SESSION 1
Paper (a)

RESEARCH AND DEVELOPMENT PRINCIPLES APPLIED TO LOGGING MECHANISATION

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INTRODUCTION

This seminar has brought us together to look at the New Zealand Logging Industry with a view to examining the equipment and machinery currently in use, its relevance to our needs, to look at the future needs in numbers and in type, to examine the development that will be needed if we are to meet those needs and to attempt to match these requirements with equipment that is capable of undertaking the work. There are many facets of such in an examining process and a number of elements must be looked at individually, and later collectively, for their interaction one against the other. Most important is our forest resource, not a general over-view, but a detailed understanding of the particular resource that is to be handled, its age, its wood type, size, the topography, its location relative to other inputs, and the way that it is managed. At the other end we have the processing industry. What is the material we are being asked to handle to be used for, how is it to be presented to this end user, what are the economic constraints, what sort of equipment will he use to move this material from the forest? In New Zealand when we talk about logging, we think about shifting the tree from its standing form to a point where it is on truck ready for transport. In other countries the word "logging" is used in an all embracing way to cover both this in-woods or forest harvesting and transport between forest and processor. For the sake of our examination in this seminar, we are confining our thoughts to the in-forest harvesting components.

What will be the research and development principles that are needed to meet our goals, how do we apply such principles to the mechanisation of our logging processes? We are here together, each with an important role to play. With your input, hopefully with some stimulus from this address, and with the thoughts from other speakers, we will finish up at the end of this seminar with some changed views and a new or more clearly identified direction along which we must move in the next few years in order to meet our combined needs. This seminar will not finish when we leave here. Take the key components out of each paper as they appear to apply to you in your business. You will draw your own conclusions. After you have gone away from the seminar give some thought to the notes you have taken, re-read the papers that have been presented, respond by writing to LIRA with your conclusions as to the development needs of our industry.

ROLE OF THE HARVESTING SECTOR

Let us now examine the operational inputs we must know. First, remember that the forest is paramount, without it we would not be here. It is a very valuable resource with multi-millions of dollars in investment and ultimate returns. At the other end we have the processing industry - again with multi-million dollar investments by New Zealanders in the future of that forest resource. We, that is most of us who are here at this seminar, equipment suppliers, equipment manufacturers, logging companies, be they part of a processing organisation or part of a forest owning organisation, and independent logging groups, are the inbetween group, rather insignificant in investment terms, but responsible for linking these two huge investment groups together. We may not have a great say in either the forest planting or establishment or in the processing of the wood, but without us the other two do not come together. We have a key role to play and to play it properly we must understand the needs of the two major investors. Our role simply is to take the standing tree, to modify it into a form that is required by the end user/processor and to do so in the cheapest possible way. If we can meet these requirements, we have done our job. To do this we must first understand our forest resource.

DESIGN PARAMETERS

We must know where the forest is located, what the roading system is, how far the forest is from the processing plants, how old is the resource, how large are the areas to be harvested, the size of the trees in this resource, what are the branch formations that have to be removed, what is the topography, what was the specification used to plant the forest, what was the silvicultural regime used to develop the resource to the stage when it is ready for harvesting?

All these must be put together in their own way and above all, related over a reasonable time framework, say five or ten years, with a view to the total volumes of material that are thus to be handled. So we have location, piece size and volume. These provide us with some of the key elements required before developing a new processing system or equipment to work within that system.

Where is the processing plant located, how should the material be presented, how is it going to be used once at the plant? These factors will also affect our development options. While we are looking at these end-of-the-scale, pure research requirements, we will also be overlaying the current methods that are being used to harvest the material. That they are already being used suggests they are probably the best available, or have been best in the past for some reason. It is very difficult to change a system that once was the best, to something new, even though the alternatives may appear to be more attractive. The costs of the labour, the way labour costs are going to move in subsequent years, what form of fuel is available and can be used, what is the likely movement in the fuel prices, the equipment that is available in this country now and the way that it is serviced and the numbers of items of plant used within this existing system. These are then overlaid on the information gathered on the resource and on the end user process.

DEVELOPMENT OPTIONS

Having analysed the resource, the processor's needs and current harvesting practices, either manually or in some computer form, we can now look at our development options. The first option is the current practice. We can then look at the alternative methods of using the resource to achieve the processor's needs. There may be a variety of ways of achieving this. By looking to the future we may see the escalating labour rates as such that we can afford to pay five times as much for the equipment component of the job, thus we can see the need for equipment which can be developed. Perhaps combining two, or even three, of the current activities in the present process, perhaps there is some way in which all activities can be combined in a mechanised form. If it is very small wood (fuelwood) perhaps it can be harvested in some way that is akin to harvesting wheat, finishing up with bundles which are simply ready for transport. If it is 25 year old, 60 metre high P.radiata, perhaps they can be mechanically felled and crosscut into five metre lengths. In New Zealand the transport system may not be suitable for handling such material. In some locations there is equipment capable of collecting the five metre logs and transporting them directly to the processing plant. The logging process cannot ignore the method of transport. If this material is being picked in our system by a mechanical grab and transported on some form of high wire yarding system, it may be possible, and perhaps the cheapest way, for such a system to transport the wood continuously over a much longer distance in much the same way as the continuous cableway moves coal from the mine to Mere Mere power station. What are all these development options?

These must first be laid out and looked at, sifted and rationalised into what appears to be the most cost effective form. Today the computer can play a much more important role in this development stage than it has done in the past. Having gone through this process, we may finish up with two or three different methods and some new equipment or developments on existing equipment which look as if they are practical and can be made to work within the constraints of the forest and the form that our processor wants his wood.

The next part of this research and development examination is to apply these ideas theoretically to give us some economic background. We may then look at building a development model which may be full size or on a smaller scale. We can look at this three dimensional option to see whether it does make sense. Did the Bell logger with its tri-axle form make sense to you when you first saw it? Was much sense made of the initial Hydraulic Hauler unit? This applied research comes under the heading of Design. At the stage where the model appears to have true worth, development work is undertaken to put those concepts into practise and we have a working model that can be used to test the principles that seem to be suited to our needs. This working model can then be put into its first field testing. Static tests and then dynamic tests. We should not expect the model to stand up to full production, but require it to test the concepts that have come through in our thoughts and design processes. Do we meet the aims that we set for ourselves? What are the limitations? Have we improved the system from that which we have been using in the past?

At this point, as in many of the other steps, we must ask ourselves a series of questions and before proceeding, we need answers to those questions. Even if the answers are negative and strongly negative, we have been successful. We may have eliminated one of the options within our design parameters. If we have a positive answer, we can move to the next stage. All development must proceed along these lines and must be a step by step process, eliminating, as far as possible, steps in the wrong direction. There will be many negative answers as we try new ideas and we try to move in the direction the design concept will not take us, or when we move in a direction which is not taking us to the goals we sought to achieve. Having gone through these processes, we should finish with a working model or a model which appears as if it will work. We cannot then go any further until we have tested the market.

MARKET

The market for whatever equipment we are developing has got to be large enough to pay not only the costs of development to this stage, but to pay the full costs of development of production models. The prototype working model should be given to our market analysis experts and in the light of what we have seen as the resource and end users' needs, they will examine the volume of material that could be handled, using such processes or the equipment evolved. What is the likely field productivity and therefore what are the potential numbers of this equipment or this system that might be introduced? This is often the point at which development stops. This applies particularly in New Zealand where there is a finite wood volume to be handled. The market options may be explored over a ten year period or projected to 15 years for larger volumes. This market potential must be fully understood and related to particular constraints with the equipment proposed. Perhaps the market experts will say "no" if it is confined to New Zealand. Perhaps in the light of knowledge of other countries requirements they may say that our investigation of their resource and processing needs is required. Will the equipment that has been developed or is being developed, meet some of these needs? Is there a new operational requirement? Does this change the market demand? Hopefully we will not always receive a negative response at this stage. In the case of the hydraulically operated hauler, LIRA was closely associated with the design prototype, an analysis of logging over the next ten years with the move to steeper country showed there should be a market large enough to continue development. The research and development process was able to proceed to the next stage.

At this point the market experts may suggest that what we have is too expensive and suggest we go back and improvise on something which has been put into production previously. They may tell us that we have gone too far in our evolutionary process and that unfortunately they cannot look as far ahead as our design. They may say we are better to improve our use of equipment that is already available, that it will go a certain way to meet our needs. Perhaps the improvement we propose is simply not justified and the $200,000 piece of equipment already in existence will do three quarters of the work and that spending a further $200,000 in capital to carry out 25% of the work is not justified. They may overlay our design and development process with other information which

we have tended to ignore, subconsciously or otherwise. They may say that the equipment we are talking about does not have the flexibility or versatility that is necessary in New Zealand, although it may be entirely suitable for an overseas market. We must then rationalise our thinking to determine whether we consider New Zealand alone or whether we look at the export requirements. Can we afford to spend the money to develop equipment for export? Our industry may not be at all interested if we are expending effort into development for our future competitors if it cannot be used effectively in New Zealand. The market constraints are equally as important as our resource and producer's requirements. Although these processes may be applied and used overseas, they cannot always be applied in New Zealand. Internally we are perhaps not large enough for some of this full development process. Mechanisation has tended to reach us as the end result of development and research in the United States of America, Canada or Europe, each with forests and processors having distinctly different requirements to our own.

PRODUCTION PROTOTYPE

However, let us continue on the basis that for New Zealand we have reached a stage where the answers we are receiving in response to our research and development principles, have given us another positive answer to enable us to move further. We can now consider building a production prototype. This normally is the stage when outside manufacturers will be used. Development work can be carried out by a pure research group or by an equipment manufacturer. In New Zealand it would be more normal for an organisation such as LIRA for example, to be moving through this research and development process for the industry as a whole, rather than being undertaken by one potential manufacturer or supplier. Perhaps we ask an equipment manufacturer to make the initial model, perhaps not. But we are now asking him to prepare a production prototype. What we now have, or what we are now asking for is not just a working model, but a full sized production machine which will do the work that we have set out in our design parameters. It may look a little rough but it will be made out of permanent materials. It may even go on to be used for 20 years, it might be rebuilt at a later stage, but this is the machine that will go into the field in a production situation to enable the manufacturer, and those who have set the design parameters, to examine it as a production tool. It will be this unit that will be used to prepare full manufacturers construction drawings. The production units will not necessarily be a copy of the production prototype. It may be that various model concepts are developed from the prototype and it may be necessary for a production prototype to be built in two or more sizes or models that the market demands. The testing of this prototype should again be undertaken by our research and development experts. They will examine its performance, alongside those parameters that were set. They will advise on modifications that may be necessary, either to meet their parameters, or in the light of data now available they may change their parameters. We will probably find that what was thought could be achieved in some way, will not be achieved, but something else will become possible that was not previously thought possible. Thus, continuously changing inputs are required. There is an immense flexibility required by the people who are involved. There is no place in

research and development for people with inflexible and fixed ideas. However, and most importantly, neither is there a place for someone who wishes to spend too long experimenting with an infinite number of options - many of which have very little chance of success. Good control and good management of the research and development team is necessary and must eliminate quickly, options that will only lead in the wrong direction. There is not time, if we are talking of commercial success, merely to use it as a toy to obtain much unnecessary information. Being able to recognise how far one can go and when one is wasting ones time, is the key to successful management of research and development.

So our evolution continues and we undertake design developoment from the work done in the field and from the data that is collecte and analysed by our research group. This is the information that is then used to produce the production drawings and finally the production machine. However, before we finally get into production, we must go back to our market place once more and feed the new information, the much better looking equipment, the quantative production capacities, to our marketing people. We ask them again, within the time it has taken us to move from the model stage to the prototype stage, what changes have taken place in the market. As you know, in the logging industry changes take place quite quickly and can affect the short term market dramatically. However, we are looking a little bit into the future and our market people then take this new information and come back with much more finite data which indicates whether we have a market and whether the market is large enough to warrant what we now know it will take to put the machine into full scale production. We have not yet spent all our money getting to the prototype stage. If the market is small, perhaps manufacture on a more or less one off or two off basis can take place. Perhaps research and development costs can be recouped gradually over a lengthy period, particularly if either the processing or forest grower sectors have been supporting the development. It may be that in New Zealand, where there is never going to be a great market for large numbers of new equipment, that the ultimate saving in costs of production or holding the increases in harvesting costs, can be met in advance by development paid for by these two major beneficiaries, with the aim of reducing the costs of logging. It may be to their advantage to have this equipment development well in advance of production needs. If, however, all the costs must be recouped in equipment sales, then quite a different basis for making a decision to proceed to manufacture must be made. In this case all the costs to date and further costs to get it into the market place, have still got to be met. It is at this point that one can perhaps see in New Zealand the need for an organisation such as we have in our own Logging Industry Research Association. There is no equipment manufacturer in New Zealand of a size related to the size of any one particular market that could absorb all the research, design and development costs on a major plant item and hope to recoup them from normal commercial sales.

However, perhaps our industry as a whole can afford the cost of research and development on the basis of reduced or held harvesting costs through the involvement of an independent co-ordinating group. Putting together the basic research,

obtaining the information necessasry to adapt, to develop, to design - meeting the current and future needs of the forest industry.

MANUFACTURE

We have now reached the stage where we have been instructed to go ahead with manufacture as there is an adequate market. We have put the production prototype to a manufacturer and we are ready to construct our manufacturer's production model. We have encouraged the development of the prototype and we are now encouraging manufacture of production models. If we again consider the development of the hydraulic hauler as our example, we had the model, the production prototype and are now seeing the manufacturer's prototype finally being evaluated in the field. The next step is full production to catch the market of tomorrow when we move into larger areas of steep country. The evolutionary process has taken place, built upon information gathered from improvisation of various pieces of equipment, after use of standard off the shelf equipment available to do part of the job or to do the job to the best of its ability, input from the forester, from the machinery supplier, from the end user and from the logger. We have moulded it all together and finally compromised at the market stage to determine how much we can spend and what we can build. We should now have our manufacturer's production machine ready for the market. It is at this stage that we hope the manufacturer will receive the support of the industry that has had such a say in the development and will assist to make the evolutionary process worthwhile. To close the gap in the cycle is to purchase the plant that has been developed. Everyone will have had to make a compromise. It will not be the equipment that the end user may have thought he needed, neither will it be the equipment that the logger thought he was going to get. The new machine will probably not meet all the criteria that was laid out by the forester and forest owner, but we have worked to obtain a compromise to meet many of our needs. We must now work together to use it within the limits of those compromises.

Of course, the designer's role has not finished at this stage. He has yet to provide the user, the logger, with a detailed method of operation. The equipment was designed around compromises to get to this production stage. It is built on certain concepts and these user parameters must be built into a methods manual. The forester, the designer and researcher and developer, must all have their input into the manual so that the logger can translate the developed equipment into an operational success.

SUMMARY

This paper provides an outline of the standard research and development procedures which can be applied to the forest industry in New Zealand. We might have started with "off the shelf" equipment, with very low development costs and relatively low risk financially; but which is full of compromise and is usually costly to the end user at the time it is used. Or, have we moved to the improvisation stage? Improvisation has the advantage of being done by the logger in the field to meet his immediate needs, maybe compromising the system that is being used. Certainly it will not be the optimum financial solution from a unit cost point of

view, but may certainly be a manageable investment cost. Or, have we, and are we able, to go the full evolutionary way, developing something that is new, unique, extending the state of the present art for that particular type of operation? The disadvantages of evolutionary design are high developmental costs, but hopefully reduced operating costs. This full scale development has a high risk and must have a good market to enable the costs to be recovered. The length of time taken to go through the full developmental stages and because of the rather uninvolved way in which it is done, means such development can be insensitive to local and peculiar issues that may have arisen, or which may arise during development. The evolutionary process does not ignore these, but it puts them in their true perspective.

For our size, New Zealand has large forest areas with relatively large volumes of wood to be harvested. However, our equipment suppliers and manufacturers usually have a business based on the manufacture of equipment developed overseas or on the sale of fully imported equipment. One or two small firms manufacture specialised equipment. Their market place is small. No one manufacturer in New Zealand can afford to spend all the developmental costs incurred in full scale development of mechanised systems. However, the industry as a whole may well be able to benefit from the development of such systems. It will be the industry that must provide most of the assistance, that must pay most of the costs of this development in advance, thus lessening the risk to the manufacturer, but spreading the cost across the industry as a whole. For this to take place there is an absolute necessity for a strong co-ordinating group to pull together these three factions that will pay. Is this the role of the Logging Research Association in New Zealand, or, is it best that the industry in New Zealand does not go for full evolutionary development? Should New Zealand development remain within the confines of improvisation on standard "off the shelf" equipment, using the limited resources that are available to manufacturers and suppliers and the resource of the logger himself?

Those then are the parameters around which research, design and development take place. During this seminar we shall be listening to papers on the various particular aspects that are involved and that are used in our decision making processes. You must assess the inputs from the specialised papers and by the end of the seminar we will have your opinions, which will assist in interpretting the needs of our industry and how these needs might best be met. It is very expensive to design and develop new and innovative equipment. However, it is equally expensive to do nothing. Grower, processor, logger and researcher, must all participate to ensure development proceeds at the speed and in the form required to enable our industry to be competitive with alternative end use products and in the world market place.