

## **Rising to the Challenges – Reflections on Future-oriented Technology Analysis**

**Final peer-reviewed version – please cite as Luke Georghiou and Jennifer Cassingena Harper, Technological Forecasting and Social Change, Volume 80, Issue 3, March 2013, Pages 467–470  
<http://dx.doi.org/10.1016/j.techfore.2012.10.009>**

**Luke Georghiou<sup>1\*</sup> and Jennifer Cassingena Harper<sup>\*\*</sup>**

**\*Manchester Institute of Innovation Research, Manchester Business School,  
University of Manchester, United Kingdom**

**\*\*Malta Council for Science and Technology, Kalkara, Malta**

### **Abstract**

Drawing upon the presentations made at the fourth conference on Future-oriented Technology Analysis, this essay reflects on the implications of the current period of instability and discontinuity for the practice of FTA or foresight. In the past the demand environment for foresight on research and innovation policy favoured application to priority-setting and articulation of demand. New tendencies include a heightened search for breakthrough science and a focus on grand societal challenges. By their nature boundary-spanning, these make it less easy to locate FTA institutionally to achieve the necessary cross-cutting perspective. New institutions, methods and combinations of methods are noted. Dealing with disruptive transformations is seen as the key forward challenge for the practice of FTA.

### **Keywords**

Future-oriented, innovation, foresight, grand challenges, disruptive, transformations

---

<sup>1</sup> Corresponding author: Manchester Institute of Innovation Research (MIoIR), Manchester Business School, Booth Street West, Manchester M15 6PB, UK. Tel.: +44-161-275-5921; fax: +44-161-275-0923.

*E-mail address:* [Luke.Georghiou@mbs.ac.uk](mailto:Luke.Georghiou@mbs.ac.uk) (Luke Georghiou).

When circumstances become more turbulent it is often the case that an era is regarded retrospectively as one of calm and continuity even if it were not so perceived at the time. In the current less stable economic, political and social environment it is possible to apply such a lens to the preceding two or three decades. This essay reflects on the implications for the practice of Future-oriented Technology Analysis (FTA)<sup>2</sup> of the current period of instability and discontinuity. It is inspired by the presentations made at the Fourth Conference on FTA but takes them as a point of departure rather than seeking either to report upon them or to perform a synthesis across diverse themes.

The reduction of stability was highlighted by a series of transitions evident from the opening addresses. Participants heard about the evolving technology strategy of one of Europe's leading companies. Since the 1990s Nokia would have been on any list of European industrial success stories as it rose to global leadership in the mobile telephony sector. While there remains much to admire, the company now best illustrates the fragility of success when fast moving technological and social changes can expose wrong bets made both on platform technologies and the demands users would make of their devices. It could even herald a possible loss of momentum in the underpinning technologies which have driven the successes of the information age – this is the publicly expounded view of recent physics Nobel Laureate André Geim [7]. Hal Linstone, editor emeritus of this journal encapsulated an important aspect of what is going on by observing that the rate of social change has overtaken the rate of technological change and that we are in the midst of a transformation from information to molecular based technologies. A further keynote highlighted the rise to prominence of the Brazilian economy, and by implication wider changes in the world economic order.

Taking the conference as a whole, regularly used keywords emphasised discontinuities with a discourse around grand challenges, transformations and disruptive change while references to adaptation and alignment hinted at strategies for coping with these futures. While it is the task of futurists in general to anticipate, understand and if possible guide society through what lies ahead, the FTA community eponymously and in practice, takes as its anchor point the role of technology and by implication the conduct and consequences of research and innovation. As noted in the context of previous FTA conferences [8], the term 'future-oriented technology analysis' seeks to apply a wider collective identity around several strategic intelligence activities including technology foresight, forecasting, intelligence, roadmapping, assessment and modelling but faces a reality where the community regards FTA as the name of the conference series and foresight as the label for most of the activities it presents. More recent attempts to impose a new collective term of 'forward-looking activities' remain largely a bureaucratic construct within the European Commission. Here, we use the term FTA in the wider sense but recognise that many of the references and presentations discussed use the term foresight interchangeably.

---

<sup>2</sup> Future-oriented Technology Analysis developed from an initial paper by Porter et al [1] and subsequently tracked through a series of special editions of multiple journals arising from the FTA conference series in Seville, for example, Scapolo [2]; Scapolo, Porter and Rader [3]; Cagnin et al, [4]; Cassingena Harper et al [5]; Georghiou et al [6]

Let us then set the scene against which change is considered. In the domain of innovation policy, government actions have been fundamentally gradualist in their approach since the 1980s. Largely conceived in the light of market failure arguments that sat comfortably with the neo-liberal economic paradigm, such policies have generally veered away from activity that could be perceived as near-to-market or which involve government officials in making decisions about what companies should do. The result of this has been a portfolio which has consisted of three main elements. The first has been so-called direct measures, grants or fiscal incentives for R&D, the former largely restricted to collaborative grants under the argument that firms needed an incentive to work together on pre-competitive activities, with the argument reinforced when the boundaries being spanned crossed national borders. Fiscal incentives have also been driven by arguments about attracting mobile international R&D investment.

The second powerful strand has been a package of measures designed to reinforce research-business linkages, ranging from networking support through to direct subsidy in various ways. The third strand, focused almost exclusively on small and medium-sized firms, seeking to build their capabilities and offering some limited resources. What has generally been missing or at least downplayed has been any sense of broader coordination around missions.

Similar tendencies are visible in investigator-driven research. Funding models in most countries evolved but only slowly towards accommodating more interdisciplinary thematic approaches. As indicated above there has been a steady increase in the application of criteria of relevance and impact, particularly but not exclusively in terms of working with business. Nonetheless, the organisations that administer research support are broadly unchanged and have been organised fundamentally on disciplinary lines. The corresponding institutions responsible for technology and innovation policy are normally on a smaller scale and tend to conflate the two labels. Some reside in specialised ministries while others are devolved to agencies.

This landscape has formed the demand environment for FTA activities and has largely influenced the practice of the field. Studies have indicated that the principal applications of FTA have been in supporting priority-setting and in the analysis and articulation of the potential of future technologies [9]. What these have in common is that they are seeking to order and direct the existing situation and to inform agencies that disburse funding or at most to try to stimulate R&D collaborations and networks. Priority-setting methodologies normally begin with a fixed choice set and even where they do not, the technologies that they address are generally developments of well-known domains. Articulation is of course within the context of a defined phenomenon which is then typically analysed through scenario approaches. The main exception to this anchorage in the mainstream has been the emergence of horizon-scanning where in the face of uncertainty the goal is to uncover the Rumsfeldian ‘unknown unknowns’<sup>3</sup> even if the results often have the familiar ring of ‘known unknowns’. A key problem with horizon-scanning is that it normally adopts a scattergun approach which leaves each topic treated superficially and in isolation, with little guidance on

---

<sup>3</sup> From the well-known quote by the former US Secretary of Defense, Donald Rumsfeld made to the Press in 2002 “[T]here are known knowns; there are things we know we know. We also know there are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns – there are things we do not know we don't know.”

interlinkages and cross-impacts, or on which will be significant and which remain dormant or even remain in the world of fantasy. For this reason up to now it has remained a relatively small part of the picture of FTA practice.

How then has the new environment affected FTA? Is it managing to co-evolve with what could be the emerging shape of research and innovation policy? What indeed does the new landscape look like? As it was long ago observed by researchers at Fraunhofer ISI, the research policy landscape evolves less by displacement of the old by the new and more by a process of geological accretion where the structures and policy styles of earlier decades continue, perhaps with some diminution, while new activity is imposed on the top. It is interesting to speculate whether the luxury of this accumulation can survive the cold economic winds that are causing many European Governments to cut spending and focus it more sharply but a counter hypothesis would suggest that deeply embedded institutions are better equipped to fight for survival (one thinks of the persistence of at best partially-reformed institutions from the Soviet-dominated era in some post-transition countries).

Nonetheless, we may discern some new policy tendencies as well as some reinforcement of pre-existing trends. For science the need to demonstrate impact dominates the policy agenda in some countries and even the most responsive-mode oriented of European programmes, the European Research Council (ERC) has seen fit to launch an activity targeted at exploitation of results. A further trend has been towards an increased focus of funding on the research elite, again exemplified by the ERC but a pattern repeated by research councils and charitable funding organisations. This could be interpreted as a response to uncertainty – an attempt to facilitate those most likely by their track record of excellence to achieve breakthroughs that may have a transformative effect. There could be a conflict between short-term gain and long-term erosion of excellence as new entrants and hence potential future research leaders are excluded to a greater degree. For FTA activity breakthrough science is less something to be anticipated and more an input into understanding what its transformative implications might be. This implies a closer coupling with and scanning of what is going on in research than is currently the case.

The bigger change in policy is in the domain of strategic and applied research where the notion of grand or societal challenges has risen to prominence, most noticeably but by no means exclusively at European level where societal challenges such as health, energy and food security, transport, climate and resources and innovative and secure societies became first a part of the ERA debate [10] and subsequently a central plank of the new core programme Horizon 2020 [11]. The tendency is also visible in the United States where the White House Office of Science and Technology Policy has as its first goal to: “Ensure that Federal investments in science and technology are making the greatest possible contribution to economic prosperity, public health, environmental quality, and national security”.

We know that Grand Challenges are boundary spanning, address ‘wicked problems’ and do not fit current institutional and governance structures [12]. For example, universities find grand challenges difficult to use as an organisational principle both because of their interdisciplinary nature and because of the very large and not clearly defined scope of activities that would be drawn under such an umbrella. Some try to deal with this problem by using them as a presentational device (what we are doing

on...energy etc). Similar difficulties are encountered by funding agencies and their parent administrations. Where they have a thematic or disciplinary structure Grand Challenges force them to work collaboratively. A further dimension of complexity is that few challenges are nationally bounded, so that serious attempts to address them need to be transnational or in some cases global.

What do these shifts mean for FTA? The features outlined above are reflected in the practice of FTA. At a practical level the shifts makes it less clear where the activity should be situated – who has ownership of the problems and can therefore act as commissioner of authoritative work with the capacity to act on the findings? Within the activity itself strategic knowledge is distributed across organisations, which means that an FTA activity can end up as a proxy for coordinated views that would normally rest within agencies. FTA activity is mostly situated nationally or regionally and so is potentially handicapped in dealing with the transnational nature of the challenges. To the extent that FTA is situated in specific domains it is again at risk of achieving only a partial view. It could be argued that a potential need for holistic cross-domain approaches could run contrary to earlier conclusion that FTA functions most effectively when it is tailored to the requirements of a field or sector [13] but equally the need could be for tailoring to the circumstances of the grand challenge.

More worryingly, there are concerns that administrations would like to harness FTA in order to constrain uncertainty to the point where traditional tools may be used. The rub would be that by concealing the full scope of a highly complex problem in both social and technological dimensions, the ensuing simplification would render ineffective from the start the efforts being made to address it. Interestingly, these difficulties in the political and public spheres are less evident in the private sector where business, which has an inherently problem-based focus and in any case does not carry prime responsibility for the wider picture, is more likely to see Grand Challenges as an opportunity for innovation and new markets.

An important question to ask is what the user community might want from FTA in respect of guiding research and innovation strategies in the light of grand challenges? Three functions could be distinguished – identification of a challenge, articulation of a challenge that has already been identified at a general level and helping to achieve what is variously called orchestration or alignment of actors around the challenge. Of the three the most difficult is likely to be identification of new challenges. In the taxonomy of transformations emerging at the conference [14], the distinction made by a European Science Foundation working group between recognised and disruptive challenges highlights the problem. The lists given above for EU and US research policies consists entirely of well-recognised challenges in which FTA work would be focused on articulation and orchestration. However, policymakers would really like to know about new and unforeseen challenges that could disrupt their activities. The instability following the financial crisis which was foreseen by a few but where little attention was paid to warnings has intensified this desire. Similar reactions have followed epidemics (the institution of government horizon scanning in the UK was at least in part a reaction to the BSE epidemic).

There is some distance between wanting to identify new challenges and doing so effectively beyond the hope that the scattergun might hit the target. Horizon scanning experiences are converging on the need for holistic rather than atomistic information.

There is a need to assembling plausible narratives, overarching themes and clusters rather than lists and to develop commensurate abilities to perceive interconnectedness

A practical consideration is that much FTA activity depends upon expertise but the very act of selecting the experts goes some way to predetermining the outcome. Choose your experts and you choose your challenges. There is also the possibility that some transformations may be catastrophic in the sense of occurring suddenly and with great impact having been preceded by little or nothing in the way of prior signals.

While there is as yet no clear methodological answer to the identification issue there have been some institutional responses and new organisational models of FTA. This is encapsulated in a move from discrete programmes to embedded units or continuous scanning institutions. Several types of organisations are seeking to build capabilities in FTA, for example efforts to build an anticipatory culture in Research and Technology Organisations, and the establishment by the European Commission of a new advisory body, the European Forum for Forward Looking Activities (EFFLA) which includes in its remit the identification of challenges but is more interesting in that it is a new kind of intermediary body that seeks to select from and synthesise findings from forward-looking activities. It is mandated to do this in a form directly useable for policymakers, with the aim of improving the robustness of EU research and innovation strategies and programmes.

In slightly more familiar territory, FTA activities clearly have a role in articulating recognised grand challenges. If approached correctly FTAs, instead of seeking to manage away uncertainty, can accommodate it. Their application to innovation is increasingly taking into account the user perspective and the need for social shaping. Consensus is something to work towards but may not be desirable to achieve. Challenges are not soluble in a single way or at a single point in time and hence variety of approach remains beneficial. Alignment is a more realistic objective.

A particular challenge is to find the methodological core of FTA practice, not because of a lack of methods – the field is rich with them – but because there is a lack of agreement as to which clusters of these have prime validity in particular circumstances. The principal epistemological divide is that between qualitative and quantitative approaches, sometimes exacerbated by lack of mutual trust [15]. A clear confusion, particularly among users is to assume that only qualitative work is subjective. Quantitative and qualitative work can be equally subjective when underpinning assumptions are taken into account.

Of course some practitioners can and do seek to bridge the gap but there is little to suggest that this creates a common culture – at least it can further mutual understanding. Combinations of methods are fairly common but very many of these are of the form ‘Scenarios plus X’. Apart from combining recognised FTA methods, there are also instances of bringing in insights from other disciplines or from techniques rooted in other disciplines.

A running theme in the world of FTA is the need to address evaluation and impact. But there are shared issues with the wider discipline of evaluation in dealing with time-lag between action and effect and in seeking enough continuity to create the opportunity to apply lessons from previous experiences. The interdisciplinary nature

of challenge-oriented results is difficult for traditional governance structures to absorb. A paradox is that consensual FTA is more likely to be absorbed than is an antagonistic output but the latter is more likely to give insights that can assist in comprehending transformations that are going on and to take us closer to the Holy Grail of anticipated disruptive innovations and events.

The next two or three years promise to be a critical period for the challenged practices of FTA, offering both an opportunity to seek a truly central role in guiding research and innovation activities and a threat or marginalisation or even of partial extinction as traditional bases of support are themselves squeezed or terminated. Perhaps the only certainty is that the need for intelligent anticipation will not go away and is only enhanced when circumstances are challenging.

### **Acknowledgements**

The authors would like to acknowledge the stimulating ideas of the FTA participants, including the authors of the papers in this special edition but going well beyond and into the discussions, formal and informal, which each session yielded. Thanks are also due to the conference committee who acted as rapporteurs and captured the essence of what had been said while adding their own valuable insights. Contributors are not normally cited individually except where a published output is referenced. Responsibility for the interpretation and reflections made here is solely that of the authors who apologise in advance for any misinterpretation but also value the new directions that their different understanding may have opened!

### **References**

- [1] A. Porter et al (also cited as Technology Futures Analysis Methods Working Group) Technology Futures Analysis: Towards integration of the field and new methods, *Technological Forecasting & Social Change* 71 (2004) 287–303 2004
- [2] F. Scapolo, New horizons and challenges for future-oriented technology analysis—The 2004 EU–US seminar, *Technological Forecasting & Social Change* 72 1059–1063, 2005
- [3] F. Scapolo, A. Porter, and M. Rader, Future-Oriented Technology Analysis (FTA): Impact on policy and decision-making — The 2006 FTA International Seville Seminar, *Technological Forecasting & Social Change* 75 (2008) 457–461, 2008
- [4] C. Cagnin, M. Keenan, R. Johnston, F. Scapolo, and R. Barré (eds) Future-oriented technology analysis – strategic intelligence for an innovative economy, Springer Verlag: Berlin Heidelberg, 2008
- [5] J. Cassingena Harper, K. Cuhls, L. Georghiou and R. Johnston, Future-oriented technology analysis as a driver of strategy and policy, *Technology Analysis & Strategic Management*, Volume 20, Issue 3, pp 267-269, 2008

- [6] L. Georghiou, J. Cassingena Harper and F. Scapolo, From priority-setting to societal challenges in future-oriented technology analysis, *Futures* 43:3 (2011) 229-23, 2011
- [7] A. Geim, Curiosity-driven science: Philanthropy or economic necessity, Plenary address to European Commission Innovation Convention, 2011
- [8] L. Georghiou, J. Cassingena Harper and F. Scapolo op. cit.
- [9] L. Georghiou and J. Cassingena Harper, From priority-setting to articulation of demand: Foresight for research and innovation policy and strategy, *Futures* 43:3 (2011) 243-251, 2011
- [10] L. Georghiou, Europe's research system must change, *Nature* 452, 935-936, 2008
- [11] European Commission, Communication from The Commission to the European Parliament, the Council, the European Economic And Social Committee and the Committee of the Regions, Horizon 2020 - The Framework Programme for Research and Innovation, Brussels, 30.11.2011 COM(2011) 808 final, 2011
- [12] C. Cagnin, E. Amanatidou and M. Keenan, Orienting Innovation Systems towards Grand Challenges and the Roles that FTA Can Play, *Science and Public Policy* vol. 39, issue 2, pages 140-152, 2012
- [13] A. Schoen, T. Konnola, P. Warnke, R. Barré and S. Kuhlmann Tailoring foresight to field specificities, *Futures* 43:3 April 2011, 232-242, 2011
- [14] M. Weber, J. Cassingena Harper, T. Konnola and V. Carabias Barcelo, Building FTA Capacities for Systemic and Structural Transformations: New FTA Systems for Anticipatory Action in a Fast-changing World, *Science and Public Policy*, vol. 39, issue 2, pages 153-165, 2012
- [15] K. Haegeman, F. Scapolo, A. Ricci, E. Marinelli and A. Sokolov, Premises and Practices in Combining Quantitative and Qualitative FTA Methods, *Technological Forecasting and Social Change* (this issue)