Priorities, capability and potential models for RD&E for the forest and wood products in Australia- if the model is broken, what is the new model?

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Abbreviations

ABARES	Australian Bureau of Agricultural Resource Economics and Sciences
ACIAR	Australian Centre for International Agricultural Research
AFPA	Australian Forest Products Association
ANU	Australian National University
APPI	Australian Pulp and Paper Institute (Monash University)
AWRI	Australian Wine Research Institute
CRI	Crown Research Institute (New Zealand)
CRC	Co-operative Research Centre
CRCFFI	CRC for Future Farm Industries
CSIRO	Commonwealth Scientific and Industrial Research Organisation
FPI	Forest Product Innovations (Canada)
FT	Forestry Tasmania
FTE	Full time equivalent
FWPA	Forest and Wood Products Australia
GWRDC	Grape and Wine Research and Development Corporation
IPMG	Industry Pest Management Group
IUFRO	International Union of Forest Research Organisations
NSW DPI	New South Wales Department of Primary Industry
QDAFF	Queensland Department of Agriculture, Forestry and Fisheries
RD&E (R&D)	Research, development and extension
SCU	Southern Cross University
STBA	Southern Tree Breeding Association
SRA	Sugar Research Australia
UMelb	University of Melbourne
UQ	University of Queensland
USC	University of the Sunshine Coast
UTAS	University of Tasmania
UTS	University of Technology Sydney
UWS	University of Western Sydney

Preamble

The Forests and Wood Product Sector RD&E Forum constituted under the National RD&E Framework for Primary Industries developed and adopted a set of National Research Priorities in 2013 as means of focusing discussion on future strategic research for the sector and a framework for future organisation and investment. This paper explores the national capacity to address these priorities, discusses the main issues confronting R&D provision for the sector, explores a number of models for delivery, and finally discusses options for international collaboration.

The work of the Forum in thinking about future sector R &D provision is coincident with the AFPA proposal for a National Institute of Forest Products Innovation. At this time the latter is a vision and one possible organisational model for sector R&D. This discussion paper has been prepared to canvas issues and to help stimulate ideas and discussion about the way forward for the sector.

Part 1: Future priorities and current capability

In the consultations leading up to the drafting of the National Research Priorities for the Forest and Wood Products Sector, participating agencies were asked to identify existing research capabilities and key work areas. While the key work areas that were identified could be loosely mapped to the priorities, there was no clear picture of the current investment profile against those priorities at a national scale, and the current capability to meet those priorities. Investment and capability can be characterised as active (work currently under way that addresses one or more of the priorities directly) and latent (existing expertise and infrastructure that has the potential to address priorities, but that may currently be committed to work in other areas). Several assessments of RD&E capability and investment have taken place in recent years, which have highlighted the rapid changes and decline in both RD&E investment and capacity taking place across the sector.

Part 1 therefore provides a brief and approximate overview of the relationship between investment by the main research organisations in the Australian forest and wood products sector and the National (Forest and Wood Products Sector) Research Priorities. It is based on existing reports and assessments, including background material provided to participants in the March 2013 Research Providers meeting, and consultations with representatives of all the major agencies. The assessments presented here are approximations only, and the data have only been partially validated, since responses were not received from every agency approached at the time of drafting this report. Nevertheless, we maintain that the overall picture that would emerge from a more detailed, precise and inclusive data collection exercise would not be substantially different to the one presented here.

The approach used involved an assessment of staffing levels as reasonable surrogate for investment. The results are superimposed on the National Research Priorities.

The data used are input measures (FTE staff). Classification errors or inconsistencies will have arisen through the assignment of staff to a given priority – an imperfect match at best. It is also likely that despite the best intentions, staff FTE may have been double counted across distinct but similar priorities – the larger than expected total of FTE would suggest this. Greater accuracy of active capacity could be obtained by looking at output measures such as publications or reports, but these are not necessarily easily assigned to particular research priorities and tend to carry greater importance in citation focused organisations (universities and CSIRO) than they do in state agencies. This report does not take into account research carried out by private sector organisations for the most part. This appears to be at a low level and in the most part would be classified as applied development rather than research.

Results: Draft National Research Priorities showing indicators of activity, investment and capability.

These research priorities support the goal of an economically prosperous and environmentally sustainable forest products industry that is recognized and supported for the multiple benefits that it provides to Australian society.

Australia's demand for wood products is increasing in line with our growing population. There are opportunities to expand this market through increasing the use of wood in the built environment and developing new generation products and wood-based biomaterials and bioenergy.

However, Australia's forest products industry exists in a market economy and must compete for resources (capital, land and labour) based on return on investment (ROI). Biological and technological innovation to improve productivity, reduce costs, diversify products, manage risk and demonstrate sustainability are national R and D priorities for the industry.

A. More volume and value from the existing and an expanding estate

1. Continued development of commercially valuable genotypes.

Investment in this area has reduced in recent years but current active groups include CSIRO, STBA, QDAFF/USC, UTAS and UMelb. Groups that maintain latent capability and/or current activity indirectly related to the goal include UTAS, UMelb, and possibly SCU. While research providers maintain that there is a substantial amount of work continuing in areas such as genomics and conservation genetics, there is diminishing emphasis on commercially valuable genotypes *per se*. This reflects commercial investment: private sector demand for improved *Eucalyptus* genotypes is stalled at present, although there is still steady demand for improved softwood genotypes.

Active Capacity: Total of approximately 14 FTE across at least 9 organisations
Latent Capacity: High in 7 organisations, Medium in 2 organisations.

2. *Develop integrated genotype x environment x management regimes adapted to future growing conditions or new environments and that minimize losses from pests and diseases.*

CSIRO in collaboration with others continue related work in this area, but not with a strictly commercial focus (e.g. the $4m Science and Industry Endowment Fund project with ANU and UWS). UTAS are working with Greening Australia on environmental planting projects that touch on aspects of this priority, but no agencies are working to directly address the priority at present, *from a commercial forestry perspective.* Latent capability within QDAFF, UMelb, SCU and USC and other agencies is still relatively strong in growth and yield

modelling, reforestation and to a lesser extent, silviculture.

Active Capacity: Total of approximately 6 FTE across at least 4 organisations
Latent Capacity: High in at least 4 organisations.

3. ***Widen the base of forest producers through fostering wood and carbon production in Indigenous communities and privately owned native forest and the integration of forestry within agriculture and conservation land uses.***

A small amount of work is taking place in collaboration with Indigenous communities, and there is a reasonable spread of small-scale, farm-forestry, carbon capture and related projects being carried out by a range of organisations including SCU, FT, QDAFF, CRCFFI, UMelb and UTas. Latent capability is reasonably strong across a range of institutions. It should be noted that a number of smaller scale private businesses and consultancies have been recently active in this area following provision of funding under the Commonwealth Carbon Farming Initiative.

Active Capacity: Total of approximately 11 FTE across 7 organisations
Latent Capacity: High in 5 organisations, Medium in 2 organisations.

4. ***Increase the value recovery from the available forest resources from native and planted forests***

Activities in this area include innovations in veneer recovery and use (QDAFF, FT, UMelb, UTAS), some work on engineered wood products (QDAFF, UTS, FT, UMelb) and a range of biomass utilisation, bioenergy and bio-refinery investigations that are mostly in preliminary stages (USC, CSIRO, NSWDPI, CRCFFI, SCU and a variety of private sector initiatives).

Active Capacity: Total of approximately 11.5 FTE across 5 organisations
Latent Capacity: High in at least 5 organisations.

5. Assess opportunities for resource expansion to meet future markets

ABARES and state agencies have previously undertaken a considerable amount of work in this area including a number of land capability assessments that remain current. State agencies maintain some activity. For example, QDAFF has recently completed a Land Audit, which has identified areas across Queensland with potential for expansion of agriculture and forestry to meet future markets.

Active Capacity: Total of approximately 3 FTE across 2 organisations
Latent Capacity: High in 2 organisations.

Rationale: Australia's planted forests now supply >85% of harvested wood. Sustainable increases in productivity can improve ROI while genetics and silviculture can also improve wood properties, adaptability to a changing environment and reduce pest losses.

Maximizing the value of products produced also allows opportunity for increasing grower ROI.

B. Supply chain optimisation and manufacturing productivity

1. ***Improve the efficiency and reduce the costs of harvesting and transport operations***

A 5-person research group at USC (formerly CRC Forestry RP 3) is focusing on this area, with a small amount of co-investment from the private sector.

Active Capacity: Total of approximately 3 FTE in 1 organisation.
Latent Capacity: High in 1 organisation.

2. ***In-field log segregation and pre-processing options to minimize processing costs.***

QDAFF has work underway to look at low-cost, in-field log segregation options, including acoustic and in-field NIR sampling. USC is involved in research of acoustic tools integrated in optimising harvesting heads. This area used to be strongly led by CSIRO, but this no longer appears to be the case.

Active Capacity: Total of approximately 4.5 FTE across 2 organisations
Latent Capacity: High in 2 organisations.

3. ***Innovation through new technology, training to better utilize that technology, and, optimized manufacturing to reduce costs and increase profits in existing manufacturing operations.***

There appears to be relatively little domestically focused capability in this area that is now largely dependent on investment overseas via mechanisms such as New Zealand Research consortia to provide technology development and expertise. QDAFF and UMelb are involved in overseas, ACIAR funded technology transfer projects to increase profits in existing manufacturing operations through adoption of new technologies and training to better utilise technologies that helps maintain some capability.

Active Capacity: Total of approximately 5 FTE across 3 organisations
Latent Capacity: High in 2 organisations, Low in 1 organisations.

Rationale: To compete in a high cost economy innovation is required across the supply chain and manufacturing processes to reduce costs and maximize resource utilization. At the same time there is opportunity to introduce new process and products.

C. Know, grow and diversify the market

1. Develop an improved understanding of international market and technological developments to aid their deployment in Australian industry.

Activities in this area are sporadic, and largely supported/coordinated by AFPA,FWPA and the Gottstein Trust via Fellowship awards (e.g. recent Canadian study tour organised by AFPA). No evidence of systematic research in this area.

No organisations identified active or latent capacity for this priority.

2. *Identify opportunities to use wood fibre based products and systems in the built environment and to refine building standards accordingly.*

Some activity by UTAS, UTS, UMelb and supported by FWPA. QDAFF/UQ has capacity in this area and is working to develop systems to use a range of wood products and systems in multi-story construction and to refine building standards, particularly fire regulations, accordingly.

Active Capacity: Total of approximately 9 FTE across 4 organisations
Latent Capacity: High in 4 organisations.

3. Research to identify barriers to innovation and support the development and introduction of new wood fibre based products including bio-materials, chemicals and energy.

A number of activities, but all in early/pilot stages. Deakin University has established the Australian Future Fibres Research and Innovation Centre (AFFRIC) which is developing a research program focused on next generation biomaterials. The Bioresource Processing Research Institute of Australia (BioPRIA), recently augmented by an ARC grant under the Industry Transformation Research Hubs program, is also investigating the creation of value added materials from wood resources. Latent capacity within the traditional forest products R&D community is weak in areas such as biomaterials (except possibly CSIRO) but technology can be sourced from overseas although adaptive research is still required for Australia.

Active Capacity: Total of approximately 15 FTE across 3 organisations
Latent Capacity: High in 2 organisations. Unknown within non-traditional R&D providers.

Rationale: Apart from the market benefits of effective competition against substitute products, wood products are renewable and deliver environmental benefits through low emissions in manufacturing and carbon storage in use.

D. Resource risk management and biosecurity

1. ***Improve understanding of risks and the appropriate mitigation strategies across the value chain.***

Research activities are fragmented with no agencies taking a whole-of-value chain approach, although several are discussing it. There has been a large effort (mainly CSIRO) to evaluate longer-term climate related risk with some focus on mitigation strategies. Other organisations are looking at aspects of risk and mitigation (climate variability, fire, pests, pathogens) but often with more of an ecosystem, as opposed to a commercial, focus.

Active Capacity: Total of approximately 3 FTE reported by one organisation only.
Latent Capacity: High in 1 organisation.

2. ***Develop models to predict and assess impacts of key risks particular changing incidence of pests, climate change and attendant risks of increased fire incidence, changing rainfall patterns and drought.***

This is a focus of work for CSIRO, not confined to the production forest estate, but there is a significant investment in modelling tools. Bushfire CRC has done a substantial amount of work on fire risk (including climate change related) that is likely to continue. QDAFF/USC /NSWDPI also have capacity in this area, with expertise in entomology, pathology, carbon sequestration/cycling and fire ecology with a particular strength in Myrtle Rust research and development. Capacity also exists in several of the universities and CSIRO.

Active Capacity: Total of approximately 14.5 FTE across 7 organisations
Latent Capacity: High in 5 organisations, Medium in 2 organisations.

3. ***Contingency and response plans for exotic pest introductions.***

Most state agencies have activity and capability in this area but overall level of investment is in decline, as is latent capacity. The loss of capability is to some extent moderated by integration of commercial forestry into national emergency response arrangements via Plant Health Australia.

Active Capacity: Total of approximately 6 FTE across 5 organisations
Latent Capacity: High in 5 organisations.

Rationale: The longer-term nature of forests in the landscape means they are exposed to a range of risks including climate change, fire and potential exotic pest introductions with impacts that range from reduced growth rates to complete loss of resources with impacts on growers and processors. This risk must be assessed to determine if incremental adaptation can occur or transformational industry change is required.

E. Environmental and social sustainability

1. ***Development of improved measures to assess forestry as a sustainable land-use and approaches to manage environmental impacts.***

CSIRO Sustainable Agriculture Flagship maintains strong capability in this field. Latent capability exists in many agencies; there is some activity in state agencies, but little evidence of systematic effort. UMelb and CSIRO have a substantial capability in catchment hydrology and water resources in relation to forestry as a land use.

Active Capacity: Total of approximately 7.5 FTE across 6 organisations
Latent Capacity: High in 5 organisations, Medium in 1 organisation.

2. ***Provide the knowledge base to underpin improved forest industry policy.***

This is a broad priority. Most state agencies or organisations funded by states are carrying out some applied work that would fall under this priority but there is no major national forest policy research capability.

Active Capacity: Total of approximately 3.5 FTE reported across 2 organisations
Latent Capacity: High in 2 organisations.

3. ***Research to understand the social concerns about production forest management and to enable managers to develop new management approaches that respond to these concerns.***

No obvious strong concentrations in this area with a forestry focus since CRCF/ANU work in this area, although there is latent capability in universities (Universities of Canberra and Melbourne) and CSIRO.

Active Capacity: Total of approximately 0.5 FTE across 1 organisation.
Latent Capacity: Medium in 1 organisation.

Rationale: Forest industries are subjected to rigorous environmental scrutiny. There is an ongoing need to expand the knowledge base for science based decision-making and policy development for an industry that is based on a renewable resource and can provide multiple benefits across the social, economic and environmental domains.

Conclusions

In total, 105 FTE were counted as actively engaged across the priorities, representing a high proportion of the FTE scientists engaged in Forest and wood products R&D nationally. The distribution of existing effort across each of the headline national priorities is as follows:

A. More volume and value from the existing and expanding estate: 43%
B. Supply chain optimisation and manufacturing productivity: 11.9%
C. Know, grow and diversify the market: 11.4%
D. Resource risk management and biosecurity: 22.3%
E. Environmental and social sustainability 10.9%

This is further broken down in the figure below. In most cases, reported latent capacity was tightly correlated to active capacity.

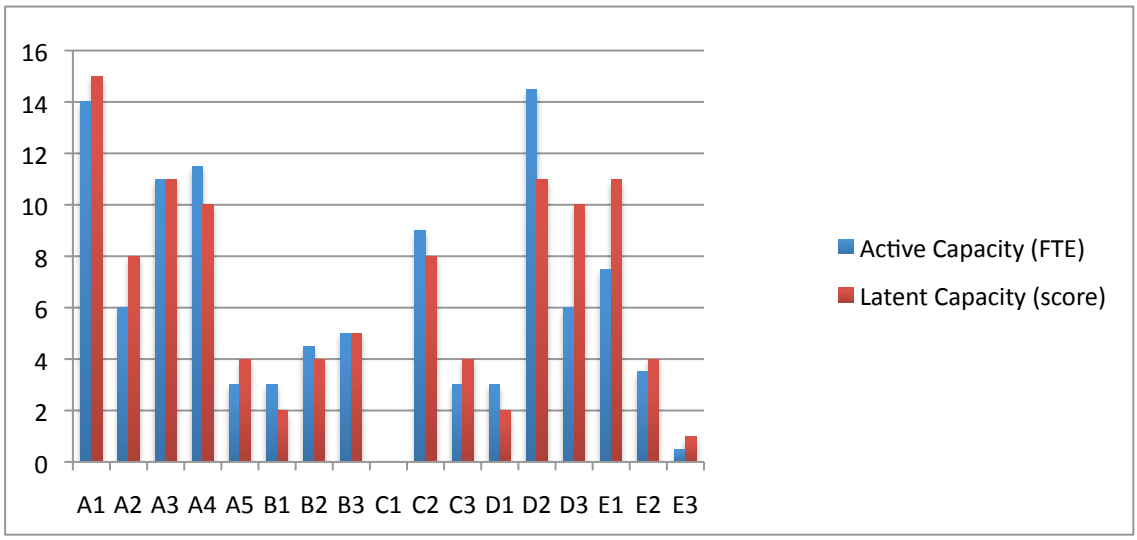

Figure shows FTE as reported/estimated to be active in each of the national priorities, or latent capacity scored as the sum of organisations with high (2), medium (1) or low (0.5) capacity.

Summary commentary

Priority A - More volume and value from the existing and expanding estate

This priority area remains the largest investment area and Australia retains the capacity to be strong in tree improvement and deployment strategies. There appears to be moderate capability in relation to value recovery although much of the strategic research capacity has been lost. There appears to be expanding participation in forest production and resource expansion, but targeted at an increasingly diverse array of outcomes in addition to commercial production and harvesting. There is little market analysis expertise available in public organisations, so much of the effort in tree improvement assumes that future market drivers will be similar to current ones.

Priority B - Supply chain optimisation and manufacturing productivity

There is a core group in the harvesting and supply chain optimisation area, but this is heavily reliant on external funding and most of the members of the group remain on short-term contracts. Much capacity in terms of wood quality assessment and segregation has been

lost but there is some available, and efforts are being made towards consolidation and collaboration. Capacity for wood processing innovation is now minimal.

Priority C - Know, grow and diversify the market

In general this area is weak in public institutions although perhaps with most capability in relation to priority C2 (use of wood in the built environment). It can be argued that understanding and development of markets is more the province of the commercial sector, supported by the public institutions in some instances. There is relatively little capacity available to respond to emerging processes and markets for bio-refinery products and biofuels, although interest in these areas is growing.

Priority D - Resource risk management and biosecurity

This remains a relatively strong area overall although some areas are now fragmented e.g. forest health. Strong process based modelling capacity remains which can be deployed to address a variety of issues – e.g. productivity in new environments, climate adaptation. However, much of this capacity is currently focussed on areas other than production forestry, such as carbon farming, food production or biodiversity.

Priority E - Environmental and social sustainability

A strong area of investment over the last decade but in rapid decline although some of the capacity has been deployed to other areas and can be considered latent. Strategic capacity to underpin future forest policy also appears to be fragmented or diminished. If we are to realise aspirations for future expansion of the sector, research capacity in this area will be critically important..

Part 2: Issues, questions and principles

The analysis in Part 1 raises a number of issues and principles that need to be recognised as part of developing a new R&D model.

1. Why have we reached this situation?

The precipitous decline in R&D capacity and capability is linked to:

- The changing business model of forestry with increasing privatisation of plantation resources and rationalisation of industry firms, and a corresponding reduction of investment in R&D by the public sector;
- A short term focus in difficult economic times;
- Lack of demand or unwillingness by industry to invest in strategic R&D.

We are witnessing structural as well as cyclical change and a new model for R&D provision is required recognising that there is probably a smaller market for commercial forest and wood products sector R&D than in the past. The traditional role of state agencies in forest research is probably approaching an end game. Only Forestry Tasmania retains a small in house capacity, other industry entities (resource investors/resource managers/corporatized state entities) are in the main research purchasers not research providers. Only QDAFF and NSWDPI have identified forest/forest product research groups within larger research divisions, supported by government appropriation and external contract funding. Victoria has a different strategy where former state research staff has been moved to the University Melbourne and the state contracts for research services with that entity mainly for native forest ecosystems research. Commercial forest and wood processing R&D is dependent on external contracts.

2. Fragmentation and lack of scale.

Fragmentation of R&D capacity in Australia is a major weakness compared with other countries (e.g. Canada, New Zealand, Finland), and this fragmentation has become more acute in recent years with the structural changes in CSIRO and the windup of the CRC for Forestry. There are increasingly fewer organisations with any real scale or critical mass, and many of these are hampered by insecure funding, changing internal priorities and consequently increasing proportions of staff on short-term contracts. Whatever future organisational, coordination and funding models are to be considered, there is little doubt that some consolidation in key areas of the existing, fragmented effort and investment will be necessary if we are to retain and grow strategic RD&E capability and capacity. As is the case with Grains Research and Development RD&E strategy this indicates the need to move to more of a partnership vs. competition model.

3. Which part of the value chain?

The results of the analysis in Part 1 show more investment in the forest growing to mill door elements of the supply chain, which is both historical and reflective of where there is market failure that justifies public investment. A rule of thumb based on past studies of sector research in developed countries was a two thirds - one third split in public investment in forest growing and to the mill and wood processing and products. Is this a reasonable balance, or should we be looking at changing the relative spread of effort and investment? To a certain extent, the national priorities reflect the *status quo,* a consequence of the substantial role played by existing agencies and research providers in their development. However, even with that inherent potential bias, there is a very uneven spread of effort across the priorities. What would a desirable profile look like?

What are the priority areas for domestic (publicly funded) investment, and which are the priority research organisations that investment should be focused in to give those organisations confidence to continue to co invest? In order to answer these questions we first need to differentiate between strategic, precompetitive research and applied R&D. Much of the focus in industry and state agencies is on the latter when the particular business concerned seeks to capture the full benefit. Applied research by individual companies on areas further along the value chain such as product testing and market analysis will obviously continue and is therefore not the primary focus for this discussion.

4. Domestic or overseas?

With the dismantling of R&D capability and capacity in Australia we have little or no capability to develop new technology in forest information technology systems, harvesting and transport, processing and manufacturing technology or the product innovation areas of the sector. The Australasian market, being of a relatively minor scale compared to Europe and north America, cannot support an equivalent R&D effort in the harvesting and processing sectors. Much of this part of the value/innovation chain is in the hands of the equipment suppliers (increasingly consolidated) or smaller, innovative companies (sometimes subsidiaries of research organisations). Hence awareness of, access to and rapid introduction of new technology and products developed outside Australia are increasingly important to the competitive position of the industry. The role of Australian researchers in these areas are likely to be increasingly focused on undertaking adaptive or translational research for the application of such technologies in firms operating in Australia.

Should we try and redevelop expertise where we have lost it or try and build some scale where we have expertise to build on? We need to recognise we are mendicants in some areas and get better at adopting new technology from elsewhere more rapidly. Whilst there is discussion of buying research expertise in from overseas, this is a far more viable option in the down stream processing and products end vs. the upstream growing end. This topic is discussed further in Part 4 of this discussion paper.

This suggests Australia needs to concentrate on being first rate in a few research areas (rather than second rate in many) and rely on overseas project investment or translational research in areas where it is commercially and intellectually property wise viable to do so. This would have potential consequences in terms of institutions as it will not be possible to keep numerous small groups viable with supplemental external funding with the need to focus investment in R and D organisations that have expertise in priority areas.

5. Will industry invest?

Finally, discussion about new models of research provision is pointless unless industry is prepared to invest at a realistic level. It has been Australian Government policy since the late 1980s that industry (especially those seen as mature) is expected to co invest in its own future, and the government's expectations have moved towards an increasing proportion of the costs of research being carried by the private sector. In the primary industries that led to the RDC model and its evolution since that time. The forest and wood products sector has always been at the rear of the pack in terms of investing through this mechanism. The industry is now seeking additional government funding to establish a new R&D model. If such funding is to be forthcoming industry will be required to significantly increase its investment above the current very low levels. Given the history it is not evident it is prepared to do so without significant leadership.

Part 3: Options for a new model

In order to approach a shared vision for a new model for strategic R&D to serve the Australian forest and wood products sector, it will be helpful to explore the strengths and weaknesses of a range of models. We acknowledge that the views expressed in this analysis are based on our own experiences but put forward to stimulate debate on the positions we advance. However, we maintain that it will be necessary to be realistic in terms of the scope and scale of what can be done in Australia, and therefore if the model is to succeed it will be necessary to take a disciplined approach to identifying and adhering to priorities for investment of, and co-investment with, publicly funded resources.

Maintaining and building the capability to address the national research priorities will require clusters of research capability across a range of key disciplines or discipline groups. Irrespective of the model chosen to coordinate, direct and support the national research effort, any structure will consist of a number of groups of experts, each within a broad research or technical discipline. This will apply even in the case of multidisciplinary activities.

We believe that a relatively small number of discipline groups (identified below) can address all of the national research priorities. We have made an attempt to classify these discipline-based groupings into areas for major, medium or relatively minor investment, and where possible have identified the best-positioned research providers (a centres of excellence investment model) as leaders for this investment. This is followed by an analysis of some of the organisational models on offer.

1. Tree breeding and genetics A(1),A(2) – Major future investment

Australia's wood supply is increasingly plantation based. Tree breeding has previously delivered improvements in growth rates, tree form and increasingly, wood properties. Breeding/selection for pest resistance and climate adaptation will become more important in the future. Molecular technologies will help to increase the rate of genetic gain. Australia has been first rate in this area in the past and needs to be in the future. Importation of overseas-bred material (e.g. eucalypt clones) has proved unsuccessful and while creating a single breeding programme for *Pinus radiata* in Australia and New Zealand is often promoted, the advent of pitch canker in New Zealand would stop the importation of genetic material. Australia also breeds other pine species with potential spill over benefits from radiata pine R&D.

CSIRO already has the quantitative and molecular genetics skills and is major centre of commercial plant breeding. Tree breeding can benefit from technology and infrastructure available for other crops, and CSIRO has a big skill base in commercial plant breeding.

Several universities have strong tree genetics discipline-based teams and play a significant role in research training, but are not as strong in the applied, commercially focused areas of tree breeding.

2. Predictive capacity and risk management D1, 2, 3 (link to A (2)- adaptive silviculture) -Major future investment

Predictive capacity for growth and yield, pests and adaptation to climate change resides in process based models and their adaptation into user-friendly decision support systems. CSIRO are the major players in this field. Forest health capacity exists in a number of institutions and forest health needs to be organised on a network basis to provide national coverage. The most likely lead institution is NSW DPI. One option could be for an agency such as DPI NSW rto un a national forest health surveillance system that could bring in revenue to support that operational function and research. FWPA previously developed a business case for a forest health network based on the IPMG model At the time, most major forest growers indicated that their preferences were to maintain some form of in house capacity and to engage contractors in the event of a major outbreak in a form of 'self-insurance'. More recent discussions have indicated that forest growers are becoming more receptive to the concept of a distributed network of expertise that could be drawn upon in the event of an outbreak as well as to provide redundancy backup to any existing internal arrangements.

3. Market knowledge A (5), C (1) - Minor future investment

While research and research capability in this space is neither pre-competitive nor the province of publicly funded organisations, some capacity to forecast future markets is critical to decisions about contemporary tree breeding, deployment and site selection – decade-plus time lags between breeding, deployment and harvest require some sense of future product demand and likely preferred processing technologies and product characteristics.

4. Harvesting and transport – supply chain logistics, pre-mill segregation technology B (1), B(2) - Medium future investment ***(including the investment needed for technology adaptation and transfer)***

Required research in this area is generally a long way down the applied end of the spectrum, and comments made previously regarding importation and adaptation of technological advances made elsewhere apply particularly in this case. Nevertheless, because of the very significant cost reductions that can be made through relatively small efficiency gains, maintaining capability to adapt and evaluate new technology in this area will continue to yield significant benefits. There is currently a small but viable research group at Sunshine Coast University and focussing investment and industry engagement with that group will help to maintain viability.

5. Value recovery, processing efficiency A(4), B(3),C(1) - Medium future investment

While technological advances continue to be made overseas, they mostly require adaptation to Australian resources. QDAFF have the only significant facilities for applied development work in veneering, sawing and drying. It is therefore logical to focus Australian investment on that group, with some possible co-investment overseas (New Zealand?) in some areas. Value recovery also includes other new products and processes (bioenergy, bio-refinery products) that need to be addressed separately.

6. Timber engineering, building systems - Medium future investment

Similar to 5 (above). Adaptation of building systems to Australian conditions, standards and regulations will continue to be an important precursor to the expansion of timber-based building systems. Expertise mostly resides in universities: UTS, UQ and to a lesser extent UTAS? .

7. Biomaterials, bioenergy A (4), C (1) – Minor future investment

Value adding to residual biomass is highly desirable in terms of industry economics and environmental outcomes. However, biomass tends to be widely distributed and commercially viable processes require low cost material, a criteria that may be difficult to meet for woody biomass in Australia.

APPPI is the current investment node for pulp and paper. Other biomaterials, chemicals and bioenergy: a range of organisations working on scoping/pilot projects, including the adaptation of overseas technologies to Australian resources, and the logistics of commercial-scale supply of raw material for processing biofuels and other bioproducts (see 4 above). In reality in spite of the promise there has been limited progress in establishing new commercial biomass processing in Australia over the last 15 years.

8. Policy/ sustainability (economic, social and environmental) E (1), E(2), E(3), A(3)- Medium future investment

Research in this area can largely be done on a project basis tapping generic skills in ABARES, Universities and CSIRO. The establishment and retention of a forest industry policy 'think tank' may be worth considering. Investment will be necessary to encourage these institutions to focus on the forest sector.

What sort of organisational model?

FP Innovations model -three funding streams (Provincial, Federal, Industry) with a significant percentage (80%?) still derived from government. Staff distributed in east and west centres in Canada. Some collaborative arrangements with universities, and co-location of some facilities on university campuses but staff are FPI employees. Product (from forest to

market) focus with forest research *per se* being done by the Canadian Forest Service and provincial research centres.

Scion – national institute (one of seven CRIs). Two centres (North and South Island) – money from Government appropriation and external earnings (much of it recycled government money). Forest growing to markets. Forestry represents approximately 20% of New Zealand GVP, has major emphasis on one tree species with limited environmental diversity. Industry privatised for longer than in Australia but a mechanism for collective precompetitive industry investment in R&D has been a long discussion with recent agreement for an industry levy to help support R&D and industry services.

Australia- The situation in Australia is made complex by a diversity of species and growing environments, and plurality of research systems (although that is changing with rapid decline in State forest agency investment, as management of plantation resources is transferred to the private sector). Given these complexities, most discussions have led to a hub and spoke model delivering national, strategic programs. Any future model will need stronger translation research capability than current or previous arrangements if we are to take advantage of opportunities to adopt and adapt overseas technology and innovations.

What type of hub and spoke model?

a. Modified CRC or Centre of Excellence type model:
an incorporated entity, with participant agency staff assigned to work on national programmes. Headquarters can be anywhere but co-location with a university is preferable in terms of access to post-graduates. Such a centre could be established relatively quickly. This is a co-investment model with a small number of organisations forming the core. These organisations get some reasonable return of their investment but the arrangement doesn't exclude other projects being funded with non-core organisations.

Other strengths:

- a proven model so there is no need to reinvent arrangements;
- there may be opportunities in future to bring in additional competitive funds via the CRC program (see below);
- model works with existing institutions.

Major weakness:

- tends to be supply driven rather than demand driven, as a cost of doing business with established research providers, particularly CSIRO and larger universities. Some of these problems could be overcome by ensuring research providers aren't required to contribute cash and the corporate entity employs the program managers.

Attraction of additional funds via the CRC program will need to meet certain pre-conditions, most importantly:

- a high level of end-user co-investment;
- Identification of a coherent, nationally important goal that is amenable to research;
- a core program of internationally competitive, cutting-edge research to be carried out by an internationally recognised researchers.

b. National Institute (AFPA) model:

employ existing and new staff in a new (corporate?) entity (but still geographically distributed) and headquartered in a regional university. There is potential for significant administrative complexity in establishment phase with only 4 years initial funding proposed. The incentive for co-investment is not necessarily clear, but the AFPA proposal suggests 2:1:1 Commonwealth: States: Industry investment ratio. Greater centralised control of staff and funds means greater capacity for a genuinely strategic focus to research as opposed to adaptation of existing programs and capacity.

As well as the level of funding its sustainability is a critical issue. Given the long time frames in forest and wood products sector R and D short-term program funding of 3, 4 or even 7 years typically results in considerable diversion of resources in reapplication processes. Longer term commitment of say 10 years with satisfactory evaluation after that time leading to another 10 year commitment might be a desirable objective.

Other models

Sugar Research Australia – SRA is an industry services company established in 2013 akin to FWPA. SRA however incorporates the old Bureau of Sugar Experiment Stations and hence has its own researchers and research infrastructure mainly directed at sugar cane production. Much of SRA research funding is intended to be contestable hence in-house capability may not be assured in the longer term. There is also the Sugar Research Institute that that services the sugar-processing sector.

Australian Wine Research Institute - incorporated entity undertaking R and D and providing commercial services to the wine industry. In 2012, 100 FTE with about 40 % of funding from GWRDC. AWRI negotiates investment agreements with GWRDC. The sugar and grape industry models illustrate the opportunity for industries of similar scale to the forest and wood products sector to shape their own future.

Part 4: International Science Collaboration /Introduction of New Technology

If part of the Australian strategy is to be a fast adopter of new technology or an investor in off shore projects that might deliver benefits to industry this is also a topic for strategic consideration and for incorporation in any new model.

Whilst science collaboration and introduction of new technology the two are not necessarily unrelated they are separated for this discussion.

1. International science collaboration

This may operate at a two broad levels.

a. Networks/information sharing.

Typically scientists will have their individual international networks that will involve attendance at conferences, visits to labs and sharing of non-commercial in confidence information. Overseas fellowships or visiting scientists programs can build these types of linkages. There are a whole range of international conferences and specialist (discipline and sub sector) meeting groups such as IUFRO working parties for networking, sharing knowledge, understanding new developments etc. Ric Sinclair (FWPA) has recently put forward a further working group proposal that is perhaps directed more at research investment, research management and coordination (research director level) based around common species across the southern hemisphere.

b. Direct project investment.

Australian investment (cash or in kind) in collaborative projects in countries outside Australia has often developed an opportunistic basis. These may be small scale activities supported by grants from learned Academies, professional societies, trusts and foundations or Government program's (generally more directed at individual professional development or developing projects for ongoing networking and collaboration) to more significant investments e.g. the Eucalypt Genome Project, overseas testing of Australian genetic material for susceptibility to pests not extant in Australia (Western Gall Rust, Pitch canker) or investments such as those made by FWPRDC/FWPA in several New Zealand Research Consortia – The Wood Quality Initiative, Solid Wood Initiative and the Structural Timber Innovation Company. The expectation of return on investment and in what timeframe will depend on who is making the investment, the level of resources and the nature of the R&D program. Some may be precompetitive with investment by research organizations or universities e.g. Eucalypt genome project vs. the applied research programs of the New

Zealand Research Consortia. Industry companies make direct investments with overseas R&D providers when they think they can capture the benefit.
Overseas research agencies may claim the capacity to undertake R&D projects in Australia or service the Australian market via consultancies. This may work in some areas but past experience suggests it is likely to be a very costly approach for strategic R&D. The one overseas organisation that did set up an office in Australia some years ago subsequently withdrew.

International science collaboration might be expected to have a greater government contribution vis a vis industry investment unless the investment is in close to market projects.

2. Introduction of new technology

With the dismantling of R&D capability and capacity in Australia we have little or no capability to develop new technology in the following areas:

- forest information technology systems,
- harvesting and transport,
- processing and manufacturing technology or the product innovation areas of the sector.

Much of the value/innovation chain is in the hands of the equipment suppliers (increasingly consolidated) or smaller innovative companies (sometimes subsidiaries of research organizations). Hence awareness of, access to and rapid introduction of new technology and products developed outside Australia are increasingly important to the competitive position of the industry. If Australian researchers have a role it will essentially be reduced to undertaking adaptive or translational research for the application of such technologies in firms operating in Australia.

a. Awareness and evaluation

Typically done through international trade fairs, industry conferences, and direct company promotion. Whilst industry can be made aware through these mechanisms, researchers have an important role to play in many instances through their networks and in a more systematic compiling, comparing and assessing applicability of technology and products such as the via technology scanning studies. Industry has limited technical capacity in many instances and precompetitive comparisons and evaluation should be of value to industry.

b. Access

Access to market ready technology will generally be on commercial terms except if derived from an overseas parent company or some co investment in the development has occurred that may result in access on more privileged terms.

c. Introduction and operation

New technology developments into product manufacturing may be introduced with minimal need for adaptive research whilst the introduction of new products may require preparatory or consequential changes to instruments such as standards or building codes to allow application. Barriers to introduction may include receptor failure, technical /standards issues and the resistance of incumbents to new technology, system or market changes. Essentially introduction of new technology is an industry issue but government support might occur in the awareness/assessment stage and possibly in higher risk areas such as pilot plants for new products. Large companies would no doubt see the issue as their own responsibility but smaller, less resourced companies would see the benefits of some collaboration. Introduction of new technology would in general terms be predominately industry funded.