics were chosen as working themes for the breakout groups: **'Future of automotive systems / testing automobiles'** and **'The future of the food processing industry'**.

In relation to the chosen topic the breakout groups were asked to address the following questions: Is the rapid response needed and is it useful? What topics require a rapid response mechanism? How did this topic come up? What are the knowledge needs? What kind of RRM steps is needed? Are the topics on different time perspective or processes? What does rapid mean, 10 to 30 days?

To these ends, the workshop aimed at addressing three key questions:

1. The request formulation: How should a request from the EC look like? (context, added value of experts, terminology, prioritizing, iterative feedback);

2. The architecture: How can the expert group develop an answer? (collecting inputs, output format, setting up a specific network, collective intelligence methods);

3. The Impacts: the impacts of the mechanism and its results within the EC.

The breakout groups were asked focused specifically on the first two questions. The last question was tackled in plenary after the end of the breakout sessions.

2. Discussion

Group 1: 'The future of the food processing industry'

1. ***Request formulation***

The discussion started on the basis of a jointly decided topic: 'The future of the food processing industry'. This topic was raised due to a statement that was published by the WHO in mid-October 2015. It raised an extensive debate among different stakeholders such as the health interest groups, food industries etc., on one hand, and a lot of concern among the public on the other hand. The discussion was started by asking: is this issue a topic for Rapid Response (RR)? And how it could be defined as a question?

The opinion was that this topic could be a question for RR for two reasons. As the WHO statement relates to a wider theme (food importance and health protection), it requires better understanding of its consequences from different angles. In addition, it could be relevant in the policy context of the COP 21 conference in Paris. Thus, both the proximity of the Paris event and the important implications of the topic called for a rapid response.

The discussion started from the specific topic of eating red meat in general and processed meat more specifically, and extended to a more general question on the importance of health food ingredients. For years there has been a debate related to the sustainability of food: although a lot is known, it is difficult to change habits and opinions among the public regarding food consumption. Moreover, there is a consensus that sustainable food relates to other R&D areas than meat, such

as 'the protein system approach' which may deal with water provision, insects, legal issues, regulatory frameworks... Therefore, there is a need to have a more holistic approach that links health, environment and food.

Process-wise, the following elements were mentioned:

- ✓ ***It is important to identify <u>who</u> is raising the question and <u>what</u> we want to influence and <u>why</u>,*** *before going more in depth into the topic.*

- ✓ ***Knowledge about the decision-making process*** *is important.*

- ✓ ***The added value of a RRM should be defined****.*

- ✓ ***The request could be raised both ways: 'top-down'****, with the EC formulating a request to experts,* ***or*** *'**bottom-up',*** *with experts proposing to the EC a rapid-response topic to address.*

2. *Architecture*

In order to have a broader view and a more holistic picture about the question, it is recommended to involve a variety of experts from different fields, which are relevant to the specific question. Access to a broader network of experts would be of great value. For example, in the case of the proposed topic, information could be retrieved from experts in the field of health, environment, agriculture, economy, or technology. It was also suggested that the experts represent different sectors: academia, industry, government, NGOs, the public.

In a related way, it was suggested to use the experience of the variety of advisory groups (AG) who are involved in EC foresight activities. As Advisory Groups are often related to the DG foresight correspondents, they may take over a role of forwarding and receiving opinions. This would be useful as it was mentioned that a link to strategic programming and agenda-setting would be important.

The discussion also focused on **the type of knowledge required** for the RR request and answer, and **what is the added value of foresight in this context**. The type of knowledge required includes: policy and regulations; scientific knowledge relevant to the topic; technological data; societal aspects; knowledge about societal values Knowledge in foresight methodologies would be valuable as well, such as scenarios, horizon scanning, short term and longer terms trends, weak signals.

Another important issue was raised which relate to **the need of validation of the data** and **how to motivate the experts to be involved** and contribute through the networks.

Conclusions about the process:

- ✓ ***Having access to a wide network with diverse fields of expertise is important.***

- ✓ ***The required RRM architecture should integrate the top-down and bottom-up mechanism.***

- ✓ ***The RRM needs to be connected to the different foresight activities as well as to other relevant networks and activities in the EC.***

- ✓ ***The added value of foresight in a RR context should be clearly defined.***

- ✓ ***Quality review and expert motivation should be addressed.***

Group 2: 'Future of automotive systems/testing automobiles'

1. Request formulation

The topic was proposed in the wake of the Volkswagen scandal and 'Dieselgate' backlash.

The discussion started by defining the scope of the topic, moving from the broader topic 'The future of the automotive industry' – or even: 'The future of mobility'– to more focused themes, including decarbonisation and alternative technological solutions (to the internal combustion engine). The topic finally chosen as the focus for further reflection that could be addressed through RRM was *testing of automobiles*, in terms of equipment and other technological elements of testing, as well as regulations and the organisational structures concerning testing.

At a broader scope, two STI policy scenarios were considered. Scenario 1: continue to invest in developing and producing the current internal combustion engines. Scenario 2: stop investing in developing and producing the current internal combustion engines and invest instead in alternative technical solutions including electric and hybrid engines.

The consequences of opting for the second scenario include an element of ensuing disruption while existing systems and processes are displaced or reconfigured. The introduction of a number of changes at different levels will need to be based on informed opinion and robust data and intelligence on technological, economic, political and social feasibility. Investment in alternative solutions will entail a significant cost in terms of public investment in new infrastructure, resources and skills. There are also risks and mitigation concerns. The motivation for this paradigm shift needs to be clear. There are issues relating to the broader vision for the future of the industry and how the normative aspects are addressed.

Conclusions about the process:

- ✓ ***There is a need to clarify the level of ambition on the part of the RR proposers in order to take advantage of windows of opportunity****. At the same time, the RR formulation needs to ensure that the request is formulated by keeping in mind what is actually feasible to provide within the set timeframe and resources available.*

- ✓ *The narrowing down of the topic to testing of automotive systems highlights the need to focus on **initially resolving a specific issue/ problem rather than tackling a larger, more complex challenge** with political, economic and social constraints. This may provide an insight into how RRM questions can be co-reformulated by the proposers and the experts, to make them manageable and to **ensure expectations management.***

2. Architecture

The type of architecture required for addressing the testing issue is possibly ***a task force*** **which may coordinate a range of experts with different profiles** to ensure a holistic approach, including regulatory, technical expertise and including representation of key organisations (e.g. businesses, policy-making bodies, NGOs). Depending on the topic, this will determine the level and type of involvement of civil society needed for the user/consumer perspective and for validation purposes.

The discussion focused on what is selected as **relevant knowledge**, how to locate this knowledge and how to use it. Another key aspect is how to ensure **quality control** of the content (data inputs and outputs) and process.

- ✓ *RRM does not operate in a vacuum and needs to take account of on-going foresight or anticipatory intelligence exercises completed recently, or are on-going or planned.*

3. Targeted outcomes and impacts

How should we use the results?

Discussions focused on three main topics:

- The **target group** – who is asking the question and who is receiving and using the answer?

The target group is the most important factor in the RRM. It defines the specification of the question as well as the type of knowledge which is required. Therefore it was suggested to reverse the order of the three questions and place this question first.

- The **layout** of the answer

  The results can be displayed in several ways depending on the target audience. For example, the high-level decision-makers will be satisfied with a half-page summary and possibly a graphical presentation of the results, while others might want to get a more detailed report including extensive and deeper analysis.

- The **timescale** for the answer

  The timescale dictates a lot of the quality and information. There is a need to connect timescale and content level. 10-14 days for an answer could be envisaged to give an overview or precise topics (half page), more time might be needed for more complex issues. The timescale could be flexible, depending on the needs of the target group and the urgency of the issue.

  In the other breakout group, the issue of urgency was approached in a different way: why and how can a topic become urgent and require a Rapid Response? Different scenarios were considered: current crisis, pending crisis, weak signals. A current crisis is likely to impose a shorter response time, however it is important to structure the rapid response to deliver advice in phases, starting initially with an overview of what can be delivered realistically and assuring a level of quality control.

  Depending on the complexity and breadth (scope) of the challenge, 10 days may not be enough. **Different types of Rapid Response requests require different types of responses with a different timing.** Some may be needed as an input for PR, others to inform the design of new legislation or funding programmes. **There is a need to clarify the request so that the response provided is used for a relevant (adequate) purpose.**

As a general consideration, it was also mentioned that importance should be given to the broader consequences and repercussions of the advice given, as it can entail significant policy impacts.

4. Key messages

- There is **a need for RRM** that provides quick answers to various issues. Such a mechanism can be effective to decision-makers.

- RRM mechanism should be dynamic and flexible and adjust itself to the target audience and the type of question. It is a **rapid and agile** mechanism mainly motivated by political triggers.

- The first question in a RRM should be about the **Targeted Outcomes and Impacts.** This will define all the other aspects, such as type of information, time scale,level of information etc.

- There is a need to **clarify the added value of foresight in the RRM context** and its difference to science. In this context the **impact and benefit of the RRM** need to be better formulated and clarified.

- The **data flow of the RRM can be top-down and bottom-up,** connecting many expert groups and other people who can provide information. Motivating the experts is a key aspect of an effective network and of success in data collection.

- The **timescales of RRM could be flexible** and flow from 10-14 days in the short scale to a longer scale of a few months.

- **Validation and quality control** of the data need to be formulated in the RRM to ensure sound advice for the EC.

- **Pilot** – It is important to test the RRM with a real question. The benefits could be in two directions: first, to validate the RRM as a process; second, to raise awareness for the need of RRM as a tool for decision-makers.

- **RRM Sustainability** – it is important to take into consideration the sustainability of the RRM after the SFRI mandate: How will this mechanism continue to be operated and by whom? Budget considerations should also be part of it.

5. Next steps

The results and conclusions of this successful workshop will be integrated in the final report of the SFRI (Autumn 2016). Meanwhile the key messages from the workshop will constitute the main building blocks for the further development and testing of the RRM and as such they will be presented and discussed at the plenary meeting of the SFRI on 22 December 2015. The communication with the EC officials will continue in view of possible new topics for pilot testing of the RRM.

Background Paper 8

Workshop report 'Democracy 2.0 - Foresight for better R&I policy'

1. Introduction

The workshop was an interactive mutual learning training session organized by the Commission's expert group on 'Strategic Foresight for R&I in Horizon 2020' (SFRI) and Unit RTD.A6 with the participation of additional external experts in the areas of participatory approaches in policy development, trend analysis, and citizens' empowerment at local level.

Date and place

Wednesday, 8 June 2016, 9:00-15:30, in Brussels (ORBN building, Square Frère-Orban 8, room 5/66, 5th floor)

Objective of the workshop

To illustrate foresight processes and tools for programming and policy design in the context of 'Democracy 2.0'.

Workshop participants were invited to:

- explore possible futures for future changes towards a Democracy 2.0 in the next 5-10 years and the implications for EU R&I policy and programming;
- discuss the role of foresight, its inspiration and tools in policy design and programming drawing on good practice from different contexts;
- identify different opportunities/ possibilities of applying bottom-up foresight approaches in the preparation of a EU Framework Programme (current and next) and their implications - both in terms of the process for identifying priorities, and for embedding the concept and approach in the content itself.

At the end of the workshop participants should have a better understanding of bottom-up foresight tools and their combinations, and how to conceptualize and use foresight in deliberative policy contexts.

The workshop[1]:

Democracy 2.0 refers to transformations of political systems that involve much more deliberative policy-making and public participation in governance. These elements are becoming increasingly important for R&I policy.

The scope of democracy has become more extensive and inclusive in recent years powered by the enabling and widespread force of ICTs (internet, ambient intelligence and smart devices). Democracy 2.0 thrives in the new enabling environment for stakeholders, allowing them to engage more proactively in shaping, implementing and reshaping policies, which affect their well-being and daily life. This shift in whole cycle engagement in policy shaping, implementation and review by a wide range of stakeholders is happening in real time but currently captures a fraction of the stakeholders in parts of the process. There are different perspectives on what Democracy 2.0 is or should constitute and these have implications for how prominently such a concept will/should feature in public policy design and programming processes. The current understanding of Democracy is in flux and some see a 'Democracy 2.0' emerging.

In the current highly dynamic policy environment where crises fester and emerge with sudden impact, anticipating changes to the policy environment itself becomes an important issue.

[1] The concept of the workshop is based on the background paper '*A frame for selecting bottom-up topics*' that was developed by the SFRI expert group.

Exploring different possibilities of applying foresight more broadly in a 'Democracy 2.0' will help develop anticipation of changes in the policy environment.

Effective policy design and programming needs to keep up with societal trends, which include unease, misunderstanding, tension, discord, disruption, as well as satisfaction with policy decisions and programmes, which work. Often such trends emerge as signals in communities that are not organized and represented as stakeholders in established policy processes. When developing R&I policy it is not only important to listen to the usual lobbies, scientists or policy-makers, but also to demand forward-looking perspectives and inputs from those citizens who are the addressees for later applications (technologies or products or processes). Both, the actors and the sources in foresight need to be broader and taken up bottom-up (instead of asking ready-made questions top-down) at a pre-competitive stage. An important part of the workshop is about identifying non-represented groups and the question of how to engage them through foresight.

Finally, it is important to develop concepts and tools to strengthen the conditions for effective translation of emerging issues and needs perceived by those affected by policy changes, into policy. The workshop was based on the assumption of a 'Democracy 2.0' to explore such translation concepts and tools.

In particular, the workshop consisted of the following elements:

1. Exploring personal definitions of 'Democracy 2.0' – results from a short 'survey'

2. Short case studies and stories of external experts: four examples of practices and experiences in Democracy 2.0 – how to bring new stakeholders into policy processes and planning?

3. Group work: work out concept/tools for a bottom-up approach for policy design or programming.

The working groups were assigned the following tasks:

- Who are the groups in any community or country that appear to be suffering in the current system?
- Who are the groups that are actively protesting some part(s) of the current system?
- Which projects and programs are designed to move people from victim status to self-help status?
- Who might be the change agents (who may be using everything from violence to peace as strategies)? If any group has gone to violence, it means that foresight was passed over and the problems were ignored; and the major task was
- How to design a concept for a process flow how to integrate these different actors from bottom-up. Describe the 'tools' used.

4. Summary and discussion of the ideas of the day

Programme

9:00	Welcome by the European Commission
9:10	Introduction: objectives, rationale and workflow
9:30	Personal definitions of "Democracy 2.0" – results from a short "survey"
9:45	Short case studies and stories five examples of practices and experiences in Democracy 2.0 - key success factors and barriers
11:00	Coffee break
11:15	Opening-up the discussion: values and attitudes towards Democracy
11:30	Group work: work out a concept/tools for a bottom-up approach for policy design or programming
12:30	Lunch break

13:30	Prepare presentation in groups
14:00	Ideas of the day
15:00	Discussion + flashback
15:30	End of the meeting

Invited external experts

Ms Joke Quintens (City of Genk, Genk)	- long standing career in facilitating group processes and now is active in local politics - long-term experience in bottom-up processes - soon to become responsible for city and community development in Marseille
Mr Robin Bourgeois (GFAR, Rome)	- futurist and member of World Futures Studies Federation working group on empowering local farming communities and farmers organisations through foresight

2. Results from a survey on Democracy 2.0 conducted among participants

Prior to the workshop, a limited survey among the participants of the workshop and members of SFRI was undertaken. The major aim of the survey was to find out about different understandings of Democracy 2.0. The questions asked were:

1. What is your understanding and perception of democracy 2.0 and its significance for governance and policy processes in current policy systems in the next 10-20 years?

2. What are the main drivers which could impact on the enhanced emergence and embedding of democracy 2.0 in policy processes?

3. In which areas of policy and at what level (international, European, national, regional and local) is this most likely?

4. What roles could democracy 2.0 play in policy co-design in research and innovation now and in future? To what extent can these be implemented at European level?

5. Which concepts, approaches and tools are relevant and could prove effective in exploring the role of democracy 2.0 in developing community-driven policies to address societal challenges? Cite examples if possible.

Although only eight people participated, the qualitative analysis produced interesting insights as starting points for the discussion:

1. Even though there is no single definition or understanding of 'Democracy 2.0' participants link the term 'Democracy 2.0' mostly to the following characteristics: Involvement of citizens and their communities in policy-making processes, social networking, dissolution of existing institutions, co-creating of policies, transparency and interconnection via internet.

2. The following main factors were identified as driving the integration of Democracy 2.0 in policy processes: Technology, disillusion with or even mistrust to existing institutional structures, crises, sense of urgency, bottom-up initiatives, growing importance of opinions in public debate compared to knowledge.

3. Democracy 2.0 has potential for being embedded in policy-making in almost all policy areas. The most appropriate level for integrating Democracy 2.0 in policy processes is the local and regional one. At higher levels (national or supranational) there is the challenge of how to bring 'big' institutions' policies closer to citizens.

4. In R&I, participatory processes may play a more important role in co-creating research agendas.

5. Several concepts and tools have been already developed for more intensive engagement of citizens in policy-making (e.g. CIVISTI project, 3D-FLUX, D-CENT) and there are also running projects aimed at testing new concepts and tools (e.g. CIMULACT). It is also important to give space to local actors and community representatives to develop own appropriate concepts, methods and tools.

3. Contributions from external experts

Joke Quintens:

The following lessons can be drawn from the experiences of citizens' participation in local policies at the city level (small city of Genk – 65k inhabitants):

- Activate collective knowledge by involving the citizens in policy co-creation

- Work on skills (both civil servants and citizens) rather than tools – people are at the centre of the process

- Set the methods and tools in the context

- Experiment – JUST DO IT!

Robin Bourgeois:

Based on the experiences from grass root foresight initiatives that help involve farmers (farmer organisations) in co-creating common future visions of agriculture in specific rural areas in Asia and Africa) the following lessons have been highlighted:

- After giving the right impetus to local farmer organisations, they took over the initiative to organise foresight exercises on the future of agriculture in their localities.

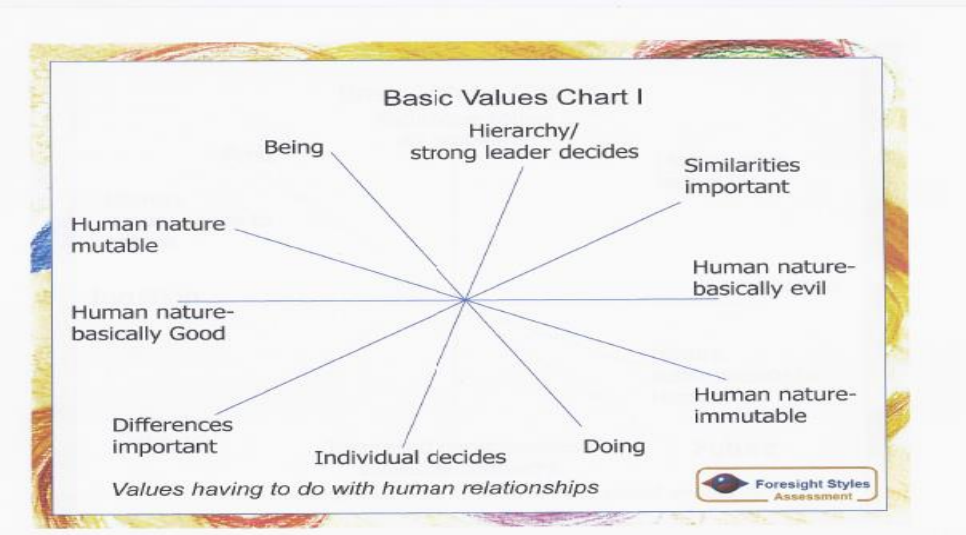
- There were positive experiences with engaging research institutes to do foresight for agenda setting that reflects the needs of local people.

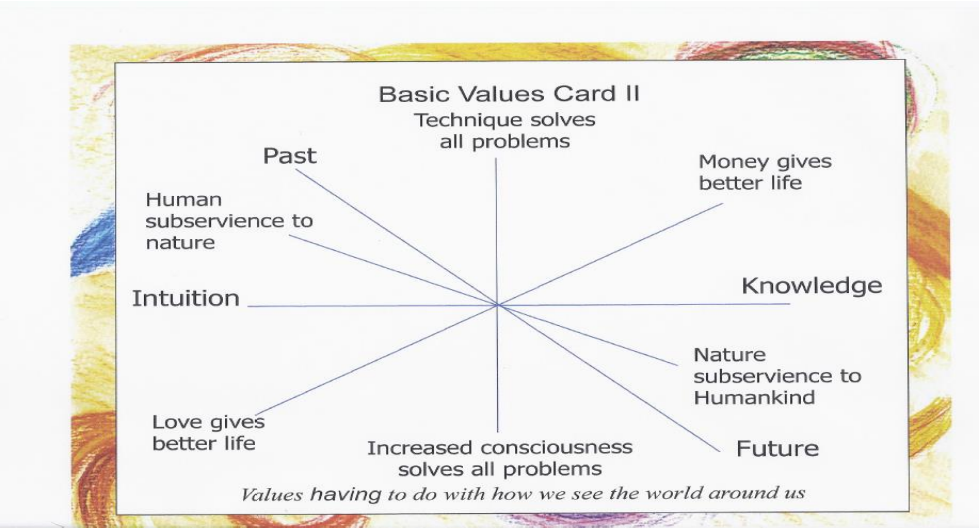
- The experiences have proven that face to face interactions are more valuable than hundreds of virtual surveys.

4. Intermezzo on values

The understanding of Democracy 2.0 and its practical 'application' are very much based on individual values. This session was intended to clarify for every individual person in the room that and how the individual values differ. This is important, because generally, we tend to involve citizens groups in Foresight or other processes that share similar values with ours, which leads to omitting minorities and other groups of citizens with different values. To be able to involve right citizens' communities it is necessary to look outside our value boundaries.

The participants were asked to estimate their own values on the following images:





5. Breakout sessions

Three breakout groups were tasked to develop a concept of bottom up foresight for the EC, identify relevant actors and introduce tools, policies, programmes, skills etc. that can help embed the bottom-up approach in future oriented thinking in EC policies (mainly in R&I policy). In the plenary session, they reported back:

Group 1 (moderated by Robby Berloznik)

This group discussed the question how to promote bottom-up citizens' participation. They found that the process of H2020 programming is too complex and complicated for citizens' participation.

It is very difficult to promote citizen participation due to limitations in how the Horizon 2020 programme is structured. The Programme is very distributed with PPPs etc. and there is a very complicated process to design the work programme and difficult to find entry points. Having citizen opinion on a pre-designed programme is not sufficient. One solution is participatory budgeting, which is happening in some cities. Cities could be encouraged to join in collaborative initiatives and to launch their own programme.

The EC could also provide support and skills to citizens for formulating their needs. Evaluation and selection of these topics could be done through citizen juries. This would work as an evolutionary process and would be hard at the beginning with learning curve to improve links between citizen and researchers. This would alleviate the decision making procedure and this would require just one big decision.

This could lead to a leverage effect on less advanced regions. There is a need to ensure that whole community can be part of this. It is important that no community can monopolize it. The funding could go to existing communities or go for a more formal democratic method, mini republics for

random groups. The initiators could be mayors. It is important to be careful and not to put money first.

However, an inspiration can be drawn from the participatory budgeting. In line with these principles, citizens can be invited to co-design part of the work programmes within the framework programmes. Citizens can be involved not only in suggesting topics but also in selecting the priority topics that should be addressed by R&I. Citizens' engagement will be an evolutionary process. The aim is randomness since completeness is not possible – it is a proxy for representation (the Participation paradox).

The Group thus proposed the launch of a citizen research initiative in FP9. Citizens themselves would design the WP. Any group of citizens could submit their needs for research and this would result in a citizen designed work programme.

Group 2 (moderated by Tal Soffer)

The concept developed by this group is based on the idea of 'Top-down approach for bottom-up solutions' and local solutions. That means that policy makers and politicians create a framework that empower citizens and utilizes space in between government (top-down) policies and citizens initiatives (bottom-up). To be successful it is crucial to build trust between politicians, policy makers and citizens. In order to build trust it is important to focus on communication, outreach and implementation that takes into account the voice of society. When talking about tools for empowering citizens, the focus should be put on education and skills of both policy makers as well as citizens. There have been successful experiences with living labs. There already exist actors that can facilitate the participatory decision making process like community organisations and centres, influencers (schools etc.) and other 'neighbourhoods' organisations'.

The discussion focussed on context, scale and the space in between. There is a need for empowerment and a system for mediation and trust is needed as well as transparency. In some context top-down, decisions are required for bottom–up results. The challenge is how to get different groups to work together? This requires communication and coordination, by finding the relevant points of contact across Europe such as: neighbourhood managers, influencers (opinion leaders) and field workers. That could be done through networking and fieldwork.

From a policy point of view, implementation is important to build trust and motivation among citizens. Citizens need to see that their participation is having an effect. The steps include a mapping of skills and tools, where the focus of skills are social skills (based on the fact that future generations will be familiar with ICT skills) and being more active citizens, and mapping of spaces living labs. Ownership and institutional culture is important. Education and engagement are essential for engaging citizens in an effective way as well as the development of the right policies and right design to make this work. Other issues that were raised related to the need for evaluation, judgment and selection mechanism of ideas, and issues that will be raised by the citizens.

Group 3 (moderated by Natalie Dian)

This group stated that the participatory approach and process is not suitable for all EC policies and selection of most suitable policies is needed. While looking for the most relevant actors in the participatory process, it is important to take into account citizens groups that might seem not relevant at present but that might be affected by specific policies in the future. In order to obtain lay opinion, a mining of media is an option. The group highlighted the fact that increasing skills is an important assumption for involving all relevant citizens' opinions and citizens groups.

The proposal is to set up a systematic framework for emergent risks for the environment. Lay knowledge is needed and not just expert judgement. Do they bring valued added for all fields? Actors in such a system include those providing expert judgement and representation of citizens. How to involve actors, which are not relevant today but important in the future beyond? How to go beyond the obvious players?

The process involves a mapping of the actors and the different strategies from different actors and the multipliers to act at the intermediate level. Media monitoring tool - paper vs online media. Do we get a better perception of citizens through this tool? Who are the citizens or only those who have an opinion?

There is a need to narrow down and focus on horizontal risks and systemic risks. There is a possibility to look at new technologies in a more specific focus and the opportunities arising from finding solutions to risks. In terms of top down and bottom up, which citizens should we be

listening to? There is a need to have broader representation of views to cover everything. Who is citizen 2.0?

6. Flashback on the question: is it worthwhile working on bottom-up foresight for Democracy 2.0?

The following flashback results demonstrate the different opinions at the end of the discussion, they are 'originals'. Some questions remain:

- Survival of EU democracy crisis. Generation identity declaration of war against a pluricultural society
- What can research and innovation contribute to this governance innovation? Technocracy vs market Democracy 2 is an attack on technocracy rather than the market
- There is a need for a process of translation. Are we just accepting trends and fighting them or are we focusing on disruptions and changing reality? Values are the biggest game changer. Skills. Transparency of processes, inputs into decisions and funding…
- Opportunities to use Democracy 2.0 we need to be careful to identify those areas – which areas?
- There is a contest of ideas. Pragmatic solutions could be found
- Prototyping in the field
- Citizens provide knowledge creativity
- Who are the citizens? – This is a highly political question.
- Make a difference between consumers and citizens
- Taxpayers vs non tax payers
- Stockholders stakeholders
- New citizen spaces for action, new types of partnership between emerging new types of actors
- Astro turfing[2] and vested interests in, for example, setting up a coalition of patient rights.
- Bottom-up citizen-driven instrument science 2.0 public private societal
- Widen the expertise and involve the democratic sector
- Possible to bridge the gap but don't know if institutions are ready for it or if we have the skills and outreach
- Very positive as there has been evolution
- Institutions have to follow as citizens won't disappear
- E-participation
- Problem of scale 500 m would be a challenge and involving all the layers researchers have hijacked 26 % through ERC
- A lot of political will is needed to put citizens back in the processes

[2] Astroturfing is the practice of masking the sponsors of a message or organization (e.g., political, advertising, religious or public relations) to make it appear as though it originates from and is supported by a grassroots participant(s). It is a practice intended to give the statements or organizations credibility by withholding information about the source's financial connection.

- Aims, techniques and success criteria ... Improve services, opening more windows and doors, ill-advised to throw open all the doors, delivery for citizens and value for money
- Not an issue of feasibility but our level of commitment to adventure
- Research agenda, action agenda
- Not top down approach to promote bottom up - need first the bottom up
- Organisations becoming obsolete but never die
- One reality one job
- Learning by doing
- From 'management by crisis' to 'management by foresight'

7. Some final recommendations for the EC

- Provide space to citizens' initiatives to develop and to engage in policy-making
- Use existing community organisations to get closer to citizens
- Work on skills rather than tools - tools have to be selected according to the needs, the objectives and the idea
- Focus on building trust between policy makers and citizens
- Citizen-centred foresight that will inform the R&I policy is an adventure but it is worth trying!

Annex

Some reflections according to activity levels and goals.

Activity Level	Goals DEMOCRACY	Goals DD MIGRATION	Goals ENVIRONMENT
EU	Democracy 2.0 Transparency Funding for projects	Respecting differences Cultivating similarities Identifying and supporting successful Cutting bureaucracy time	Statistical monitoring Announce when things improve or worsen
Country	Democracy 2.0 Activist Activity Transparency Environmental Legis. Health projects Education Gender equality Local producers gr. Local marketing gr. Festivals	Balance between pres. and future economies Awards and projects to get attention Clarify benefits of immigration for future	Stricter legal support of environ. laws. Testing clinics for pollution and chemical dumping Cleaning up projects Environmental health info Support prod. of energy saving devices.
Region	Cultural Activities Innovation in positive Policing Transportation	Health programs for newly arrived Housing proj. Family participation in housing dev. Health and energy improvement proj.	Citizen clean lakes and waterways, volunteers Support clean production and purchasing Maintain reserves, parks and animal diversity
City	Areas of cities Small towns Rural Areas	Religious leaders group Religious/parental connections strong Information and festival sharing among cultural groups	Green cities Use of sustainable project ideas Increased sustenance of city
Local Areas of a city, small towns, Rural Areas	Transition Towns Local initiatives Sustainable projects	Encouraging similarities Accepting differences Cultural sharing Adopt a family proj.	Green local areas Clean streets Have book swap stations Support sustainable cities project ideas Encourage Swap meets Encourage reuse and items exchanges

Background Paper 9

Industry 4.0: The new production paradigm and its implications for EU policy

Author: Kristel Van der Elst

1. Executive summary

In recent years, there have been signs that manufacturing is entering a new era, sometimes referred to as 'industry 4.0', in which the widespread adoption of ICT is blurring the lines between the human, machine and virtual worlds. This will have a significant impact on the way goods are manufactured, companies do business, economies operate, societies react and markets function, and that gives rise to a host of opportunities and risks.

If industry 4.0 becomes a mainstream, industry-wide reality, it will bring changes to the production system and more broadly to the production ecosystem. It will influence who produces, and how, where and when that production occurs.

Industry 4.0 is expected to be a source of significant economic growth in the future, for three main reasons: increased demand for enhanced equipment and new data applications; consumer demand for a wider variety of increasingly customised products; and the likelihood that production now done in low-cost labour countries will be repatriated closer to the point of consumption.

However, these forecasts are tabled on a number of critical assumptions. For industry 4.0 to become a mainstream, industry-wide reality the following elements need to be in place:

- The underlying **technologies need to be sufficiently mature** for real-world applicability and adaption, they need to be **economically viable and socially acceptable**

- Public and private organisations need to dispose of sufficient levels of resources, both financial and organisational, to secure the **investment** required in new technology, R&D activities, infrastructure and education

- Sufficient **skilled, educated workers** are needed to design, operate and manage production systems including software development and data analytics

- Businesses across manufacturing and high-tech value chains need to be able to access **reliable digital communication systems** and network infrastructure

- **Standards** need to exist and be enforced to ensure that the exchange of data between machines and systems can take place across national borders and platforms

- Ownership and access to **consumer and industrial data** needs to be regulated

- **Intellectual property** needs to be protectable across national borders, especially with respect to trade and commerce

Many proponents of industry 4.0 also assume that the **system-wide replacement of workers by autonomous robots** is inevitable, although this is contestable.

For industry 4.0 to be a driver in Europe's aim to achieve smart, sustainable and inclusive economic growth, the European institutions have to show foresight by reflecting on what might happen and what is needed to accompany this transformation towards a future which is desired and beneficial for European society.

The research agenda of the European Union's Framework Programme should include the following reflections, structured around priority policy areas.

Enabling the opportunity	Managing the challenges
Competitive markets **How can policy foster a competitive environment for businesses looking to leverage the large economic growth opportunity that industry 4.0 represents?**	Inclusive economic growth How do we ensure there is the right level of investment in education and (re-)training in the skills required for industry 4.0 to insure there is equality of opportunity for citizens to participate in the industry 4.0 economy? Where might the European social contract fail, and which pieces are to be safeguarded?
Free Trade **What changes to the trade framework are needed to accommodate trade in industry 4.0 products and services?**	Country level competition – single market What fiscal and social security policy needs to be developed at EU level to avoid inter-nation competition/protectionism?
Standards **Which international standard communication protocols, data formats and interfaces are required to guarantee a competitive industry and internal market, as well as inclusion in the global industry 4.0 economy?**	Digital divide between countries What is needed to encourage the deployment of the minimal level of digital infrastructure across Europe to provide a level playing field and inclusion of all European nations?
Data privacy, ownership, access and usage **What rules on data privacy, ownership, access and usage need to be defined to stimulate industry 4.0 growth and trust among actors?**	Critical / strategic infrastructure What is needed to safeguard the industry 4.0 infrastructure from attacks and who is responsible?
Intellectual property protection **Are current intellectual property protection frameworks suited for the new types of products and services that might emerge? Are all actors that will contribute appropriately and efficiently protected?**	
Sustainability **What policies are needed to capitalise on industry 4.0 to develop a more sustainable and circular economy?**	

The purpose of this paper is to highlight potential emerging challenges related to industry 4.0 that are relevant for economic and social policy. The document is a contribution to Horizon 2020, the EU Research and Innovation programme.

The document is not intended to be a fully comprehensive study on all plausible future evolutions of industry 4.0 and its implications for all actors. It aims to provide an accessible overview of what manufacturing might look like in the future and the implications this may have for policy making.

The author would like to thank the members of the European Commission Expert Group 'Strategic Foresight for R&I Policy in Horizon 2020' (SFRI) for their valuable contributions.

2. What is industry 4.0?

In recent years, there have been signs that manufacturing is entering a new era. A technology revolution – faster, more widespread and with greater impact than before – has the potential to transform production systems globally. Specifically, the **widespread adoption of ICT in**

manufacturing is blurring the lines between human, machine and virtual worlds. The digitisation and networking of existing manufacturing processes, both human and machine, is enabling a host of opportunities and risks in a new production paradigm.

This new production paradigm goes by many names, such as the fourth industrial revolution and industry 4.0. However, we choose to name it, it is clear that the application of current and future technology to production systems, and thus the manufacturing industry, will have a **significant impact on the way goods are manufactured, companies do business, economies operate, societies react and markets function.**

Driving this revolution is the **exponential growth of a number of technologies** that may not be new – many were invented over 20 years ago – but are becoming more widely applicable thanks to an increase in computing power and reduction in cost. For example, robotics has existed in one form or another for decades but only in recent years have robots become powerful, small and cheap enough to be used effectively in real world situations, which require them to work independently, make decisions and learn. Many believe that what we are witnessing at present is only the start of a vast technology revolution, as many technologies are only just entering an exponential rate of growth in their development.

Ten technologies that are driving Industry 4.0

Artificial intelligence and collaborative robotics: Autonomous robots will be able to perform more complex tasks, make sense of complex data, make decisions and interact with one another, as well as with humans, in the factory.

Additive manufacturing: Better known as 3D printing, additive manufacturing creates objects by adding rather than subtracting layers. This method will be widely used to produce customized products with complex and lightweight designs.

Nanotechnology: Nanotechnology creates physical objects by manipulating individual atoms and molecules. It will profoundly change how products are manufactured, particularly in the fields of metals, engineering and electronics.

Biotechnology: Biological processes will increasingly be used for industrial purposes, with examples including engineered leather and sustainably produced fuel and chemicals.

Cloud computing: Deploying machine data to a network of remote servers hosted on the Internet, and sharing it across sites and company boundaries, will continue to enhance productivity and supply chain management.

Sensor technology: Sensors connected to technology networks will be integrated into machines and products to collect a vast amount of data. These data streams will allow companies to prevent faults, monitor their supply chains and to provide new services to customers.

Big data analytics: The collection and analysis of large data sets from machines, production systems, suppliers, products and customers will support real-time decision-making, improve understanding of customer preferences and make supply chain management more efficient.

Simulation: By using real-time data to create a virtual model mirroring the physical factory, simulations will enable the optimisation of plant operations and machine settings before physical production.

Augmented reality: Augmented reality technology will provide real-time information to manufacturing workers that can be visualised (e.g. repair instructions). This will improve decision-making and work procedures in the factory.

Network and communication technology (industrial Internet of Things): Electronic systems that enable communication between individuals, groups and machines through Internet-based wireless technologies. Machines, systems and workers will be connected through digital networks and communicate with each other by exchanging digital information.

3. How is manufacturing to change?

We can already see the first manifestations of industry 4.0 emerging, and the concept's proponents depict a profound transformation of manufacturing in the coming years and decades. If industry 4.0 becomes a mainstream, industry-wide reality, how might this look?

3.1 Changes to the production system

Industry 4.0 will bring four main changes to the production system, each driven by a number of technologies that have individual and collective impacts on the manufacturing process.

3.1.1 Change in production

Cyber physical production systems (CPPS) are at the heart of the transformation of manufacturing. They enable the use of information communication technology to monitor and control physical processes, making production more agile.

Smart sensor technology and extensively integrated data systems enable **autonomous production management.** Resources and products are networked, materials and parts **can be located anywhere and at any time,** production systems react rapidly to **changes in demand or stock levels** and to faults, and produced items can be **customer-specific** and individualised, **produced on-demand**.

Changing demands on workers engaged in operational tasks such as production, warehousing, logistics and maintenance mean that **new skills in efficient working with CPPSs are required**.

Wearable technology – clothing and accessories incorporating computer and advanced electronic technologies – might be used to integrate workers themselves as part of CPPSs, with the ability to **monitor productivity and efficiency of individuals** on the factory floor.

3.1.2 Change in supply chains

The vertical and horizontal integration of supply chains will be facilitated through increasing digital connectivity.

Entire **supply chains will be networked** via CPPSs, from inbound logistics through warehousing, production, marketing and sales to outbound logistics and downstream services. This creates **transparency and flexibility across entire supply chains – from purchasing through production to sales.**

Customer-specific adaptations can be made not only in the production but also in the development, ordering, planning, composition and distribution of products, enabling factors such as quality, time, risk, price and environmental sustainability to be handled dynamically, in real time and at all stages of the value chain.[1]

3.1.3 Change in information

Vast amounts of data will be collected and transmitted with the increasingly digital nature of production systems and supply chains.

This data will not only provide valuable **information about consumers, their preferences, and the products they buy**, but also **influence the life cycle of product manufacturing**.

The data and information that is available at all stages of a product's life cycle will enable new, **more flexible processes** from **modelling** to **prototypes** at the product stage.[2]

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[1] Industry 4.0: Challenges and solutions for the digital transformation and use of exponential technologies, 2015, Deloitte.

[2] Industry 4.0: Challenges and solutions for the digital transformation and use of exponential technologies, 2015, Deloitte.

3.1.4 Change in context

Changes similar to those in manufacturing will take place in other industries such as energy, automotive and infrastructure. **These 'smart' industries will interact with each other to create an industry 4.0 'ecosystem'**, with future changes in one industry being likely to affect others.

For example, transformation of the mobility sector in the form of **autonomous vehicles** and **drone technology** will combine with manufacturing to generate more autonomy on the factory floor and create more efficient supply chains. Transformation of the energy sector in the form of **smart electricity grids** will enable more efficient use of energy in the production system. **Sensor technologies** combined with **critical infrastructure**, such as roads, can further heighten the efficiency of supply chains.

3.2 Changes to who produces and how, where and when that production occurs

The technology-driven transformation of manufacturing and the creation of a new industry 4.0 ecosystem will impact what will be produced, by who, how, where and when. Five potentially fundamental future changes are relevant for policy making.

3.2.1 How might industry 4.0 change what is produced?

The transformation of manufacturing processes will allow producers to better respond to the increasing demand for **customisation to individual or niche needs**. This can be both in a push model – better data on consumption preferences allows producers to better anticipate preferences – and in a pull model, engaging with the customer so he/she expresses preferences and co-creates.

There will be an **increase in digital product templates** for consumers or other businesses to build on.[3]

More focused market data will support producers and intermediaries to develop products that meet market needs.

Products are also likely to become **more digitally equipped** with the inclusion of sensors and connectivity, and become part of the internet of things.

An example of what this might look like in real life

Inspired by visual platforms such as Pinterest and Instagram, consumers would access an online tool, upload a 3-D scan of their feet and design their shoes, using digital templates which propose designs that can be altered — changing colour, material, heel heights, types of tips, and so on. The digital design is sent to a manufacturer – e.g. a local 3D print shop – to be custom-made. The shoes that are produced include sensors to trace their delivery, to obtain data on their usage and potentially to facilitate the sharing of them.

3.2.2 How might industry 4.0 change who produces?

There is no consensus around the future of employment in industry 4.0 production systems and value chains. Many suggest that many jobs will be created as a result of increased demand for high-skilled workers such as mechanical engineers, software developers and data analysts. At the same time, it is widely acknowledged that there will be shift away from low-skilled jobs that perform simple repetitive tasks, as we see greater automation on the factory floor.

Consumers will become (co-)creators as they become increasingly apt in engaging in the creation or conceptualisation of the products they buy. As manufacturers engage directly with consumers, not only will the gap between prototype and product narrow, consumers can become a **source of funding** as producers build communities of supporters around products before making them.

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[3] To Innovate or Die: The Global Economy in 2050, Van der Elst, Huffington Post, 2015; Some examples: iOS and Android app platforms, consumers who 'hack' off-the-shelf IKEA furniture (ikeahackers.net), Google's Project Ara modular smartphone (https://atap.google.com/ara/).

The world of physical manufacturing will open to newcomers, start-ups and SMEs. Barriers to entry are to diminish with lower barriers to learning (e.g. skills such as design, production, or connecting with experts), lower barriers to infrastructure (e.g. the democratisation of tooling equipment to make prototypes) or better access to funding (e.g. crowdfunding, venture capital) and lower commercialisation risks (e.g. build-to-order).

The type of intermediaries will change. **Consumer-centred intermediaries will emerge, connecting the consumer with a place to serve their needs.** Increasingly there will be players who leverage personal data to better understand consumers, engage with them and tailor offerings to their specific needs and wants – even before they know it themselves. Consumers in the future may have one store – a digital platform – serving all their needs: overwhelmed with an increasing availability of data, information and options, they might turn to 'personal shopper' platforms to help sort products for them.

3.2.3 How might industry 4.0 change how products are produced?

Under industry 4.0, products will be produced with greater productivity, flexibility, efficiency and quality of the manufacturing process, opening the opportunity to be **more resource efficient and sustainable**.

With better visibility about production demand and transparency about production capacity in relation to demand, production system owners will take the opportunity to leverage their assets, monetising spare capacity when available. This could spur a shift away from ownership models (manufacturer fully owns and utilises factories), towards a sharing model with **the leasing of unutilised time to maximise efficiency**.

3.2.4 How might industry 4.0 change where products are produced?

Production is more likely to occur **closer to the source of consumption**. As production becomes less labour-intensive, low-cost labour might no longer be a competitive advantage for a country. Combined with the prospects of production from recyclable or synthetic materials and renewable local energy, as well as the need to deliver more and faster customized products, this opens up the prospects of an increasing relocation of production to the consumption markets.

3.2.5 How might industry 4.0 change when products are produced?

Production rates will be **closer to actual demand and consumption** through digital infrastructure that provides access to near-real-time point-of-sale data. **Produce-to-order** will be an increasingly widespread proposition.

4. What are the critical assumptions behind the industry 4.0 future?

Industry 4.0 is predicted to be a source of significant economic growth in the future. According to one source, taking Germany as an example, industry 4.0 will contribute an increase in revenues of EUR 30 billion per year from demand for enhanced equipment and new data applications, as well as consumer demand for a wider variety of increasingly customised products – roughly 1% of Germany's GDP. Productivity gains from more efficient processes in industrial manufacturing and other industries such as automotive could lead to gains of over EUR 90 billion over five years.[4] The corresponding GDP gains from industrial growth of this nature are likely to be significant.

However, these forecasts are tabled on a number of critical assumptions. For industry 4.0 to become a mainstream, industry-wide reality the following elements need to be in place:

- The underlying **technologies need to be sufficiently mature** for real-world applicability and adaption, they need to be **economically viable and socially acceptable**

- Public and private organisations need to dispose of sufficient levels of resources, both financial and organisational, to secure the **investment** required in new technology, R&D activities, infrastructure and education

[4] Industry 4.0, The Future of Productivity and Growth in Manufacturing Industries, 2015, Boston Consulting Group.

- Sufficient **skilled, educated workers** are needed to design, operate and manage production systems including software development and data analytics

- Businesses across manufacturing and high-tech value chains need to be able to access **reliable digital communication systems** and network infrastructure

- **Standards** need to exist and be enforced to ensure that the exchange of data between machines and systems can take place across national borders and platforms

- Ownership and access to **consumer and industrial data** needs to be regulated

- **Intellectual property** needs to be protectable across national borders, especially with respect to trade and commerce

Many proponents of industry 4.0 also assume that the **system-wide replacement of workers by autonomous robots** is inevitable. The argument that optimisation through technology will always economically outweigh human labor is a strong assumption given the cost of labor might diminish with 'competition' from robots. And new types of work are also likely to emerge, and there is room to dispute which effect will be larger.

5. What are the implications for EU policy?

How industry 4.0 will manifest itself does not only depend on technology. The European institutions have an important role to play in shaping a future that is beneficial for European society. The EU has to show foresight by reflecting on what might happen and what is needed to accompany this transformation towards a future which aligns with its policy directions. It has to both work on the policy elements that enable the opportunities of industry 4.0 to materialise and managing the socio-economic challenges.

The analysis hereunder contains reflections to consider for the research agenda of the European Commission's Framework Programme structured around priority policy areas. This is a contribution to Horizon 2020[5], the EU Research and Innovation programme, and its aim to achieve smart, sustainable and inclusive economic growth.

Enabling the opportunity	Managing the challenges
Competitive markets **How can policy foster a competitive environment for businesses looking to leverage the large economic growth opportunity that industry 4.0 represents?**	Inclusive economic growth How do we ensure there is the right level of investment in education and (re-)training in the skills required for industry 4.0 to insure there is equality of opportunity for citizens to participate in the industry 4.0 economy? Where might the European social contract fail, and which pieces are to be safeguarded?
Free Trade **What changes to the trade framework are needed to accommodate trade in industry 4.0 products and services?**	Country level competition – single market What fiscal and social security policy needs to be developed at EU level to avoid inter-nation competition/protectionism?
Standards **Which international standard communication protocols, data formats and interfaces are required to guarantee**	Digital divide between countries What is needed to encourage the deployment of the minimal level of digital infrastructure across Europe to provide a level playing field and

[5] 'Horizon 2020 is the biggest EU research and innovation programme ever. Almost €80 billion of funding is available over seven years (2014 to 2020) – in addition to the private and national public investment that this money will attract. Horizon 2020 will help to achieve smart, sustainable and inclusive economic growth. The goal is to ensure Europe produces world-class science and technology, removes barriers to innovation and makes it easier for the public and private sectors to work together in delivering solutions to big challenges facing our society'. http://ec.europa.eu/programmes/horizon2020/en/news/horizon-2020-brief-eu-framework-programme-research-innovation

a competitive industry and internal market, as well as inclusion in the global industry 4.0 economy?	inclusion of all European nations?
Data privacy, ownership, access and usage **What rules on data privacy, ownership, access and usage need to be defined to stimulate industry 4.0 growth and trust among actors?**	Critical / strategic infrastructure What is needed to safeguard the industry 4.0 infrastructure from attacks and who is responsible?
Intellectual property protection **Are current intellectual property protection frameworks suited for the new types of products and services that might emerge? Are all actors that will contribute appropriately and efficiently protected?**	
Sustainability **What policies are needed to capitalise on industry 4.0 to develop a more sustainable and circular economy?**	

5.1 Enabling the opportunities of industry 4.0

Industry 4.0 production models hold the potential to spur economic growth. Beyond the forecast increased demand for enhanced equipment and new data applications, and consumer demand for a wider variety of increasingly customised products, growth prospects stem from the likely trend that production now done in low labour countries will be repatriated to Europe. Indeed, as production becomes less labour-intensive, resources become more recyclable or locally produced and demand increases to deliver more customized products more quickly, there is the prospect of an increasing relocation of production to the consumption markets.

For Europe to fully benefit from the potential economic growth associated with this global transformation, it will need to be an innovator and have related technologies and platforms developed on European soil.

Europe has to establish appropriate standards on industrial data and intellectual property, trade frameworks that underlie competitive industry, a deep internal market and inclusion in the global industry 4.0 economy. Enabling more sustainable production of goods via industry 4.0 is also an opportunity to not miss.

As such the European Union's Framework Programme is advised to consider the following research questions:

Competitive markets - How can policy foster a competitive environment for businesses looking to leverage the large economic growth opportunity that industry 4.0 represents?

Although industry 4.0 is predicted to open new opportunities in physical manufacturing for newcomers, start-ups and SMEs, it will be expensive to upgrade production systems with the required technology and equipment. The creation of a competitive market is also closely related to data and intellectual property protection frameworks. If larger organisations have more means to make sense of the data accumulated through industry 4.0 activities and use their predictive power, this could lead to market consolidation and monopolisation – as could the drive to develop industry 4.0 integrated value chains to protect business secrets (discussed below). To avoid monopolisation, create a competitive industry 4.0 market and allow start-ups and SMEs to take part in this evolving economy, the creation of a competitive business environment is crucial.

Free Trade - What changes to the trade framework are needed to accommodate trade in industry 4.0 products and services?

Technologies, intellectual property, enhanced machinery, data analysis software and customised products are likely to become important traded goods. Agreement on the standards under which these technologies are regulated, the tariffs that they are traded under, and the relative competition between nations will be an important factor.

Standards - Which international standard communication protocols, data formats and interfaces are required to guarantee a competitive industry and internal market, as well as inclusion in the global industry 4.0 economy?

Standards are essential to ensure the exchange of data between machines, systems and software within a networked value chain and across borders.

Data privacy, ownership, access and usage - What rules on data privacy, ownership, access and usage need to be defined to stimulate industry 4.0 growth and trust among actors?

Large quantities of industrial data will be generated, collected and shared by new production systems and amongst partners in the value chain. This will include information about individual consumers, their preferences, and the products they buy. Currently much of this information is considered by commercial organisations as being given to them free of charge and rights. Consumers might change their position on this and demand legal protection.

Intellectual property protection - Are current intellectual property protection frameworks suited for the new types of products and services that might emerge? Are all actors that will contribute appropriately and efficiently protected?

The intellectual property associated with the design of smart products and advanced manufacturing systems will need adequate protection. Corporations are reluctant to enter networked-based value chains (versus integrated ones) for fear of the information (business secrets) that can be mined from them, driving consolidated markets. Protection is particularly important for trade within Europe with respect to the designs and digital content that can be used to customise products, built-on products and services. The co-creating consumer's rights also need to be further investigated.

Sustainability - What policies are needed to capitalise on industry 4.0 to develop a more sustainable and circular economy?

Industry 4.0 production systems and value chains offer the opportunity to produce products more resource-efficiently and in a more sustainable fashion, with the appropriate policies in place.

5.2 Managing the challenges of industry 4.0

For industry 4.0 to be a positive force for achieving smart, sustainable and inclusive economic growth a number of socio-economic challenges need to be managed.

Europe has to develop policies managing the transition towards a high skilled economy, job-scarce economic growth, the risk of increased protectionism, nation-level inclusiveness and the risks inherent to broadening the critical infrastructure of a country.

As such the European Union's Framework Programme is advised to consider the following research questions:

Inclusive economic growth - How do we ensure there is the right level of investment in education and (re-)training in the skills required for industry 4.0 to insure there is equality of opportunity for citizens to participate in the industry 4.0 economy? Where might the European social contract fail, and which pieces are to be safeguarded?

Amongst the most spoken-about challenges related to industry 4.0 is the inclusivity of economic growth. Automation will reduce the need for human labour in current production systems and value chains, while new types of high-skilled jobs will emerge. As such we are likely to face, at least in a transition period, both more unemployment and insufficient talent.

Industry 4.0 production systems imply a significant transition in the type of talent and skills required from workers and business actors. The importance of education and (re-)training in high-skilled occupations such as ICT, technology, R&D and mechatronics is widely accepted. Being digitally sophisticated will be a core competency of an employee of the future.

Secondly, robotics and human labour will be increasingly economically evaluated against each other as organisations optimise their production costs. Amongst the proponents of industry 4.0 there seems to be an assumption that the system-wide replacement of workers by autonomous robots is inevitable, based on the assumption that human labour cost is inevitably more expensive than robots. This is a strong assumption given the cost of labour might diminish with 'competition' from robots, pushing down hourly rates, and putting strains on social security and healthcare provisions for example. The developed world might become a low labor-cost economy were workers want to compete against automation.

Country level competition – single market - What fiscal and social security policy needs to be developed at EU level to avoid inter-nation competition/protectionism?

Economic competition between European countries might increase with industry 4.0 as it creates an 'insourcing' of manufacturing from other parts of the world back to Europe, as discussed above. To attract these manufacturing businesses, nations might provide attractive fiscal and social security systems for businesses. This might lead to a weakening of European cohesion.

Digital divide between countries - What is needed to encourage the deployment of the minimal level of digital infrastructure across Europe to provide a level playing field and inclusion of all European nations?

Access to the necessary digital infrastructure across European countries is a vital requirement to ensure that all nations can compete on a level footing, and avoid creating a two-tier system. One of the fundamentals of industry 4.0 is digital connectivity between suppliers, manufacturers, logistics providers and consumers. Ensuring that all parts of all countries have equal access to digital infrastructure will be a significant challenge for policy makers.

Critical/strategic infrastructure - What is needed to safeguard the industry 4.0 infrastructure from attacks and who is responsible?

The increasingly digital nature of manufacturing infrastructure will result in greater vulnerability to cyber-threats. The industry 4.0 infrastructure will become more critical and strategic for countries and businesses who will look to policy-makers to help provide protection.

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2	The Future of Manufacturing, Opportunities to drive economic growth, April 2012	World Economic Forum & Deloitte	Single future	Team of experts	Manufacturing businesses & governments
3	Manufacturing Visions – integrating diverse perspectives into pan-European foresight (ManVis), 2005	Fraunhofer Institute for System and Innovation Research	Single future	Delphi survey	European manufacturing businesses & policy makers
4	Future of manufacturing in Europe 2015-2020 – the challenge for sustainability, 2003	European Commission Joint Research Centre	Scenarios	Interactive workshops involving more than 50 experts	European manufacturing businesses & policy makers
5	The Collaborative Economy Impact and Potential of Collaborative Internet and Additive Manufacturing, 2015	European Parliament	Scenarios	Delphi analysis, Participatory process	European policy makers
6	Background Paper on the pilot project 'Industry 4.0: Foresight & Technology Assessment on the social dimension of the next industrial revolution', 2015	Institute of Technology Assessment, Austrian Academy of Sciences, Austrian Institute of Technology, Innovation Systems Department	Single future	Team of experts, Participatory process	Austrian Parliament
7	Rule-based analysis of production data - manufacturing experts at the heart of Industry 4.0	Bosch	Single future	Team of experts	
8	Industry 4.0, The Future of Productivity and Growth in Manufacturing Industries, 2015	The Boston Consulting Group	Single future	Team of experts	Manufacturing businesses
9	The Future of Manufacturing, Making things in a changing world,	Deloitte	Single future	Team of experts	Manufacturing businesses

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10	The Future of Manufacturing: A new era of opportunity and challenge for the UK Summary Report, 2013	The Government Office for Science, London, UK	Single future	Team of experts	UK government
11	The Future of Manufacturing: Driving Capabilities, Enabling Investments, 2014	World Economic Forum & UNIDO	Single future	Team of experts	Manufacturing businesses & governments
12	21st Century Manufacturing, 2013	UNIDO	Single future	Team of experts	Policy makers
13	Manufacturing the future: The next era of global growth and innovation, 2012	McKinsey& Company	Single future	Macroeconomic analyses with industry insights from global operations experts	Manufacturing businesses
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16	Industry 4.0: Opportunities and challenges of the industrial internet, 2015	Strategy&	Single future	Survey of 235 German industrial companies	Manufacturing businesses
17	Emerging trends in global manufacturing industries, 2013	UNIDO	Single future	Review of studies emerging in various manufacturing sectors around the world	Governments

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Note: Reports are only referenced in the text when they are directly attributable.

KI-01-17-428-EN-N

This compilation contains the nine background papers that have been drafted by members of the European Commission's Expert Group 'Strategic Foresight for R&I Policy in Horizon 2020' (SFRI) between June 2015 and November 2016. All papers have been finally endorsed by the entire group. They are the basis for the group's final report entitled 'Strategic Foresight in EU R&I Policy: Wider Use – More Impact'.

The Expert Group was active between June 2015 and November 2016 and supported the strategic approach to research programming in Horizon 2020 through the provision of foresight intelligence and rapid response sense-making of signals that change in society, economy, and technology is occurring.

Studies and reports

Publications Office

ISBN 978-92-79-68543-9