Professional paper

Intensive forest systems - a new forest management research programme

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Executive Summary

A new six-year ($18m) forest management research programme called "Intensive Forest Systems" (IFS) has begun at Scion in partnership with Future Forests Research Ltd (FFR). This flagship programme will help redefine the intensity and precision with which New Zealand's forests are managed and monitored from the nursery to the mill.

This article outlines the background to this research programme, the bidding process, and the associated formation of FFR. The business case is described briefly and gives the rationale for the science investment. An overview of the work programme gives the underpinning approach taken to the planned science.

The IFS Programme has been central to the restructure of the five Research Co-operatives and the associated Scion relationship with industry. The overall strategy of restructing has been validated by the 50% increase in Foundation for Research Science and Technology (FRST) funding achieved in the IFS Programme and two other FRST programmes.

Introduction

Scion has a legacy of forest managment research extending over 40 years that has helped to make New Zealand plantation forestry practices world renowned. The unique aspects of this research have been that it:

- concentrated largely on one species - radiata pine;
- took a pragmatic empirical approach with extensive data collection from field trials throughout New Zealand;
- accumulated large databases of growth and wood property measurements;
- routinely converted databases into models and functions;
- implemented models into computer based systems or frameworks for industry access and use.

The progression of New Zealand's forest management knowledge from early research trials and symposia was accelerated after the 1970s, contributing to Task Forces and Project Teams of the 1980s - 90s. By early 2000, significant questions were being asked about the strategic direction of forest management research, and whether forest management research was "mature" or if it was simply lower priority and held less glamour in the new, high-tech era.

During this time, Scion's core capability funding from government (FRST - Foundation for Research, Science and Technology) in forest management research was nearing its end and the rebid for funding was under consideration. In addition, aligned commercial funding from forest industry was under question. Several reviews followed that involved considerable industry input, and healthy debate on strategic direction and priorities. Signals eminating from FRST indicated a change of emphasis from funding to "investing" along with the associated need for a business case and strong enduser engagement to ensure globally competitive "outcomes"[1].

At the same time, research consortia were being formed (Wood Quality Initiative Ltd - WQI, and Radiata Pine Breeding Company - RPBC) to ensure greater industry engagement. Also, after 18 years of operation, questions arose about the suitability of the existing research co-operative model. There was industry interest in amalgamating the five co-ops (Stand Growth Modelling, Plantation Management, Site Management, Douglas-fir, and Eucalypt co-operatives), as the programmes appeared to overlap and some co-ops struggled to maintain consistency in technical representatives and chairmen. A Pan Co-op Board was assembled involving all five Co-op chairmen, plus Russell Burton (chair) and Graham West from Scion. This Board engaged an independent consultant, Russell Dale, to survey the industry and make recommendations on possible structural changes. The survey result was very clear, that industry desired significant change in structure and several new operating models were investigated. An Establishment Board followed (chaired by Peter Clark, CEO, PF Olsen Ltd) for what would become Future Forest Research Ltd (FFR) that worked through the detail of the setup process, research theme levies, legal and operating structures, and the election of the FFR[2] Board.

FFR Ltd was finally established in 2007 as a new venture by the forestry sector to change the way forestry research is funded and organised. It broadens the scope of research supported by the industry to include themes on other species (Diverse forests), environment and social, and harvesting and logistics. The creation of FFR has the potential to re-vitalise the research undertaken by the forestry sector through engaging senior industry and research personnel at the strategic level and becoming a champion for the benefits of research to the forest growing sector.

The IFS bid was first to trial this new structure and became central to the successful establishment of FFR. The bid was largely written by Scion (to be later novated to FFR) with contributions from a core of about 10 staff,

and the input of industry via the Bid Reference Group comprised of eight industry representives. The bid-writing process was arduous and followed a timetable and format strictly prescribed by FRST. Preparation needed to start more than 12 months prior to submission (March '07). The bidding process was in two stages: 1) a concept document (approx 40 pages) and after acceptance; 2) a full proposal (approx 160 pages). The requested investment was for $3 million per annum (incl GST) over six years, which was a 50% increase on Scion's previous contract in this research area. Fortunately for Scion and industry, the IFS bid was successful, as failure would have not only closed down New Zealand's forest management research at Scion but would have also stopped or delayed the formation of FFR.

Business case

The problem - profitability and international competitiveness

Plantation forestry in New Zealand has a current Return On Investment (ROI) of approximately 4-5%[3]. Although this is considerably influenced by exchange rate, transport costs, and energy costs, these factors also challenge other land uses and industries that compete with and provide alternatives to wood. International competitors for logs have endured (under differing conditions), and now offer clear advantages over New Zealand on cost. Price Waterhouse Cooper reported (2004)[3] that New Zealand's average cost of delivered logs was $57 ($US/m^3), while Chile ($38), South Africa ($37), and Brazil ($40) were all significantly lower.

At several key meetings of senior forest industry stakeholders in early 2007, the chairman of the FFR Establishment Board asked the question: "do we need forest management reseach?" Fortunately the answer was "yes", with the rationale being - to maintain international competitiveness. As justification, results from Brazil's intensifive hardwood plantations were described, and the strategic intent of Chilean and Scandanavian forest growers were also made clear.

The opportunity - value of research

An independent consultant (A. Katz, alphametrik) was engaged (Jan/Feb '07) to perform personal interviews of the major industry stakeholders. The purpose of this enquiry was to examine the economic contribution from the previous five-year programme of forest management science to New Zealand's forest growing industry, Two aspects were identified: 1) benefits from more effective management (reflected in greater cash flows), and; 2) lower risk (more confidence in yield predictions). Together, a total value improvement of $326m was calculated for the $10-12m invested (FRST + Co-ops over 5 years), a return of approximately 30:1 that clearly shows the benefit of research.

Better decision support

To maximise value and maintain a competitive international position, New Zealand forest owners must regularly, effectively, and efficiently assess the risks and opportunities that arise from an ever-changing matrix of factors. These factors include market requirements, environmental changes and genetic improvements over forestry's long (25 year+) time frame. Analyses of these factors and their interaction must continually be refreshed to allow forest owners to determine and implement management practices that optimise site, silviculture, and genetics. Management decisions also need to be overlaid with the ability to manipulate internal tree quality through site specific silvicultural management practices and/or segregation; and the implementation of new pre-harvest inventory assessment systems, which incorporate technologies from WQI[4] to drive better resource allocation and use. Current prediction models are largely focused on single issues, such as maximising volume, and do not integrate key factors, e.g., matching growth x quality x environment x genetics, that influence value realisation to the investor.

Implementation pathway

Over an initial three year period, FFR (in partnership Scion) will manage a total investment of over $7 million/yr in research in the areas of radiata management (i.e., the IFS Programme), species diversification, harvesting and logistics, and environment and social. At least 80% of the New Zealand commercial and amenity plantation estates will be represented by FFR[5] with the mission to "substantially enhance the international competitiveness of the New Zealand forestry sector through well-focused strategic RS&T(Research Science and Technology)."

The focus of FFR is to address key technical barriers to international competitiveness in the New Zealand forestry sector, specifically through:

- reducing the costs of production through improving productivity (human, biological and operational), and reducing regulatory compliance costs across all aspects of the value chain, and;
- growing value through improving the quality of material and the range of products produced from New Zealand's commercial forests.

Spill-over benefits

If forest profitability can be improved, it follows that afforestation will be encouraged, providing spill-over benefits to the environment through greater carbon sequestration, erosion control, and resilience through biodiversity. Other anticipated spill-over benefits of IFS research are the development of models and tools to allow

carbon monitoring i.e., resource assessment techniques applied to monitoring Permanent Carbon Sink forests and growth modelling tools to predict forest growth for carbon sequestration during Kyoto Commitment Periods.

The IFS Programme

As a parallel example, agriculture has responded to rising costs and fluctuating returns over the last two decades by intensifying farming practice and enhancing product quality and marketing. The productivity of dairying (per hectare) has risen at least two-fold since the early 1990s (with associated environmental effects) through the cost-effective use of technology such as improved genotypes, fertiliser, and animal management regimes. A similar achievement in forestry would have meant an increase from approx 600 m^3/ha harvest to 1200 m^3/ha harvest or an increase in 300 Index[6] from 20 to 40 m^3/ha MAI (mean annual increment). The key to agriculture's success has been an integrated systems approach, whereby combinations of site, genotype, and management are seen as an integrated system, and all aspects are monitored and constantly improved upon.

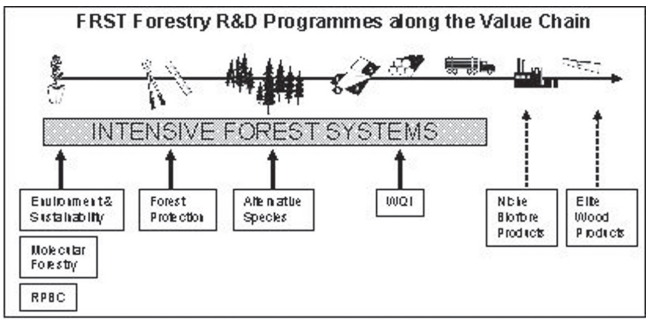

Figure 1: Integration and links with other research programmes.

Similarly, the IFS Programme moves toward a goal of intensification of management practice, and is designed to complement WQI and RPBC programmes and to avoid duplication of effort. The Programme will also take a value chain approach to integrate and link research in other present and future FRST forest sector programmes, (Figure 1) including alternative species.

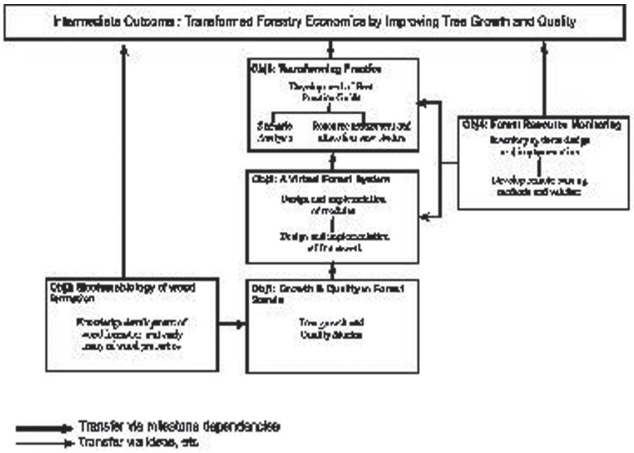

Figure 2: Structure of research programme

The IFS research programme is structured into five Objectives (Figure 2 that underpin the programme's goal or "Intermediate Outcome" to:

- improve the forest industry's cost effectiveness through productivity and quality gains;
- increase the marketable yield of wood products by describing the process of wood formation/properties;
- developing integrated forestry systems.

Achievement of the Intermediate Outcome will be measured against three long-term outcomes, i.e.:

- By 2010, improve resource assessment and log allocation to market, increasing near term forest profitability to a ROI >7%.
- By 2013, enable accounting for 70% of the variability in wood supply and quality to contribute to a $700 million/yr increase in product value.
- By 2030, export earnings will have progressively increased to $9.6 billion as productivity increases from 17 to 25 m^3/ha/yr through intensifying the management of New Zealand radiata plantations.

Underpinning approach to science

The key thinking behind the science programme in the IFS programme is as follows:

1. Understand the interaction: Genotype x Environment x Silviculture (Management = GxExS).
   This interaction is the cornerstone to many science programmes in biological production, but has not been a strong emphasis in forestry to date. It seeks to eliminate the negative interactions and exploit the positive ones.

2. Delivery though broader, full value chain modelling frameworks.
   Past systems treated site and genotype crudely (e.g., STANDPAK [7]) and stopped at the end-product simply described as "green, rough sawn, [mostly] visually graded boards". Future systems will need to be broader, i.e., extend at both ends of the value chain (from seed to product).

3. Practical knowledge support - expert systems.
   Computer models lack practical, real world constraints and risks. Capturing human experience and know how will aid the retention of an organisation's skill and capability that are frequently lost through restructuring and retirement.

4. Transform practice - Scenario analysis/case studies, best practice guidelines.
   Extensively use new models and systems in large

scenario analysis to provide insights to better practices and improved profitability.

5. Measure progress against the economics of a model forest.
   Derive metrics of the impacts of new technologies, models, and functions. Maintain a record of R&D benefits to aid future investment in this area.

6. Understand wood formation and internal stem properties - distribution within stems and variation between stems.
   Provide 3D visualisation tools to aid knowledge across the matrix of G x E x S of within-stem and -stand variation of important wood properties.

Outcome benefits to NZ and the forest industry

The successful legacy of research supported by government and industry has provided confidence to invest in the current 1.8million ha forest growing industry. The total forestry sector is estimated to have assets worth $17 billion, contributing some $3.2 billion of exports each year[8]. This research and investment put New Zealand at the forefront of plantation forest practice in the world for many years, but this is no longer the case. The aim of the IFS Programme is to underwrite the re-establishment of New Zealand to a leading position. The IFS programme will develop a fundamental knowledge-base that supports a national capability in forest management science, forest modelling, and wood science to provide better decision-making by forest growers that will contribute to the achievement of the long term outcomes while:

- producing specific "Target Trees" grown for specific markets to improve revenues by 25%;
- developing site specific management regimes to decrease growing costs by 15% and to increase wood/ha productivity by 30%, and;
- developing more accurate forecasting tools to characterise and reduce variability and uncertainty in wood supply and quality.

Conclusion

In the past, there has been a limited understanding of the bio-physical drivers of wood formation and quality, leading to little manipulation of internal tree characteristics. As a result, significant proportions of the harvest is of low quality (e.g., highly variable, low stiffness, and unstable), and it is difficult to add value, even with further processing. With new technologies emerging (e.g. from WQI) that will improve pre-harvest assessment and segregation, there are near-term opportunities to develop better intensive assessment systems of the standing crop that will lead to better resource allocation and use. The IFS Programme recognises and addresses the need to accelerate this trend and intensify the manner and precision with which New Zealand's forests are managed and monitored. This is a long term programme and transformation can only be achieved by a quantum shift in knowledge on the drivers of growth and wood formation, and on scenario-analysis tools that integrate complex biophysical and market information to intensify forest growing. This ability lies at the heart of enhancing the international competitiveness of the NZ forestry sector through well-focused RS&T and application of new knowledge1.

The structure and nature of the interaction of scientists at Scion and plantation forest managers has been substantially improved with the formation of FFR Ltd. Support and commitment from the industry is strong, now achieving co-funding through members' levies of $600 k per year, with $150 k of that going to research into site and weed management. The overall strategy to restructure the working relationship between Scion and industry has been validated by a 50% increase in FRST funding achieved in the IFS Programme and other FRST programmes e.g., Diverse Forests, and Forest and Environment.

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