

Bridging the gap between research and implementation – a personal view

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Presenting the results from experiments in the field is a common method for communicating research

Abstract

The New Zealand commercial forestry sector has been built on a century of innovation, much of it underpinned by research. The results of this research filled a knowledge gap and moving from output to implementation was a relatively linear progression. In the modern era of research and research funding, there is increasing scrutiny of research programmes by both public and industry funding bodies.

Effective means of ensuring that research creates the desired impacts are required. As the problems that we as a sector grapple with become more complex and involve a greater number of stakeholders, the traditional technology transfer approaches that have served us well in the past may become less effective. In this paper, I present a personal view on how we as a sector can become more effective at turning research outputs into positive outcomes.

Introduction

This article stemmed from a request from the Editor to talk about my role working both for Scion as a researcher and for Timberlands Limited. Rather than focusing on the specifics of my joint roles with these two organisations, I interpreted this as an invitation to discuss the role that research has played in getting the industry to where it is now and the role it will play in helping the industry achieve its future aspirations and overcome its future challenges.

More specifically, I wanted to focus on the challenges of converting research and research outputs into impacts for the forestry sector and how these might be overcome. As the title suggests, this is a personal view, albeit one that has been shaped by almost 25 years working in the sector. I am grateful for the discussions that I have had with many colleagues, both within Scion and outside it, which have helped to shape the views that I have expressed below.

I do provide a bit of a potted history of my career in forestry at the end, not as an excuse to blow my own trumpet, but to provide some examples of where research has hopefully made a difference. It also highlights that most researchers do not simply work in the same area for their entire career, but frequently re-invent themselves as new issues arise and also because of shifts in funding support.

An industry built on innovation

A century of innovation has supported the New Zealand forestry industry across the value chain from tree breeding, nursery propagation, silviculture, and the development of management and modelling systems, through to the processing and utilisation of radiata pine and other exotic species.

This innovation was born out of necessity when the 1913 Royal Commission on Forestry noted that our indigenous forests would not be able to supply the predicted future demand for timber and recommended the establishment of exotic plantations (Anon, 1913; Goulding, 2013). This was a start-up business on a large-scale, and it is interesting to note that in the current era much of the innovation is often associated with these types of businesses.

There were a number of challenges associated with the management and utilisation of a species that was not commercially grown anywhere else in the world at that time. To this end, there was a considerable investment in research and development to support the management and utilisation of radiata pine and other key exotic species.

The Forest Research Institute was established in 1947 as the research arm of the New Zealand Forest Service, but there was also significant in-house research capability in the private sector which managed about half of the rapidly developing plantation estate. Research activities focused across a wide range of areas including tree improvement, nursery practice, silviculture, wood quality characterisation, utilisation, and the development of management and modelling systems to support planning and decision-making.

Given that New Zealand was developing a new industry based on a species that was largely untested in a commercial sense, research was required to fill a knowledge deficit. In this case a relatively straightforward technology transfer approach proved highly effective, particularly as scientists were directly connected to forest growers and in many cases wood processors. There were also forestry extension agents whose role it was to facilitate the uptake of results from research.

The winds of change blew

This model of knowledge transfer served the New Zealand forestry sector well for many years. Since 1987 there has been a lot of change with the disestablishment of the New Zealand Forest Service, the exit of some established private companies, the entry of several new companies, the formation of the New Zealand Forest Research Institute Limited (now known as Scion) as a Crown Research Institute, and the introduction of contestable funding for research.

These changes have affected the way that research is funded, undertaken and applied. We have seen a shift from research cooperatives, based around a North American model, to more formal consortia-type structures for coordinating industry-good research activities which include (or have included) the Radiata Pine Breeding Company, Future Forests Research and the Wood Quality Initiative.

In 2014, the voluntary model of forest grower contributions to research was replaced by a compulsory levy for research and development under the provisions of the Commodity Levies Act (1990). This levy is administered by the Forest Growers Levy Trust and more than half of the monies collected from the levy are allocated to research. Funds are allocated to projects that address key industry priorities, including those identified in the Forest Growers' Science and Innovation Plan (NZ Forest Owners Association (NZFOA) & NZ Farm Forestry Association (NZFFA), 2017).

With these changes in funding, more formal structures for coordinating research, and increased scrutiny from central government on whether public investment in science is delivering value for money, it is beholden upon researchers and forest growers to look at the most effective ways of translating science into impact. This is not only confined to forest growing, but is an issue right across many sectors in New Zealand and overseas (Morgan, 2014).

In the primary sectors, the approaches used for transferring knowledge have tended to be linear, where tools are developed by a few (mostly scientists/researchers) and then extended to stakeholders (i.e. farmers/growers) (Vereijssen et al., 2017). This model worked well when there was an identified knowledge deficit and the problems being addressed did not require multi-stakeholder input, and also did not have to consider a range of social, economic, institutional and technical challenges. Given that many of the



Emerging opportunities such as the use of UAVs will require a systems approach that involves a number of stakeholders

industry's aspirations and challenges for the future fit into this latter category, traditional technology transfer approaches are likely to have a number of shortcomings.

From output to impact

Where research is not responding to an identified knowledge deficit, there can often be a so-called 'valley of death' into which a research output falls, never to re-appear. There are a number of possible reasons for this, such as:

- The research undertaken was not relevant to the end-user, i.e. it did not address their issue or problem
- Results were not made available in a format that could be readily used, e.g. a report rather than a decision tool
- The changes to operational practice required to implement the results would be too disruptive
- The institutional capacity required to operationalise the results was not available
- The impact resulting from the proposed changes was not known or was not well articulated.

There has been a considerable amount of study into the theory and practice around innovation systems, including those focused on the primary sector (Hekkert et al., 2007; Turner et al., 2014; Bayne et al., 2016; Vereijssen et al., 2017). The recently completed Primary Innovation research programme (www.beyondresults.co.nz/PrimaryInnovation) provided a mechanism for developing and sharing best practice around co-learning and co-innovation for the primary sectors, including forestry. I was fortunate to be able to participate in this programme and learn from national and international experts in extension and knowledge exchange.

Through this programme, I learned that for forest growing research to create the impact that I think all of us expect that it will, we need to have the following:

- A well-functioning innovation system
- A deep understanding of the problem from the viewpoint of many different stakeholders
- A framework that provides a pathway for moving from research activities, through to outputs, outcomes and finally impacts.

Without going into extensive details, some of the attributes of a well-functioning innovation system are the presence of entrepreneurs, knowledge development (i.e. research) and diffusion through networks, guidance in setting the research direction, formation of favourable market conditions for the introduction of new technologies, allocation of sufficient resources for knowledge production and the testing of new technologies, and the ability to counteract resistance to change (Hekkert et al., 2007). In other words, it is more than just undertaking good research, but clearly this is an important component.

A co-innovation approach to research and development

A deep and shared understanding of a problem is one of the key principles of co-innovation, which



Working across both Scion and Timberlands

in turn is an approach for addressing more complex problems in industries and society. Complex problems are those that often span large parts of the value chain, have multiple stakeholders, involve contested knowledge, and may have winners and losers resulting from a particular outcome. Much of our biosecurity-related research in the forestry sector would arguably fall into this category.

It is important for researchers to not only develop their peer networks with other researchers, but also with people in industry, as these connections help us to better understand each other's perspectives and to develop a better understanding of the issues and challenges.

This gets me finally to my joint role at Scion and at Timberlands. Having these two roles was an opportunity to work more closely with industry to understand their needs and to co-develop research to address future aspirations around productivity enhancement through improved silviculture. Working part-time for a forest grower helps provide insight into the wider implications of the research, including the practice changes that would need to happen in order to create the ultimate impact.

The other real benefit of working in a company, as opposed to simply visiting, is that you develop a better understanding of the operational functions within it. This is important as a key function of a successful innovation system is resource mobilisation, i.e. for innovation and impact to occur sufficient human and financial capital must be made available. It is important to understand whether existing human and financial capital can be redeployed to effect change or whether additional capital is required.

In his presentation at the inaugural conference of the Growing Confidence in Forestry's Future programme, James Turner from AgResearch noted that successful co-innovation in practice has the following five elements:

1. Participation of multiple stakeholders.
2. Development of a systemic view of the problem.
3. A broker or brokers combining elements of the solution.
4. Solutions that emerge from interactive learning.
5. Resources for ongoing testing and development.

By working more closely with industry, I hope that we can co-develop solutions to the more complex challenges we will face in the future. There is still a role for more simple methods for creating impact from research, but even these require researchers and industry to work together if they are to work effectively.

Role of formal and informal networks

Hopefully, the previous discussion has highlighted the importance of social networks in driving innovation. These networks are not only essential for facilitating

the dissemination of knowledge, but also for getting participation by multiple stakeholders that leads to the development of a systematic view of the problem.

The New Zealand forestry sector is relatively small and there are a number of formal networks (professional bodies, advisory groups, industry associations etc), but there is also huge value in the personal, informal networks that exist. We possibly take this for granted, but it is a significant asset for our industry.

My own experience of working across science and industry

I joined the Forest Research Institute in 1994 and during the past 24 years have been fortunate to have worked on many projects that have led to peer-reviewed journal papers (the currency of choice for most scientists), but have also (hopefully) created impact for industry and government. These include:

- Management of forests to reduce wind damage risk
- Development of a national system for carbon monitoring in planted forests (LUCAS)
- Wood quality and utilisation potential of British-grown softwood species
- Quantification of genetic gain for growth and wood properties in radiata pine and incorporation of this information in management systems
- Silviculture of radiata pine with a focus on productivity and profitability enhancement.

Silviculture is an applied discipline which integrates research from across a wider range of fields in order to understand the implications for growing stands of trees. As such, it naturally fills a brokering role within a research organisation and from research to industry. I have been very fortunate in my research career to have been mentored by people who have shared and shaped this view. I am indebted to Drs Bruce Manley, Doug Maguire (Oregon State University) and Barry Gardiner (Forest Research, UK and now European Forestry Institute) who emphasised the importance of not only doing good science, but being able to communicate it to practical foresters.

In 2016, I was asked if I was interested in a secondment with Timberlands Pacific Limited, a company that manages radiata pine forests in Tasmania and South Australia. Initially, I was a little hesitant as this was something quite different for me. However, it was a really enjoyable and rewarding experience where I learned a lot about the forestry planning cycle and the challenges faced by forest managers.

In early 2018, I moved to Timberlands Limited, the company that manages the forests owned by the Kaingaroa Timberlands Partnership, as a member of the technical team. The company is focused on sustainably increasing forest productivity, which aligns with my research interests. With this joint role, I am able to focus on research to increase productivity and then grapple

with the practical challenges of implementing this in a large forest estate. It is an exciting opportunity that not only benefits one company, but the wider industry, by helping researchers and industry to co-develop solutions to emerging challenges and opportunities.

I am very excited about the future of forestry in New Zealand and the role that forests can play in addressing many of the challenges that society faces as we look to transition to a low-carbon economy based around renewable resources. To achieve these goals we need researchers, forest growers, policy-makers and other stakeholders working closely together to ensure that research outputs are not consigned to the valley of death.

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