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Radiata Theme

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A Survey of Decision-Making in Forest Growing

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EXECUTIVE SUMMARY

A survey was undertaken in December 07 /January 2008 to investigate how forestry decision-making occurs and what tools were involved, The survey was conducted largely on a personal interview basis with 25 senior forest industry personnel.

Forestry decision-making was found to be generally done within a framework of multiple factors, such as company strategy, risk management, environmental issues, strategic location, contractual obligations, strategic alliances or health and safety issues. The clear implication is that tools arising from the IFS programme should fit within the context of the bigger decision-making frameworks.

All participants in the survey were using decision support tools to some extent within their businesses, and some tools were used frequently. However, output from tools was frequently adjusted by experience and intuition.

Some clear suggestions were noted on the development of future tools. These were primarily:

- The need to incorporate existing systems wherever possible
- Tools need to be simple and quick to use
- Transparency is needed of models and assumptions
- Updating and validating of functions and models was seen as fundamental
- Environmental services, particularly carbon modelling, are seen as an area where work is required
- Systems should be modular

BACKGROUND

Investors in the IFS research programme (FRST and Industry) seek high level outcomes (not outputs), i.e., they wish to improve the national economy or enterprise profitability and sustainably through forestry. To achieve this from the numerous projects and tasks in this large programme, integration of outputs into a practical delivery framework is necessary. The delivery framework is aimed at helping investors make key strategic and tactical decisions. A first important step in this process is achieving and understanding how decisions are made and what tools are needed.

Objective 3 of the Radiata Management Theme begins with a survey that provides insights into decision-making and expectations of tools from key decision-makers in the forest growing industry.

INTRODUCTION

A survey was designed to interview participants in person, where possible, and framed around a questionnaire (see Appendix 1). Participants were selected to represent the industry generally, including the membership of the Radiata Management Theme (see Appendix 2). This included representation from large forest companies, smaller companies, consultants and academics. However time constraints meant that it was not possible to speak to as many people as desired. Many participants had useful insights and additional factors to be considered, and many interviews lasted more than one hour.

In analysing the results, numerical analysis was avoided, as the way decisions are made, and tools are used, varies so much with different individuals and situations, even within one organization. The discussions were more general around the type of tools used, the way which they were used, and ideas on tools and research that would be beneficial.

RESULTS

The survey was carried out with some 17 organisations, interviewing all but two of the 25 respondents.

Decision frameworks

The most common comment relating to current decision-making was that decisions were generally made within a bigger framework of multiple factors, such as company strategy, risk management, environmental issues, strategic location, contractual obligations, strategic alliances or health and safety issues. These factors were often hierarchical, and hence had to be considered in a stepwise fashion. In some instances, influences acted concurrently and needed to be factored in simultaneously. Therefore decisions were often made within constraints or influences that overrode the technically optimal solution.

Decision-makers use a combination of tools, experience and intuition. For example, the decision to prune or thin at the stand level may be influenced by extreme terrain and limited access that makes such an operation difficult and dangerous.

Role of tools

All companies were using decision support tools within their business, to a greater or lesser extent. All were users of forecasting and resource assessment tools as part of their business. However, for most entities, information derived from existing tools, (e.g., estate yields, resource descriptions) was adjusted by experience and intuition. Tools do not replace experience.

Many tools were used frequently, particularly for scheduling silvicultural operations, and were used as a basis for exploring options or asking “what if” questions.

Application

Model accuracy can be an issue, particularly given the range of sites, genetics, silviculture and other factors that may influence the outcome, and this is where experience comes into play. Warnings of non-representative outcomes tend to come from experience, not from the tools or the models behind them. It was commented that within the variables used in modelling, it is possible to produce an optimum outcome that may not be feasible. Modelled outcomes can be difficult to implement in practice, e.g., if the “ideal” planting stock was not available in the numbers required, and the tree stocks actually planted were simply what was available. Regimes are often micro-managed in the field, where experience of operational staff may override the company standard regime for a particular stand based on visual assessment, outcomes observed in similar areas, or assessment data for that stand. Planned regimes may also be adjusted for local factors (for example a standard stocking may be altered in areas known to be dothistroma-prone, or land preparation may be altered in areas where severe frost is common).

Accurate yields, and reconcilable yields are critical to forest management, as is the use of good log allocation to assign value to the outputs. This needs to be a combination of potential yield available and realisable value based on sales, to provide inputs into both short term planning and longer term or estate level plans. For the smaller entities, there is not always information available to calibrate results, or similar areas being assessed or harvested. In such situations it is difficult to validate results, and experience is key to gaining useful information. It was felt that industry needed to build confidence in existing (or new) models, their behaviour with different inputs, and in the accuracy and usefulness of the outputs. Certain observed behaviours prove hard to model (for example growth spurts, or fast initial growth followed by much slower growth, potentially on low fertility sites with a fertilizing history). In such instances, modelled outcomes were altered to try and reflect reality more accurately.

While most entities had access to commercial software for estate modelling and resource assessment modelling, in-house systems and spreadsheets were used to provide information in other areas. Sales and operational planning tended to be based on in-house systems. Given the dynamic nature of this type of planning, there is a trade-off between time required to generate

outcomes and accuracy with modelling, as this is generally tempered by practical considerations that alter the plan.

Existing systems

There is a strong need to build on existing systems, and on the lessons learned throughout the industry over the years of software and tool development. It is important to ensure that there is no repeat of work done or replacing systems or tools already available, with only slight enhancements or improvements. This applies to work carried out by different organizations, e.g., Scion, WQI, RPBC, or to tools available from overseas or internally. To gain industry uptake, there is a strong need to produce tools that are operationally useful. Systems already in place include estate modelling, resource assessment software, stand information systems, and data capture.

Simple vs Complex

Based on systems currently available, there were mixed thoughts on the required and desired complexity of any tools. The issue of time available for analysis was frequently raised, along with the need for any tools to be simple and quick to run with reasonably large volumes of data. The tools should also be easy to learn to operate effectively without requiring extensive training and time to "get up to speed". Comparisons were made between the Calculator and Forecaster, and the uptake and use of both tools as an indication that simple tools were more likely to be of use to a broad range of industry professionals. It was reiterated that time and human resources are now more scarce commodities in the industry, and this has an impact on tools and systems utilized. Quick answers are required when processing high volumes of records. Often entities are trying to get the big picture in a commercial sense and do not need detailed analysis. The comment was made that it is expensive to capture data, and to increase the complexity of what is captured in the field may be financially prohibitive. Complex can equate to expensive, in a commercial sense, and use of a tool may be dependent on the data required and the cost of those data.

There was a range of opinions as to whether this meant that tools should be "dumbed down" to expedite uptake. Generally it was agreed that complexity was a good thing, but it was advantageous to have an accompanying "micro" version to allow fast analysis, when the time or data were not available for more detailed assessment. This meant that models should be accompanied by a sensitivity analysis to allow the user a clear understanding of the effects of altering inputs and the impact on the resulting outputs. This would give users a more informed view of the importance of attributes, where you need accuracy (and where you don't), and to allow better decisions regarding data capture (and cost versus information), and the use of estimates where known values are not available or are too costly to collect. If defaults were available for some inputs to allow a "quick and dirty" model to run, then the user should be aware of the assumptions made. It was suggested that complexity could be managed by the analysis being offered as a service, negating the need for detailed training for more infrequent users.

Transparency

Transparency of the operations within systems was deemed to be essential, and this covered a number of areas, from interactions of variables, and assumptions made by the software developers, to limitations of various models and functions imbedded in software. A black box, which produces an answer, without giving a good understanding of what drives the answer, should be avoided. The ability to "look under the hood" must be optional, to allow for a more detailed understanding of the process when required. The suggestion was made that systems should contain more error messages to highlight when inputs are outside the tested boundaries of the models being used (where the danger points lie), therefore potentially affecting the validity of results.

The need for transparency highlights the need for good reports that document the models available, and their limitations, along with assumptions made on the interactions of inputs and their impacts. Current descriptions of models can be ambiguous, so clear directions are required on what the models are based on, when to use them (and when not to use them). Tools should be providing information on the effect of the provided inputs, as a basis for decisions. Models should

aim for a range of responses, or a response surface. Lack of time or data may prevent some users from doing sufficient runs of a model to gain a good understanding of the impact of various inputs.

System

The system should aim to be modular, to allow parts of it to be used in isolation as required. This should be coupled with ease of data input and output from other systems and spreadsheets, to allow new tools to be used in conjunction with existing systems, both commercial and in-house. Potential for output of any analysis into a spreadsheet or database to allow further analysis is desirable.

There may be limited need for complex models for all situations, or to explain what is already known. For example, in some areas wood properties such as density are less important, as regional variation has dictated an outcome, so there is little value in modelling it. However this may drive an interest in other variables (occurrence of long internodes) which again may be site- or region-specific. This reinforces the need to be able to customize tools by not including attributes that are not relevant for the specific analysis, and understanding the implications of this on the results. Conflicting opinions were given on inclusion of financial information to allow DCF or IRR calculations. While some viewed it as important, others stated that they preferred to use spreadsheets to allow customisation to specific requirements.

Moving forward

Benefits

A key focus for most entities in these times is improving profitability. To be useful and utilised by industry, any tools or research should have a demonstrable financial benefit, either by increasing profit or reducing costs. This view is likely to have influenced opinions on industry knowledge gaps, and where tools could be provided or improved. It is currently difficult to model and understand the impacts of genetics and site preparation, and the long term benefits of practices or improved genetics in productivity and value versus the more immediate cost. Research has been carried out in these areas, and there may be benefit in making results more accessible to industry, either by incorporation into models, or by providing the information with the models to allow better decisions to be made regarding inputs. Better information in these areas may reduce reliance on experience and intuition. More effective chemical use management may assist in meeting FSC requirements. A number of parties expressed an interest in better information on genotypic selection, but tools currently under development by the RPBC may fill this need. .

Validation

There is a need for work to be done in validating current growth models, to give industry confidence that they are still applicable under current conditions, and deal with changes such as improved genetics, multiple rotation sites, and altered regimes. Some of the models were developed some time ago, and need to be recalibrated. Comparisons need to be made with more recent models (for example the 300 Index) to allow a good understanding of the differences between models previously used and newer models, and to explain variation in results. As growth models are a fundamental part of management, planning, valuation and decision-making, it is critical to focus on getting them right, and well documented.

Emissions Trading

The impact of carbon trading on long term profitability was one of the areas of greater interest. A number of issues were raised. For example:

- Data capture and its associated costs, particularly if it varied markedly from information currently collected in inventory.
- Alternative species that may become financially viable under the carbon scheme, and gathering information on silviculture and growth for other species to better assess their viability in the changed environment.

- An understanding of fluctuations (both short and long term) within this market, particularly if it is being artificially manipulated by the government (controlling the number of credits that can be sold internationally) and the level of associated risk .
- An analysis of the trade-offs between wood and carbon, the non-declining value of carbon versus harvesting levels, and the ability to model carbon flows from estimated wood flow.

Risk assessment

Risk assessment and management was another area identified where there are industry knowledge gaps. Monte Carlo methods or stochastic modelling were identified as potentially useful, and are being utilized by some companies. Areas for risk assessment include log price fluctuations (domestic and export), cost of transport (internally and export), wind, fire, susceptibility to escalating diseases and impacts of carbon trading.

Wood properties

Wood properties and internal characteristics were identified as an area where there are knowledge gaps, but it was noted that for the information to be useful, there needs to be an opportunity for practical applications to impact positively on returns. If information on properties does not allow for segregation of the logs at the skid site, or if there is no discernible market or price differential, then the knowledge is academic. Specific properties mentioned included density, impacts of improved genetics on wood quality, use of scanning tools in a superskid environment, resin pockets (the effects of humidity and vapour), dimensional stability, microfibril angle, compression wood, stiffness and the trade between quality and volume though silviculture.

Non-forest values

Assessment of non-forest values was highlighted as an area where there are few tools to assist with quantifying the impact on profit. Examples of such values included water quality and quantity, biodiversity, land stability and recreation.

Remote sensing data are thought to be currently under-utilized in the industry, and hold the potential to give benefits, with much of the research in some areas already done. This could include information on stocking, mass coverage, standing volume and disease.

Harvest Planning

Some entities expressed an interest in better tools for optimising and planning for roading, harvesting and sales. These areas are mostly modelled using in-house spreadsheets, and possibly value is lost through the lack of optimizing tools. However another view was that the complex and dynamic nature of the environment meant that detailed planning could prove a waste of time and money, as practical and operational considerations would often necessitate frequent changes to plans.

Pre-emptive cuts were seen as becoming more of an issue for the industry as more companies move to trialling “superskid” arrangements. However this would have limited application across the country. There may be potential to trial more detailed log segregation based on attributes that are currently difficult to segregate in the bush.

Another area mentioned was the impacts of site conditions (wind, highly exposed sites, altitude) on volume and grade recovery. The impact of a biofuels market was also mentioned should the opportunity arise.

CONCLUSION

Forestry decisions were found to be generally made within a framework of multiple factors such as the company strategic plan, risk management policy, environmental issues, strategic location (relative to resources, markets, and transport), contractual obligations, strategic alliances or health and safety issues. The clear implication is that tools arising from the IFS programme should fit within the context of the bigger decision-making frameworks.

Experience and intuition are currently a major part of forest management decision making. It is unclear whether this dependence on experience can be in part relieved by the use of more capable or intuitive tools. While tools must be recognised as only an aid in the process of decision making, there may be scope for delivering tools that better capture some of the experience and research in the industry.

Some clear ideas on development of tools were received from those spoken to:

- The need to incorporate existing systems wherever possible is paramount, to ensure that time and money is not used reproducing existing tools with only minor improvements or enhancements.
- Tools need to be simple and quick to use, able to process high volumes of data rapidly and be transparent as to models and assumptions. The required inputs need to be achievable from both a time and cost perspective, as minimising these will be critical to the uptake of a product.
- A system should be modular; allowing parts to be used in isolation, and should lend itself to easy data inputs and outputs from and to other sources and systems.
- Updating and validating of growth models was seen as fundamental to all aspects of forestry management.
- Better transparency of the existing models and functions, their assumptions and ranges, the software containing the models, and the interactions of inputs and attributes was also seen to be needed to ensure the best model was used in a given situation.
- Carbon modelling is seen as another area where work is required to allow the impacts of the new carbon trading regime to be modelled and understood.

A number of other areas were seen as having benefit, but there needs to be the potential of adding to profit to encourage uptake. Examples are impacts of improved genetics, better understanding of the impacts of site preparation, wood properties, non-forest values, and use of remote sensing data. Critical to any development is a view of how outcomes can be practically applied in a commercial sense. Cost and time required to use tools are also seen as major factors in uptake.

APPENDICES

Appendix 1:
Survey Template

1. What are the drivers for current decision making?

	Not Used	Experience	Intuition	Research	DCF / NPV	Software	Policy/ Strategy	H&S	Environment	Risk Mmgt
Land Purchase										
Genotype Selection										
Establishment / Silvicultural Regime / Scheduling										
Forest Health										
Harvest Volume / Age										
Marketing Short / Long Term										
Land Use Change (HBU)										
Wood Properties / Quality										

Other (specify):

2. What software / DSS systems are currently used in your organisation?

	Not at All	Annually	Monthly	Daily / Weekly
Forest / Land Information System				
Genotype selection				
Establishment				
Regime Analysis Systems				
Silviculture scheduling				
Crop Typing				
Resource Assessment Software				
Quality Assurance				
Forest Estate Planning				
SOP				
Sawn Product outturn				
Valuation				

Other (specify):

3. What would you model if the software was available

	Wish List / Comments
Land Purchase	
Genotype Selection	
Establishment Regime	
Tending	
Silvicultural Scheduling	
Monitoring	
Inventory	
Harvest Volume	
Current Market	
SOP	
Yield regulation	
Forest Valuation	
Medium / Long Term Market Strategy	
Harvest Age	
Land Use Change	
Wood Properties	
Sawn Product output	
Environmental Constraints	

Other (specify):

4. What major issues in available software impact on use / effectiveness?

	Ease of Use	Availability	Cost	Precision	Fit for Purpose	Support	Scale	Data managment	Other (Specify)
Land Purchase									
Genotype Selection									
Establishment Regime									
Tending									
Silvicultural Scheduling									
Monitoring									
Pre Harvest Inventory									
Harvest Volume									
Current Marketing									
Medium / Long Term Market Strategy									
Harvest Age									
Land Use Change									
Wood Properties									
Sawn Product output									

Other (specify):

5. What are the major industry knowledge gaps

	No Gap	Reasonable Knowledge	Little Knowledge	No Knowledge
Impact of genetics				
Impact of Site				
Impact of Silviculture				
Alternative Species				
Internal Wood Properties				
Market				

Other (specify):

Appendix 2:

Organisation	Location	Respondent
P F Olsens ????	Rotorua	Theo Vos, Jeff Schnell, Dave Crawley
Ernslaw One	Gisborne	Steve Couper, Bill Johnston, Ian McGuiness
Blakely Pacific Limited	Christchurch	Phil Taylor, Aaron Gunn
Wenita	Dunedin	James McEwan
City Forests	Dunedin	Grant Dodson
MAF	Rotorua	Dave Little, Mike Power
RM Consulting	Nelson	Mike Marren
Timberlands	Rotorua	Ian Hinton
Hancock Forest Management		Dave Lowry
Piers MacLaren and Associates	Rangiora	Piers MacLaren
Silmetra	Tokoroa	Brian Rawley
School of Forestry	Christchurch	Bruce Manly, Richard Woollens
Pan Pac Forest Products	Rotorua	Brian Garnett, Brett Gilmour
Nelson Forests	Nelson	Brendon Whitley
Forest Management (NZ) Ltd	Waverly	Sally Sisson
Poyry Forestry	Auckland	Bill Liley
Rayonier NZ Ltd	Auckland	Jeremy Wilson