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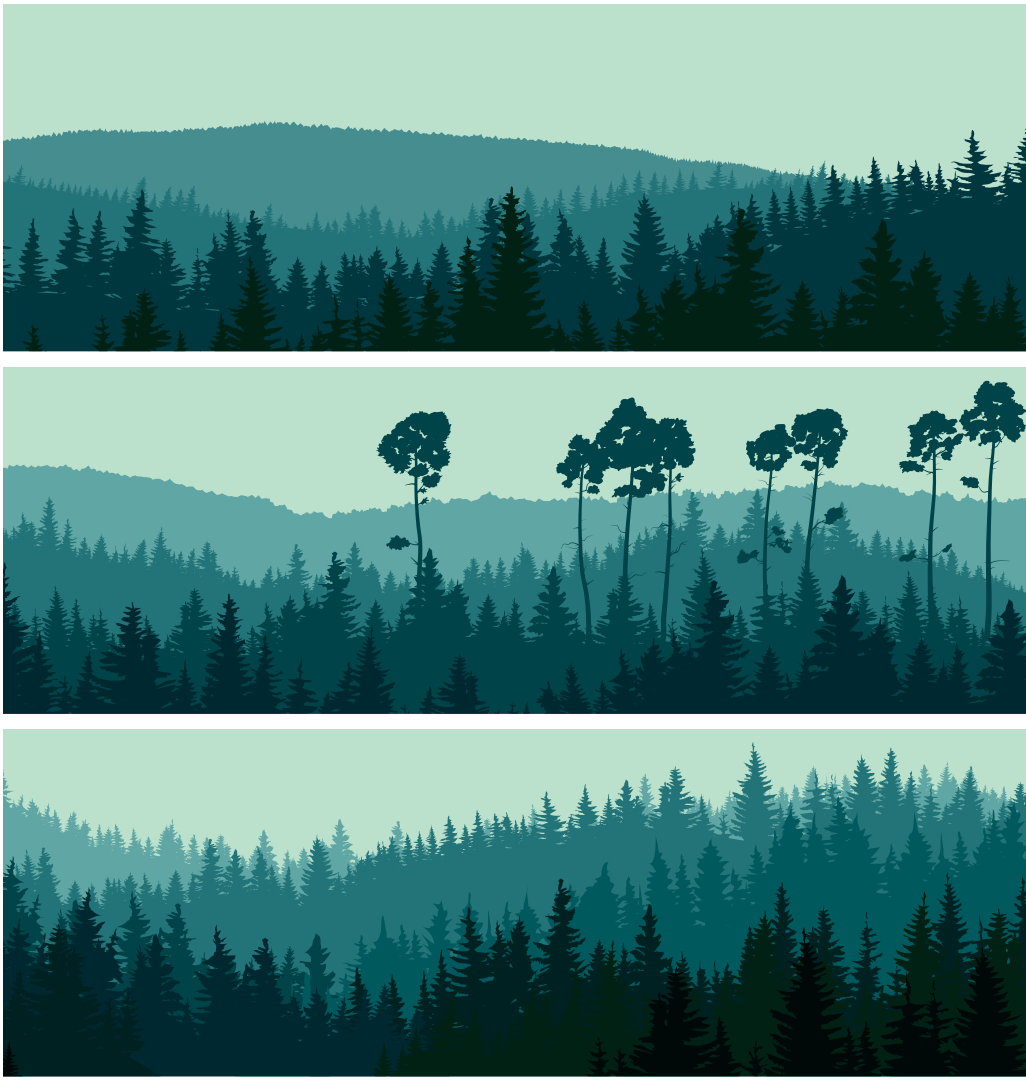

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# Future-Oriented Technology Analysis to Support Decision-Making in Meeting Global Challenges

*Experiences in anticipation from the European organisation JRC-IPTS allow to draw conclusions for the use of anticipatory intelligence in support of policy-making.*

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Anticipatory intelligence contributes to policy-making by supporting a shared approach in order to understand the present in all its complexity, to look at different possible futures and to shape a joint direction to follow that considers different stakeholders' points of view (cf. Weber 2012). Here we look at the use of anticipation in support of decision-making, building on the experiences from the European Commission's Joint Research Centre Institute for Prospective Technological Studies (JRC-IPTS). The mission of JRC-IPTS is to provide evidence-based support to the EU policy-making process by developing science-based responses to policy challenges. Its core competence is the ability to work at the intersection of the socio-economic aspects of an issue and the science and technology involved. In addition, it supports the structured stakeholder dialogue on possible future pathways by embedding these findings into society (cf. Boden et al. 2010). Similar organisations operating at the science-society interface exist in Europe at the national level, such as the Swiss Academic Society for Environmental Research and Ecology (SAGUF).

Within the JRC-IPTS anticipation activities have been developed seeking to build a dialogue between different stakeholders. In this respect, the label *Future-Oriented Technology Analysis (FTA)* aims to be a common umbrella for foresight, forecasting and technology assessment. A premise of the anticipatory activities at JRC-IPTS to date has been that anticipation is a necessary policy response component to the environment of accelerated socio-economic and technological changes.

Such changes can occur in the form of disruptive events (i. e., unexpected, short-term and sudden events, with immediate and continuing impacts, for which we are usually unprepared), ongoing processes (i.e., difficult-to-detect processes as change is gradual, with slow diffusion and with medium- to long-term impacts), or transformation by design (i. e., change processes that are planned, such as social or economic structural transformations). Drivers of dynamic processes of change and sudden disruptive transformations range from rapid technological changes to shifts in social norms, values and lifestyles.

Current and future societal challenges emerge from such transformations and call for appropriate forms of Future-Oriented Technology Analysis, such as external FTA services, the institutionalisation of FTA, as well as FTA networks to support and enable both organisations and individuals to anticipate, adapt, and respond proactively to change (cf. Weber et al. 2012).

## FTA Responding to Grand Challenges

In this context, JRC-IPTS has been organising a series of *International Seville Conferences on Future-Oriented Technology Analysis* since 2004, with the latest focusing on the role of FTA in addressing grand societal challenges by shaping structural and systemic transformations. This event has explored the potential of FTA in enabling a better understanding of the complex systems which interact in each situation and in defining effective policy responses (for results see Boden et al. 2012, Cagnin et al. >

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2013, Carabias et al. 2012b, forthcoming, Haegeman et al. 2012b).

Boden et al. (2012) identify three areas where FTA can support decision-making in response to grand challenges:

1. moving from vertically structured systems and processes to horizontal ones,
2. embedding FTA better within government, and focusing more on anticipating disruptive change, and
3. making better use of crowd-sourcing to complement official governance systems (for an example, see Haegeman et al. 2012a).

| sustainability indicators | future-oriented issues from FTA activities |
|---|---|
| **gross domestic product (GDP) per capita** | ■ global economic shocks<br>■ continued economic growth of Asian countries, with China and India likely to account for 50% of the world GDP by 2060 |
| **greenhouse gas emissions** | ■ climate disruption<br>■ increasing EU-27 energy-related $CO_2$ emissions |
| **consumption of renewables** | ■ the rising importance of decentralised power generation, with both large industrial power plants and fuel cells installed in private homes working in interconnected grids that will form the backbone of the European power generation sector<br>■ energy transition having possible impacts on the world's economic development |

**TABLE:** Future-oriented technology analysis (FTA) is useful for addressing challenges of sustainability: coverage of selected headline sustainability indicators by a variety of issues identified in FTA activities.

Cagnin et al. (2013) zoom in on conceptual, methodological as well as operational issues[1] in considering what FTA tools and approaches would be appropriate to address disruptive transformations. One specific conceptual issue they focus on relates to what can be known about the future and what cannot. This issue is also taken up by Haegeman et al. (2012b, p. 732 f.), who argue that the recognition of uncertainty and unpredictability requires emphasis on creativity and "truly alternative future developments".

Carabias et al. (2012b, forthcoming) see FTA as a means to manage inclusion of different stakeholders' perspectives in providing solutions, to steer and adapt innovation systems in response to grand challenges, and to support the development of smart specialisation strategies to generate robust science, technology and innovation agendas in a globalised era.

## Collective Sense-Making in Horizon Scanning

One specific FTA approach to better prepare policy- and decision-makers in today's complex and interdependent environments is the use of early warning signal detection and collective sense-making, such as contextual horizon scanning approaches and methods (Amanatidou et al. 2012). Since the objective of horizon scanning is to create knowledge on the emergence of issues that, by definition, lie beyond current horizons, there is often but scarce and scattered evidence to support the collection of signals and the assessment of their significance. Therefore scanners need to leverage tacit knowledge, reflecting their experiences and interpretations of perceived reality. However, sense-making is not mere interpretation: in fact, it is less about discovery and more about invention.

We can therefore adhere to the statement that "before something, an idea or object, can be sensed, it has to be constructed" (Möller 2010, p. 365). This construction is essentially a collective activity of knowledge creation.

Horizon scanning is regarded as a creative process of collective sense-making by way of collecting and synthesising observations that hold potential for the elaboration of pertinent future developments and the derivation of actionable implications for decision-making (Könnölä et al. 2012). At the individual level, sense-making builds on the actor's ability to perceive, interpret and construct meaning of the emerging landscape. Yet the broader significance of this individual sense-making is built collectively, for instance, when observations are evaluated or aggregated into more encompassing clusters. Despite the complex challenges adhered to transdisciplinary, collective knowledge sharing processes, Fry et al. (2011) identified factors for managing them successfully.

FTA not only provides approaches and methods about scanning issues that can be measured today (i.e., trends), but also indicate to policy-making those future issues or wild cards that are not yet considered in policy design but must be tackled today if we are to develop our societies in a sustainable way. Here, the main added value is to show that different, interlinked policy fields must be aligned to enable policy to tackle current and future challenges.

## FTA Anticipating Sustainability Challenges

FTA makes particularly sense in addressing sustainable development challenges. Carabias et al. (2012a) reveal strong similarities between the future-oriented issues from the FTA approaches and the topics reflected in the sustainability indicator systems (see table above). Such comparisons can help policy-making in terms of developing a better understanding of unsustainable trends and the needs for correction or prevention.

The findings also suggest that data collection could be enhanced to better monitor emerging issues that are currently not well covered by indicator systems. Today's sustainability indicator systems offer information on past and present states, but provide limited support for understanding future developments.

Combining sustainability monitoring with anticipatory activities therefore could enhance policy support in developing more adaptive and anticipatory approaches to better orient societal change towards sustainable development.

1 The following issues are identified:
- distinguish known unknowns, unknown knowns and unknown unknowns;
- combine quantitative and qualitative approaches in a relevant and feasible way;
- understand the complex and systemic nature of grand challenges; and
- orchestrate joint responses to grand challenges.

Governments and companies usually react to changes by trying to adapt rather than being able to manage them properly, let alone being able to anticipate and welcome them.

FTA initiatives such as EU and worldwide foresight studies on global challenges at regular intervals are critical to building a common understanding of current situations and to translating it into common visions of the world's future to be jointly pursued. In a decision-making world, foresight does not appear naturally as the preferred method for sustainable development (Destatte 2010). This is not surprising, because so far sustainable development is only being monitored to assess performance and decide on additional measures.

FTA activities could anticipate the need for action and change the course of existing action, thus contributing to an ongoing renewal of the approach to sustainable development by emphasising its systemic and holistic aspects. Various SAGUF working groups support this process (e. g., Kläy 2012).

### Anticipatory Intelligence in Support of Decision-Making

Experiences in the use of anticipatory intelligence at the European level suggest a considerable importance of the use of creative approaches in jointly shaping the future. Connected is increasing attention to consider unlikely events, both positive[2] and negative, how we can avoid or mitigate them, or on the contrary make them happen, and how one can align different policies to support this. In more general terms, alignment of FTA with decision-making and the coordination mode of governance seem to prevail in recent FTA, despite the richness of foci on different types of transformations, methodological choices and organisational setups for FTA. The analysis shows increasing evidence of institutionalised forms of FTA and exploitation of FTA networks to provide agile and strategic support for decision-making. Finally, there is a growing interest in sharing experiences on the use of anticipatory intelligence in support of decision-making. Examples are the *European Foresight Platform*[3] and the International Foresight Academy (see box), which promote the professionalisation of the field in support of organisations at the interface of science and decision-making.

**BOX:**

**IFA International Foresight Academy**

The recently created ***International Foresight Academy*** is the first organisation to bind together foresight activities around the globe and from contrasting cultural and political contexts. Foresight activities vary with regard to their functions in political priority-setting and strategy formulation of modern democracies. Many foresight practitioners value the possibility granted by foresight exercises to bring topics on the political agenda that need to be discussed with broad public involvement.

**Announcement**

The ***European Academic Seminar*** addressing issues around foresight, public participation, and decision-making with sessions on smart futures (e. g., cities, energy) is planned for

**September 16–19, 2013,**
**Zurich University of Applied Sciences (ZHAW), Switzerland.**

Members of the SAGUF working group on energy future will co-organise a respective session and interact with the international FTA community to advance knowledge generation in this field.

The views expressed are purely those of the authors and may not in any circumstances be regarded as stating an official position of the European Commission.

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2 An example is the use of electricity from the atmosphere as a source of energy. This has become more realistic thanks to the research of Ducati et al. (2010).

3 *www.foresight-platform.eu*