FTA FOR STRATEGIC STI POLICIES IN A MULTI-LEVEL, MULTI-DOMAIN GOVERNANCE CONTEXT

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Abstract

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, i.e., the stronger orientation of STI policies towards societal challenges.

Yet this turn does place more demanding requirements on FTA. In an instrumental sense, it is expected that FTA continues to help orientate and design specific programmes and initiatives; but in a more strategic sense, FTA is also expected to influence the wider innovation ecosystem, in which these specific programmes and initiatives are embedded and, more generally, the broader governance context in which an innovation ecosystem is embedded.

In this paper, we analyse the strategic positioning of FTA in these two contexts by looking at the example of the European framework programmes for R&I. First, we identify those tasks and steps in the planning and implementation processes of the next FP for which FTA seems relevant; in particular, we discuss the features of FTA approaches that can support these tasks and steps. We also highlight what the main pros and cons of these approaches and associated tools are.

Second, we consider the influence of FTA on innovation ecosystems, including practices and structural requirements for successful RTDI and exploitation activities. These activities are shaped by advances on the S&T supply side; but in the meantime, their impacts are contingent on the evolution of the broader socio-technical systems in which new ideas and knowledge are exploited and which effectively constitute the demand side of innovation. Hence, it is pertinent to broaden the scope of FTA beyond a comparatively narrow S&T focus especially in domains where there are strong systemic interdependences, with the aim of including a range of inter-dependent features on the demand side, in order to better understand how desired development paths of innovation ecosystems can be best promoted.

The need for FTA with an explicit focus on these systemic aspects makes it necessary to account for multi-level and multi-domain governance structures and attendant practices to ensure coherent policy impulses. This has implications for the range of addressees to be considered in FTA as well as for the modalities of FTA. As for the latter, particular attention needs to be devoted to inclusiveness; communication support and structuring of networks; awareness of and tolerance for uncertainties; problem-focused experimentation; as well as speed, adaptability and flexibility in implementing FTA processes.

Against the above backdrop outlining two types of embedding, we provide practical lessons and guidelines on the design and implementation of FTA in support of a strategically oriented STI policies and exemplify them in the case of the EU RTD Framework Programmes.

Keywords: FTA for strategic STI policies, FTA in innovation ecosystems, FTA in a multi-level and multi-domain governance context, EU RTD framework programmes

1 INTRODUCTION

Day-to-day decisions guided by long-term, strategic thinking tend to lead to more purposive (and ideally 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.[1] It applies *a fortiori* to the decisions of promoting research, technological development and innovation (RTDI) activities, given these decisions have major long-term consequences and may take considerable time to bear fruit.

There is a large number of quantitative and qualitative FTA methods. These range from forecasting (incl. trend analysis, STEEPV/PESTLE analysis of major drivers[2]), simulation, Delphi studies, horizon scanning and SWOT analysis to approaches for vision-building which may seek to articulate a single normative future,[3] a fully-fledged scenario,[4] or multiple futures presented through fully-fledged scenarios.

FTA methods can be used in various ways and settings. They can be deployed (i) either for pure academic purposes or as instrumental decision-preparatory tools; (ii) in participatory processes which encompass stakeholders broadly or in smaller, usually shorter, projects which involve experts only. Moreover, some FTA methods are suitable (iii) for considering multiple futures, while others seek to predict a single future, whilst (iv) FTA projects can focus on *S&T developments* or embrace a broader, *systemic view*.[5]

In comparison with other forward-looking activities, foresight is distinctive in that it not only facilitates thinking about and debating the future, but it also has a structuring effect by bringing together different communities of practice for different and possibly combined purposes, such as exploring areas of consensus and disagreement, issues of transparency and trust, and means of creating orchestrated policy synergies.

Specifically, 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).

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[1] This 'strategic' (Weber 2012) or 'normative' (Daimer et al. 2012) turn in STI policy has been observed for the past ten years. It is based on a re-orientation in the purpose and rationales behind STI policy, away from the emphasis on improving the structural and institutional settings in innovation systems for the sake of improving innovation performance "per se" (i.e. based on the prevailing innovation systems framework), and towards a stronger emphasis on thematic prioritisation in line with longer-term ambitions such as the tackling of societal challenges, or certain "emerging" technologies. At least in programmatic terms, this turn is visible in the rationales behind the current European framework programme Horizon 2020.

[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 Havas and Weber (2017).

Foresight activities are carried out 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, exhibiting variability in their specific aims, thematic coverage, geographic scope, focus, methods and time horizons.

In this paper, we consider both participatory FTA processes and expert-based FTA projects, with the aim of identifying what approaches can be deemed appropriate in the different tasks that are encountered in the various planning and implementation phases of EU RTDI FPs.

2 CONCEPTUAL FRAMEWORK AND METHODOLOGICAL APPROACH

Based on the above definition of FTA, and what spectrum of activities FTA covers, we introduce some key categories, which are important to better understand the role and function of FTA for policy-making.

First of all, it is important to stress the distinction between *expert-based* and *participatory FTA* (or foresight, in short). It is crucial, because expert-based FTA aims at exploiting the knowledge of individuals, with the aim of providing a well-founded analytical perspective on future developments. Foresight does this, too, but in addition it addresses and mobilises participants who have at least some decision-shaping if not decision-making power. Through the involvement in a foresight process, not only their knowledge is exploited, but also a deliberate attempt made to shape future perspectives, which are expected to influence the mindsets of participants, who subsequently transfer this augmented understanding to their organisation and decision-making processes (Jarmai 2015).

Second, we distinguish between the *instrumental* and *strategic use of FTA*. The instrumental use of FTA is useful to inform the design of RTDI programmes or any other type of intervention in the innovation system. Its reach is restricted to those individuals directly involved in that process, and the wider innovation system is only affected once the new policy instrument is implemented. FTA can also be an intervention in the innovation system itself, in order to trigger debate about ongoing changes, for instance in the practices of RTDI, and thus enable reflexivity and systemic learning. Third, in relation to the instrumental use of foresight, matters of organisational and procedural embedding are particularly important for the usefulness of foresight. Therefore, this paper considers which of these two FTA approaches – expert-based or participatory – is more suitable for a certain task during the various **planning and implementation phases** of policy making.

Finally, and in view of our intention to better understand the role of foresight for the shaping of EU RTD Framework Programmes, we take into account the **multi-level and multi-domain nature of the systemic context** in which FTA is embedded. Here, the key point is to distinguish to what extent the difficulties of achieving the strategic ambitions pursued by FTA (i.e. to trigger transformation, to overcome a crisis, or to overcome inertia) are aggravated by the multi-level and multi-domain nature types of the European context of FTA.

In methodological terms, the paper builds on our personal experience as FTA practitioners and members of EC expert groups. It is also grounded in the relevant grey and academic literature, but we do not aspire to provide a comprehensive literature review here.

3 RESULTS, DISCUSSION AND IMPLICATIONS

In the three sub-sections below, we anchor our discussion in salient observations on the relations between foresight and the processes of STI policy design and implementation.

3.1 Beyond exploratory analysis: Benefits of foresight for designing STI policies

When FTA is not strongly embedded in the decision-making systems, it is more likely that early warnings about relevant threats are ignored and weak signals of emerging opportunities are overlooked. Indeed, the 2008-2009 global financial and economic crisis hit the entire world very hard, not least the European Union. Furthermore, in spite of abundant analyses of factors that pose threats to security (e.g. influx of refugees due to failed states, civil wars, and comparable violent conflicts; deterioration of environmental conditions; breaches in water and food security; and 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 as a shared vision. These visions and associated operational roadmaps can be powerful instruments to assemble key players around a shared agenda, with the aim of shaping the future into the desired direction. Uncertainty about the ambitions of major actors can be reduced substantially, allowing investment decisions to be made in a less 'alien' environment. Moreover, assuming that the participants arrive at a shared vision, it can be expected that they take steps to achieve that chosen future, and thus align their future actions towards the realisation of the jointly identified favourable future.

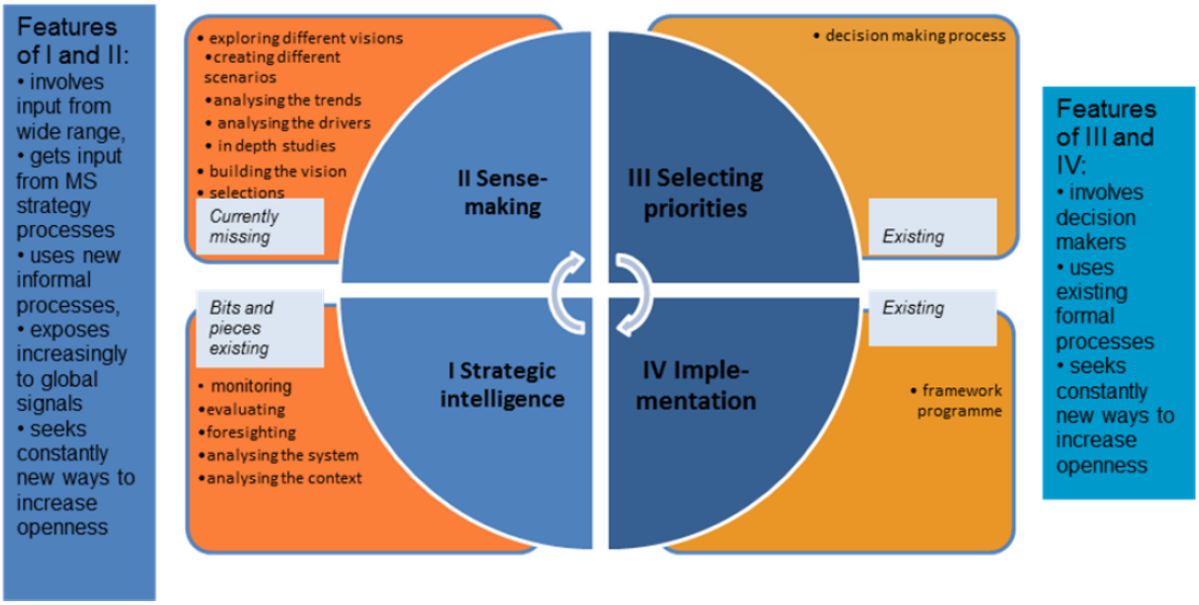
Transparent, systematic decision-preparatory processes can also reduce the influence of vested interests, and thus diminish the chances that public money is misappropriated or that the overall decision-making process would be unduly hijacked by a small group of strong players.

3.2 Instrumental role: The relevance of FTA methods to support the planning tasks of the next FP and its implementation

Following a functional approach, this section starts by identifying those tasks and steps in the planning and implementation processes of the next FP in which various types of FTA seem particularly relevant, drawing upon the 'four-phase model' suggested by EFFLA (Figure 1). It then discusses the main features of those FTA approaches that can support the completion of these specific tasks. The main pros and cons of these approaches and tools are also highlighted.

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). We elaborate on this observation 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 the first phase of 'Strategic intelligence' can be supported with several forward-looking methods, there are hardly any systematic forward-looking tools for the crucial sense-making phase. Overall, these first two phases are often rather informal, while the latter two ones are governed by the highly formalised decision-making procedures between the Commission, Council and Parliament and, moreover, may include formal consultation processes with other stakeholders (whereby we contend that even these processes could benefit from the systematic use of forward-looking methods).

The remainder of this section presents relevant approaches both for the 'I Strategic intelligence' and 'II Sense-making' phases (these two phases are the major steps in the overall design of the next FP) as well as for the 'IV Implementation' phase (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 involving underlying assumptions and results that are not necessarily easy to reconcile. At the same time, this diversity of strategic intelligence findings mirrors the diversity of perspectives on the future. Methods for generating such mutually enriching perspectives include the following:

- **System analysis** at different levels can be deployed to capture information about 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** draws attention to new and emerging developments (in an automated or semi-automated way, or by people; Cuhls et al. 2015).

- **Analysis of driving forces** (supported by PESTLE, STEEPV, SWOT or similar frameworks) help characterise the pertinent features of innovation ecosystems that are relevant for the next FP.
- **Trend analysis** can be pursued to explore those major trends within and beyond the EU that may give rise to challenges and opportunities for FP policy tools (such as research projects, networking activities, international co-operation and exchange programmes).
- **Qualitative scenario techniques or quantitative simulation models** are useful in exploring the interaction of different trends and driving forces, possibly supported through forecasts of future developments that are relevant to the next FP (e.g. demographic trends or climate change).
- Various forms of **assessment tools** (e.g. Delphi survey, TA, Future Surveys) help assess the significance and timeframe of emerging trends and developments.
- Different **workshop formats** (e.g. Future Workshops) serve to explicate the tacit knowledge possessed by people (experts, laymen). These formats can be enhanced with creativity methods as well as methods for opening up futures thinking (Cuhls and Daheim (eds) 2017).

II 'Sense-making' phase

The sense-making phase is crucial in leveraging the full diversity of insights from the 'Strategic intelligence' phase on a specific issue or task (such as developing a new RTDI Framework Programme). While the 'Strategic intelligence' phase invariably produces many inputs, it is a major task to integrate these inputs as building blocks within a common and coherent framework. In 2015, an EC expert group coined the notion of 'concurrent design foresight' as a framework to capitalise on the broad range of forward-looking activities across Commission Services (Köhler et al. 2015). Several methods are appropriate during this stage.

- **SWOT-type analyses** relate trends and driving forces to the current situation of a given organisation and its strategic ambitions; i.e. here the next EU RTDI FP.
- Conceptualised and moderated **workshop formats** can be used to assess and explore issues that are relevant to EU FP issues.
- Building and exploring **multiple futures** can position the future role of an organisation and its actions in those futures.
- Devising a **path scenario** will specify the steps needed to reach a desired future (or a set of path scenarios leading to different futures if the resulting diversity is believed to benefit the policy-making process).

Ideally, this second phase ends up with clear indications as to the way ahead, including what goals are to be pursued and through what pathways these can be realised.

III 'Decision-making/ Selection of priorities'

The selection of priorities does not start in this phase, given that it is an integral, albeit 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 is particularly important in anticipating possible conflicts and/or synergies

between the actions of different agents along the paths. Options for action can be assessed against the backdrop of different futures and adjoining path scenarios, in order to identify robust and flexible options in the face of uncertainties about how the future may unfold.

- **Scenario-based impact assessment** gives the current 'standard' policy impact assessment practices a more systematic and longer-term forward-looking twist. Combining foresight methods and impact assessment can enhance the interaction and communication between the Commission, the Parliament and the Council; the main bodies involved in formal decision-making.
- Methods of **multi-criteria decision analysis** (Salo et al. 2003) and **portfolio decision analysis** (Salo et al. 2011) serve to clarify the objectives and map these into corresponding criteria that can be employed to lend structure to facilitated discussions and pave way for the development of priorities, as well as resource allocation plans.

Ultimately, this phase ends with **the legal decision about the Framework Programme**. This decision specifies the main directions to be followed and instruments that will apply. Still, further priority setting activities are set to continue at the lower levels of administrative planning and even during the implementation of the Framework Programme. Methodological approaches such as the identification of options and scenario-based impact assessment can be pursued at these levels as well.

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) 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, possibly supported by a set of quantitative techniques, seems to be relevant in this phase. Because 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. foresight correspondents) who have been involved in the strategic planning of FP and its work programmes. In essence, the methods here can be the same as in phases I and II, taking into account the limited room for manoeuvre and the more targeted nature of tasks.

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

3.3 Strategic role: FTA in response to changing RTDI practices and systemic requirements for successful RTDI activities

Beyond the instrumental benefits and role of FTA for programme development along the four-phase model as discussed in the previous sub-section, FTA can also play an important role in shaping innovation ecosystems. This relationship between FTA and the innovation ecosystem(s) in which it is embedded, is a highly dynamic one, as it depends on the changing characteristics and patterns of the ecosystems, as well as on the intervention purpose behind an FTA. In general,

[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.

the intention of an FTA in relation to the wider innovation ecosystem can be to (i) overcome inertia, (ii) handle a crisis, or (iii) foster a major system transition.

There is a broad array of alternative FTA approaches that could, in principle, be used to operationalise these intentions. These approaches 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 aptness 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. 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 generated and exploited. In consequence, especially in those domains where such systemic interdependences are strong, it is pertinent to broaden the scope of FTA to foster a better understanding of how desired development paths of the innovation ecosystem can be best promoted. Hence, the reach (and thus also the range of actors and stakeholders addressed) of an FTA activity needs to be much broader.

There are many dimensions along which the scope of the FTA 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 FTA projects with an explicit focus on these systemic aspects is illustrated below 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, platform companies such as 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 permit 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 FTA should not be restricted merely to the 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 important to be aware of the positions and the driving forces of the different actors in the emerging innovation ecosystems.

Thus, an increasingly important activity in seeking to boost the performance of innovation ecosystems is 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 that benefit from network effects, these new businesses are likely to achieve a stronger position in conquering markets globally.

- **Business-academia collaboration:** A defining property of systemic innovations is that they constitute novel solutions, 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 EU FPs, the very identification and characterisation of such overarching problems (e.g. ‘grand challenges’) can suggest useful ‘units of analysis’, around which FTA can be structured to shape alternative solutions. Here, there may be an inherent tension between (i) the pressures to provide solutions quickly and (ii) the relatively long delays in producing outcomes and impacts through instruments such as the EU 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 are enabled by combining existing competences through novel business models (e.g. platforms à la Uber).

These changing characteristics of innovation processes have **implications for policy governance structures and practices**, partly in response to the needs and opportunities of emerging innovation ecosystems, and partly to transform them into (pro)active co-shapers of these systemic changes. In an EU context, they are further enhanced by the multi-level nature of policy-making, which may often require to address actors and stakeholders both at EU and national (or even regional) level. In any case, the recognition of the *systemic nature* of ecosystem evolution has important *implications for the design and implementation of FTA projects/ foresight processes*.

- *Inclusiveness of participants*: By design, the FTA 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. 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 FTA.
- *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 possess sufficient general knowledge of the topics covered

by a particular FTA project. This 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 building 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 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 in that 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 FTA infrequently and on a broad scale it may be necessary to invest in pursuing FTA more frequently or even on a continuous basis, possibly with a somewhat narrower and more contextual focus,[7] with the remit of ensuring that the STI policy instruments themselves have the forward-looking and horizon-scanning activities to support sense-making.

4 CONCLUSIONS

To conclude, we highlight several major issues that need thorough considerations when devising foresight and other types of FTA activities in support of strategically oriented STI policies in the contexts of EU RTD Framework Programmes and emerging new innovation ecosystems. In both contexts there is strong need for multi-level, multi-domain governance to find appropriate strategic actions. In the former one the major challenges seem to be (i) overcoming inertia; (ii) tackling crisis

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

situations; and (iii) shaping, or adopting to, transformative changes (depending on the speed of these changes) in order to exploit radically new opportunities and alter, or at least slow down, unfavourable trends. The latter one is pertinent for the emerging innovation ecosystems, too.

The 'matching' between a challenge (why to launch an FTA project) and FTA methods should be done at different levels of FTA: is the project addressing the EU FP as a whole, a specific societal challenge or a sub-challenge? A combination of these levels is also possible and might be useful in real life cases, but we keep it simple, just to illustrate the need and relevance of this 'matching'. Given space limits, we can only present this 'matching' at one level of FTA, that is an EU FP as a whole (Table 1).

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

Phase / Why to launch FTA	Phase 1 Strategic intelligence	Phase 2 Sense-making	Phase 3 Priority-setting	Phase 4 Implementation
Overcoming inertia	Scanning for alternative sources of intelligence Weak signals of change Different perspectives and approaches to business as usual	Exploring multiple visions and disruption scenarios Analysing trends and breaks in trends	Structured discussions with policy-makers, those resisting change, and 'agents provocateurs' (change agents)	Defining disruption pathways at a systemic level
Tackling 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
Shaping transition	Scanning at a systemic level	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

Source: Own compilation

As for hints on how to organise FTA projects, we start with a consideration that may sound trivial, but still worth stressing it in the light of practical experience: learning from previous successes and failures of FTA(-type) efforts (regardless the label attached to them) can offer important insights, spare scarce resources (be they intellectual, financial or time for conducting analyses) and help in not repeating costly mistakes.

A specific challenge for devising EU FPs, the phase of sense-making so far has received less support by way of formal methodologies than those phases that are inherently more formal. Indeed, it may be sobering to ask how amenable sense-making is to methodological support, given that it is about seeing the interconnectedness of seemingly disconnected bits of information (Könnölä et al. 2012). Still, considerable advances can be made by devising foresight processes which help the participants assimilate a sufficiently rich body of relevant background knowledge in the light of which the relevance and meaning of new pieces of information can be appreciated.

Here, relevant statistical information, historical analogues as well as longitudinal analyses uncovering causal relations may be effective, or the constructive moderation offered by broadly knowledgeable open-minded experts who are able to perceive beyond conventionally defined habitual domains of expertise. Yet, the well-deserved emphasis on sufficient background knowledge may involve tensions in the sense that if the actors in the RTDI systems are rewarded only for their 'narrow' expertise that is geared towards contributions within their respective specialisations only, the capabilities for sense-making may remain more limited than what would otherwise be the case.

The multiple levels in the governance of STI policies and instruments such as the EU FP programmes lead to the questions of what is the appropriate level of granularity in view of different foresight objectives. If the level is too high or 'coarse', foresight results may appear superficial and void of compelling concrete significance; but at the other extreme, focusing on specific examples alone will make it hard to paint a systemic picture. In order to balance between these extremes, foresight and FTA methods should arguably aspire to transcend several levels, with an explicit emphasis on the interconnectedness between these levels and the importance of intermediaries.

When the broader outcomes of RTDI activities are contingent on quickly unfolding external determinants, the implementation phase of an EU FP may benefit from embedded foresight that equips the programme with capabilities for sense-making and realignment (Salo and Salmenkaita 2002). Furthermore, when the uncertainties are high and when the objective of RTDI activities is to foster radical innovations that produce transformative impacts, it may be pertinent to introduce reallocation mechanisms to permit the shifting of resources from the less fruitful activities to those areas that remain on a positive trajectory (Vilkkumaa et al. 2015).

Our final point might also sound trivial, but in most cases it is neglected: neither foresight processes nor other types of FTA 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 FTA project.

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