# New Zealand, new futures, new ways of science engaging with society?

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***Science and innovation are largely valued in New Zealand as drivers of economic growth. Yet society, in charting growth, is facing increasingly real resource limits and impacts threatening the integrity of life-supporting aspects of our environment. Through a deeper understanding of what we mean by science and society, New Zealand has the potential to be truly innovative, both locally and internationally, around complex issues such as sustainable use of natural resources and reducing the use of damaging materials and processes, while keeping growth firmly on the agenda. In this paper we argue that, though gains could be made through a changed science agenda, the most significant step-change could occur at the interface between science and society – particularly in the way science engages, motivates, and drives the future.***

## 'New' Zealand

New Zealand (Aotearoa), as befits half its name, is in perpetual pursuit of 'newness'. Not only, as a relative geological newcomer at a mere 85 million years old, is it the 'youngest country on the earth',[1] it also was one of the last temperate land masses to be colonised when Māori settled around 1280 (Wilmshurst *et al*. 2008). Yet this 'newness' is more than temporal, being entrenched in the psyche. Bell (1996), for example, discusses how newness and national identity are closely allied and notes that, for early Europeans, 'New' Zealand was both a new territory and a new Eden. Newness as an element of national identity can be liberating, and provide permission to unshackle oneself from the fetters of tradition. But the concept of newness can also bring risks of a false sense of the extent of our innovation or our cleanness and greenness – inhibiting rather than engendering attention and action.

Among all this newness are there signs of genuine innovation that is relevant and responsible? New Zealand's approach to future trends and the process of innovation is an important consideration in understanding the current development of science in the context of productivity and the need to address problems of national significance (Cameron *et al*. 2008; Frame 2008; Rutledge *et al*. 2008; Frame *et al*. 2009; MoRST 2009; Pride *et al*. 2010). In this context we differentiate between invention as the 'creation of new knowledge through research' and innovation as 'creating and putting into use new combinations of often existing knowledge' (Wedderburn, pers. comm. 2010).

## New futures

New Zealand has traditionally focused much of its research energies on increasing innovation as a means to boost economic growth and labour productivity, while attempting to minimise complex social and environmental impacts. However, tackling growth and protection as two separate agendas does not adequately resolve issues of national significance. The Crown

[1] www.teara.govt.nz/EarthSeaAndSky/Geology/GeologyOverview/3/en

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Research Iinstitutes Taskforce Review report (2010) created a climate for change within the science community, calling for greater innovation in the delivery and transfer of knowledge and science (including more effective collaboration across research providers and their stakeholders), to cross the divide between pursuit of economic goals and the protection and enhancement of environmental, social and cultural assets.

This echoes calls for greater innovation in response to global trends in science such as:

***Emergence of environmental challenges that impact across environmental, social, cultural and economic domains***: The greater complexity of these 'wicked problems'[2] demands new ways of engaging stakeholders and finding solutions, with a shift from linear technology transfer to a more dynamic interaction between science providers and users (Frame *et al*. 2009).

***Science in diplomacy***: 'Grand challenges' for science (e.g. climate change, water allocation) that cannot be addressed by the resources of single countries, but demand new levels and methods of international cooperation including an increasing role for science in facilitating progress (e.g. in complex negotiations around climate change mitigation nd adaptation).

***Science in markets and trade***: Given increasing scrutiny of the identity, origin, safety and integrity of products and producers, businesses are coming to scientific institutes for help with innovation and differentiation (e.g. in biological materials). More than ever society is granting social licence to operate and thus society needs to be factored in as a major stakeholder within science, business and governance.

***Science as an evidence platform***: Policymakers need better evidence to support policy development, implementation and evaluation as well as methods for 'experimenting' with policy options in safe but credible environments.

***Greater public involvement in science*** (e.g. climate change scepticism growing steadily over 18 months): requiring not only innovative methods but also authenticity in the engaging, communicating and marketing of science. These methods include greater public access to information through open-access data and commentary on the Web (reliable or otherwise) and social media (YouTube, Facebook, Twitter, etc.) as used powerfully by NGOs and increasingly by Government science entities.[3]

## New ways of doing science

To continue to innovate, New Zealand needs to be an early adopter of initiatives that simultaneously consider economic goals and the complexity of interactions and dependency of the economy on the environment and its ecosystems. Our environments are facing 'problems of national significance', which we align with the scientific term 'wicked problems' (Ravetz 2006; Verweij *et al.* 2006; Frame & Brown 2008). Our science must therefore be responsive to the growing need to engage with a range of 'stakeholders', including society, if it is to maintain relevance on the global stage and deliver the transformations demanded by the CRI Taskforce. Here we propose methods that reflect a move from deterministic to post-normal, and align with an emerging literature on how science is changing to include a much wider appreciation of social and cultural systems (Ravetz 2006; Verweij *et al*. 2006; Frame & Brown 2008; Berkhout in press).

***Engagement with a broader range of stakeholder communities***: This requires multiple groups of people to become more closely involved in decision-making and policy implementation, including people without formal institutional accreditation who have a desire to participate in attempts to resolve an issue. In this context extended stakeholder communities are a mechanism that enables the full range of relevant types of knowledge to emerge and develop into a meaningful solution. A high-profile example of this in practice has been the recommendations of the Land and Water Forum (http://www.landandwater.org.nz/) and their manifestation through practical examples such as the consultation processes developed as part of the Canterbury Water Management Strategy (http://www.canterburywater.org.nz/).

***Improved science–citizen relationships and civic responsibility***: Several factors have come into play as the interface between science and society becomes more blurred. First there is an increasing public scrutiny of science following events such as Climategate and GE debates. Second is a growing ethical involvement in the process of social progress through, in New Zealand, topics such as mining on Schedule 4 conservation land, agricultural development of the Mackenzie Basin, and the protection and remediation of iconic landmarks such as Lake Taupo. Third is the notion of 'corporate' and 'consumer' responsible citizenship which is providing important signals for New Zealand exporters and is seen as potentially a core part of national identity.

These factors suggest a bridging of the gaps between science, politics and business practice, and privileging individual choice to be responsive and responsible. Such developmens may lead public debate to a shift away from reducing local rates and towards greater civic responsibility for local environmental and social resources. The responsibilities of government, business and citizens may also move into the realm of post-normal science in which people are credited with multiple capacities and expertise that can support the co-production of knowledge about sustainability alongside professional experts. It assumes citizens have some expertise regarding sustainability issues in their own daily life and socio-political situations.

***Processes to deal with irreducible differences***: A societal shift is required to deal with aspects of some (but not all) forms of conflict. The desired approach respects varying viewpoints as the norm, remains open to ongoing debate and does not seek to reduce everything to a utopian consensus (Verweij *et al*. 2006). Such processes, termed 'agonistic', are being developed in New Zealand around natural resource issues following the Land and Water Forum as noted above. While these less adversarial approaches are new and provide new opportunities, they will not necessarily yield harmonious and peaceful patterns of co-operation. They will be much more about ongoing debate and,

[2] The term 'wicked' in this context is used, not in the sense of evil, but rather as an issue highly resistant to resolution, and the term wicked problem is an increasingly common research terminology to describe these highly complex irreducible issues ( Editor)

[3] Examples include the Department of Conservation (http://blog.doc.govt.nz/), the use of 1080 (http://sparrowscience.com/1080/index.html); the Royal Society of New Zealand 's Science Media Centre's Sciblogs (http://sciblogs.co.nz/ ); and the Informatics team at Landcare Research (http://wiki.zen.landcareresearch.co.nz/informatics/).

in some cases, conflict that will remain 'messy' rather than lead to a one-off solution. In other words, participants can compete and win, but never on a once-and-for-all basis. Institutions that enable experiments with such processes are providing approaches that steer courses between token environmentalism ('plant a tree to prevent climate change') and utopian fantasies (Save the Planet, etc.). As New Zealand engages with such approaches across various wicked problems, questions will arise as to the most effective mechanisms and how best to develop capacity and capability to engage with both ideological conflict and the complexity of power dynamics. It is into this role that New Zealand science can also start to create its own contribution through appropriate reflection and enquiry.

So science agendas will naturally change, but we hypothesise the biggest step-change will come from innovation and transformation in the way science engages, motivates and drives the future and we will now explore some possible directions for this.

## New ways of science engaging with society

New relationships are emerging within the science community to promote peer recognition of science excellence and mutual support for those contributing to highly complex global 'grand challenges' (e.g. greenhouse gas mitigation, food security, biodiversity loss, etc). In particular there have been several workshops,[4] to develop deeper understanding about the boundary between science and society (and especially the policy world) and how science can best contribute. While these are but tentative steps, the changes provided by the CRI Taskforce review and the creation of the Ministry for Science and Innovation (MSI) suggest that a new way of working is beginning to take place with an apparent move from transactional to transformational science. Increasingly, such partnerships will be facilitated by information technologies (e-science) in initiatives such as the Royal Society of New Zealand Science Media Centre's Sciblogs (http://sciblogs.co.nz/), which brings together New Zealand's science bloggers on one website, creating a hub for scientific analysis and discussion and facilitating reader interaction.

Changes will also be needed in relationships with the policy and business communities, through significantly better engagement with science to overcome the artificial barriers of the past, such as funder–provider models that worked against timely and flexible relationships. Science and scientists can be perceived as having a reputation of being difficult to engage with. Reasons include: the science is focused and deep rather than broad like a strategic issue; scientists may be unavailable when needed, unwilling to engage or comfortable in releasing knowledge that isn't in a 'perfect' or 'final' state; businesses and policymakers may be uncomfortable engaging with specialists; they may not feel 'in a safe space' for exploring options; easy access to apparently sufficient information through Google may be seen to suffice; etc. As a result, decisions may be inadequately informed by good science. What is needed is a safe space to explore options, benefit from tools and expertise that are fit for purpose and accessible at the right time, and engage in facilitated discussion with other stakeholders, where appropriate, using science resources.

Finally, relationships with public stakeholders will need to change. Through the Internet, and the scepticism born of technological misadventures, the public now challenges the trust it used to place in science experts. The public is, however, a reserve of insight into national and global issues that needs to be more consciously involved in science issues as well as the keeper and granter of licence to operate.

On this premise we believe there is considerable scope for transformation and innovation in the way science engages with its peers, policy and business communities, as well as public stakeholders. There are many pressing national issues which New Zealand has to address, but by their complex nature these issues are increasingly 'wicked' – defined as having high inherent uncertainty, polarised stakeholder viewpoints, high risks (to economy, society, environment) and no 'right answer'.

In Landcare Research we are discussing some specific initiatives, namely:

***Evidence Portfolios***: In the UK the Chief Science Advisor ensures each government department receives independent scientific advice and a summary of the source of evidence and its quality for every Cabinet paper. We note that already the Prime Minister's Chief Science Advisor advocates that government-specified questions should be supported by a multidisciplinary or transdisciplinary group (including scientists, practitioners, community representatives, etc.) that assemble an evidence portfolio of the best available thinking such as the adolescent demonstration project and the pseudoephedrine study (Gluckman 2009a, b). There has been no such application in the natural environmental space even though there is a clear need for comprehensive evidence portfolios in cases where irreversible decisions are to be made (e.g. mining on conservation land) and where, typically, decision-making processes are selective in their use of information. For example, the media reported that exploratory work is under way to determine the mineral resources beneath national parks without an investigation of the economic value proposition of not mining (considering non-market returns and benefits derived from biodiversity, iconic landscapes, health and well-being). Similarly, analysis of farming options in the Mackenzie Country appear to have omitted analyses of systems that link all aspects (energy, greenhouse gases, nutrient sources and losses, forage crop options, waste disposal options, animal health, etc.).

***National Conversations and the Foresight Engine***: Many far-reaching environmental decisions are taken in the public eye, with stakeholders adopting strongly held and opposing positions, supported by lawyers, and often excluding wider public debate. Other decisions are made by default and without debate, because the opportunities for a different vision of the future are not realised at the time. The rebuilding of Christchurch infrastructure after the earthquake may be an example of where a 'business as usual' approach is taken in spite of public calls for new vision.

A specific example of an improved method is the Foresight Engine concept as developed by the Institute for the Future in Palo Alto which involves thousands of participants to develop creative solutions to complex issues over a 24-hour period using crowd-sourcing technologies. In particular, in a global web-

[4] These include the NZAS conference 'Re-setting science and innovation for the next 20 years' on 21 October which produced the papers in this Special Issue; the 'Degrees of Possibility: Igniting Social Knowledge around Climate Change' workshop on 6 December 2010; plus activities of, among others, the Asia Pacific Science and Technology Studies network (www.esr.cri.nz/competencies/socialscienceandsystemsthinking/Pages/AsiaPacificSTSNetwork.aspx)

based experiment (http://water.signtific.org), the Signtific Lab Experiment E=$H_2O$ posed the question, 'How will the world work differently in 2020, as we try to manage the water/energy dilemma?' This micro-forecasting platform was developed to foster open discussion about the future of science. The Lab ran for 24 hours on 4-5 June 2010 (NZ time) and was supported by a 5 minute video clip, IEEE Spectrum reports plus a Lab blog that ran throughout, documenting the game, highlighting the key issues, and providing commentary on progress, as well as encouraging positive behaviours. Most of the players were engineers, researchers, and academics. More than 1200 players from 32 countries registered with over 5000 cards played over 24 hours - mostly from the hundred or so highly active players - which meant over 400 ideas per hour at peak times. All data were open-source and made available with those from the three other Signtific Lab experiments.

Such a device could generate high-value engagements by New Zealanders to showcase science and its contribution to resolving complex issues. Perhaps it could be around a question such as: 'What will the New Zealand economy be built on in 2025?' A New Zealand specific example[5] of how this might be implemented is being developed with a group of potential sector leaders in the public and private sector.

***e-Science***: As society's 'grand challenges' such as climate change and food security demand more complex analysis of ever-larger datasets, and global cooperation between scientists and other stakeholders, many countries have begun to invest in the infrastructure to support the sharing of knowledge (data, models) and high-performance computing resources. The New Zealand Government is about to invest around $30m over 4 years in national e-Science infrastructure, but investment in Australia, the EU and North America is an order of magnitude greater. Concurrent with developing the technology for e-Science, we need to develop people's ability and desire to make use of the new infrastructure so that this human interface is not neglected, as can be the case in information technology developments.

If New Zealand is to respond positively to the increasingly complex global challenges along the lines determined by the CRI Taskforce Review and other policy statements, we believe that there will need to be adoption of significant innovative methods in engagement over the coming years. If innovation is to be a critical component in the New Zealand science system, we must address these social issues as much as technological developments. For, as we noted in the opening, New Zealand by its very name is burdened with the perpetual pursuit of newness and this is nowhere more relevant than in science.

[5] http://www.landcareresearch.co.nz/research/research_details.asp?Research_Content_ID=137


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