# Orienting Innovation towards Grand Challenges: A Real-Time Experiment in the Application of Foresight-assisted Processes

**Professor Ron Johnston**

**Australian Centre for Innovation, University of Sydney, NSW 2006, Australia**

**rj@aciic.org.au**

**Keywords:** foresight, grand challenges, FTA capacity building

## Summary

The Australian Government established a National Enabling Technologies Strategy (NETS) in 2010. A major objective of this strategy is "to increase government, industry and the community's understanding of the ways in which applications of enabling technologies may help to address major global and national challenges and to encourage the responsible development and uptake of these technologies. "

Activities under the NETS include the identification of major challenges which the enabling technologies may address, facilitation of projects that demonstrate applications of enabling technologies, and identification of future skill, capability and infrastructure needs.

An Expert (Foresight) Forum for Enabling Technologies has been established to guide and advise on the implementation of the strategy. As Chairman of the Forum, this author, with extensive experience in the design and application of foresight, has launched a number of 'learning exercises' designed to examine the key influences, be they theoretical, methodological, structural, organisational, economic or cultural, in the effective framing and promotion of initiatives to address future major challenges.

The results of this analysis reveal that government officials are primarily interested in the extent to which foresight can be applied to reduce uncertainty in their decision-making and provide guidance about possible technological developments and their consequences ie to reduce or remove possible surprises. In summary their driving interest is in moving from having to consider multiple possible futures to a single probable and preferred future which would be more amenable to their analytical skills, procedures and well-tested policy mechanisms.

In contrast, industry representatives were more interested in the extent to which foresight processes could open up to them the possibility of new business and market opportunities. Their driving interest, in contrast to that of government officials, was to increase divergence in order to discover new possible futures, to which they could apply their strategic planning tools to pursue a beneficial outcome.

THEME: 1. ORIENTING INNOVATION SYSTEMS TOWARDS GLOBAL CHALLENGES AND THE ROLES THAT FTA CAN PLAY

These findings indicate both the need to tailor foresight processes and messages to the very different audiences of government and business, and the importance of understanding these different perspectives in attempting to facilitate dialogue between stakeholders and in order to address grand challenges effectively.

# 1 Introduction

One of the more substantial findings of the Seville FTA Conference in 2008 was summarised in one of the subsequent publications:

> The recent onset of crises and challenges ranging from climate change, financial and economic downturns, to security threats highlight a rising need to incorporate more forward-looking approaches into the decision- making processes of public and private organisations and stakeholders all around the world…forward-looking approaches need further tailoring in order to suit better the needs of decision-makers and their changing environment. (Haegeman et al, 2010, p.3)

In the intervening three years, these "crises and challenges" seem only to have multiplied and the need for better "forward-looking approaches" become more urgent. Many problems appear to be more intractable, either not capable of being rationally analysed, or existing in an environment in which rational analysis is able to make only a limited contribution to any resolution. The causes would appear to lie in part with the perceived authority of the rational analysis, and in part with the nature of the issues being addressed.

With regard to the first of these, it can be argued that we are witnessing a loss of legitimacy and authority of institutions, and of codified formal knowledge, which would appear to significantly transform the mechanisms available to arrive at collective agreement on the nature of grand challenges and the best measures to address them.

For example, consider the phenomenal growth of the transformative technology, and processes, of Internet-based social networking. It is evident that, at least for some, traditional expert knowledge is losing its former authority.

For some, this is a welcome move toward more democratic processes:

> The empowering capability of ICTs is centered on their ability to permit previously marginalized individuals and groups—who would otherwise be silent and invisible—to be heard and seen. By doing so, ICTs reveal the diversity in society, a range of opinion that has always existed, but was previously without voice in public decision making. This, in part, is due to the fact that ICTs facilitate the dispersal of power away from centralized governments with the result that rational, administrative institutions are being challenged as a sole means of political and social control. In what appears to be a worldwide phenomenon, bureaucratic institutions are losing their monopoly over key sources of information and the capacity for surveillance, permitting alternative voices in civil society to emerge. (Milakovich, 2010)

Another view is that it is the quality control processes that underpin reliable knowledge which are at stake:

> The traditional control of knowledge, involving specification, standardization, and validation, by professors, teachers, researchers and experts, is paradoxically challenged and amplified at the same time. It is challenged by alternative, more individualized re-expression of traditional knowledge, and because new areas of application gain recognition. At the same time, the appearance of experts on the mass media scene, as providers of explanations and background commentaries, and in the market arena, as

> consultants, has opened new control opportunities for knowledge owners, as suppliers of rationality, according to a just-in-place and just-in-time logic. (Skagen Roundtable, 2001)

A more strident critical view is that:

> Out of this anarchy, it suddenly became clear that what was governing the infinite monkeys now inputting away on the Internet was the law of digital Darwinism, the survival of the loudest and most opinionated. Under these rules, the only way to intellectually prevail is by infinite filibustering. (Keen, 2007)

It appears safe to conclude that new approaches to engage the community in understanding and addressing the grand challenges which many believe we face will require the positive use of all the tools of education and communication available.

In addition to the challenges to institutions and knowledge, the nature of the problems themselves that we face are raising new challenges. This is best captured by the now familiar concept of 'wicked' problems.

Wicked problems have a range of interacting characteristics:

- difficulty to clearly define - the nature and extent of the problem depends on who has been asked ie different stakeholders have different versions of what the problem is;
- many interdependencies, often multi-causal - which make them hard to clearly define; the disagreement among stakeholders often reflects the different emphasis they place on the various causal factors;
- attempts to address them often lead to unforeseen consequences;
- often not stable - a wicked problem and the constraints or evidence involved in understanding the problem are often evolving at the same time that attempts are being made to address it;
- usually have no clear solution - since there is no definitive, stable problem there is often no definitive solution to wicked problems; solutions are not verifiably right or wrong but rather better or worse or good enough;
- social complexity – this, rather than technical complexity, overwhelms most current problem-solving and project management approaches;
- rarely sit conveniently within the responsibility of any one organisation - they require action at every level, from the international to the local and by the private and community sectors and individuals;
- involve changing behaviour - innovative, personalised approaches may be necessary to motivate individuals to actively cooperate in achieving sustained behavioural change. (adapted from Australian Public Service Commission, 2007)

Taken together, the features of wicked problems and the reduction in the legitimacy of expert knowledge suggest the need for new approaches among which foresight could, and I would argue, should be prominent.

In addition, an approach designed to orient innovation towards addressing grand challenges needs to take into account the changing context and hence requirements, for innovation. Principal among these is the emergence of the concept and practice of 'open innovation'.

The previous, and still continuing 'closed innovation' model was largely based on the generation and adaptation of knowledge by specialists within a company in accord with judgments about which new products are likely to appeal to the market and the customer. Concerns about strategic positioning in markets, commercial confidentiality and control of IP ownership precluded the notion that important knowledge and innovation could be sourced from outside the company.

Under the pressures of global competition in the knowledge economy, there are two major limitations in the closed innovation model for companies: they cannot generate sufficient knowledge from their necessarily limited resources, and they cannot predict sufficiently rapidly or reliably what markets and customers will want.

The rapidly growing open innovation approach relies on the sourcing of knowledge from wherever it can best be generated anywhere in the world. The location of this knowledge will be determined by talent, infrastructure, focus, local need or demand. Codified knowledge can be readily accessed in this digital age, provided the necessary capability to identify, locate, evaluate and adapt exists. But tacit and context-specific knowledge is, by its nature, local and can only be accessed by having a physical presence in this space. Furthermore, given that components of the required knowledge will need to be sourced from different locations, combining the knowledge to achieve competitive advantage becomes a key competence.

This is placing a premium on the capability of a national STI system, supported by appropriate policy, to facilitate access to the global pool of knowledge, to negotiate access on suitable terms, and to develop a sound competence in knowledge integration.

A second aspect of open innovation is the need for companies (indeed all organisations) to become more open not only to knowledge, but also to customers, suppliers and competitors. It is argued (OECD, 2009) that in many industries, technology has become more of an enabler than a driver. A key new driver of innovation is the informed and empowered customer demanding a customised response to their specific needs, wherever they are located across the globe. The response under open innovation rests on the direct engagement of customers and users into the co-design and co-creation of new products, facilitated by a range of communication technologies.

The environment of open innovation is placing new demands on structures and governance systems designed under the previous assumptions of publicly-funded research being clearly either a public or private good capable of being produced only by expert researchers. One implication is that, while science and technology-based knowledge, information and skills will remain critical, knowledge and skills of a different kind about knowledge integration, design, and behavioural responses may be just as important. One strategic challenge to be determined is whether this capability should be integrated into the STI system, or developed as a distinct capability outside it.

These forces provided the context for a real-time experiment in the application of foresight-assisted processes to assisting in addressing grand challenges, with a particular emphasis on the perceptions, attitudes and values of the participants in the process.

## 2 The Context of this Study

The Australian Government established a National Enabling Technologies Strategy (NETS) in 2010. The context for this decision was the release of the report 'Powering Ideas: An Innovation Agenda for the 21st Century' by the Australian Government as part of the 2009-10 Federal Budget. The budget delivered a significant increase (25 per cent) in funding for science, technology and innovation. The government also announced the National Enabling Technologies Strategy with funding of $38.2 million over four years. The Strategy complements the new investments in science, technology and innovation and provides a framework for the responsible development of enabling technologies such as nanotechnology, biotechnology and other technologies as they emerge in Australia. The Strategy builds on the work of the earlier National Biotechnology Strategy (NBS) and National Nanotechnology Strategy.

The view of the Government is that enabling technologies have the potential to provide significant long term social and economic benefits for Australia:

> Enabling technologies have the potential to underpin an increasing number of breakthrough innovations in products, services and processes and to offer effective solutions to help address major global and national challenges, such as medical treatments, energy generation and environmental remediation. They may also pose new health, safety and environmental risks and have ethical and social impacts. A balance needs to be found that manages the risks and impacts while ensuring that the benefits can be obtained. (DIISR, 2010)

Major objectives of this strategy are firstly "to increase government, industry and the community's understanding of the ways in which applications of enabling technologies may help to address major global and national challenges and to encourage the responsible development and uptake of these technologies." But in addition, the Strategy will assist government, researchers, industry and other stakeholders to prepare for the advent of new technologies by undertaking foresighting activities and supporting the development of policy and regulatory frameworks. (DIISR, 2010)

Activities under the NETS include the identification of major challenges which the enabling technologies may address, facilitation of projects that demonstrate applications of enabling technologies, and identification of future skill, capability and infrastructure needs.

An Expert (Foresight) Forum for Enabling Technologies has been established to guide and advise on the implementation of the strategy, and, in particular, to support foresighting to identify new and converging technologies that may have implications for policy makers, regulators, researchers, industry and the broader community.

As Chairman of the Forum, this author, with extensive experience in the design and application of foresight, has launched a number of 'learning exercises' designed to examine the key influences, be they theoretical, methodological, structural, organisational, economic or cultural, in the effective framing and promotion of initiatives to address future major challenges.

## 3 Methodology

The issues that have been examined include a series related directly to foresight:

- understanding of foresight;
- challenges in addressing issues with a strong future dimension;
- benefits from foresight; and
- ways to make foresight more effective.

In addition, a broader question was posed about developing and mobilising capability to address grand challenges:

The context for the research underpinning this paper is a series of foresight workshops with a variety of industry sector representatives. These workshops were designed to identify potential major challenges impacting on the sector and the role of enabling technologies in responding to these challenges. During this process, the views of participants from industry and government on the issues identified above were surveyed and also were the subject of exercises designed to elicit opinions and experience.

In addition, detailed interviews were held with a range of officials in a number of governments to establish their views about what their expectation of foresight were, and how they could see it contributing to their roles and responsibilities.

# 4 Findings

## *4.1 Government*

### *Understanding of foresight*

The common view among government officials was that foresight was a process that could provide a window into the future:

> "It is a way of looking out longer term, identifying a range of issues and then applying scenarios to areas of our responsibility…It forces you to think more about the future and gets you thinking about what other things you might have to face."

> "It is a tool for challenging you to think about issues further ahead. If you have thought about it you reduce the unknown unknowns."

> "Scenarios projecting forward far enough to escape present condition…it removes you from the present."

> "It's taking an issue or technology and looking at its applications and long-term outcomes for society in 20-30 years time…It is not a horizon scanning type of thing."

On the basis of these statements, foresight is seen as a tool to enable you to project beyond the world shaped by current pressures. It is not seen as an attitude or framework. It also is only used in specific circumstances in which a longer time horizon might apply.

## *Challenges in addressing issues with a strong future dimension*

The characteristic response identified the urgency of addressing current issues as the major constraint on taking a longer-term view:

> "The biggest challenge is getting anyone to pay attention to them… they don't survive the urgent, the short-term dominates…people don't have the time or the interest."

> "The electoral cycle drives everything and restricts looking ahead, because it can all change so quickly."

> "There are so many urgent issues every day that you don't get the chance to take a longer-term view."

> "I think the biggest challenge is accuracy – picking the right thing to focus on…It's hard to know if what you are focussing on is still relevant and important, given the constant flow of new information."

> "We are trained to look backwards and learn from past mistakes, rather than looking forward to what might happen.""

> "The essence of our approach is to gather information with the objective of reducing uncertainty. We prefer to implement in small steps…A strong guide in a new situation is what does it resemble from the past."

The later statements indicate that in addition to the limited operational time horizon of government bureaucracy, there are constraints of mindsets, and accepted practices, that place a relatively low value on speculating about the future and its possible uncertainties.

## *Benefits from foresight*

The government officials were asked what they would most like foresight to be able to deliver in their present job. The responses reflect primarily a concern with avoiding or at least reducing surprises, and influencing others to take a longer-term view:

> "I would greatly value having a much better idea of what is going to be important in the future, so we can think it through and develop robust mechanisms to deal with it… people

will have much more confidence in a government if it is seen to be in control, rather than having to suddenly react to new situations."

"I know what is happening now, and I have a pretty good idea of what is likely to emerge, in terms of new technologies, over the next ten years. But I don't have any idea of what might be building up further out over the horizon."

"Framing stuff in a way that engages people's attention and interest; for example, getting regulators to think more about their role and its consequences, and the ways the world can change."

"Establishing the necessary receptors elsewhere in government…creating a trigger that can change a mindset."

"It can contribute to dialogue about risk…a way of getting people thinking about all the possible consequences of a new technology."

"Thinking through all the structural blockages and adaptations in funding, skills, regulations, attitudes, etc that are required to get a new technology in place and properly accepted."

The last of these statements projects foresight as a useful tool in assembling and negotiating the complementary social and organisational assets necessary for a new technology to take its place in and generate capabilities and benefits for society.

### *Ways to make foresight more effective*

The major approaches to making foresight more effective in Government appear to lie in more effective communication with government officials, using the language and terms with which they are familiar, and interfacing better with the practices that dominate their decision-making processes.

"You need to mainstream foresight…get it into the processes of government so that thinking about the longer term is natural."

"In a perfect world, foresight should be part of strategic planning, not a stand-alone tool; it should be embedded in the processes of planning and decision-making."

"Foresight is not widely understood. It is commonly confused with forecasting… It is not well enough understood to be an effective tool for communicating about the future."

> "Language is important. Foresight reports are too vague, general and ambiguous, lacking a clear message and action orientation,. It needs to be something a senior manager can quickly grasp, expressed in familiar language… For example, our strategic plan is written in terms of priorities, objectives, deliverables and responsibilities – how does foresight get translated into that language?"

> "You need to understand the way we work. We have to gather enough evidence to justify a particular judgment, knowing we are accountable to the Minister and Parliament. So you tend to sit on the fence for as long as possible.

These statements are in accord with the common findings about the impact of foresight, that translation, adaptation and communication in the language and context of the potential user are crucial for effectiveness. (Havas et al, 2010, Johnston, 2011)

### *Developing and mobilising capability to address grand challenges:*

The general approach acknowledged that some challenges may be grand, though it is often difficult to make a sound case that some challenges are grander ie more important, than others. Regardless, it was most appropriate to address grand challenges through conventional organisational and decision-making structures, with primary responsibility clearly allocated to a single Minister and Department, rather than attempting to establish a structure tailor-made for a particular challenge.

As a consequence, the requirements of addressing grand challenges were not seen as requiring different approaches to stakeholder engagement than previously applied in a number of other situations. Representative committees or advisory boards, supported by clearly articulated objectives were seen as appropriate.

No special purpose mechanisms were seen as necessary. The consultative establishment of appropriate priorities within existing structures and budgets were generally seen as the most appropriate type of response.

## *4.2 Industry*

The industry respondents contacted in this survey fell into two almost entirely distinct categories. The first group were characterised by being in mature industries, locally rather than globally focussed, with short-term planning horizons and little or no experience with or interest in foresight. There is little value in examining their views in any more detail, except to identify and understand the challenge of driving a commitment to global competitiveness through all sectors of industry.

The second group operated in knowledge-intensive, globally focussed companies, were committed to long-term perspectives and the institutionalised application of foresight to assist

them in planning their future business. These companies are industry leaders, from which m,uch can be learnt.

They possessed a clear ***understanding of foresight*** and had substantial experience with it:

> "We regularly engage in 20-year over the horizon exercises to guide our future positioning particularly with regard to business models."
>
> "It is our practice to employ specialist from new fields that we might not understand. They are usually young, and we engage in a reverse mentoring process so their insights can be shared upwards."
>
> "We subscribe to the Prahalad slogan: we need to make our future."

The ***challenges of addressing the future*** were just that:

> "Of course there are challenges in addressing the future; that is what is so exciting about it."
>
> "We have a horizontal network across all our offices around the world tasked to challenge the mental mindset of the company."
>
> "Reinventing our business model and practices is a continuous process."

The ***benefits of foresight*** are evident and considerable:

> "I cant imagine how you can be in a competitive business and not use foresight in some form or other."
>
> "We committed to a two-year process which has identified the major new market/technology spaces that we needed to move into."
>
> "One significant benefit of foresight is that we used it to get all our staff around the world onto the same page about why they approached tasks the way they do, and not just how to do them."

***Making foresight more effective*** appears to be largely a matter of ensuring commitment at the highest level of the company, enshrining it in company procedures and expectations, and engaging in continual learning:

> "With the kind of people we recruit, our approach is to support them to pusue their dream and take us with them."
>
> "Its engaging in the process that matters, and of course learning from it. The precise procedures or techniques matter very little."

***Grand challenges*** are "the markers of where a lot of future business will be, and we are determined to have the capacity to be a big player in that space."

An example of a company with a deep commitment to, and exemplary practice of, foresight is Arup. Arup is an independent firm of designers, planners, engineers, consultants and technical specialists offering a broad range of professional services, including building design, economics and planning, infrastructure design, management consulting and specialist technical service, with offices in 33 countries.

Arup is renowned for its remarkable contributions to the built environment, which include Sydney Opera House, Centre Pompidou in Paris, the Millennium Bridge in London, the Channel Tunnel Rail Link, the Water Cube in Beijing and the Chanel Travelling Pavilion.

Arup has an international foresight network, the aim of which is to better understand the drivers shaping the future of their businesses and explore their likely impact on the built environment. A continuing project since 2006 has been focussed on drivers of change. 'Drivers of Change' is a research-based publication developed by Arup to help its business and clients identify and explore leading factors which will affect our world in the future to 2050.

The publication is a planning tool that helps the user to ask the right questions in order to plan effectively for the future. It investigates themes including: energy, waste, climate change, water, demographics, urbanisation and poverty. 'Drivers of Change' serves not only as a vibrant, visual record of research, but also as a tool for developing business strategy, brainstorming and education.

Arup has participated in the World Economic Forum since 2006. It helped to bring the importance of cities as vital pieces of the global economic engine to the attention of the Forum. This focus led to the development of the SlimCity work program for which Arup produced the SlimCity knowledge cards in 2008. In 2009, as part of the same initiative, a partnership was formed with Habitat for Humanity, the Rockefeller Foundation and UN Habitat which led to the creation of a new knowledge card set on 'Housing'.

# 5 Conclusions and Policy Implications

The results of this analysis reveal that government officials are primarily interested in the extent to which foresight can be applied to reduce uncertainty in their decision-making and provide guidance about possible technological developments and their consequences ie to reduce or remove possible surprises. In summary their driving interest is in moving from having to consider

multiple possible futures to a single probable and preferred future which would be more amenable to their analytical skills, procedures and well-tested policy mechanisms.

In contrast, industry representatives were more interested in the extent to which foresight processes could open up to them the possibility of new business and market opportunities. Their driving interest, in contrast to that of government officials, was to increase divergence in order to discover new possible futures, to which they could apply their strategic planning tools to pursue a beneficial outcome.

These findings indicate both the need to tailor foresight processes and messages to the very different audiences of government and business, and the importance of understanding these different perspectives in attempting to facilitate dialogue between stakeholders and in order to address grand challenges effectively.

**References**

Australian Public Service Commission, 'Tackling Wicked Problems: A Public Policy Perspective', 2007, accessed at http://www.apsc.gov.au/publications07/wickedproblems.htm.

DIISR, National Enabling Technologies Strategy, accessible at http://www.innovation.gov.au/Industry/Nanotechnology/NationalEnablingTechnologiesStrategy/Documents/NETS_booklet.pdf (2010).

Haegeman, K., Harper, J., and Johnston, R., 'Introduction: Impacts and implications of future-oriented technology analysis for policy and decision-making', *Science and Public Policy,* Volume 37, No. 1, February 2010, pp3-6.

Havas A., Schartinger D., and Weber, M, 'The Impact of Foresight on Innovation Policy-Making: Recent Experiences and Future Perspectives', *Research Evaluation*, Volume 19, No 2, June 2010, pp.91-104.

Johnston, R., 'Developing the Capacity to Assess the Impact of Foresight', Foresight, 2011, forthcoming

Keen, A., *The Cult of the Amateur*, Random House, 2007, p.15.

Milakovich, M., 'The Internet and Increased Citizen Participation in Government', *Journal of Democracy,* Vol.2, pp.1-9, 2010.

OECD, 'New Nature of Innovation', Paris, 2009.

Skagen Roundtable, 'Sharing Knowledge and Experience in Implementing ICTs in Universities', 2001, accessed at www.iau-aiu.net/he/icts/rtf/icts_confsk**age**n1.rtf.