LOGGING INDUSTRY RESEARCH ASSOCIATION

NEW ZEALAND

PROJECT REPORT

LOG TRANSPORT AND LOADING SEMINAR PROCEEDINGS

The Proceedings of a Seminar
Held in Rotorua,
June, 1979.

P.R.8 1979

N.Z. LOGGING INDUSTRY RESEARCH ASSOCIATION (INC.)

P.O. Box 147 Rotorua New Zealand

N.Z. Logging Industry Research Assoc.Inc.

Project Report No. 8.
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- TABLE OF CONTENTS -

		PAGE NO.
	BACKGROUND TO SEMINAR	1
SESSION I:	INTRODUCTION AND KEYNOTE ADDRESSES:	2
	(a) "Current Issues Facing Licensed Transport Operators." I. Johnson	3
	(b) "Research and Development of Transport Systems, What can be Achieved." H. Brabin	11
SESSION II:	THE PRESENT STATE OF KNOWLEDGE:	22
	(a) "The Economic Importance of Transport and Loading in the Forest Industry." J. Tustin	23
	(b) "The Present Fleet of Equipment Used and Volume of Raw Materials Handled." R. Gordon	28
	(c) "Future Forest Volumes for Loading and Transport." H. Levack	36
	(d) "Log Transportation - Choice of Mode and Decisions on the Provision of the Transport Infrastructure." F. Stewart	58
SESSION III:	FIELD TRIP:	68
	Programme of a field trip to Whakarewarewa Forest and Waipa Mill to observe loading operations, weighbridge operations, truck unloading and truck rescheduling.	
SESSION IV:	FILMS AND INFORMAL DISCUSSION:	69
	Programme of an informal social and film evening showing various overseas developments in transport and loading.	

		PAGE NO.
SESSION V:	COSTS IN TRANSPORT AND LOADING:	70
	(a) "How Much to Invest in a Logging Truck. Results of a New Zealand Study." C. Savage	71
	(b i) "Costing Trucking Operations." R. Harlick	77
	(b ii) "Financial Planning for a Log Loading Business." G. Wells	84
	(c) "Vehicle Availability and Maintenance." K. Steel	97
SESSION VI:	TRANSPORT AND LOADING SYSTEMS :- PART I:	106
	(a) "Standing Time and Influences on Productivity in Log Cartage." M. Howard	107
	(b) "The Effect of Road Standards on Logging Truck Performance." C. Cornelius	114
	(c) "Development and Operation of a Truck Scheduling System." G. Sperry	126
SESSION VII:	TRANSPORT AND LOADING SYSTEMS:- PART II:	133
	Loading and unloading systems. Format for separate controlled group discussions and the separate group findings.	
SESSION VIII:	EQUIPMENT OPTIONS:	142
	(a) "Loading Equipment Options - Criteria for Selection and Application of Log Loaders." R. Gordon	143
	(b) "Trucking Rig Layout Options." Background reference paper and the results of a panel discussion.	154
SESSION IX:	SEMINAR SUMMATION:	172
	(a) "Further Research Needs in Transport and Loading." J. Spiers	173
	(b) "Seminar Summation" A. Cameron	176
ACKNOWLEDGEMENTS:		178
APPENDIX I:	Registration List	(i)

- BACKGROUND TO SEMINAR -

The cost of transporting logs commonly accounts for approximately half the total log harvesting costs between stump and mill or port. Efficiency of the transport phase is tied closely to the log loading methods used, and in loading there is a wider choice of options available than in any other aspect of logging.

With a significant and increasing portion of New Zealand's forest production aimed at export, there is thus a need for our log transport and loading systems to be as efficient as possible.

All persons involved with log transport and loading, such as in equipment operation, supervision, management, supply and maintenance, play a vital role in the effectiveness of their logging operations. LIRA thus arranged this Seminar to examine factors which influence operations, to exchange information and to explore directions for the future.

How important is transport and loading in logging economics?
What do we know about the future log volumes to be handled?
Are there realistic alternatives to transport by truck?
Are high cost trucks more effective than low cost units?
How do we get maximum availability and minimum cost?
What cost information assists running a business efficiently?
What are the major factors influencing truck cycle times?
Can truck scheduling systems be improved?
Is there potential with other loading and unloading systems?
What equipment options exist for loading and trucking?

These are some of the topics which were explored at this Seminar through paper presentations, a panel session , group discussions, and a field trip.

The following proceedings provide a record of the papers, discussions and conclusions drawn at this Seminar held on the 6th and 7th of June,1979, and which was attended by approximately 140 people.

- SESSION I -

INTRODUCTION AND KEYNOTE ADDRESSES:

Chairman - P.C. Crequer, Chairman of Board, Logging Industry Research Association.

"CURRENT ISSUES FACING LICENCED TRANSPORT OPERATORS"
An indication of the importance of transport generally on the economy, focussing specifically on road transport in the logging industry of New Zealand.
(I.J. JOHNSON - Senior Vice President, N.Z. Road Transport Assoc.)

"RESEARCH AND DEVELOPMENT OF TRANSPORT SYSTEMS, WHAT CAN BE ACHIEVED."
Some examples of the value of Research and Development to the various modes of transport available.
(H. BRABIN - Chief Executive Officer, Ministry of Transport)

SESSION 1

PAPER a

CURRENT ISSUES FACING LICENSED TRANSPORT OPERATORS

I.J. JOHNSON

Senior Vice President

N.Z.R.T.A

We licensed road transport operators have two slogans which I want to mention at the outset. Not as propaganda, but as the basis for what I want to say to you about various forms of transport.

We claims that "If you've got it, it came by road." We claim also that "Tomorrow depends on road transport". They are simple phrases, but they contain a tonne of truth.

Transport in all its forms absorbs about 30 percent of the gross national product - that is 30 cents in every dollar spent in New Zealand.

About half of that amount - 15 cents - is spent on freight transport, in all its forms - road, rail, sea and air. The balance is taken by passenger transport, private cars, buses, railways, air and sea.

The 15 cents spent on freight transport breaks down into 7.5 cents on road transport and 7.6 cents on other modes.

Transport in any form is, of course, the moving of people or goods from one point to another. It is an operation which in a sense produces nothing. You can't buy $100 worth of transport and put in into storage. Nor can you manufacture it and put it in the marketplace.

Freight transport's stock-in-trade is tonne-kilomtres expressed in one form or another according to whether we are talking about road, rail, sea or air transport. But you can't see or handle tonne-kilometres.

Yet without this intangible commodity - transport - goods are themselves of no value. A manufacturer's finished goods are worthless to him at the factory. A farmer's bales of wool are worthless to him in the woolshed. They're no use to the consumer in these places either..

These products assume a value only when they have been transported to a market. Thus transport is the key to commerce. It is the artery through which the New Zealand economy flows. Cut the artery and you risk the economy bleeding to death.

This basic principle applies to any country in the world. Those with the highest overall standards of living have the most extensive and efficient transport systems. From the state of a nation's transport services you can readily assess the state of its economy.

The World Bank, a source of funds for developing countries, uses transport efficiency as an infallible guide to a country's condition. It also stipulates that any funds it earmarks for for development in a country must include high priority for transport facilities.

Let's look at our own country. Our standard of living has slumped badly in the last decade or so. In the mix-sixties our economic well-being was strong and healthy. Few other nations could equal it. Now we are well down the list and still dropping. What has caused this reversal of fortune?

Obviously the oil crises, the worldwide economic recession, trade protectionism, inflation, the wage price spiral - all these and other influences have combined to erode our balance of payments, slow production, discourage investment in industry, and consequently reduce our living standards.

Where the economy suffers, so too must the transport sector suffer. But I put to you that transport is not simply a passive, reactionary service. In fact it has almost the opposite role in our economy. As I said earlier, it is the key to our commerce.

A well-structured, efficient, cost-wise transport industry has a vital role to play in supporting the economy, even in sustaining it. Unfortunately, rather than being on the receiving end of New Zealand's economic downturn, I believe that in some respects New Zealand's internal transport system has actually contributed to it through not being as efficient, or as cost-efficient as it should be.

Witness the decline and stagnation of our coastal shipping network; the huge annual losses suffered by railways; the losses incurred by metropolitan bus services; the struggling air service operations; and the marginal operating conditions of many road transport companies, utilising a road network that we can barely afford to maintain, let alone develop.

Our options are limited. These four transport modes as we know them are likely to continue for a long time yet. There is simply no alternative. They are all in competition to a certain degree, yet in most respects they perform the same broad service - moving goods to the markets.

But there is one vital difference between road transport and the other modes. It is the difference which makes valid our claim that "If you've got it, it came by road". The vital difference is this: rail haulage is limited to a steel track and begins and ends at a railway station or siding. Shipping begins and ends at a wharf. Air freight begins and ends at an airport.

How do goods move from factory to rail and rail to warehouse, from factory to wharf and wharf to consumer, from factory to airport and airport to retailer? The answer, obviously, is by road.

Road transport by nature of its very flexibility is the key to all other forms of transport. Within each of the two main islands of New Zealand, there is no commodity that cannot be handled from end to end by road vehicles. Conversely there are very few goods indeed which can be moved through their entire journey by any other form of transport.

Road transport, then, would appear to be the key to our commerce. It is time we considered whether it is efficient enough, how it can be made more efficient, and how this country's gross transport bill can be reduced, yet still offer primary and secondary industries the lifeline they need to restore our economy.

One of the first things that should be cleared up is the respective roles of road and rail within the transport sector. For historical and political reasons, rail has for many years enjoyed protection against road for most goods over a certain distance. Originally it was 30 miles, then 40 miles, and now the limit is 150 kilometres.

This arbitrary limit implies that theoretically road transport is best equipped to carry goods up to, but not over 150 kilometres. Similarly, rail would seem to be best equipped to move freight over the longer distances.

This is not a hard and fast rule, of course, because the two modes compete strongly against each other below the limit and in some areas above the limit. But there is more than a grain of truth in the principle embodied in this distance concept.

Road is ideally suited to carry goods over the shorter distances, because of its inherent flexibility, as I outlined previously. Rail is not so flexible and cannot be so efficient in this area. Yet it persists in competing against road over short-haul distances. It strikes rates for this work which cannot possibly cover the total cost of the services, and while the rates may suit the consignor, the tax payer ultimately foots the bill.

Rail is best suited to long haul, route-type operations. That is where its profitability lies and that is where it can be most efficient from a cost point of view. It should concentrate on this type of operation and leave road transport the short-to-medium haulage work.

This is an example of the sort of transport luxury this country cannot afford. By definition, the road and rail modes should have clear and distinct roles, but they overlap in too many areas.

Besides the arbitrary distance limited imposed on us, there are some limitations on our efficiency by circumstances which we recognise as thoroughly valid. As an example, a quantity of goods or draft of livestock is to be hauled over mainly Class One roads. This means an approximate gross permissible load of about 39 tonnes for a normal truck and trailer rig. But the journey starts or ends on a few miles of Class Two road with a gross limit of about 35 tonnes, or somewhere along the journey is an ageing bridge with severe restrictions on its loading capacity. As a result, loading is reduced to the lowest factor and it comes necessary to use two vehicles, or make two trips. Thus the owner of the goods or stock is denied the economies of the best service.

Such circumstances are a serious curb on our efficiency, although they are gradually being removed. I say "Gradually" in its slowest possible sense because the progress in roading standards has fallen alarmingly in recent years. The funds available to the National Roads Board are just not sufficient to make real roading progress. Much roading and highway construction and upgrading cannot be done because inflation has gobbled up the progress percentage of the funds available. In many areas it's all the roading authorities can do to keep up with maintenance.

It would be disastrous to allow our roading system to deteriorate. Good roads result in increased productivity and higher living standards. There are direct benefits to property owners, and to regional developers from good roads.

Theycreate business opportunities, allow greater efficiency andexploitation of natural resources. All these things are dangerously jeopardised because not enough money is being put into maintaining and improving our roading network.

At present my Association is pressing Government to contribute one-sixth of the National Roads Board's annual budget, which is currently $170 million.

Government from time to time has made contributions to the kitty, but these have never had a consistent pattern, It would appear that from April next year Central Government will make no annual contribution to the Board. This would mean the roading funds will be paid for exclusively by road users through motor spirits duty and road user charges.

This possible development is seen as a serious threat to the viability of the road transport industry, which, as a major road user, is likely to be placed in an unenviable role of tax gatherers to the nation's roading funds.

Roading requirements, I submit must be planned ahead and in this regard as assured income from dedicated sources is essential. Central Government has an obligation to contribute towards our roads on behalf of the many beneficiaries from roads who make no direct contribution. We say it should declare its intention to contribute one-sixth of the National Roads Board's annual income effective from next year.

For years a large proportion of motor vehicle licensing and registration fees have been swallowed into the Consolidated Revenue Account. These are funds which should have been returned to roads. Let's hope that this Government will see fit to channel some of that money back into roads, then perhaps we will begin to see roading progress again.

There is another area of transport, and road transport in particular, where nationally there are big savings to be made. Up to now I have spoken of transport as if it were a neatly packaged industry. Well it is not.

Road Transport is New Zealand is represented by some 80,000 heavy trucks. Of this total about one-fifth belong to licensed public carriers. The others belong to Government and local body operators and mainly to people we term ancillary operators - merchants, tradesmen, factories, breweries, farmers, and so on.

Licensed trucks cover an annual distance of some 500 million kilometres, an average of about 30,000 kilomtres per vehicle. Their annual turnover is estimated to be in the vicinity of more than $500 million.

Our estimate is that some 700 of the licensed trucks are engaged in the cartage of logs and green sawn timber.

The unlicensed trucks probably cover a similar annual distance but there is no way of calculating their turnover. What is known, however, is that thousands of them pass their time with only nominal loads. You have seen them, as I have, about the streets of any town with a quarter load, or perhaps only a large package.

But all the time they are using diesel and petrol and tyres. The vehicles themselves represent an extravagant spending of overseas funds. Few of these ancillary operators have a true picture of what their transport costs are.

The distinction then is that while the ancillary operator appears to ignore his transport economies, the licensed carrier cannot afford to. While the ancillary operator is willing to sacrifice economies for expediency, the country can no longer afford to.

The licensed carriers sells his transport services in a competitive world and he knows he cannot carry fractional loads and keep his charges down. Far from not worrying about this costs he is constantly searching for techniques and avenues to reduce them.

To assist him in this the licensed road transport industry organises and conducts a wide variety of training courses aimed at promoting efficiency. Most recently these have placed emphasis on cost and revenue aspects of transport operators' businesses. These concentrated study courses are part of our industry's contribution to the driver for better transport economy.

What's to be done about the waste of resources in the ancillary sector? The answer probably lies in education, in showing the truck owner what his real costs are. this could be done through a new licensing system whereby all trucks were licensed and subject to entry conditions and economic guidelines. In fact this is one of my association's arguments in its submissions to the Government on the review of transport licensing currently taking place.

But part of the answer is a continuing challenge to our licensed industry to sell its advantages to ancillary users and free their capital for other purposes. The licensed carrier's contribution to the national economy is real enough. As an industry we do not pretend that we have always been as efficient as we might have been. We are conscious of certain shortcomings in the past, but in more recent years we have accepted and I believe met the challenge.

We know our contribution is real and it has grown substantially in the past decade or so. But there is still a lot of scope for national cost-cutting and savings, in the ancillary field and by allowing the most suitable form of transport to perform the job, no matter what the job might be.

This is the area in which we believe the licensed carrier fleet can best help New Zealand. Today and tomorrow depend on road transport.

DISCUSSION ON JOHNSON'S PAPER - SESSION I

Stewart

It seems implicit in your paper that what is good for the transport industry is good for the economy. Shouldn't we look at what is good for the user is good for the economy, because a healthy road transport industry might not necessarily represent the best use of resources?

Johnson

What I implied was that for the economy to prosper it is essiential that road transport be allowed to play its role. I think that if you have got an efficient transport industry, then surely the use of that form of transport will benefit the economy.

Corkin

In your paper you suggest that all trucks should be licenced subject to entry conditions and economic guidelines. We are criticised now for our regulations and you are wanting to extend this, with protectionism. Would not a better movement be to do away with licencing altogether?

Johnson

Because transport forms a very large part of our spending in New Zealand, we cannot afford the luxury of supporting vehicles running around the country using up vital overseas funds,and fuel. I don't suggest that we are trying to close the door or make it tighter to enter transport. We want people who are entering the transport industry to be more qualified to operate an efficient business.

Gordon

Rail has enjoyed protection over road transport for distances starting at 30 miles, then 40 miles, and now 150 kilometres. Do you see this trend going any further?

Johnson

I can see it being extended to certain commodities, and on certain goods it being eliminated completely. The distance figure is arbitrary. I don't know if there's anyone who can say rail is more efficient from 150 km on. The general concept though, that rail is more efficient over longer distances for bulk loads, has a certain amount of truth in it.

Crequer

You mention the flexibility of road transport against the rigidity of rail. Road however, is very inflexible when it comes to fuel, as it requires diesel or motor spirit. Rail has the flexibility of steam, diesel or electrification. Shouldn't you take that into account when you are balancing flexibilities of various systems?

Johnson

It's true that currently road is dependant on diesel or petrol. Government and private enterprise, including the oil companies, are however, spending a tremendous amount of money in researching alternative forms of energy. From that point of view we retain our flexibility.

Spiers

You talked about the large percentage of ancilliary unlicenced vehicles. Quite a lot of the ancilliary vehicles are specialised vehicles, run by the big companies, and these are very effectively utilised. Are you inferring that they don't pay their way because they are not a licenced vehicle?

Johnson

No, not necessarily. Take for example a milk tanker; the tractor unit could be used for numerous other applications if part of a licenced carrier fleet. A similar analogy could be put to trucks in the logging industry.

SESSION I
PAPER b

RESEARCH AND DEVELOPMENT OF TRANSPORT SYSTEMS, WHAT CAN BE ACHIEVED

HARRY BRABIN
Chief Executive Officer
(Economic Studies)
Ministry of Transport

INTRODUCTION

Given a subject such as this there is a great temptation to say that the short answer is that appropriate research can achieve anything. If I were to make such a claim it would be to say the least rash. Indeed one of the more cynical economists has gone so far as to allege that research in transport economics has become the unfulfilled promise of the decade. He is not alone in this view because it has become common for major transport research projects to find an acceptable solution elusive. Nevertheless such a statement cannot be allowed to go unchallenged and some thought must be given as to why such a claim can be made. Essentially the claim arises from research aimed at problems which have not been sufficiently identified, or in some cases research designed to solve a controversial issue. In the latter case the supposed conclusions dispute preconceived ideas as to what the solution should be.

The cynic I referred to previously was in fact commenting on the fact that in the United States great debates had been raging for years between economists who were either attacking or defending regulatory proposals. One of these debates, or rather the consequences has now spilled over into the New Zealand scene with so called free sky policy supporting increasing numbers of airlines having the right to land in New Zealand. That such a policy may threaten the financial base of some airlines does not concern the supporters of unrestricted competition. Both sides of the argument are well supported by research proving each are right. So we have researchers using the same skills and tools producing totally different answers. It is small wonder that the public, business and governments end up confused.

Even your own industry has been a victim of the sort of situation where research may not provide a solution. In the disagreement between loggers on the one hand and the environmentalists on the other there may never be agreement as to the danger to wildlife. I have no wish to enter into the controversy, but I would point out that when two parties look at an issue with totally differing values it is doubtful that research can arrive at a satisfactory conclusion. Research does not produce "great truths".

I hope that I have not given the impression that research is of no value. That is not the case. What I have tried to do so far is to sound a warning note. Some research may produce a controversial answer, but this does not invalidate the result.

What is important is that before research is conducted it must have a very clearly stated objective. So the first question to ask is why are we doing this work, and what purpose will we achieve.

RESEARCH IN NEW ZEALAND

There are in New Zealand three main streams of research. What I call main streams are those organisations which initiate and conduct research in the context of transport. The first, although not necessarily the most important, is research conducted by government both central and local. Here the objective is to solve problems which affect the citizens and which often have social implications. I make the distinction because the motivation is not limited to solving a problem affecting one segment of the community. Such research will probably not be profit motivated nor will it be designed to demonstrate academic ability.

Much of the research by government is aimed at increasing efficiency or at helping decision making where capital expenditure is involved. Most of governments decision making is how best to spend its resources or put in another way how to get maximum benefit from a given level of expenditure. When the expenditure relates to capital works such as ports, roads, railways or airports it is common to use one of two techniques. Cost-benefit analysis or cost effectiveness. These techniques do not tell what to do, but illustrate the consequences of a range of options being considered. The difference between the techniques is somewhat subtle, and the choice of technique may be dictated by the objective. Cost-benefit analysis is designed to measure social costs to the community and attempts to measure intangible things such as the value of a persons time, and visual pollution. Later I will go into more detail when I give some examples of research which has been done.

Cost effectiveness was originally developed as a planning tool for the armed forces. Its objective is to find the best use of a given amount of money to achieve an objective. For example if the objective is to destroy an aircraft and a specific budget is provided the research would consider all the ways in which to destroy an aircraft. It may prove cheaper to build another aircraft capable of shooting the enemy down, or it maybe more effective to develop a new anti-aircraft gun. This latter technique certainly has the potential for use in industry.

The second mainstream of research is the universities, which in New Zealand are increasingly conducting transport research at both graduate and under-graduate level. While much of this research is undertaken to develop the academic skills of the researcher there are opportunities for industry to benefit. Most universities welcome both government and industry contracting research to students and staff, so that even small organisations which cannot afford to establish a research unit can get work done at modest cost. There is a valuable by-product from this approach in the creation of a relationship which sometimes results in recruiting qualified staff to both government and industry. One important point is that the organisation funding the research must be very precise in setting the objective of the research and must insist that the project is properly supervised.

More close to your organisation, the third stream is of course industry based research. In the context of transport there are two major aspects - technology based research which LIRA has been conducting and research aimed at better utilisation of vehicles which you have also done some work on. In general where an organisation is large enough it has its own research unit. Both Air New Zealand and N.Z. Railways have research units which examine ways of improving performance. However where an industry, such as yours has multiple ownership, or its units are small to medium in size it has become common practice to establish an industry research association. I understand that discussions are taking place to establish a Transport Research Association (TRANZ) and I think this is an excellent move. I believe that your organisation may well get considerable benefit from this development.

What I have tried to do thus far is to demonstrate that research is being conducted on transport in New Zealand. I must however admit that the objective of such research probably does not equate with the objectives of transport research your industry would want. In particular your industry surely needs to find more efficient, and therefore less costly ways of moving timber from origin through processes to final destination. This may call for new technology, or it may call for better mode utilisation. It may call for more intensive use of equipment or it may call for a new approach to the job such as taking the mill to the forest instead of the reverse. It is no accident that most improvements in transport are the result of trying to find ways to reduce production costs. In transport the product is capacity to carry a commodity at a point in time. If that capacity is not used at that time it is lost forever. What the logging industry needs to do is to identify what its transport problems are, and having done so objectives for research will emerge. I cannot promise that research will solve them.

At this point it might be useful to give some examples of research projects which have been done. The examples are all major exercises which have been done to solve an investment dilemma for government. The ability to provide advice to government on complex transport problems has only been recently achieved. The technical skills of economists, transport planners and operation researchers combined with the capacity of computors now mean that problems which were so enormous to be beyond comprehension are now capable of being handled.

COST-BENEFIT ANALYSIS FOR AIRPORTS

In the world of aviation the most difficult decision which government has to make is that of whether or not to make new investment. In the case of airports these decisions are forced on government because vehicle characteristics (i.e. aircraft) demand improved passenger handling facilities or longer runways.

In common with other types of publicly owned transport undertakings, airport authorities have in recent years shown an increasing interest in pre-investment studies. The objective is normally to examine the economic justification of a proposed development, or to produce a comparative economic analysis of a number of alternative courses of action. The research is usually carried out concurrently with an engineering feasibility study, enabling the results to be presented in the form of a cost-benefit analysis.

Within the framework of a major airport development, runway construction costs may of course account for a minor proportion of the total investment including the terminal areas, navigation aids, services and surface transport access, and it may be more appropriate to use the minimum total system-cost approach to the comparison of alternative schemes.

The request for a feasibility study calls for an analysis of "relevant information, particularly in relation to aviation and tourism, freight schedules and aircraft types likely to be used". Traffic forecasts are prepared for passengers and freight with and without the runway extension, so that the net benefits of the extension could be assessed.

It is envisaged that these benefits would fall into three main categories:

(i) increased tourism,

(ii) increased air freight, resulting in induced agricultural and industrial export activity, and

(iii) increased airport revenue from the higher level of traffic.

The issues raised by a limited runway length should not be over-simplified; but, broadly speaking, they can be summarised as follows:

(i) An aircraft generally uses less power and lift to fly from A to B at its operating altitude than it does to take off and climb to that altitude. The lower limit imposed on the power-weight and lift characteristics of the design, and hence on the fuel consumption of the vehicle, is therefore imposed by its ability to get airborne.

(ii) The power-weight ratio and lift characteristics are expressed in the length of runway required to accelerate the vehicle to its take-off speed.

(iii) The longer the stage length over which a given aircraft is operated, the greater its initial fuel load, and the longer the take-off run required.

(iv) The critical flying speed on take-off is affected by atmospheric pressure, as lower air densities reduce the thrust developed by the engines. Take-off distance is therefore unfavourably affected by increase in the airfield's ambient temperature and height above sea level.

(v) The higher the power-weight and lift characteristics of an aircraft, giving better take-off performance, the poorer is its overall operating cost-revenue factor. This follows because payload is sacrificed for more powerful engines, greater fuel capacity and greater structural strength, whilst wing designs with high lift devices increase initial cost, operating complexity and maintenance.

From this we see the presenting problem of a wish to obtain the benefits of larger aircraft against which must be weighed the cost of providing increased facilities. Airport extension projects are larger in capital requirements than private enterprise can fund, and not all the benefits are received by the immediate user. Thus the technique of social cost benefit is employed to assist in the decision making processes which has implication at national rather than local level. One such study was that undertaken in respect of Wellington airport in 1968 to determine whether the runway should be extended or relocated elsewhere to cater for aircraft larger than the Locheed Electra then in use. Such a study should include consideration of various aspects such as problem definition, enumeration of costs and benefits, valuation of costs and benefits, discounting future values, and allowances for risk and uncertainty[2]. What I want to draw to your attention is that these techniques include valuation of intangible things which can at best be subjective. For example the value of a passengers time is most important and can influence the location of the airport if the geographic centre of origin of passengers is closer to an alternative site. The Wellington Airport Study[3] considered several alternatives including the choice of not doing anything, and concluded that the most benefit accrued by extending Wellington to 8000 ft sufficient to accommodate DC10's and 747's. One point is that the study indicated that over the time frame used an extension of the runway produced benefits to the passengers of over $12 million in 1970 values.

Having read so far you may well ask how studies such as this are relevant to LIRA or the logging industry in general. The relevance is I believe that in future you as an industry may have to make decisions which have implications for others. Just as the aircraft industry responds to airlines by making bigger aircraft to reduce seat/passenger costs no doubt truck manufacturers will respond to your vehicle needs which will try to reduce ton/mile costs. You may ask how does that impose costs on others. If your future vehicles do not have a high enough power/weight ratio this can cause traffic congestion or delays on the highway raising a demand for passing lanes or multi lane highways. Who will pay for such a cost. The user, the car owner or should it be shared.

You may be able to produce strong evidence that a new road, or port facilities can be justified because of the national benefits additional to the benefit to you as users of the facility.

INTERMODAL SIMULATION TECHNIQUES

Where one mode of transport has effects on other modes of transport it is useful to simulate the consequences of a course of action on either modes to obtain an indication of the probable best way of undertaking a particular task. Shipping has in the past thirty years been subject to more radical changes than any other form of transport. The move towards specialised vessels such as container ships, Ro-Ro, bulk carriers and composite bulk ships meant that the major changes in handling by other transport modes was inevitable. The changes that have taken place in shipping were a response to increased operating costs and handling costs. In addition the non-earning time, common to all transport in that a vehicle at rest is not earning an income, has becoming increasingly longer. This problem clearly called for research to reduce operating costs and to reduce handling time.

Containerisation was seen as one method of doing this, and there is no doubt as to its success. Containers were first used, (I.S.O. that is) on long distance rail in Europe, but it was not long before the shipowner recognised the advantages not least of which was a major reduction in turn round time.

However such a change immediately signalled a number of things - enormous costs for harbour boards, new handling techniques. It implied new road and rail techniques, and probably less well understood potential industrial relation problems. New technology often does. In New Zealand's case the technology was well established elsewhere by the time shipping companies serving our trade links decided to use container ships. Nevertheless the Government realised that it was probably important to establish the extent to which investment in the new technology should be permitted. Accordingly it was decided to commission consultants to study the extent and direction to which New Zealand could reasonably commit its resources[4]. This is now history, but what I want to draw to your attention is the methods used by the consultants. The consultants employed what is known as simulation modelling. They developed a series of models, one for each surface mode, i.e. rail or road, one for each port capable of taking ships of the likely draught and one for the vessels. With the aid of computors it was possible to examine the costs likely to occur by a wide range of ports. The costs of using only Auckland, Wellington, Lyttelton or Port Chalmers were compared. Later the costs of using any two were compared. At the time the study was done it was as comprehensive as was possible. Nevertheless it had one major defect because it failed to recognise the social and economic costs of containerisation. It failed to cost the lost jobs, and ports which had heavy capital expenditure in the past losing revenue. The consequence of this has been that instead of having two container ports (Auckland and Wellington) which the study recommended we now have four ports plus two others with the facility to handle self sustained container ships. I used this example because something important can be learnt from it. Essentially it was a numbers exercise. It did not recognise let alone value social consequences, it did not recognise the bane of New Zealand life parochialism, and it did not recognise that least cost solutions are sometimes not acceptable to the public.

A ROAD VERSUS RAIL CASE

Both of the previous examples have been studies which had implications at the national level, and before concluding I think an example of a more local problem would be useful. In this particular case the problem was that of an uneconomic branch line. The operator was faced with operating a section of railway which made insufficient contribution to variable costs let alone his fixed costs.

Clearly the line should be closed, but the issue was not that simple. They rarely are in transport. If closure of the line imposes social and economic costs on the community which are of sufficient size as to place a real burden then some means must be found to alleviate the problem. So clearly a cost-benefit exercise was called for.

One such exercise was conducted by M.O.T. some years ago to deal with the proposed closure of the Catlins River Branch Line in Clutha County.

The area is close to Balclutha and is primarily a livestock farming area with some timber production. At the time the study was made the railway was paralled by a Class II road, so that alternative transport was available. Railways carried about 18,000 tons per annum on a thrice weekly service.

The range of options considered was to do nothing, in other words leave the line open, to close the line now, or in 1 year, 2 years, 5 years and 10 years. These options gave a wide enough time frame to establish clearly the effect closure would have. The objective was to determine whether it was in the public interest to close the line bearing in mind the social costs to the community as opposed to the benefits to the rest of New Zealand i.e. reduced taxes to pay railway losses. The analysis would evaluate the economic resources of labour, materials and capital necessary to carry the traffic by road. It would also value the adverse effects on income redistribution and the broad social effects which offset the economic gains.

What the study did establish was that users of rail, would if the line was closed, face higher transport costs, but could well benefit by a more frequent service. Not surprisingly the study showed conclusively that the lowest social cost would be achieved by closing the line immediately. The reports recommendation was adopted, but as a measure of assistance to the users of rail a special road service at rail rates was established. In essence not much was achieved because the differential between road and rail rates became a charge to rail. (Attached to this paper as an appendix are some comments on cost-benefit analysis for those who are interested).

CONCLUSION

I hope that the examples I have given will have proved to be of some interest. Subsequent papers to be presented cover a wide range of topics. I saw my task as one which treated the subject of research in a general way. But in concluding I think I can point to some areas where a research effort may be of value to LIRA. It was perhaps an accident that the initials of your organisation also stand for a currency. Which leads me to say the major problem of most industry association and particularly transport is that of cost and increased efficiency. This is the area where I would concentrate research effort. But you need to ask the question. What is your business logging or transport, because it does not necessarily follow that logging requires you to provide transport. You may be able to more effectively carry on your main business and let a transport specialist do the cartage.

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APPENDIX

COMMENT ON COST-BENEFIT ANALYSIS

Cost-benefit analysis has come into prominence in recent years among economists, arising from a need to assess public investment decisions against proper economic criteria. Although having academic status this technique is subject to abuse and hence misunderstanding. For those wishing to gain a fuller knowledge of cost-benefit analysis there is a vast amount of literature available.

This appendix gives an explanation of some of the concepts used and their deficiencies.

1. THE DISCOUNTED-CASH-FLOW TECHNIQUE

When assessing an investment decision a proper allowance has to be made for time in the investment process. Essentially the principle at issue is a simple one, namely that a dollar received today is worth more to the recipient (and costs more to the spender) than a dollar received, say, five years hence. A receipt today provides command over the full amount of the resources involved immediately, and those resources can therefore immediately be put to work by their owner to increase his future return. A similar receipt in five years time does not convey a comparable benefit. An essential problem of investment appraisal is therefore to find a way of validly removing the factor of time from the appraisal. The discounted-cash-flow technique overcomes this problem by converting all cash flows to a common base known as "present value".

All forecast future cash flows are discounted back to a present value at a particular rate of interest. This process ensures that all costs and benefits, which fall at different points of time, are adjusted to a common basis in order that they may be compared.

2. CHOICE OF DISCOUNT RATE

The choice of the rate to be used in discounting future costs and benefits to present values raises perhaps the most difficult conceptual problem in cost benefit analysis. A large volume of literature has appeared on this particular problem, resulting in many varied opinions. One opinion is that the problem of the appropriate rate can be minimised somewhat in the evaluation of many projects by expressing the results in terms of an internal rate of return on the investment. Emphasis has been placed on "the opportunity cost of capital" when choosing a rate for discounting purposes.

3. INFLATIONARY AND DEFLATIONARY EFFECTS

Costs and benefits of projects will, naturally, be affected in money terms by any changes that may occur, or be thought likely to occur, in the purchasing power of the currency during the lifetime of the project.

Appendix (Contd)

"Strictly, however, any general inflationary, or deflationary, effects of this kind are ignored in the evaluation. The fact that the costs of building dams today are in money terms much greater than they were twenty years ago does not mean that dams are now more expensive to build, in terms of real resources of labour and materials, than they were - on the contrary, improvements in technology will almost certainly mean that they are now less expensive in that sense. By the same token, the fact that a project constructed twenty years ago is now yielding benefits which, valued in the currency of today, appear to show a good "return" on the original investment, valued in the currency of that day, proves nothing as to the original desirability of the project. In valuing future costs and benefits, therefore, any expected changes in the general price level may be set aside; only expected changes in relative prices would be relevant."

4. PROBLEMS OF DOUBLE COUNTING EXCLUSION OF TAXES

The social benefits of a project in the area of infrastructure involve quite a few different elements. In bringing these together so as to evaluate the total social benefit of the project, it is important to avoid double counting. Although the danger of double counting does not appear very great as long as we consider the problem on a general and abstract level it becomes a distinct possibility as soon as the analysis is pushed to the level of detailed calculations. In calculating the social value of the factors released by the project we must exclude any specific taxes on the factors of production, to the extent that these taxes represent transfers.

5. CONCEPT OF SOCIAL COSTS AND BENEFITS

All investment decisions explicitly or implicitly involve a comparison between costs and benefits, in the present and during the future economic life of the assets involved. In applying a cost-benefit criterion the definition and evaluation of costs and benefits raises a number of problems. In private projects this is a relatively simple question as only the money costs and the money revenue are considered relevant. In the public sector, however, other costs and benefits may have to be considered. Money costs and money revenues are quite often not considered as a correct or a sufficient basis for decision. Investment is based on consideration of "social costs" and "Social Benefits" which include other elements besides money costs and money revenues.

The social cost of a project is the present value of the maximum social benefit that could have been obtained if the project would not have been carried out. It is the value of the goods and services that could have been produced instead of the project under consideration, ("opportunity cost"). In determining the social benefit of a project we have to compare the situation prevailing when the project is carried out with the situation that would prevail if the project were dropped. In doing this we have to disregard the cost of the project and hence the disbenefits of the project to those who have to pay for it, since the cost aspect has already been considered separately.

Appendix (Contd)

6.

In sum what cost-benefit analysis endeavours to do is "to compare benefits from projects with their costs in such a way as to iron out difficulties associated with the time-phasing of the project and to take into account alternative uses of the resources involved. The analyst makes estimates of benefits and costs, discounts them back to present values, and expresses discounted benefits and costs in terms of net benefits for comparison with other specific projects".

It cannot be denied that cost-benefit analysis has its limitations. A lot of conflict could arise in the <u>interpretation</u> of cost-benefit analysis. "Cost-benefit studies assist decision-makers; they do not dictate to them".

DISCUSSION ON BRABIN'S PAPER - SESSION I

Wells

Do you have difficulty in collecting data for estimating the benefits of a particular course of action?

Brabin

In some cases we use a subjective decision and we show a range of valuations so you can see how sensitive it is to different valuations

Loughlin

When you do a transport analysis in an area, do you ever get transport firms involved to supply information?

Brabin

Not necessarily. It depends on the type of job, but if we felt it important, then we would do so. On a very small area it is easy to involve transport firms, but on a national exercise, it is not so easy.

Williamson

In relation to your closing remarks, are you suggesting that road transport is sufficiently expert in its own job that LIRA should take no interest in researching the transport sector of logging?

Brabin

No, I am not suggesting that. In the paper I mentioned the proposed transport research association. You people should be right behind them and work in conjunction with them

Spiers

LIRA sees 'logging' as a materials movement exercise, starting at the stump and ending up at the factory or on board ship. We feel that you have got to look at the whole system of moving the product, including the transport part of it. Transport is an integral part and shouldn't be treated in isolation.

Brabin

What I am getting at can be illustrated by considering the example of your one-way load problem in logging which immediately doubles some of the costs. In one N.Z. area the Dairy Company does not use its own trucks. It hires a contractor who spends half the day hauling tankers, and the other half pulling a freight trailer. This gives good vehicle utilisation and is the type of thing I am inferring. Do you use logging trucks the whole day, if not, you could improve efficiency by using a contract common carrier using his tractor unit and your log trailer, thus aiming for better vehicle utilisation.

Williamson

I think that the logging industry's transport section would have a very minor part of it, only using its vehicles for a part day only.

Johnson

This would depend on whether your day is 8 hours or 24 hours, of cours

- SESSION II -

THE PRESENT STATE OF KNOWLEDGE:

Chairman - J.J.K. Spiers, Director, Logging Industry Research Association.

"THE ECONOMIC IMPORTANCE OF TRANSPORT AND LOADING IN THE FOREST INDUSTRY"
(J.R. TUSTIN - Branch Head, A. TWADDLE - Scientist, Forest Research Institute. Presented by J.R. Tustin)

"THE PRESENT FLEET OF EQUIPMENT USED AND THE VOLUME OF RAW MATERIALS HANDLED"
(R.D. GORDON - Research Engineer, Logging Industry Research Association)

"FUTURE FOREST VOLUMES FOR LOADING AND TRANSPORT"
(H.H. LEVACK - Principle Forester, N.Z. Forest Service. Presented by J. Hansen)

"LOG TRANSPORTATION - CHOICE OF MODE AND DECISIONS ON THE PROVISION OF THE TRANSPORT INFRASTRUCTURE"
(F. STEWART - Senior Economist, Ministry of Transport)

SESSION II
PAPER a

THE ECONOMIC IMPORTANCE OF TRANSPORT AND LOADING IN THE FORESTRY INDUSTRY

JOHN TUSTIN
Branch Head, Production
Forestry Division, FRI

ALASTAIR TWADDLE
Scientist, Production
Forestry Division, FRI

1. PAST WORK Comprehensive economic analyses of growing and harvesting and transporting radiata pine plantation wood were prepared for the 1969 Forestry Development Conference and subsequently published in the NZ Journal of Forestry Science Vol. 2, No. 1. 1972 and Vol. 2 No. 3 1972. These volumes provided much of the justification for the establishment of LIRA but unfortunately not many people have studied them in any depth. The detailed data base used for the studies is dated but the implications for New Zealand forestry are still very relevant. Table 1 provides a sample of results. The conclusions were:

(a) Logging (including loading) is the highest of forest costs; and this is greatly accentuated when a high ratio of cable country is included.

(b) Log cartage can be even more important than logging depending on lead distance.

(c) Location of forests relative to utilization points has a large impact on profitability.

(d) The absolute mass to be moved in forestry is considerable; and closely linked to forest productivity and location.

Planners need to be more aware of this in the face of a liquid fuel crisis.

The other important piece of past work which should be noted is the logging industry survey for the year ended March 1974. This FRI survey provided a useful base line for harvesting research and the statistical "back stop" so essential to planning in any segment of our industry. The main focus of the survey was stump to roadside activity but some information relevant to loading emerged as a by-product. For example:

(a) Twenty percent of the total 1974 harvest was logged by cable systems and 80% by skidders or tractors.

TABLE 1: RESULTS FROM THE FORESTRY DEVELOPMENT CONFERENCE MODELS

(a) Export Log Project: Relative Importance of Costs

Cost Item	Percentage of Total *
Forest establishment	7
Tending	4
Protection	5
Administration	11
Accommodation and main roads	9
** Logging	14
** Cartage (140 Km)	23
Loading on ship	27
	100%

* At 10% Interest Rate

(b) Location Effect on Profitability: net L.E.V. Dollar/hectare*

Interest Rate %	Kilometres from Port or Mill 140	110	80	50
4	958	1102	1245	1386
7	235	284	333	383
10	35	57	77	96

* For Site Index 29 m (95 ft)

(c) Location Effect on Load Hauls: Total Annual Load *
(million tonne- Kilometres)

Site Index (m)	Forest to Mill Lead Distance (Km) 140	110	80	50
24	23.4	18.2	13.0	7.8
29	29.5	22.9	16.4	9.8
33	33.9	26.4	18.8	11.3

* For a 10 100 ha (25 000 acre) Forest at normality
i.e. steady state production

(b) Tree length extraction dominates (91%) and exotic clearfelling is by far the most important production category.

(c) Many (68% or more) clearfelling gangs control their own loading operations but most thinning operators (80%) do not.

(d) In exotic clearfelling the most popular machines are front-end loaders (54%) and then crane type loaders (30%).

(e) The most common practice is to segregate logs into 3 or 4 sorts; but some gangs have up to 8 or more sorts. In Rotorua Conservancy 81% of respondents were segregating 3 or more sorts - a reflection of the more sophisticated market in this region.

(f) Of 212 organisations surveyed; only 15% worked their loaders on two shifts/day.

I draw your attention to this survey because it should be repeated annually or at least every 3 years to monitor trends and service every aspect from the development of research programmes, to machinery statistics; to seminars like this.

2. COMPARATIVE ADVANTAGE IN DELIVERED WOOD COSTS Transport and loading are just components of the whole wood delivery system. One of the principal objectives must always be the achievement of low delivered costs. Table 2, attempts to compare the New Zealand situation with some other major timber producing regions. Such comparisons help to highlight special features in our situation, factors which assist or hinder our competitiveness and why wholesale adoption of overseas systems is not necessarily appropriate. Some of the features we enjoy are:

- a concentrated harvest of relatively large trees
- a high number of working days/year
- some easy terrain
- relatively low roading costs
- relatively cheap labour

But none of these factors are unique to New Zealand and our delivered wood cost is not necessarily low by North American standards, Table 2.

Negative factors which impinge (or will impinge) on future delivered wood costs are:

- an increasing proportion of cable country (stump to roadside costs double)

TABLE 2: NEW ZEALAND versus SELECTED REGIONS: TIMBER HARVEST

ITEM	COUNTRY AND REGION New Zealand	Canada B.C. Coast	Canada B.C. Interior	USA Pacific NW	USA South East
Predominant species	Radiata pine	Hemlock/Cedar Balsam fir	Spruce/Pine Douglas fir	Hemlock Douglas fir	Loblolly pine
Average D.B.H. (cm)	50 - 75	56	30	50	20
Yield/hectare (m^3)	620 - 1035	414 - 1035	103 - 345	414 - 620	69 - 172
Ave. tree length cut (m)	20 - 35	30	24	36	14
Predominant Logging method	Tree length	Bucked log 10 m	Tree length	Bucked log 10-12 m	Short wood 50% Tree length 50%
No. days/year operating	200 - 240	130 - 220	180 - 220	180 - 240	200 - 240
Terrain	Flat to very steep	Rolling to steep and rocky	Flat to rolling	Flat to steep and rocky	Flat to rolling
Transport mode - stump to roadside	Tracked tractor 46% Skidder 35% Cable 16%	Cable high lead	Skidder	Cable high lead	Skidder
Distance (m)	100 - 200	170	210	180	200
Transport mode - roadside to mill	Truck or Truck and rail	Truck to ocean Ocean tow to mill	Truck	Truck	Mainly truck some rail
Distance (Km)	Truck 10-150 Rail 50+	Truck 3-50 Tow 15-320	65-150	15-80	Truck 65-100 Rail 100-160
Primary Road Cost/Km ($)	6000-12000	31000-65000	3000-20000	N/A	N/A
Labour rate/Man/hr ($)	$4.50	$11.00	$11.00	$10.00	$5
Stumpage component ($/$m^3$)	1-21	1.4-2.1	0.3-1.0	0.3-3.0	3.5-5.2
TOTAL WOOD COSTS AT MILL ($/$m^3$)	10-33	26-30	12-16	16-49	16-21

Note: This comparison relates to 1977 conditions and is indicative only. It does highlight however, regional comparative advantage.

- more expensive roading outside Bay of Plenty region
- stumpage for plantation wood which will more closely reflect growing costs and quality premiums
- smaller piece sizes and more live branches to remove on tended shorter rotation crops (increase logging costs)
- more log segregation and much more attention to log allocation as the range of tree and log quality widens and end use options increase. (The cost of these should be justified by even higher returns).

The most unique feature of the New Zealand scene is the dependence on plantation forests, whose growing costs have to be paid for. Forest growing costs in 1979 dollars are at least \$10-15/m^3. This sets a base line for stumpage from the growers point of view and if incorporated in our delivered wood costs would lead to unfavourable comparisons with some of our overseas competitors.

Another unusual feature is the dependence on tree length systems for big trees by world standards and on steep country. This combination can lead to a host of problems in some operations including -

- difficulties with skid congestion
- high labour input on skid work - 22%
- interference between hauling and sorting
- interference between sorting and loading
- low machine utilization
- much double handling of logs

Critical evaluation of current stump to mill systems and continual efforts to improve these will be essential in maintaining our export growth in forestry.

SESSION II
PAPER b

THE PRESENT FLEET OF EQUIPMENT USED AND THE VOLUME OF RAW MATERIALS HANDLED

R.D. GORDON
Research Engineer,
LIRA.

INTRODUCTION

In New Zealand the equipment used for log loading and transport includes front-end loaders, cranes, stackers and hauler rigging, (for various forms of loading), and trucks, trains and barges, (for various forms of transport).

The majority of logs however are loaded by front-end loaders and cranes, and transported by log truck. This paper thus concentrates on these two areas only.

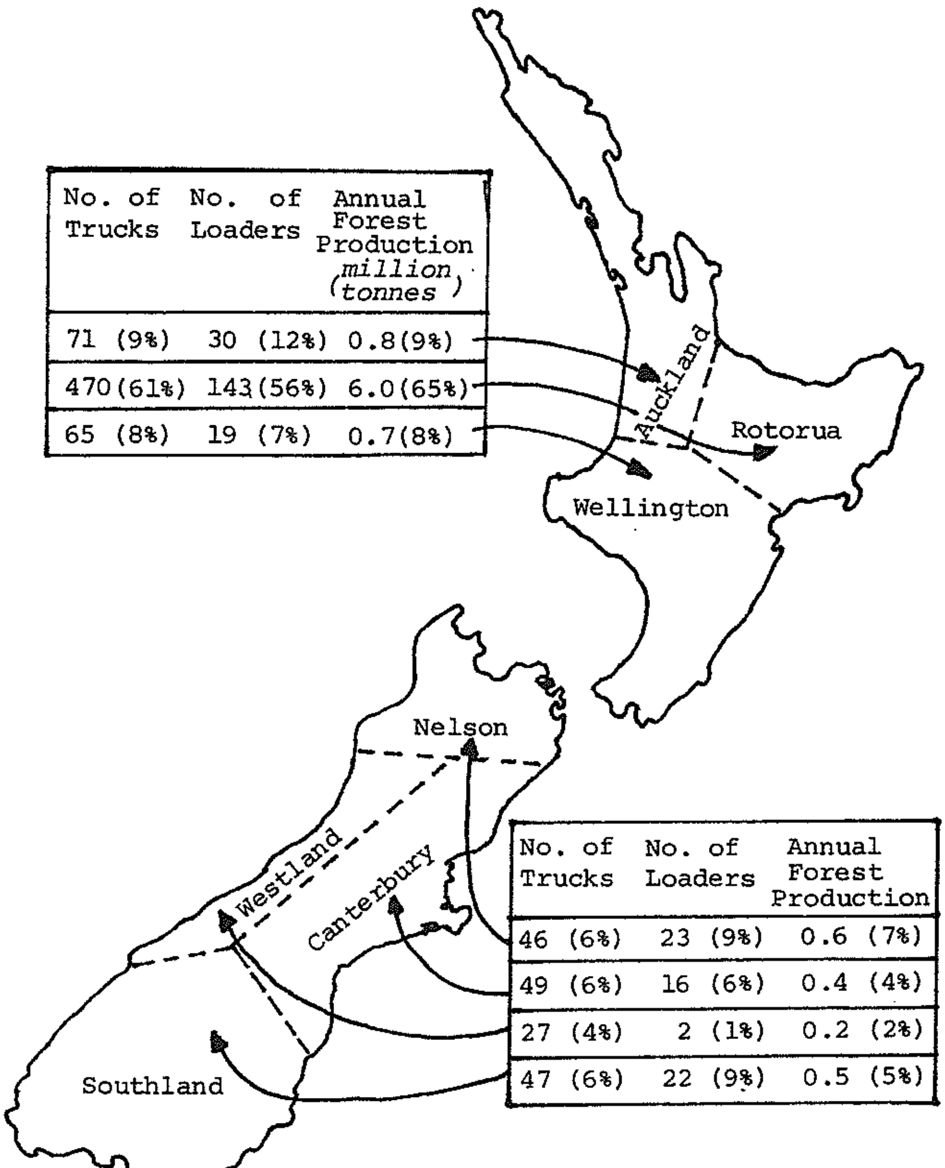
During 1977 LIRA carried out a detailed survey of the N.Z. log trucking industry and this was followed in 1978 by a similar survey of log loaders in N.Z. Both these surveys were parts of separate research projects and they are used as the basis for this summary of the present fleet of loading and trucking equipment used.

In simple totals there are approximately 255 log loaders in use and 775 log trucks. This represents a fleet replacement cost of some $70-80 million.

INDUSTRY SIZE

The recent surveys show these 775 log trucks and 255 loaders are distributed throughout New Zealand as shown in *Figure 1*. This distribution compares reasonably well with the 1977 distribution of roundwood (logs) production which totalled approximately 9.2 million tonnes.

The loaders are operated by approximately 150 different owners and the trucks by approximately 225 different owners. In terms of individual fleet sizes, 60% of loader fleets are one loader machine fleets and 45% of truck fleets are one truck fleets. At the other end of the scale, 4% of loader fleets had more than 8 loaders, and 4% of truck fleets had more than ten trucks.



No. of Trucks	No. of Loaders	Annual Forest Production (million tonnes)
71 (9%)	30 (12%)	0.8(9%)
470(61%)	143(56%)	6.0(65%)
65 (8%)	19 (7%)	0.7(8%)

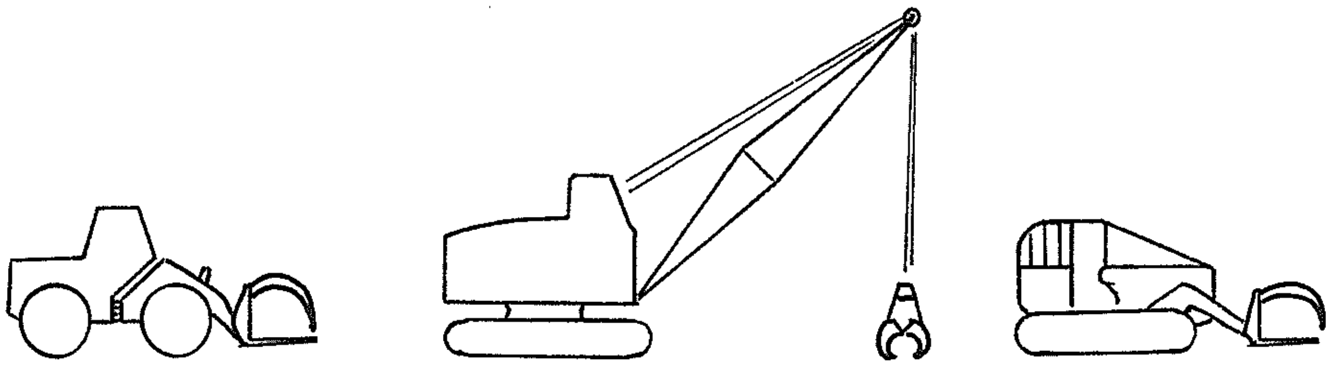
No. of Trucks	No. of Loaders	Annual Forest Production
46 (6%)	23 (9%)	0.6 (7%)
49 (6%)	16 (6%)	0.4 (4%)
27 (4%)	2 (1%)	0.2 (2%)
47 (6%)	22 (9%)	0.5 (5%)

(Areas by N.Z. Forest Service Conservancy)

Figure 1 - Industry Size

LOADING EQUIPMENT USED

In 1978 the most common type of loader was the rubber-tyred front-end loader, (61% of total) followed by crane-type loaders,* (31% of total) and tracked front-end loaders (8% of total).



Rubber-tyred front-end loader *Crane-type loader* *Tracked front-end loade*

Figure 2 - Types of loader used.

The most common brands of loading machine were as follows:

Fiat Allis	22% of total
Clark Michigan	19% of total
International Hough	15% of total
Bucyrus	15% of total

A comparison of these figures with a similar survey done in 1974 by FRI indicates more rubber-tyred front-end loaders are in use but not at the expense of crane-type loader numbers.

A categorisation of the loader sizes by power rating indicates that the bulk of machines are in the 38-112 kW (51-150h.p.) class as follows:

Power Class	Portion of all Machines
0 - 37 kW	1%
38 - 75 kW	26%
76 - 112 kW	59%
113 - 150 kW	6%
150 - Over kW	8%

Average power for the different loader categories is as follows:

Average rubber-tyred front-end loader power	-	101 kW	(range 55-194 kW)
Average tracked front-end loader power	-	40 kW	(range 30- 47 kW)
Average crane-type loader power	-	85 kW	(range 62- 93 kW)

* This group of crane-type loaders includes a small number of hydraulic knuckle boom cranes, the majority being track mounted rope crane loaders.

For the loading equipment used in exotic operations (93% of machines), the distribution of machine ages is shown in *Figure 3*.

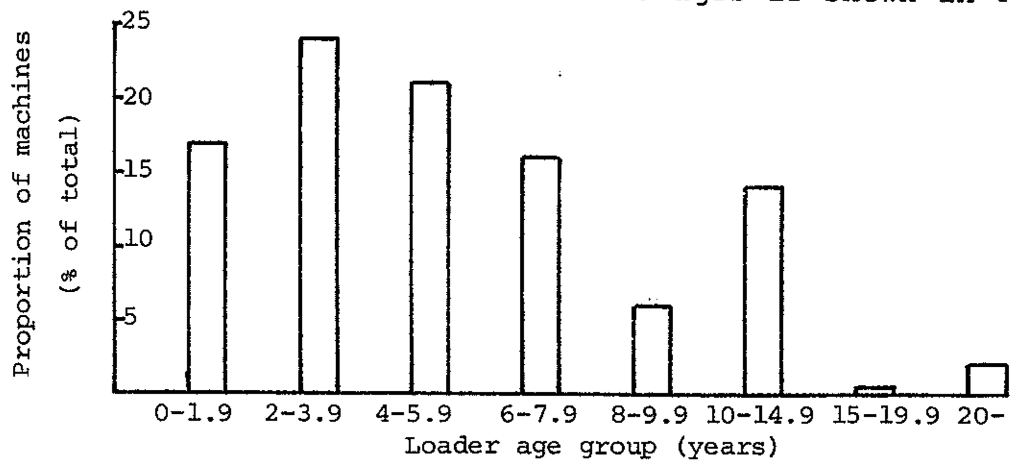


Figure 3 - Age Distribution : Loaders (Exotic only)

Note the early peak at 3 to 4 years, a low at 9 years, and a second peak at 12 years, which drops quickly away. This is a similar pattern to that obtained in the FRI 1974 survey. The current average age of loaders is 5.7 years for machines in exotic operations.

LOG VOLUMES HANDLED BY LOADERS

The survey showed the majority of all loaders, (59%), are required to perform all the four functions of:

Clear landed logs.
Sort and stack.
Load trucks.
Off-load empty trailers.

Only 20% of the machines handled the logs once, (that is either just sorting and stacking or just loading), so double handling of logs by loading equipment is prominent in our industry.

An indication of the volumes of logs loaded out per day by different loaders is shown in *Figure 4*.

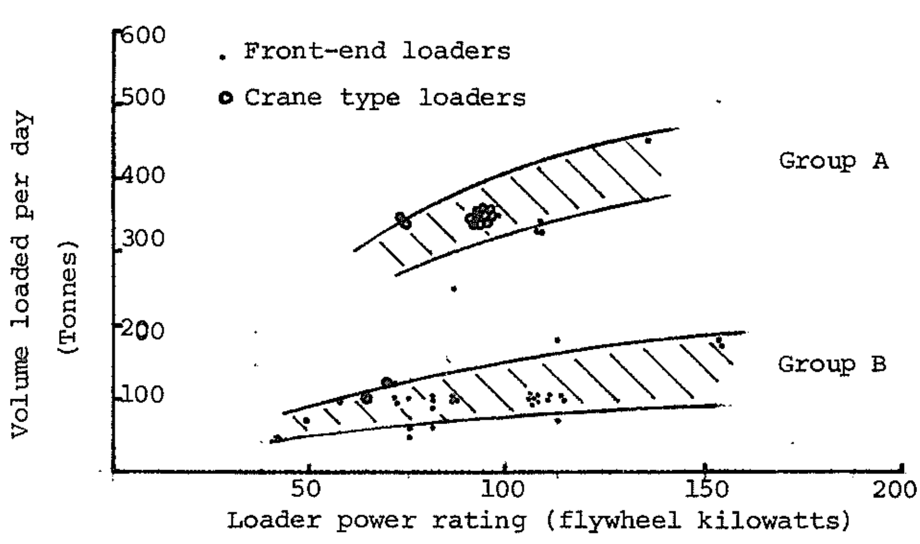


Figure 4 - Loading Machine Performance

The patterns are not strongly evident, however it would seem that for all loader types, a higher power rating does provide a slightly higher log handling rate. It should be noted however that for loaders in the 38-112 kW range, (where most lie), the difference in performance due to power rating is small

Two groups of loaders are shown in Figure 4. Group A are mainly loaders associated with company truck fleet operations, and which achieve a higher daily loading rate by either:

(1) Night-shift loading as well as day-shift stacking and loading.
(2) Loading out from a number of logging operations with no stacking.

Group B comprise loaders that tend to be tied to a single logging gang's production and are used on a single day-shift basis only. In the main they handle the volume of logs shown in the graph twice, as they first stack them and later load them out.

TRUCKING EQUIPMENT USED

Generally there are three main categories of log truck used in New Zealand, being:

Long-log rigs (8 m - 15 m logs)
Short-log rigs (4 m - 6 m logs)
Post-length (2 m) rigs

The majority fall into the long-log cartage category, however many units are convertible between short-log rigs and long-log rigs.

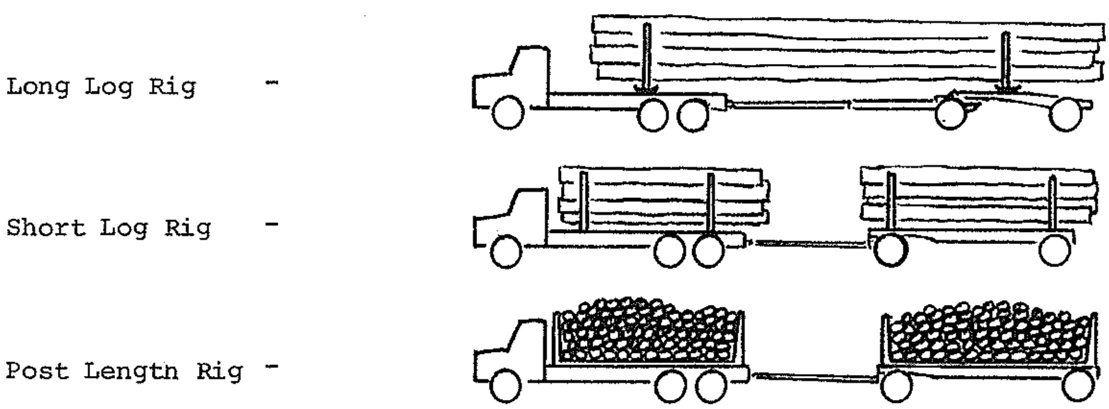


Figure 5 - Categories of Log Truck Used

In 1977 the most common log truck layout, (59% of those surveyed), was a 3-axle truck with a 2-axle log trailer set up for carting long length logs, (8 m - 15 m), with the 2.4 m spaced-axle type log trailers being the most common.

Although this was the most common 5-axle layout, there were others as 5-axle layouts accounted for 70% of all rigs. Next to 5-axle combinations, the 6-axle combinations are most popular. The 6-axle combinations though come from a wide range (See *Figure 6)* including twin-steer trucks, 3-axle drive set trucks, trucks with dollies and 3-axle trailers. The extent to which each of these alternatives occurs is very small though.

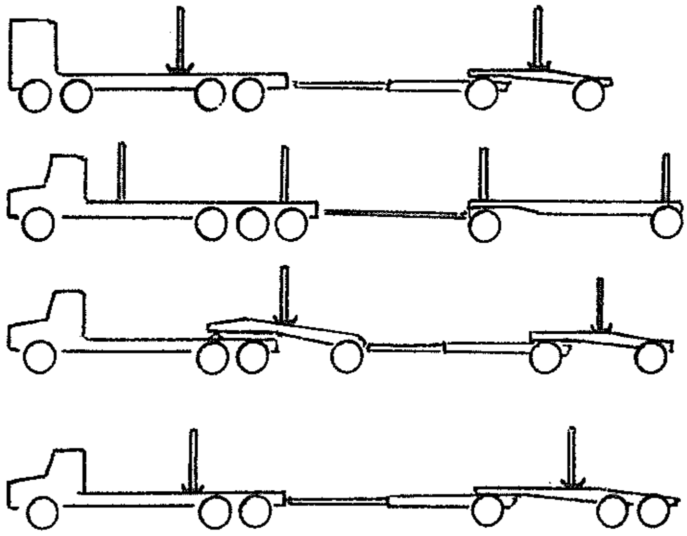


Figure 6 - Some Alternative 6-axle Layouts Used

The most common makes of truck surveyed were:

Kenworth	30% of total
Leyland	14% of total
Pacific	9% of total
Mercedes	9% of total

Overall, there was only a slight preference for conventional long nosed trucks instead of cab-over-engine types.

For all trucks surveyed, the average power rating was 203 kW and the average number of transmission ratios was 13. While these characteristics varied with area and truck application, a significant pattern is evident when comparing truck power with truck age, and this is shown in *Figure 7*. For four surveys carried out at weighbridges, average truck power rating over the last 10 years has grown at a rate varying from 2% to 6% per year. There could, however, be a hint of tapering off of this trend to higher powered trucks over the last five years, possibly due to the increased importance placed on liquid fuels as an energy resource.

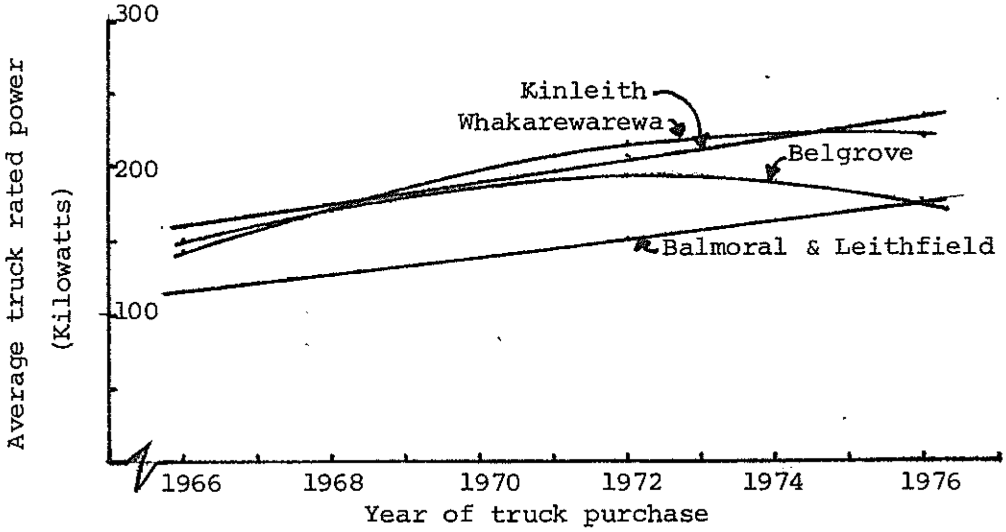
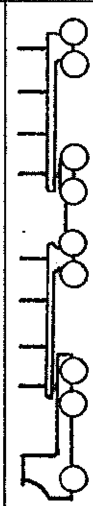
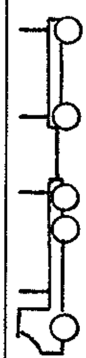
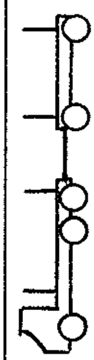


Figure 7 - Ave. Growth Rate of Truck Power Rating at 4 Weighbridges

For all trucks, average truck age was 4.1 years, and average truck mileage life-to-date was 342,000 km, indicating an average mileage rate of 83,000 km per year.

The major fleet operations in each area play a major role in influencing the characteristics of trucking in that area. *Figure 8* shows some of the variations in the different N.Z. localities surveyed.

Area (by Conservancy):	Auckland	Rotorua					Nelson	Canterbury		N.Z.
Weighbridge:	Riverhead	Kinleith	Whakarewa-rewa	Kawerau	Murupara	Waimihia	Belgrove	Balmoral	Leithfield	Total Surveyed
No.of trucks surveyed:	7	76	41	13	22	23	35	8	26	251
Most Common Layout:										
Av. Tare this layout: (tonnes)	12.5	13.5	13.0	12.4	31.4	13.1	13.0	12.9	12.8	13.0
Most Common Make:	Merc.	Kenw.	Kenw.	Leyl.	Pacif	Kenw.	Merc.	Bedf.	Bedf.	Kenw.
Av.Power Rating: (kW):	170	216	216	206	261*	246	186	160	151	203
(h.p.):	228	290	290	276	350*	330	249	215	202	272
Av.No.Transm.Ratios:	7	14	13	13	15*	13	16	13	12	13
Av.Truck Age (Yrs.)	6.5	4.1	3.6	4.4	12.0*	2.4	3.6	3.9	6.0	4.1
Av.Truck Mileage (to date) (Thousand Miles):	403	263	212	298		150	140	114	169	214
(Thousand kms.):	645	421	339	477		240	224	182	270	342

(* These figures relate to KLC trucks only, and are not included in the N.Z.averages)

Figure 8 - Variations in Truck Characteristics by Area

LOG VOLUMES TRANSPORTED BY TRUCKS

An indication of the movement of wood daily by trucking equipment is shown in *Figure 9*.

Area (by Conservancy)	Auckland	Rotorua					Nelson	Canterbury		N.Z.
Weighbridge:	Riverhead	Kinleith	Whakarewarewa	Kawerau	Murupara	Waimihia	Belgrove	Balmoral	Leithfield	Total Surveyed
Av.No.Loads weighed per day	20	380	110	33	309	100	70	6	41	not relevant
Av.Truck Payload (tonnes)	21.1	25.6	25.6	24.1	42.0	24.7	22.2	22.3	19.3	24.7
Av.Payload Haul Distance (kms.)	18	24	60	56	29	109	56	50	50	39
Av.No. Trips per Day (24 hr period)	2.9	* 5.6	2.7	2.5	* 6.0	2.3	2.0	1.4	1.6	not relevant

(*- indicates 24 hr operations)

Figure 9 - Log Truck Performance

Average truck payload is 24.7 tonnes, and trucks average from 2-3 trips per driver shift, (on an average 39 km payload haul distance).

CONCLUDING POINTS

Some points to note from this paper and which can be explored later in the Seminar are:

1. The increasing use of rubber-tyred front-end loaders is considered beneficial in terms of cost, flexibility, and mobility. However, there is also a trend to higher powered and larger machines. In terms of log handling ability this seems difficult to justify and possibly it is due to the need to off-load trailers, or to load trucks quicker if others are waiting.

2. Much of our loading equipment is used in systems requiring the machines to double, or sometimes triple handle the same logs.

3. In log trucking,our industry is strongly dependent on 5-axle layouts, which in the main are 3-axle trucks with 2-axle (wide spaced) trailers. As such these units are limited to a maximum gross weight of 36.3 tonnes if operating on Class 1 highways. By comparison, common 6-axle rigs can operate at 39 tonnes gross weight.

4. There is also a strong industry dependence on premium quality higher priced trucks, particularly in the higher producing area of the central North Island where higher powered trucks are most common. High value vehicles require high utilisation,in terms of loaded trips per day,to justify themselves against alternatives.

SESSION II
PAPER C

FUTURE FOREST VOLUMES FOR LOADING AND TRANSPORT

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SUMMARY

New Zealand's existing forest estate and land suitable for new afforestation are described. Forest development alternatives are discussed in terms of possible eventual steady state yields and the times taken to reach them. Attention is drawn to the fact that even if no more new exotic afforestation is prescribed, annual exotic roundwood removals could rise to a steady 17.6 million m^3/year, about twice the current rate, within fifteen years.

The consequences of following current forestry management intention in New Zealand is described in terms of changes in stocked exotic forest area, changes in the rate of exotic and indigenous roundwood removals, changes in the rates of new planting, restocking, tending, utilisation thinning and clear felling, changes in the log quality, species, and the geographic distribution of roundwood removals and changes in the type of logging system and forest ownership associated with future roundwood removals. Forest attrition effects are briefly discussed.

It is concluded that from about 1900 onwards a substantial upsurge of activity in the forestry sector can be expected which will largely be aimed at export markets.

Introduction

This paper is primarily concerned with providing the logging industry with an indication of future volumes of roundwood likely to be available from different geographic locations up to the year 2016.

The data base for this paper is the supply sections of the 1977 National Forestry Planning Model. This model provides a systematic overview of the current and potential interaction of State, private, indigenous, exotic and regional wood flows of various log quality classes. The wood supply data have been calculated using simplified cutting schedules which indicate the current management intention of the various forestry organisations.

It has not been possible to provide data on estimates of log sizes or any detailed data on log weights.

1. STRUCTURE OF THE EXISTING FOREST ESTATE AND THE AVAILABILITY OF LAND SUITABLE FOR NEW AFFORESTATION

Land

Land suitable for exotic afforestation in New Zealand is compared in Figure 1 with indigenous forest land, exotic forest land and agricultural and other land. A total land area of 1.7 million ha has been estimated to be suitable for exotic afforestation. Planning District distribution of this area is outlined in Figure 2. Unavoidably, these estimates are somewhat arbitrary but have been made by taking into account factors such as soil, climate, present vegetative cover, location, accessibility and size of individual units. In most cases the land considered suitable is undeveloped or reverting scrubland or unstable agricultural areas such as parts of the Poverty Bay hinterland. For obvious reasons national parks, biological reserves, scenic reserves and indigenous forest areas are not considered suitable for exotic afforestation. Map 1 outlines the Forest Service Planning District boundaries.

Present Indigenous Forest Structure

There are about 6.2 million ha of indigenous forest in New Zealand. Deducting protection, logged and/or inaccessible forests, some 1 million ha could be considered merchantable. However, most of these 1 million ha are unavailable because they are located in national parks and other reserves. Because the reservation process is still proceeding actively, and there are still uncertainties about the economics of extracting, processing and marketing some species, the final area of merchantable indigenous forest remaining is poorly defined, but is thought to be of the order of only 35 000 ha.

Present Exotic Forest Structure

The species composition, ownership, and age class distribution of the productive exotic forest area as at 31.7.76 are detailed in Table 1. By 31.3.78 the national total productive stocked exotic forest area had risen to 741 000 ha.

The progress of annual new planting of exotic tree species from 1921 to 1978 is represented graphically in Figure 3.

Table 1: Net Productive Stocked Exotic Forest Area 31.3.76

Species composition

	(000 ha)	%
Radiata pine	525	82.5
Douglas fir	43	6.8
Minor species	68	10.7
	636	100.0

Ownership

	(000 ha)	%
Forest Service	373	58.6
Large private companies	184	28.9
Small Govt depts and local bodies	16	2.6
	636	100.0

Age Class Distribution

Age in years as at 31.3.76	(000 ha)
1-5	238
6-10	123
11-15	63
16-20	36
21-25	23
26-30	20
31-35	7
36-40	18
41-45	42
46-50	52
51+	14
	636

Age in years as at 31.3.76	(000 ha)	%
1-10	361	56.8
11-25	122	19.2
26-51+	153	24.0
	636	100.0

2. FOREST DEVELOPMENT ALTERNATIVES

As suggested by Alison (1978) the normal forest* concept is one way of comparing a particular state of forest development with another. The degree of forest development can be quantified by calculating its eventual steady state yield (supporting normality was the object of management) and how long it takes to achieve that state. It is worthwhile contrasting the present state of exotic forestry in New Zealand with the idealised normal condition. This is clearly shown by Table 1 (by age classes) which outlines the marked imbalance in area of forest contained in each age class. Most New Zealand forests are far from "normal".

Because of the preponderance of trees in the 1-10 year age class the eventual sustainable level of roundwood availability per annum is expected to be substantially greater than the current annual cut even if no further new planting is carried out. It is important to estimate the magnitude of this sustainable level and when it is likely to be attained because it is a measure of the current achievement in forestry development.

Further development depends largely on further new planting.

*A normal forest is taken to be a forest in an idealised condition such that all age classes are present and of equal area, and all grow according to the same yield curve. The normal forest yields a sustained annual flow of wood.

Consequences of Stopping New Planting after 31.3.1981

A decision now to stop buying land for new planting and to run down nurseries providing stock for new planting effectively would mean a cessation of new planting by about 31.3.81.

If this was done and the annual level of exotic roundwood removals was held constant at the current level of 8.5 million m^3/year a normal exotic forest estate, based on a 30-year tree life span, could be attained by 1993. The steady state yield would then be 17.6 million m^3 per year.

Each conservancy would behave in a different manner, the steady state condition being attained at different times. Table 2 outlines this.

Consequences of Continued Afforestation

An important point that has been emphasised is the fact that even if no more new exotic afforestation is prescribed annual roundwood removals can be expected to rise to a steady state which is about twice the current level within 15 years from now.

Cessation of new planting is not the current intention of the forestry sector, however. Recently a major investigation was carried out to determine what new planting rates were intended and to model the consequences of the strategies that are implicit in current silvicultural regimes, management plans or any other guide that exists to indicate the present intent of forestry concerns. This model, which is called the "Continuation Scenario", will be described in detail later, but at this stage it is worthwhile discussing the consequences of the assumed new planting rates in terms of the changes in total stocked area and increases in the associated eventual steady state yields. This is outlined in Table 3.

Generally, management intention is to continue new afforestation at about the current level until suitable and available land runs out. This land will run out at different times in different regions with the overall result of a slowly declining national new planting rate.

It is important to appreciate that the steady state yields described in Table 3 are eventual yields. Because the age class distribution is usually unbalanced to start with, it would take several years after a given total stocked area is attained for the steady state yield to be attained.

Table 2: Statistics associated with a strategy of stopping all exotic new planting after 31.3.81, aiming for 30-year tree life spans and aiming for a steady state annual yield of roundwood

Conservancy	Area in thousands of hectares			Mean annual roundwood removals in millions m^3		Date that steady state yield and tree life spans are attained
	Net productive forest area as at 31.3.76	Mean annual net gain in productive forest area	Net productive forest area as at 31.3.81	Yield before steady state is attained	Steady state yield	
Auckland	86.3	10.70	139.8	0.82	2.86	1990
Rotorua	330.4	15.25	406.6	6.03	8.33	1991
Wellington	67.7	7.07	103.0	0.57	2.11	1993
Nelson	69.8	5.56	97.6	0.52	2.00	1991
Canterbury-Westland	30.8	1.83	40.0	0.16	0.82	1987
Otago-Southland	51.5	4.40	73.5	0.40	1.50	1991
TOTALS	636.5	44.81	860.5	8.50	17.62	

Table 3: Currently intended new exotic planting plan and the associated increase in the eventual steady state level of roundwood removals from New Zealand forests.

Five-year period	1976-80	1981-85	1986-90	1991-95	1996-00	2001-05	2006-10	2011-15**
Intended new exotic afforestation (thousands of ha per five years)	224	210	190	153	144	114	90	75
Total productive forest area at end of five year period	860	1070	1260	1413	1557	1671	1761	1836
Eventual steady state yield (in millions m^3/year) associated with the total productive forest area at the end of the 5-year period*	17.6	21.9	25.8	28.9	31.9	34.3	36.1	37.6

*Assumes 30 year tree life-spans

**After year 2015 about 500 000 ha of land will still be available and suitable for exotic new afforestation

3. DESCRIPTION OF THE CONTINUATION SCENARIO

Introduction

Tables 4 and 5 summarise the results of the continuation of current management intention scenario, at the same time putting it into perspective with past area and yield changes. A boom in exotic afforestation occurred in the late 1920s and early 1930s (this is shown in Figure 3). This resulted from an awareness that the indigenous sawlog material being used by the domestic market was fast running out, an appreciation of a potential export market for forest products (particularly paper), good forward planning, and an investment boom followed by the need to find useful work for the unemployed men of the great depression. Over the next 20 years, partly because of the war, very little was planted, but during the late 1960s and early 1970s another boom in new planting occurred. This was stimulated by new industries which had flourished by processing wood which had risen from the depression plantings. It was also stimulated by good revenues being received for pine logs sold on export markets.

Until plantings of the 1960s and 1970s boom start to reach financial maturity (i.e., ages 25 to 30) increases in roundwood removals are likely to be insignificant. Foresters have aimed at spinning out the crops planted before about 1960, most of it being planted before World War II, to give a more or less constant level of yield per annum from now until about 1990. If national roundwood removals were boosted during any one year in the next decade, it would either have to be paid for by a concomittant drop in roundwood removals before 1990 or by cutting into financially immature crops.

However, from about 1990 onwards a surge in the availability of roundwood supply is expected and by the year 2015 roundwood removals probably will be near the eventually attainable steady state level associated with the area of the exotic forest estate at that time.

Table 4: Estimated growth of total stocked area of productive exotic forest for the continuation scenario

Year	Estimated total stocked area of productive exotic forest (000 ha)
1921	77
1931	247
1941	329
1951	338
1961	358
1971	483
1981	1068
1991	1257
2001	1552
2011	1752

Table 5: Estimated average roundwood removals (in millions m^3 per annum) for the continuation scenario

Period	Indigenous	Exotic	Total	Period	Indigenous	Exotic	Total
1921-25	1.9	-	1.9	1976-80	0.7	8.6	9.3
26-30	1.2	-	1.2	81-85	0.4	8.9	9.3
31-35	1.4	0.2	1.6	86-90	0.2	9.2	9.4
36-40	1.4	0.2	1.6	91-95	0.2	12.4	12.6
41-45	1.4	0.4	1.8	96-00	0.2	17.5	17.7
46-50	1.6	1.0	2.6	2001-05	0.2	24.1	24.1
51-55	1.6	1.6	3.2	06-10	0.1	33.4	33.4
56-60	1.6	2.5	4.1	11-15	0.1	36.4	36.4
61-65	1.3	3.9	5.2				
66-70	1.1	5.9	7.0				
71-75	0.9	7.1	8.0				

Expected Planting Rate Changes

New planting reduces as land runs out but the overall planting rates (i.e., new planting plus restocking) only declines before 1991 and then increases again to a level of 70 000 ha/year at the end of the planning horizon (Table 6). The change in restocking is a reflection of clear felling operations in the previous 5 year period.

Table 6: Estimated future average annual planting rates included in the continuation scenario

Period	Average future annual planting rates in 000 ha/year		
	New planting	Restocking	Total planting
1976-80	45	12	57
81-85	42	12	54
86-90	38	12	50
91-95	31	19	50
96-00	29	28	57
01-05	23	37	60
06-10	18	51	69
11-15	15	55	70

Expected Tending Rate Changes

The aim of pruning and thinning to waste is to minimise the detrimental effects of bark encased knots, stem malformation, and pathogens thus improving the profitability of the forestry project. Currently, the exotic forest estate is pruned and thinned to waste according to a number of strategies which vary according to the constraints of location, terrain, site fertility, markets and other factors. The strategies themselves are fluid because of short-term financial difficulties and changing ideas, but assuming that current management intention is carried out tending rate changes will occur as described in Table 7.

Table 7: Estimated future average annual tending rates included in the continuation scenario

Period	Average future annual tending rates in 000 ha/year		
	Pruning	Thinning to waste	Total tending
1976-80	53	48	101
81-85	84	71	155
86-90	92	77	169
91-95	86	73	159
96-00	82	69	151
01-05	86	73	159
06-10	97	82	179
11-15	107	91	198

Expected Changes in Total Stocked Area

The current new planting rate which totals some 44 000 ha per annum is assumed to continue until suitable land for exotic afforestation in each planning district is exhausted. The direct effect of this assumption is a massive increase in the total stocked area at the end of the planning horizon (2016). The stocked area increases from the beginning to the end of the planning horizon and the percentage of the total forested land contained in each Planning District are outlined in Table 8.

Table 8: Total stocked area as at 31.3.76 and 31.3.2016

Planning District	YE 31.3.1976	% of Total	YE 31.3.2016	% of Total
Northland	33 362	5.2	200 989	11.0
Auckland	52 893	8.3	216 656	11.9
Rotorua	309 714	48.7	449 514	24.6
Gisborne	20 673	3.2	152 673	8.4
Taranaki	8 314	1.3	34 714	1.9
Wellington	23 223	3.6	89 623	4.9
Hawkes Bay	26 666	4.2	87 866	4.8
Wairarapa	9 475	1.5	49 475	2.7
North Nelson	53 268	8.4	137 918	7.5
Marlborough	15 212	2.4	78 962	4.3
South Nelson	1 294	0.2	6 694	0.3
Westland	7 352	1.2	20 361	1.1
North Canterbury	22 658	3.6	70 109	3.8
South Canterbury	810	0.1	4 010	0.2
Otago	33 811	5.3	149 811	8.2
Southland	17 664	2.8	77 664	4.4
New Zealand	636 389	100.0	1 827 039	100.0

Expected Changes in Roundwood Removals

Table 9 shows the expected changes in the average annual area for thinning and clear felling. Expected changes in average annual volumes of roundwood removals by species, log quality, forest ownership and logging system are outlined in Table 10.

(1) Species composition

Tables 9 and 10 show that increasingly radiata pine will dominate exotic forestry in New Zealand. There are dangers in this, but the pathological risks appear to be less, certainly no worse, than with most other tree species. Having regard for ease of establishment, rate of growth and use and other relevant factors, most forest managers believe that radiata pine offers the best potential for industrial forestry, provided, of course, that it is established on suitable sites.

Table 9: Estimated future average annual areas for thinnings and clear felling included in the continuation scenario

Average future annual areas cut in 000 ha/year

Period	Thinning	Clear felling: Radiata pine	Clear felling: Douglas fir	Clear felling: Minor species	Total
1976-80	9	6	1	5	21
81-85	13	7	1	4	25
86-90	12	10	1	2	25
91-95	11	18	1	1	31
96-00	10	28	1	-	39
01-05	10	37	1	-	48
06-10	11	50	1	-	62
11-15	12	53	1	-	66

Table 10: Expected changes in average annual volumes of roundwood removals by ownership, logging system, species and log quality (millions m^3 per annum)

	1976-80	81-85	86-90	91-95	96-00	2001-05	06-10	11-15
Ownership								
Forest Service	5.1	5.2	5.0	6.2	10.0	13.0	18.0	19.5
Other owners	3.5	3.7	4.2	6.2	7.5	11.1	15.4	16.9
Total	8.6	8.9	9.2	12.4	17.5	24.1	33.4	36.4
Logging systems								
Cable logging	1.5	1.9	2.3	3.6	5.8	8.7	13.4	16.4
Tractor logging	7.1	7.0	6.9	8.8	11.7	15.4	20.0	20.0
Removed by thinning	0.6	0.8	0.6	0.6	0.6	0.7	0.7	0.6
Removed by clear felling	8.0	8.1	8.6	11.8	16.9	23.4	32.7	35.8
Total	8.6	8.9	9.2	12.4	17.5	24.1	33.4	36.4
Species								
Radiata pine	6.4	6.8	7.7	11.3	16.6	23.1	32.3	35.0
Douglas fir	0.5	0.5	0.5	0.6	0.7	0.8	1.0	1.2
Other species	1.7	1.6	1.0	0.5	0.2	0.2	0.1	0.2
Total	8.6	8.9	9.2	12.4	17.5	24.1	33.4	36.4
Log quality								
Big logs	6.1	6.2	6.8	9.9	15.0	21.3	30.0	32.9
Small logs	2.5	2.7	2.4	2.5	2.5	2.8	3.4	3.5
Total	8.6	8.9	9.2	12.4	17.5	24.1	33.4	36.4

(2) Log quality

Two log quality classes have been recognised - big logs and small logs. Big logs refer to material which is suitable for sawing while small logs refer to material unsuitable for sawing because of its size or shape or internal rot, but still recoverable as pulpwood, posts or poles. Where a pulp log market exists some of the volume shown as big logs may in fact be pulp logs. Some big logs may be peeled.

Changes in the expected yields of big logs and small logs per year are outlined in Table 10.

Pre-1940 plantings were seldom pruned but most post-1940 plantings have been (or are intended to be) pruned. Overall about 70 percent of State forests and 40 percent of private forests of the appropriate age classes are currently being bottom log pruned. Increasing volumes of pruned butt logs will be coming out of New Zealand forests from 1986 when the unpruned old crop cuts out.

Genetically, planting stock since the war has steadily improved thanks to tree breeding programmes. As this improvement has also been accompanied by widespread thinning (culling) programmes, loggers should have better form trees and more homogeneous crops to deal with in the future.

On the other hand, branches above the pruned butt log of trees in tended stands may be significantly larger in diameter than they would have been if the stands had not been thinned, so logs above the pruned butt log may in future be a little lower in quality.

(3) Forest ownership

Changes in forest ownership which would result from current management intention being followed are also outlined in Table 10.

(4) Geographic distribution of roundwood availability

Projections of roundwood availability as big logs, small logs and total by planning districts are outlined in the following tables:

(a) Table 11 - Exotic yields by planning distrists - Big logs
(b) Table 12 - Exotic yields by planning districts - Small logs
(c) Table 13 - Exotic yields by planning districts - All Logs

These tables serve to give industry planners an estimate of volumes of roundwood available by quality class and the time periods for each planning district at which significant volumes for industry planning purposes come on stream.

A national summary comparison of (a) the roundwood available in each planning district as a percentage of the total availability for periods 1976 to 1980 and 2011 to 2015 and (b) the areas in each planning district clear felled with yield for periods 1976 to 1980 and 2011 to 2015 are detailed in Table 14. It is clear that Rotorua Planning District dominates the national forestry scene in the 1976 to 1980 period but as 2015 approaches its influence declines somewhat with Northland, Auckland, Gisborne, Hawkes Bay, North Nelson and Otago Planning Districts gaining importance as major wood-producing areas.

Table 11

EXOTIC YIELDS BY PLANNING DISTRICTS

PRODUCED ON 19790522

ALL SECTORS - BIG LOGS

(000)CU.M./YR

PLANNING DISTRICT	1976:80	1981:85	1986:90	1991:95	1996:00	2001:05	2006:10	2011:15
NORTHLAND	164.3	172.2	255.1	262.9	757.0	1252.1	2203.6	2781.3
AUCKLAND	497.9	431.8	370.2	361.4	709.0	1360.3	2855.3	3600.1
ROTORUA	4142.5	4193.1	4404.3	6071.0	6814.2	7973.9	11159.4	10917.2
GISBORNE	3.6	19.8	37.2	76.6	165.1	765.7	1773.6	2985.7
TARANAKI	78.5	95.0	100.2	128.3	336.8	425.5	473.7	483.5
WELLINGTON	177.8	183.1	266.6	335.8	556.3	1129.0	1571.3	1653.9
HAWKES BAY	87.8	114.1	154.3	610.6	1512.8	1752.7	2215.6	2299.8
WAIRARAPA	58.9	60.1	88.0	217.7	316.4	566.8	559.1	615.1
NORTH NELSON	332.9	346.6	420.1	759.5	1400.0	1704.3	2018.5	2238.2
MARLBOROUGH	56.7	52.3	58.9	83.6	251.7	966.7	1035.8	1041.8
SOUTH NELSON	2.7	5.3	5.3	21.9	22.6	40.0	87.1	90.6
WESTLAND	6.5	6.6	35.9	98.6	179.9	194.8	255.0	254.9
NORTH CANTERBURY	190.7	144.6	160.9	253.1	585.4	761.9	648.2	681.8
SOUTH CANTERBURY	0.0	0.0	3.3	39.1	36.5	46.4	46.4	51.0
OTAGO	251.1	232.4	287.7	451.4	895.6	1416.5	2138.2	2179.1
SOUTHLAND	92.2	118.1	130.4	196.8	452.5	908.9	975.1	1006.4
NEW ZEALAND TOTALS	6144.0	6175.2	6778.4	9968.2	14991.6	21265.4	30015.9	32880.3

Table 12

EXOTIC YIELDS BY PLANNING DISTRICTS

PRODUCED ON 19790522

ALL SECTORS - SMALL LOGS

(000)CU.M./YR

PLANNING DISTRICT	1976:80	1981:85	1986:90	1991:95	1996:00	2001:05	2006:10	2011:15
NORTHLAND	36.2	49.7	134.2	133.5	135.4	162.9	221.9	292.4
AUCKLAND	124.9	132.0	144.0	152.5	168.3	223.9	338.3	325.3
ROTORUA	1888.2	2001.3	1633.2	1442.9	1249.2	1034.9	1248.7	1223.6
GISBORNE	0.2	1.0	2.0	4.2	8.7	40.4	95.0	163.9
TARANAKI	13.5	51.3	49.9	57.8	53.4	47.6	46.8	47.4
WELLINGTON	136.7	141.0	106.7	32.1	56.8	108.5	137.7	138.6
HAWKES BAY	10.7	17.3	28.4	157.6	117.6	169.8	144.7	145.9
WAIRARAPA	9.4	8.7	20.3	22.0	28.6	49.2	48.4	53.6
NORTH NELSON	109.8	117.7	115.1	191.5	351.1	420.1	497.3	545.1
MARLBOROUGH	13.0	12.6	14.0	21.5	60.0	238.7	254.8	256.3
SOUTH NELSON	0.5	1.3	1.3	5.6	5.7	10.3	23.0	24.0
WESTLAND	5.6	2.5	6.5	30.0	33.2	25.2	28.5	28.5
NORTH CANTERBURY	100.7	102.2	102.1	156.8	131.9	153.4	134.2	112.2
SOUTH CANTERBURY	0.0	0.0	1.0	8.3	3.6	4.6	4.6	5.0
OTAGO	43.0	36.8	35.7	37.3	64.4	96.3	142.4	140.6
SOUTHLAND	11.6	16.3	9.2	14.5	29.1	59.3	63.2	66.7
NEW ZEALAND TOTALS	2503.9	2691.7	2403.7	2468.2	2497.0	2845.2	3429.4	3569.1

Table 13

EXOTIC YIELDS BY PLANNING DISTRICTS

PRODUCED ON 19790522

ALL SECTORS - ALL LOGS

(000)CU.M./YR

PLANNING DISTRICT	1976:80	1981:85	1986:90	1991:95	1996:00	2001:05	2006:10	2011:15
NORTHLAND	200.6	221.9	389.3	396.4	892.4	1415.1	2425.5	3073.7
AUCKLAND	622.7	563.8	514.3	514.0	877.2	1584.2	3193.6	3925.4
ROTORUA	6030.7	6194.4	6037.5	7513.8	8063.5	9008.8	12408.1	12140.8
GISBORNE	3.7	20.9	39.2	80.8	173.8	806.1	1868.6	3149.6
TARANAKI	92.0	146.3	150.1	186.2	390.2	473.1	520.5	530.9
WELLINGTON	314.4	324.1	373.3	367.9	613.0	1237.5	1709.0	1792.5
HAWKES BAY	98.5	131.4	182.7	768.2	1630.4	1922.5	2360.3	2445.7
WAIRARAPA	68.3	68.8	108.3	239.8	345.0	616.0	607.4	668.6
NORTH NELSON	442.7	464.3	535.2	951.0	1751.1	2124.4	2515.8	2783.2
MARLBOROUGH	69.7	65.0	72.9	105.2	311.7	1205.4	1290.6	1298.1
SOUTH NELSON	3.3	6.6	6.6	27.5	28.2	50.3	110.1	114.7
WESTLAND	12.1	9.0	42.4	128.6	213.1	220.0	283.5	283.4
NORTH CANTERBURY	291.4	246.8	263.0	409.8	717.3	915.3	782.3	794.0
SOUTH CANTERBURY	0.0	0.0	4.4	47.4	40.1	51.0	51.0	56.1
OTAGO	294.1	269.2	323.4	488.7	960.0	1512.8	2280.6	2319.7
SOUTHLAND	103.8	134.4	139.6	211.3	481.6	968.2	1038.4	1073.1
NEW ZEALAND TOTALS	8647.9	8866.9	9182.1	12436.3	17488.7	24110.7	33445.3	36449.3

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Table 14: Comparison of clear felling statistics for periods 1976-80 and 2011-15

Planning District	Roundwood availability as a percentage of total availability Periods		Area clear felled with yield Periods	
	1976-80 %	2011-15 %	1976-80 ha/year	2011-15 ha/year
Northland	2.2	8.4	256	4 505
Auckland	7.3	10.8	830	6 810
Rotorua	65.6	33.2	8 531	17 021
Gisborne	0.1	8.6	4	3 354
Taranaki	1.4	1.5	123	922
Wellington	3.5	4.9	606	2 589
Hawkes Bay	1.0	6.7	188	3 995
Wairarapa	0.7	1.8	175	1 279
North Nelson	4.7	7.6	655	4 691
Marlborough	0.8	3.6	101	2 007
South Nelson	0.6	0.3	6	217
Westland	2.8	0.8	19	814
North Canterbury	3.1	2.2	159	1 639
South Canterbury	0.0	0.2	0	88
Otago	3.2	6.4	533	3 628
Southland	3.0	3.0	133	1 604
	100.0	100.0	12 319	55 163

(5) Average age of clear felling and average recoverable volume of wood per hectare

Table 15 shows how the average age of clear felling drops steadily until 1991. Because of the early liquidation of many unthrifty minor species stands, and as a consequence the increasing proportion of old crop radiata pine in the area of forest clear felled, the average yield/ha actually rises to 821 $m^3(r)$/ha by about 1985, but then rapidly plummets and levels out at approximately 650 $m^3(r)$/ha. This correlates with a concomitant drop in the average tree size harvested. In Kaingaroa Forest for example mean dbh is expected to drop from around 63 to 43 cm within the 5-year period 1986-90, a very important consideration for planners concerned with the replacing of wood harvesting and processing machinery.

The tending regimes now being applied to the young crop will have the effect of countering this age-associated piece size decline slightly.

Table 15: Expected changes in the average annual age of trees at the time of clear felling and the average yield per hectare (continuation scenario)

Period	Mean age of trees at time of clear felling	Mean yield/ha for clear felling operations ($m^3(r)/ha$)
1976-80	48	765
81-85	45	821
86-90	39	795
91-95	31	653
96-00	29	616
01-05	29	637
06-10	30	652
11-15	30	662

Forest Attrition

For simplicity all estimates of changes in stocked forest area and annual roundwood removals from 1976 onwards have ignored forest attrition caused by the usual time lag between clear felling and restocking and stock losses due to frost disease, fire, windthrow, future roadline construction, and other factors. Because the estimates of stocked area changes so far discussed have ignored forest attrition they are over-estimates. They probably over-estimate total stocked area by between 7 and 14 percent of the new planting rate at any given time. This percentage is dynamic because as the forest resource increases more annual attrition occurs, and because the new planting rate itself changes with time.

While it is certain that the estimates of stocked area changes are over-estimates, it is uncertain whether the associated roundwood availability levels are over-estimates also. Often volume can be recovered from stands killed by pathogens or accidents, and the yield estimates so far discussed have not allowed for changes in factors like tree breeding, fertilising, site cultivation, and the harvesting of stumps and branches, which taken together could boost volume markedly.

4. CONCLUSION

For the year ended 31.3.1978, 9.3 million m^3 of wood, including indigenous material, was removed from the forests of New Zealand. 3.9 million m^3 of solid wood equivalent of this was consumed within New Zealand as sawn timber, posts, poles, panel and paper products. 4.1 million m^3 of solid wood equivalent of products including pulp were exported and 1.3 million m^3 of residues were burnt (in the greater part for fuel) or dumped to waste.

A great upsurge of activity in the forestry sector can be expected from about 1990 onwards. Unless there is a massive increase in the domestic demand for forest products, this activity will be aimed at export markets.

ACKNOWLEDGEMENTS

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NZ Forest Service, 1978 "Statistics of the Forests and Forest Industries of New Zealand to 1977", NZ Forest Service.

NZ Forest Service, 1977 "The 1977 National Forestry Planning Model", unpublished.

Figure 1 : Land Classification 1976

Total New Zealand land area 26.9 million ha

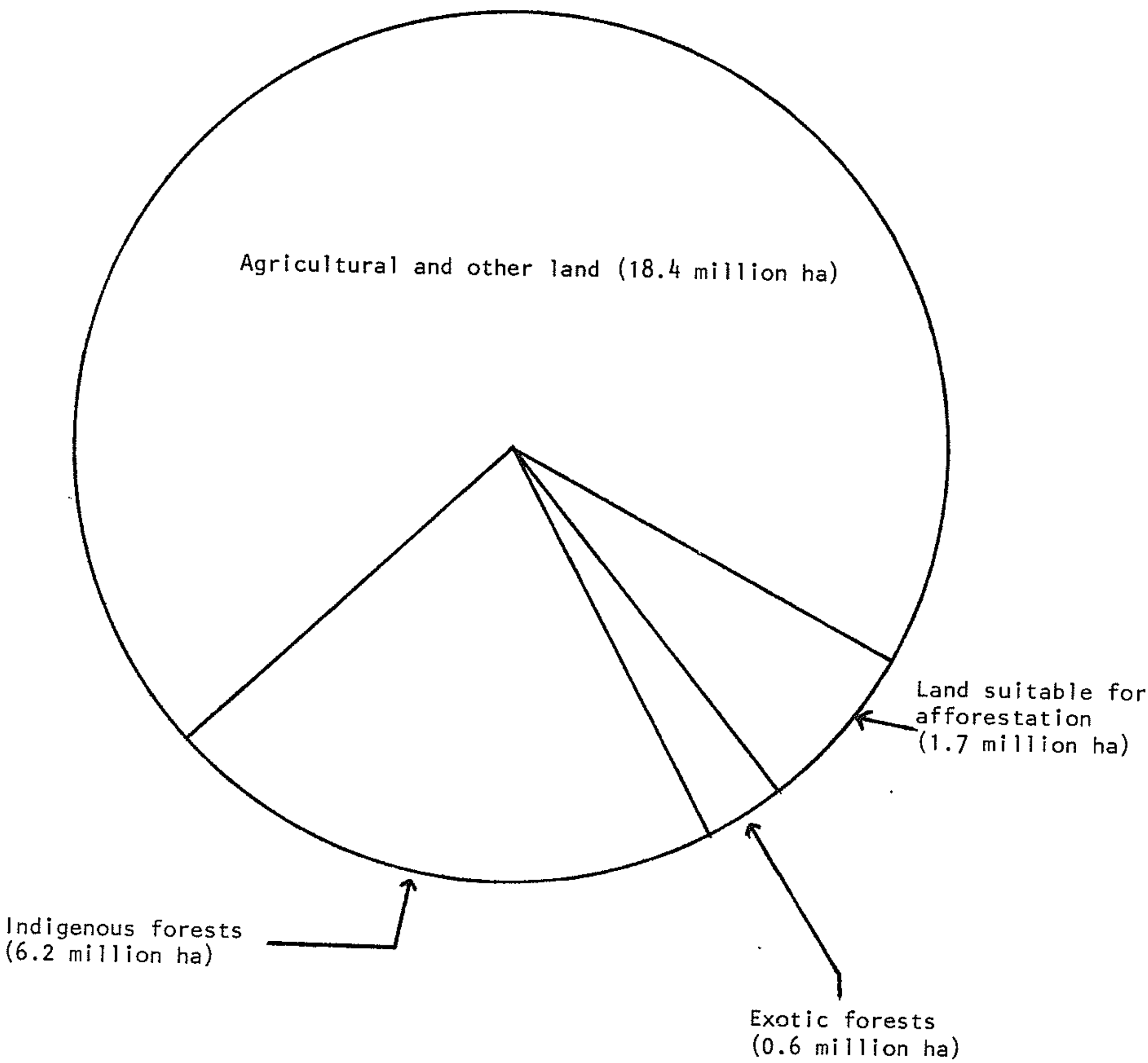


Figure 2 : Estimated land suitable for new afforestation by planning district (as a percentage of the total estimated 1.7 million hectares)

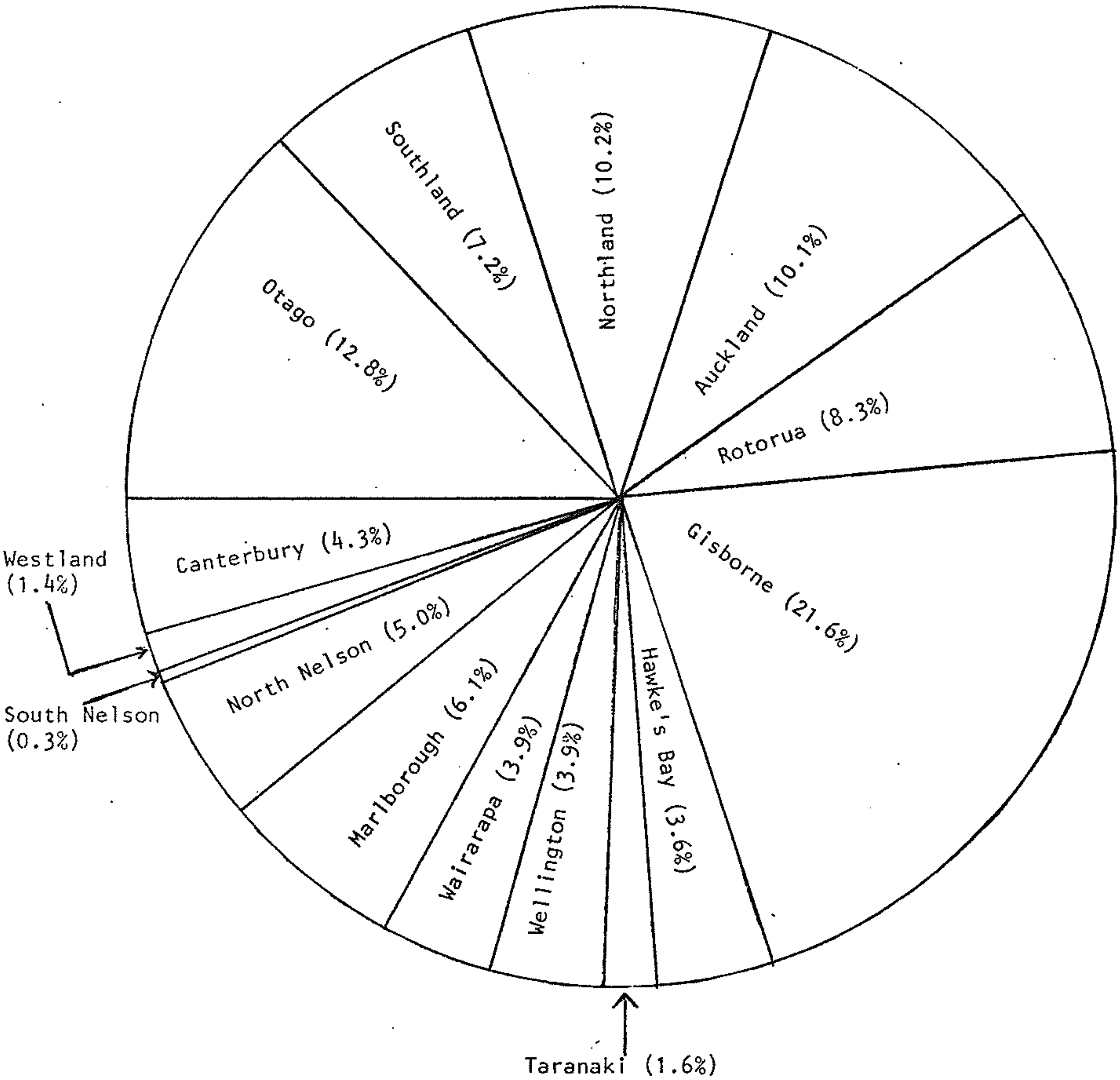
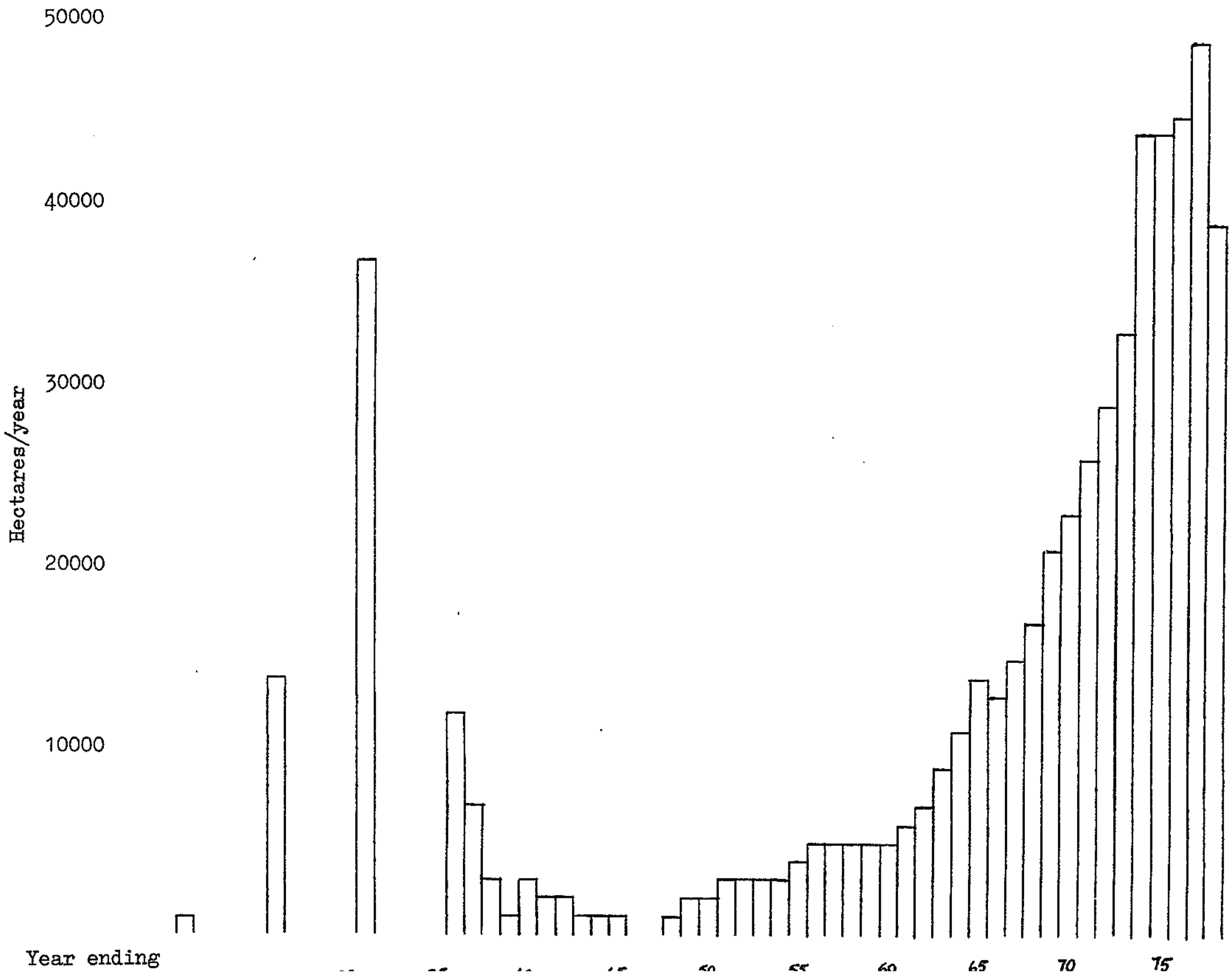
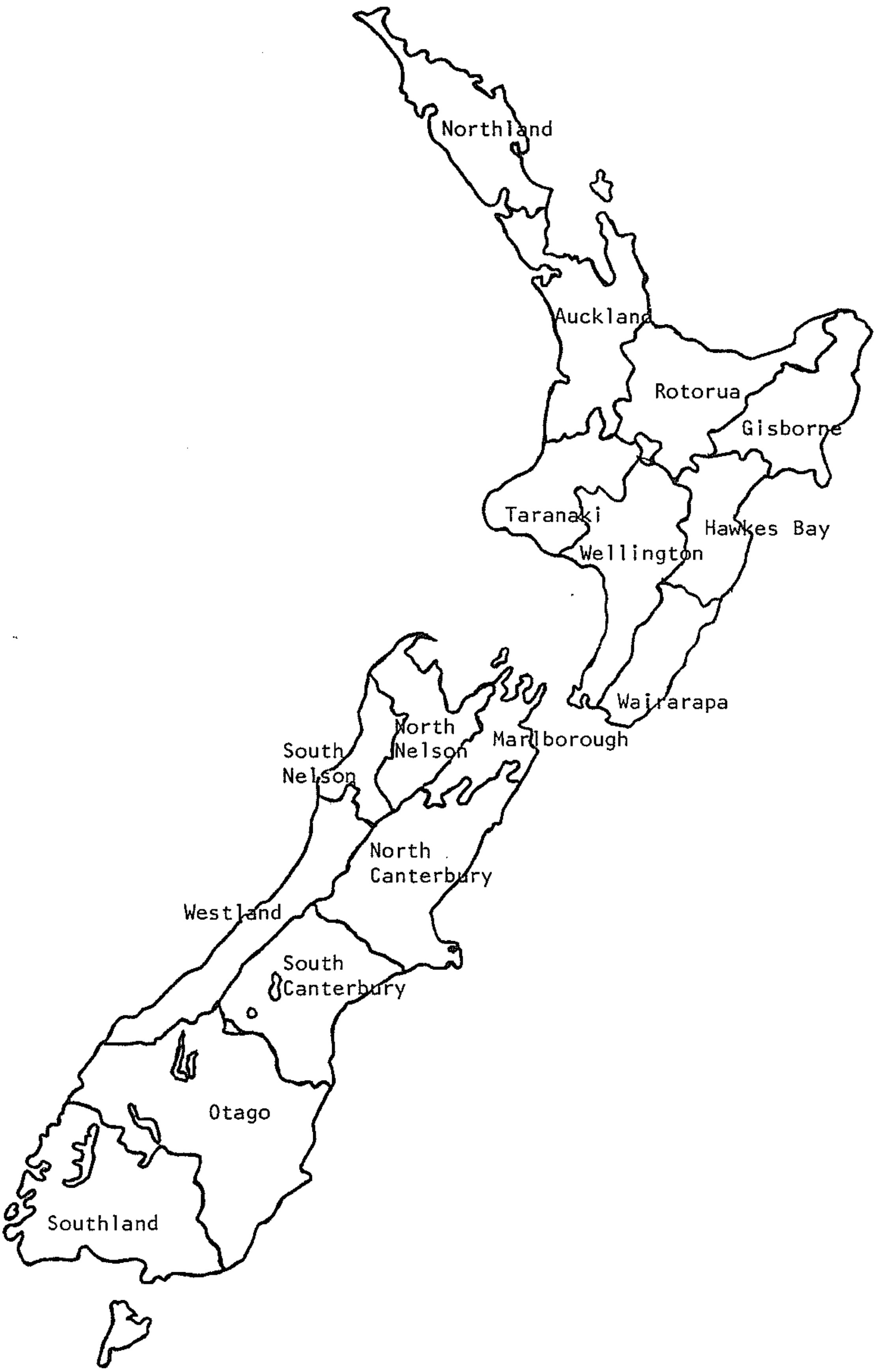


Figure 3: Annual new planting of productive exotic forest- State and private 1921-1978



Map 1 New Zealand Forest Service Planning District boundaries



LOG TRANSPORTATION - CHOICE OF MODE AND DECISIONS ON THE PROVISION OF THE TRANSPORT INFRASTRUCTURE

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Introduction

This paper discusses a number of regions where decisions must be taken in the future concerning the provision of the transport infrastructure for the transportation of logs and log products. The paper then examines some economic factors which must be taken into account when evaluations are undertaken and draws some general conclusions which have emerged concerning the provision of transport facilities.

Even if decisions are some time off it is important to know the likely consequences of various planting regimes, processing and export options. This is in order to judge the economic wisdom of planting at all or of speeding up planting in marginal areas or areas with access problems and also in order to assist with long term planning. Internal transport costs are important in spite of the fact that much of the price received for wood products is absorbed in paying for overseas shipping.

It is fair to say that up to now the planting of trees has largely been an act of faith with little knowledge of the ultimate return. This situation is unfortunately likely to continue because of the uncertainty of international markets due to unstable world economic growth and tariff or quota barriers. Fortunately unlike our other export products such as lamb or wool, trees are relatively slow growing and can be effectively stored until needed over a period of 10 or more years. If the return over a particular period is expected to be unfavourable logging can be delayed. Unfortunately while this makes economic sense as a total package; for those providing the transport facilities this factor adds to the uncertainty. It is no good building a railway, a road or a port which will be comparatively unused for 10 years. This is particularly important for ports which have about a 10 year lead time from their conception to their ultimate use.

These are the problems faced by the three areas discussed in this paper Northland, East Coast and Marlborough listed in decreasing order of complexity with respect to the provision of transport.

Northland

Even given the presently planted timber, saw log output from Northland's exotic forests can be expected to increase from virtually nil at present to about 1.8 million cubic metres per annum by the turn of the century. If present planting continues at the same rate the annual output could be well over 3 million cubic metres annually by the year 2010.

The supplies of timber will provide a sizeable surplus over domestic requirements and Northland's transport network will require considerable development to be able to handle these quantities.

The Ministry of Transport's involvement stems principally from a need to know what port facilities might be required and where these might be located. A study group of Government Officials, Local Body Officials and representatives of business interests has undertaken what has been called the Northland Freighting Study.

It is up to the Northland Regional Planning Authority to release the findings of this study. I shall however describe some of the transport options considered by the study group.

Eighteen separate scenarios for timber processing were considered up to the turn of the century each with different transport requirements. Most of the scenarios are concerned with the treatment of small round wood and the location of pulp mills. Saw logs, representing the bulk of the timber output were assumed to be about 40% exported directly without processing and about 60% processed by regional saw mills into various timber products.

As each of these scenarios had different transport requirements a number of transport options were considered for each scenario. In all the study considered a total of 44 transport options so I will not detail them here. As well as rail and/or road together with one or two port alternatives the possibility of barging was also considered.

For each of the transport options considered total annual charge out rates for road, rail and barge transport were calculated based on the year 1995. The capital requirements for the upgrading of the transport infrastructure were also costed including construction of rail lines, upgrading of roads, provision of barge terminals and provision of port facilities.

These calculations enable a comparison to be made on the costs associated with a single export port or two export ports and give an indication of desirable extensions to the rail network.

East Coast

Similar rapid increases in available timber are expected in the East Coast of the North Island where a similar exercise is being conducted. This particular exercise is being undertaken by the Ministry of Works for the Interdepartmental Committee on the East Coast on which I represent my Department.

The East Coast Study is different from the Northland Study in that its primary purpose is to undertake an economic evaluation of the whole of the forestry venture not just the transport activities. The methods used are also different in that a full economic analysis using cost/benefit techniques is being carried out looking at future flows of wood rather than picking a target date such as in the Northland Study.

The East Coast Study not only considers the relationship between the forestry and the transport infrastructure required but also the impact of forestry on the agriculture of the region through competition for land and through erosion control.

The evaluation considers three different scales of forestry in the region:

(a) "Stop Planting"

(b) "Status Quo"

and (c) "Maximum Afforestation".

The "Stop Planting" alternative is designed to test whether the forests already planted would support the investment required for harvest and export. The "Status Quo" alternative assumes the current planting rate in the East Coast will continue and examines the longer term viability of this planting. The "Maximum Afforestation" alternative assumes a greater area of forestry with double the present planting rate.

Each alternative takes the resources spent in establishing the existing forests as given, representing a sunk cost which does not affect the future economic viability of any alternative.

Because the analysis considers the venture as a whole and not just the transport sector it is sensitive to export prices. The analysis assumes that the output of the forests is exported in log form. If any wood processing does take place it would only be at a higher rate of return than exporting logs and so improve the economics of each of the three alternatives.

Some work still needs to be done on this study however some preliminary tentative conclusions can be made. The first is that the export value of existing planting is sufficient to justify developing ports and roading to service the industry. Secondly further planting on the most erosion prone areas has a low rate of return of under 10% and so is marginally justifiable if only log exports are considered. It appears therefore that to be viable logging must compete more with agriculture for land or be further processed to have added value.

Much of the preliminary work leading up to this wider study has been undertaken by technical committees of the East Coast Planning Council. The technical committee on roading evaluated the amount of road re-construction required in the region and prepared cost estimates. This committee also considered and made recommendations on the thorny question of who should pay for the roads and when.

The technical committee on transport of which I was a member considered port development and possible rail extensions. Among the issues considered by this committee were the costs of a port at Hicks Bay compared with surface transport to Gisborne and the possibility of extending the rail line North from Gisborne to the Southern forests of the East Cape. The committee concluded that two ports with one at Hicks Bay and one at Gisborne was preferable to transporting logs from the North over difficult country. Barging was ruled out essentially because of the difficult seas in the area and the additional ship to shore transfers involved. It would seem preferable moreover to barge out of the region to say Mt Maunganui in any case.

An extension of the rail line north from Gisborne was considered uneconomic principally because of the short distance involved despite the fact that a branch line once existed.

Marlborough

Marlborough is another area of the country where large volumes of timber could present us with difficulties in providing the transport infrastructure. The Marlborough situation is unusual in that access is far more difficult and the planting more dispersed than in Northland or the East Coast. In the East Coast a major problem is to persuade land owners to release land for forestry in order to combat erosion. In Marlborough private planting is such that forestry is a conditional land use.

By conditional I mean that it is an approved land use provided that the Local Authority is not obliged to provide road access. Cable logging and barge transport appear to be most economic means of extracting the timber. As the forestry is within harbour limits there are no industrial impediments to the use of barge transport which is used in a small way at present.

The total timber available in Marlborough is much less than in the other two regions and growth is less well advanced. Nevertheless there is some concern particularly in the region that planning should be underway to provide the appropriate transport infrastructure. The Marlborough Harbour Board which has a substantial interest should timber be exported through a port in the area is particularly interested in the forestry development. The Board commissioned a report on the potential for a large capacity saw mill and processing plant near Picton. (1) This report investigated the potential for timber export and processing in the region and made a preliminary investigation of a canal linking Queen Charlotte and Pelorous Sounds.

Given that timber in both Sounds would be brought out by barge a canal in the Linkwater area would allow consolidation of the logs. The Harbour Board has land at Shakespeare Bay which would be available for such consolidation and processing. It is likely that the Ministry of Transport will be requested to look more deeply into the question of transport in the region in the near future.

It is important to put the Marlborough situation in perspective and sound a note of caution however.

The timber plantings are much less extensive and younger than in the neighbouring Nelson region. The economics of the development of the region's resource is by no means clear although there is significant potential. It is likely that there will be major processing in the region but it is possible that the resource could be linked with the Nelson resource.

Place of these regions in the total New Zealand context

The following table indicates expected log production in the three regions of Northland, East Coast and Marlborough together with the Nelson and Rotorua regions as well as for New Zealand as a whole. These estimates are somewhat dated being made in 1977 but place the regional production in perspective.

Estimates of Average Volume per annum in 000's cubic metres

	1981-85	1991-95	2001-05	2011-15
Northland	220	400	1420	3070
East Coast	20	80	800	3150
Marlborough	70	110	1210	1300
Nelson	490	1010	2210	2450
Rotorua	6270	7530	9010	12140
Total NZ	9500	12700	24500	36200

Economic Analysis

Turning aside from the three regions where transport decisions are to be made it may be useful to outline the means by which transport options should be evaluated. I say should be because they are not always carried out this way. Some of you will be familiar with the saying that if all the economists in the world were laid end to end they would fail to reach a conclusion. Economists generally argue however on the appropriateness of the method rather than the details that follow.

When evaluating transport alternatives from the national point of view the following practices should be observed.

(a) Value future costs or benefits less than present costs or benefits.

This does not reflect the attitude of "to hell with tomorrow live for today" but reflects the fact that money or resources can be put to use in the intervening period.

(b) Exclude transfer payments.

When considering the costs of a mode some taxation items such as sales tax and customs duty on trucks must be removed. Taxes on fuel must be similarly excluded.

(c) Avoid double counting.

This means not including road user charges paid as part of transport costs as well as the cost of road reconstruction to carry the traffic. Road user charges as transfer payments should be excluded from estimates of transport costs. Some road operators here would no doubt be delighted if they could make the real Road User Charges vanish at the stroke of a pen.

(d) Attach a premium on foreign exchange.

(e) Ignore "sunk" costs.

What has gone is gone.

(f) Allow for a large degree of uncertainty in capital cost estimates.

The Kaimai Tunnel and its ever escalating costs highlighted the danger of not allowing for uncertainty in construction costs.

There are other considerations in undertaking economic analyses but these are the principal ones as I see them. Some of these factors are compensatory for example the foreign exchange premium "increases" transport costs and the removal of sales tax "decreases" them. When sales tax on commercial vehicles, including logging trucks, is lowered to 10% of wholesale value on 1 April 1980 it will be an appropriate market place recognition of the value of the foreign exchange component of vehicle capital costs.

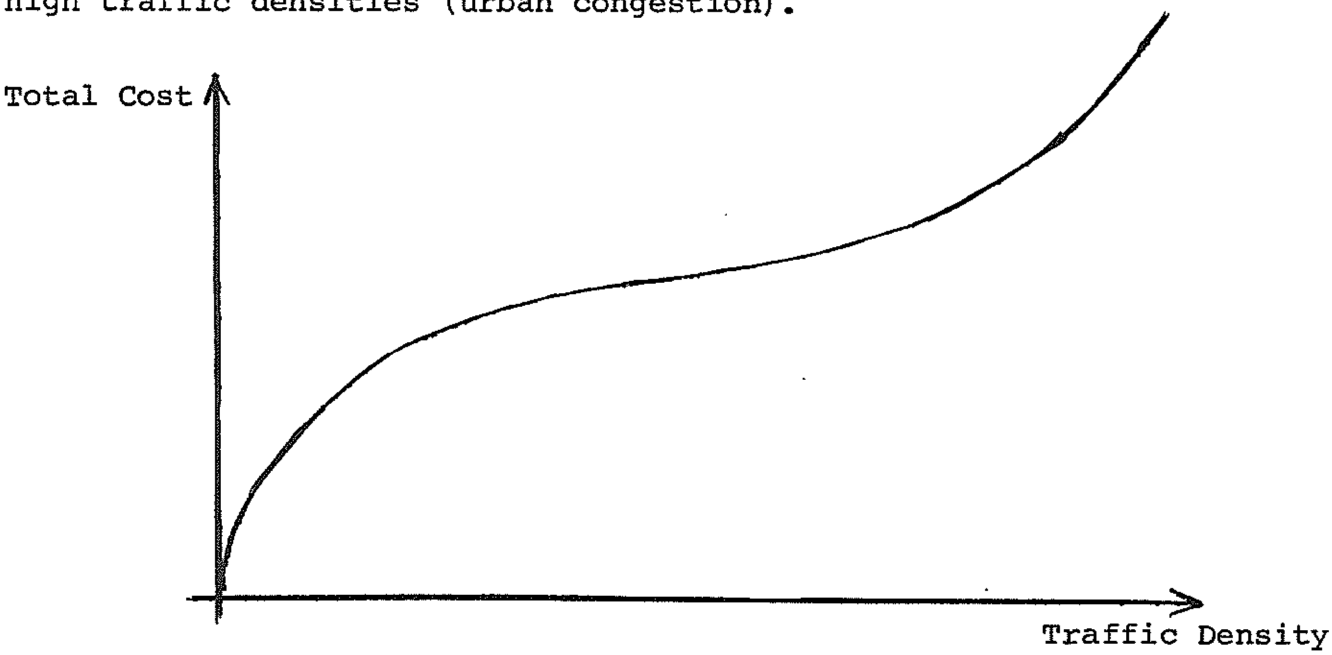
Road User Charges

Some controversy developed recently concerning the transport of pulp from Karioi to Napier. I believe the National Roads Board was correct in discouraging road transport over the Gentle Annie road.

It is important that the costs of alternatives are considered when deciding on such an issue rather than just looking at who pays for what. Of course the question was eventually resolved with Railways finding that they could offer a more attractive rate and still cover their direct operating costs.

It should be expected that road user charges will not always compensate for road costs given that the charges are based on costs across the whole country. It is a fact that heavily trafficked roads, provided they have been constructed to carry the traffic, pay for low density roads. It may be a surprise for some here to learn that motorways generally provide the better value for money in terms of costs per vehicle kilometre than most rural roads.

A typical cost curve for roading might look like the figure below which comes from a textbook on road user charges. (2) The figure shows economics of scale followed by diseconomies with extremely high traffic densities (urban congestion).



Road versus Rail Transport

I commented earlier in the paper on the relative economics of road and rail in the Gisborne area where a rail extension north of Gisborne was discounted because of the short haul involved. There are a number of circumstances where the economics are altered in favour of rail and some of these are listed below.

(a) Where the haul length is long.

I have no recent figures but in 1972 the Transport Policy Study (3) indicated that the breakeven distance on the basis of economic costs was approximately 161 kilometres (100 miles).

When the numbers were re-calculated on the basis of tariffs the breakeven distance dropped to 80 kilometres (50 miles) reflecting road rates which were at that time cheaper than underlying economic costs and reflecting a relatively high level of rail terminal costs assessed by the Transport Policy Study consultants.

(b) Where there is an existing rail link and where the cost of upgrading roads in particularly high due to local factors.

and (c) Where high volumes can be carted and the transfer between road and rail is rapid to ensure high equipment utilisation. A good example is the Murapara operation where heavily laden off road vehicles and efficient road-rail transfer equipment are used.

Conclusions

I hope to have indicated in this paper that there is more to decision making in transport than just a simple comparison of road,rail and shipping rates. I have avoided giving generalised "costs" for road, rail or barge transport in each of the above areas because of the differences between economic costs and rates in general and for two other reasons. The first is that while rates may not vary significantly from region to region economic costs do, due to marked differences in terrain type, soil type, availability of construction materials and the extent of bridging required. The second is that there is a wide range of costs depending on factors such as haul lengths and load factors.

In practice of course rates in the market place are what the individual shipper, including the commercial sector of the Forest Service, must consider when making his transport decisions. This is a fact which cannot be forgotten by the transport planner. It is no use designing an ideal transport infrastructure if market forces are such that it will not be used.

It might seem that I have painted a picture of confusion and uncertainty in long range planning of transport facilities for forestry and this would be fair comment. There are however two major conclusions which emerge from the studies I have referred to above and these are summarised below.

1. Each region is unique with its own costs and problems and there are no simple solutions based on generalised average costs for road rail or water transport.

2. There is a large degree of uncertainty concerning when a forest should be harvested depending on market conditions and the total New Zealand timber availability. This is particularly important when planning the transport infrastructure. We must therefore learn to live with delays in decision making until the last possible moment.

(1) "The Potential of Marlborough Exotic Forests for a large capacity Sawmill/ Processing Plant at the Port of Picton" by R. Dosser, Port Promotion Consultant, Marlborough Harbour Board, Picton. 1976

(2) "The Economics of Road User Charges" by A.A. Walters World Bank Staff Occasional Papers Number Five. 1968

(3) "New Zealand Transport Policy Study" Wilbur Smith & Associates. 1973.

SUMMARY OF SESSION II BY CHAIRMAN

(J.J.K. SPIERS)

The object of this session was to put before you the basic facts as a basis for our future discussions. Initially, John Tustin, in examining the economic importance of the transport phase, showed that it was 23% of total cost in the export log model and a higher percentage of the cost in the other model. Its importance is very dependant on forest location. He showed that forest profitability on land at 80 kms from the mill or port, was nearly twice that on land at 140 kms. In the 140 km situation you've also got somewhere near double the tonne-mileage to haul so transport distance to mill or port is very important. A characteristic of our loading is that the majority of it is handling long length logs in exotic clear felling operations. The loader efficiency is controlled by the logging phase, and the number of sorts that are required. He pointed to some significant N.Z. advantages, which don't seem to be reflected in lower wood costs and he pointed out some of the future difficulties that will face us when we are trying to sell on the export market. Our future situation is going to be very export dependant, so we've got to take a note of that, and strive to keep costs low.

Bob Gordon, in looking at the equipment situation, traced the trends and analysed the position with regard to loaders and trucks at present. There is a very high fleet value here, with $70-80 million tied up in the fleet at new prices. There is a high percentage of owner operators, so the questions raised earlier about on-again/off-again cartage work and effective utilisation of high value trucks, are very important. Currently the front-end loader is dominant. It has four functions to fulfill, not just loading, and it would appear that one of the functions that often influences the type of loader used, is its ability to unload heavy trailers. Maybe we should look at that. He showed that 80% of the wood is handled by loaders twice or more, and he distinguished two groups with distinct differences in efficiency. I think that he pointed out the need to look again at some of the things we are doing with loaders and how we use them. Do we need those bigger front-end loaders or do we need to design some sort of better trailer off-loading system? Can we make our machine usage more effective? We will explore these later on in the seminar.

John Hansen covered wood supply and availability which is very important in looking at our future. He showed, that with the trees we have in the ground now, logging activity would double by 1993. If we continue on the planned planting level, production would be over four times the current level by the year 2000. His Table 10 shows the importance of cable logging areas compared with tractor logging areas and also the future log sizes which will certainly influence the type of machinery that's used. Although Rotorua doesn't increase log production at the rate of other regions, it still will be the biggest supply area, but other areas will increase in importance such as Northland, Auckland, Gisborne, Hawkes Bay, Nelson and Otago. He again pointed out the importance of exports and that any increase in our logging must go to exports and therefore we've got to keep our costs low otherwise we won't sell wood. I think the key to the question about the future is, if we can produce wood at low cost, we could get world markets. If we can't, we don't.

Frank Stewart's paper examined the future development of three problem areas that were shown by the previous paper to be important as far as expansion is concerned. These were Northland, East Coast and Marlborough, and there are a number of choices of transport options in those areas. He said that in certain areas there is an act of faith in forestry and he showed that the economics in some areas will be very critical, particularly the East Coast, where there's a fairly large resource being planted. I think he gave us a bit of encouragement in that he showed that good roads were economic and he gave us some good background into the studies that are carried out before Ministry of Transport make some of the important decisions that affect our industry.

Those basic papers have brought out a number of important points which will be discussed in more detail later in this seminar.

- SESSION III -

FIELD TRIP

A half day field trip to Whakarewarewa Forest and Waipa Mill to observe and discuss operations.

STOP I - WHAKAREWAREWA FOREST
Application of a loader in sorting and loading
(Outlined by A. Baker - New Zealand Forest Service)

STOP 2 - WHAKAREWAREWA WEIGHBRIDGE
Weighbridge operations for weight and volume scaling
(Outlined by A. Rockel and R. Washborne - New Zealand Forest Service)

STOP 3 - WAIPA MILL SITE
Unloading log trucks by overhead gantry and mobile stacker
(Outlined by T. Harris - N.Z.F.S. Waipa Sawmill)

STOP 4 - WAIPA MILL SITE
Truck dispatch and scheduling system
(Outlined by K. Holland - N.Z.F.S. Waipa Sawmill)

- SESSION IV -

FILMS AND INFORMAL DISCUSSION

Chairman - R.D. Gordon, Logging Industry Research Assoc.

Informal discussion around the following program:

FILM - "SWEDISH FORESTRY TECHNIQUES" - A 1978 film showing the results of an industries' research and development effort on the methods used to harvest and transport logs in Sweden.
(LIRA film supplied by Skogsarbeten, Sweden)

FILM - "AERIAL LOGGING SYSTEMS" - A 1977 film highlighting a specific research and developemnt project that compares skyline, balloon, and helicopter transport of logs.
(LIRA film supplied by Oregon State University, U.S.A.)

OUTLINE - OF AIRSHIP PROPOSALS - An illustrated outline of the airship proposals currently being put forward by New Zealand Aerospace Industries Limited, Hamilton.
(J.J.K. Spiers, Logging Industry Research Assoc.)

FILM - "LOG DRIVE" - Part only of this historical film which features manual loading and horse drawn sled transport of short logs in Canada.
(Supplied by N.Z. National Film Library)

FILM - "CHIPS FOR EXPORT" - A 1974 film showing the production and shipping of both logs and chips from Baigent's operations, Nelson, N.Z.
(Supplied by N.Z. National Film Library)

SLIDES - OVERSEAS ALTERNATIVES FOR LOG TRANSPORT AND LOADING - A series of slides outlining items of interest from Australia and some other countries.
(A. Cameron, C.S.I.R.O., Australia)
(R.D. Gordon, Logging Industry Research Assoc.)

FILM - "RUSSIAN FORESTRY" - A 1970 film featuring some interesting concepts for producing, loading, and transporting logs in the U.S.S.R.
(Supplied by Skogsarbeten, Sweden)

FILM - "REDWOOD LOGGING WITH ALLIS CHALMERS" - A 1935 film featuring the introduction of one of the first crawler tractors into logging.
(Supplied by Cable-Price Corporation Limited, N.Z.)

- SESSION V -

COSTS IN TRANSPORT AND LOADING:

Chairman - W. Withers, Transport North Canterbury Holdings Limited.

"HOW MUCH TO INVEST IN A LOGGING TRUCK - RESULTS OF A NEW ZEALAND STUDY"
(C.P.J. SAVAGE - Technical Assistant, P.F. Olsen & Co. Ltd. Present by P.F. Olsen)

"COSTING TRUCKING OPERATIONS"
(R. HARLICK - Executive Officer, N.Z. Road Transport Assn.Inc.)

"FINANCIAL PLANNING FOR A LOG LOADING BUSINESS"
(G.C. WELLS - Research Forester, Logging Industry Research Association)

"VEHICLE AVAILABILITY AND MAINTENANCE"
(K. STEEL - Transport Manager, Nelson Pine Forests Ltd.)

SESSION V
PAPER a

HOW MUCH TO INVEST IN A LOGGING TRUCK
(Results of a N.Z. Study)

C.P.J. SAVAGE
Technical Assistant,
P. F. Olsen & Co. Ltd.,
Forest Managers &
Consultants.

Manager: Fleetwood Loggin[g]
Co.Ltd, Rotorua

In October of last year, I was approached by L.I.R.A. to carry out a study of log cartage operators to investigate the significance of the level of vehicle investment and truck quality with respect to its effect on the operating costs, truck life, utilisation and productivity. i.e. Does the level of capital investment in a log truck have any relationship with the operating costs and expected vehicle life within a given situation. In broad terms it was postulated - that with the growing trend of contractors to purchase "premium" quality trucks with resultant higher investment, can these contractors expect lower overall operating costs, improved truck life and better utilisation. Or conversely - do trucks in lower investment levels attract higher operating costs, shorter truck life and lower utilisation in the same given situation.

In order to carry out this study I drew up a questionaire covering the many salient points required to formulate a full picture of why an operator chose a certain type of truck, the type of operation on which this truck was utilised and the resultant historical operating data. It was hoped to compare this data from as many sources as possible and deduce some positive relationship between level of investment versus operating cost and truck availability.

This questionaire was personally discussed with operators of 6 truck fleets covering 49 trucks currently operating in the Bay of Plenty. The results of these questionaires made it very obvious that the information required to make comparison of cost data feasible and the basic survey aim possible was extremely limited and in some cases - non-existent.

The majority of contractors questioned, including many seemingly profitable operators, did not appear to have any accurate fleet records covering their past operating costs. This lack of positive information may have been partly influenced by their natural desire not to reveal their operational costs to others within their industry.

However, I am convinced that in general, the majority of operators merely produce financial records for annual statutory returns required by the Registrar of Companies and Inland Revenue Dept. and make no attempt to gain any real benefit from the wealth of sound historical information that they are daily producing within their own operations. Their annual accounts so produced do not differentiate between individual trucks within their fleets and lack accurate cost factor classifications to give meaningful indications to these operators of the movements or trends in the various cost centres effecting their operation.

It would appear that the majority of operators work on the principle that their profitability and sole guideline for continuation of their cartage operations is based on their assessibility for taxation by the Inland Revenue Dept based on "book" profits produced by their accountants, coupled with their current liquidity situation. Throughout discussion of this survey questionaire with individual operators, the majority of answers received to specific questions fell into the category of "Global estimates". Annual mileages travelled and tonnages carried in the majority of cases fell into the "unknown" category. I stand to be corrected by those here assembled.

Only one fleet operator was able to give accurate, factual and meaningful information built up from individual truck records. His system provides cost records for each truck, listing operating cost factors, repairs and maintenance etc versus actual mileage and tonnage carted for the same period.

I summarise now the basic findings excluding any cost information.

1) Truck Quality Category

- Premium Category	Those specially built for logging - Kenworth, Mack, Pacific -	16 trucks
- Second Category	Those partially specified for logging - Leyland, Fiat, Mercedes -	25 trucks
- Third Category	Modified freight trucks - Ford, Bedford, Nissan -	8 trucks
	Total	49 trucks

2)	Horsepower Rating	Up to 200 h.p.	Nil
		200-300 h.p.	25
		Over 300 h.p.	24
3)	Axle Configuration	5 axle	36
		6 axle	13
		Other	-
4)	Type of Job	Exotic	45
		Indigenous	4
		On Highway	59%
		Off Highway	41%
5)	Total mileage for last annual period	Answers varied	
6)	Total tonnage for last annual period	Answers varied	
7)	Driver Classification	Operators sought conscientious drivers who could deliver maximum production but incurring minimum downtime. Operators expected to cart maximum number of loads possible without necessity for excess speed. Except in exceptional cases, driver speeding fines were responsibility of driver	

In general, most operators sought a compromise between caring for trucks at expense of "extra" load per day.

8) a) Payload/haul distance: Answers various

b) Road condition classification: Majority of Exotic cartage - Kaingaroa, Kingleith Off-highway network with Class I & II on-highway. Indigenous cartage ranged from extremeties of Motu to Mamaku Plateau.

c) Normal Payload: Answers various

d) Length of Working Shift: Average 5days x 12 hours. Saturday 4 hours maintenance.

e) Truck Utilisation achieved: Lost time averaged 5 days/year/truck.

9) Frequency of Mechanical Services -

Miles: Majority of operators had daily check on fluids.

Time: Weekly grease and oil change

Other: Most operators had no planned major overhaul programme and attacked problems as they occured. They sought to get truck back on road as soon as possible with 100% repair. Only one operator resorted to "patch-ups".

10) Estimated Truck Life Before replacement considered

Miles/year	Premium	) **
2nd Class		) not assessed
3rd Class		)

** Answers varied with median opinion indicating approximatetely 5 years or between 500,000 and 750,000 miles

11) Reason for Replacement

Age
Unreliability/ R & M
Taxation
Resale value

a) Some operators had a regular truck upgrading programme - say purchasing one new truck per year, giving continual fleet turnover - dependent on overall fleet size.

b) Some operators purchased new equipment based on income taxation reasons. They attempted to minimize their annual income tax payment through claiming of maximum depreciation allowances permittable on newer and higher priced trucks. Maximum depreciation allowance benefit is gained in the early years of ownership, with the taxable exemption diminishing rapidly annually thereafter.

There are thus great advantages, where liquidity permits, in replacing vehicles on this basis, although depreciation recovered may negate this effect to a certain extent. If able to carry out this policy, an operator can maintain an updated fleet without obvious resultant heavier capital repayments partly financed by income tax payment savings.

c) Unreliability/R & M was a factor considered by most to be important in planning for replacement. If componentary, through age and useage became troublesome causing excess downtime, and major overhauls were not warranted as being economic in the long term, a replacement would be sought.

Another major factor which came out of the study was the relationship between driver care and attention versus age of truck, aging design and configuration or other features which made the vehicle "sub-standard" in the view of the driver. Most operators were most conscious of this factor and sought to replace their trucks prior to them reaching this "unattractive" stage.

d) Most operators attempted to obviously maximise resale value and replace their trucks before they fell into out-moded or obsolete class.

12)	Method of assessing depreciation	Almost exclusively Inland Revenue Dept. requirements.
13)	Method of assessing truck resale value	The maximum the market will allow - subject to depreciation recovered factors which may colour their decisions.
14)	Truck operating costs	Answers various
15)	Truck owning costs	Answers various

In order to effectively continue this study, it will be necessary to obtain accurate, comparative historical cost and operational data from other industry sources which will hopefully give some positive indicatio of higher capital "Premium" trucks are more cost effective. It is hoped that this information will be made available from some of the larger fleet operators who are known to maintain full and accurate fleet records.

In the current climate of extreme competitiveness for log cartage contracts tendered, it is vital that an operator knows personally his basic operating costs in order to put in a cost effective but economically viable price. I am sure all present will know of examples of operators who have been successful at tender, but unable to economically sustain their operation due to insufficient accurate operating information being available to them to formulate an accurate tender price with sufficient margin for profit and equipment replacement.

In the majority of cases, contractors, whether fleet operators or owner/drivers, will employ Accountants to carry out their basic accounting functions. With very little extra effort or cost by both operator and accountant, meaningful information on his operation can be derived, avoiding the "hit and miss" methods that I have observed in a number of cases during my employment in this industry.

Although costing data collection was not particularly successful, other points of interest came out of this study which are perhaps relevant to this subject.

A) Selection of Truck Type

Operator truck selection was based on many factors, apart from the choice of horsepower and investment level. Indigenous cartage in general requires a truck with different characteristics than the lighter exotic cartage runs. Extraction and cartage of indigenous species is usually associated with poorly formed access roads in remote areas, adverse terrain and high rainfall. These features require a durable tractor unit able to withstand the above, and provide maximum tractibility under all conditions. Units are available which produce maximum torque at very low engine revolutions with assistance from double differential locks. These units contrast sharply with the successful exotic loggers such as Kenworth, Macks etc. which offer greater power output at higher engine revolutions with resultant loss in controllable traction and are thus more suited to better roaded, easier terrain currently found in exotic areas such as Kaingaroa and Kinleith.

B) Cab-Over versus Long Bonnett Units

This subject created perhaps more discussion than any other one factor involved in truck selection. Reasons and justifications were both varied and interesting.

a) A long bonnet has definite advantages in event of frontal impact.

b) Better accessibility to motor etc is available in long bonnet unit. Drivers more likely to carry out regular minor service checks etc while waiting for a load than cab-over variety requiring complete tilt of cab.

c) Long snout alleged to be more comfortable as driver not sitting directly over front wheels.

d) Cab-over however, provides for better visibility ahead, especially going both up and down steep inclines.

e) Cab-over units allow load to be brought further forward over total tractor unit wheel base (useful in shorts situation). Better spread of total payload over axles.

f) Cab-over units are in general higher from the ground than comparable long bonnet units making driver access slightly more difficult.

However, there is a large school of thought that state that the long bonnet is the recognised symbol of a custom built logging unit (derived from the much publicised American scene), and that cab-over units are inferior adaptations. Continental log carters may dispute this statement. However, individual operators and drivers lapse into the realms of fantasy to justify their personal choice on this subject.

C) Age. Quality, Condition of Trucks versus Staff Turnover

Discussions with operators revealed interesting trends re staff turnover in their fleets. Operators of Premium type vehicles stated that they can offer drivers a better class of vehicle, greater reliability, driver comfort and psychological driver status than operators of inferior types or older trucks are unable to provide. This was borne out by their relative staff turnover figures when compared to Class II & III type truck operators. One Premium truck operator has not employed a new driver for over 5 years which he directly attributes to his providing a first class, modern, well maintained vehicle which the driver can take pride in.

The operators of older, and in most cases, used equipment, had in general a greater problem keeping their units maintained, both optically and mechanically, 100%. Their staff turnovers were quite high in comparison to Premium operators. It is postulated that Driver Satisfaction resulted in better continuity of production with less down time.

D) <u>Choice of Truck</u>

Operators agreed, but with varying justifications, that their choice of truck would be determined on:-

a) Current and continued availability.

b) Availability of parts, ease and standard of service. Iif reliant on supplier workshops)

c) A unit with good trade-in value after intended length of useage.

d) Give best return on investment both mechanically and capital wise.

e) Choose a unit robust enough for intended useage which will travel maximum distances without need for major overhauls of motors, diffs, etc.

SESSION V

PAPER b (i)

COSTING TRUCKING OPERATIONS

R. HARLICK
Executive Officer
N.Z.R.T.A.

Introduction

Practical operators all too frequently and perhaps understandably find paperwork irksome. However, records are the base information for any useful analysis of the operation, upon which effective decision making is dependent. It is effective decision making or sound management that separates the profitable from the unprofitable enterprise.

Profit, the raison d'etre of any commercial enterprise may be viewed as what remains from receipts after costs.

For the enterprise to be viable profit has to

(i) meet interest charges on borrowed funds.

(ii) provide a return to shareholders.

(iii) contribute to capital surpluses essential to the replacement of plant and equipment.

(iv) meet company income tax requirements.

It may be presumed that in a successful business adequate profit is somehow naturally acquired. However it may seem, the fact is that profit is the consequence of thought and planning. Any profit plan is affected by three basic factors;

(i) Work: type and availability

(ii) Costs:

(iii) Rates:

If the profit is insufficient recourse to the following possible actions or combination of actions may be required;

(i) increase rates (to cover costs plus profit).

(ii) decrease costs while maintaining rates.

(iii) increase efficiency (to maximise work output while minumising costs).

(iv) sell out.

(v) amalgamate with others.

Costs

Of the three basic factors, costs are of central importance and should be assessed at regular intervals. For some businesses such as a full-time contract service (with suitable escalation clauses built into the contract) a six monthly analysis may be adequate. But generally for businesses that have diversified operations, quarterly or monthly analysis are recomended. Obviously, however the administration costs of financial controls must be weighed against the benefits of the analysis.

In a transport business the elements of cost can be divided into three major groups.

Running costs - those incurred by a vehicle when it is operating, and which vary in proportion to the distance covered.

Standing charges - those incurred by a vehicle over time regardless of whether it is operating.

Administrative costs - those incurred through involvement in the business but not related to the vehicles used.

Estimating the costs

a) Basic records: drivers work sheet, delivery dockets, invoices, employee records, cheque-butts, cash book, vehicle records; these will contain data of

(i) work undertaken

(ii) amounts charged

(iii) distance travelled

(iv) time worked

(v) costs incurred

(vi) revenue received

b) Running costs

Fuel & oil

The total value of purchases for the given period divided by the total fleet distance for the same period, gives the average cost per km for the average vehicle.

Tyres

Because of the irregularity of actual expenditure this is best assessed as follows;
the cost of a set of new tyres, plus the cost of a set of tubes, plus the cost of a set of recaps (if used) for each vehicle, divided by the total life expectation in km gives the average cost per km for the vehicle(s).

Repairs & maintenance

Because these costs are also subject to fluctuation from period to period, a problem similar to that with tyre costs occurs. A possible approach is;
From the financial accounts of previous years accumulate the total expenditure and the total fleet distance. The total expenditure divided by the total fleet distance gives the average cost per km for the average vehicle. However this value will not reflect the effects of inflation. It is possible to estimate the effects of cost increases by increasing each years expenditure by cumulative percentage increases between that year and the current period.

An indication of the inflationary effect is shown by the following national average percentage increases in repair and maintenance costs recognised by the Secretary for Transport.

AREA SCHEDULES

Year	Increases recognised	Cumulative increase necessary for adjustment
1974	12.9%	120.0%
1975	22.4%	94.9%
1976	6.1%	59.2%
1977	25.7%	50.0%
1978	6.2%	19.3%
1979	12.3%	12.3%

Any assessment of long term repair and maintenance cost should still be tested against the ongoing results, i.e. the total expenditure for the given period divided by the total fleet distance for the same period.

Road User Charges

To the total expenditure for the given period divide by the total fleet distance for the same period. Alternatively this may be calculated by accumulating the licence category rate per km for a given gross weight for each vehicle and dividing the resulting sum by the number of vehicles in the fleet.

Depreciation

This is the loss in value of an asset over time and though no payment is made it should properly be included in analysis for costing. A usual approach to this cost is to assess it at current levels then to apportion it to both running costs and standing charges.

From the estimated current value of the vehicles(s) less the value of the tyres and tubes deduct the estimated value at current levels after 7 years. Apportion this sum two thirds to running costs, one third to standing charges. The running costs portion is then divided by the total fleet distance per annum to give the average costs per km for the average vehicle. The standing charges portion is then divided by 7 times the number of vehicles to give the average cost for the average vehicle.

c) Standing Charges

Depreciation

See above

Wages

(Drivers assistants and casual labour) amount for the period from the payroll records.

Superannuation - amount for the period from the wages book.

Accident Compensation Levy - assessed on gross pay.

Proprietors labour - assess when necessary.

Licences/registration

Annual amount divided by the number of periods per year.

Vehicle insurances

Annual amount divided by the number of periods per year.

Interest payments

Interest is a cost paid if the business has been financed through a loan and should be included in any costing.

d) Administration Costs

Management and Office salaries - amount for the period from the payroll records.

Office expenses eg. telephone, radio telephone, rates, rents etc;
take the amount for the previous year and update by a fixed percentage; (in this regard a guide often used is the Consumer Price Index movement) then divide that sum by the number of periods per year.

Periodic Cost Summary

Running Costs

Fuel & oil	Amount ÷ fleet distance	cents/km
Tyres	assessed	cents/km
Repairs & maintenance	assessed	cents/km
Road user charges	amount/assessed	cents/km
Depreciation	calculated	cents/km

Standing Charges

Depreciation	calculated	$/period
Wages	amount	$/period
Licences/registration	amount	$/period
Vehicle insurances	amount	$/period
Interest payments	amount	$/period

Administrative Costs

Management & Office salaries	amount	$/period
Office expenses	assessed	$/period

Once the costs are established each element can be readily converted to various bases, e.g. per annum, per month, per operating hour, per km for comparison.

The same elements may then be converted to a percentage of total cost. The following table (slightly modified) is that shown by the national indices for the average vehicle used on Area or Town operations.

It is worth noting that costs may fluctuate markedly from these percentages for very good reasons, e.g. the topography or operating conditions are unusual, the vehicle utilized for the operation is necessarily different form the norm.

However, it is wise to investigate the reasons for any fluctuation observed from period to period.

NATIONAL COST INDICES

Decision 4031 of 11 April 1979

Table I

	TOWN		AREA	
	$	%	$	%
Fuel & Oil	1424	6.8	4137	12.0
Tyres	308	1.4	1908	5.5
Repairs & maintenance	3209	15.2	4862	14.1
Road User Charges	1321	6.3	2770	8.0
Depreciation	1454	6.9	6368	18.4
Wages	8161	38.7	9204	26.7
Licences/Registration	63	0.3	56	0.2
Insurances	183	0.9	435	1.3
Management salaries	3408	16.1	2911	8.4
Office expenses	1565	7.4	1848	5.4
Total Costs	21096	100.0	34529	100.0

Pricing

Rates may be based on

i) time ($ per hour) To obtain this rate; convert the cost elements of the periodic cost summary to a uniform base, e.g. $ per period. Add to this total a fixed percentage margin for profit and divide the resultant sum by the total number of effective operating hours per period.

ii) distance (cents per km) To obtain this rate; convert the cost elements of the periodic cost summary to a uniform base e.g. cents per km. Add to this total a fixed percentage margin for profit.

iii) time and distance To obtain these rates; convert the running costs elements of the periodic cost summary to cents per km and to that total add a fixed percentage margin for profit - this is the distance rate. Then convert the standing charge and administrative cost elements to $ per period, add to this a fixed percentage for profit and divide the resultant sum by the total number of effective operating hours per period.

Using table I above and assuming

		TOWN	AREA
annual distance	(km)	23,000	38,000
effective hours	(hrs)	1650	1700
margin for profit	(%)	15	15

the following rates are obtained

	TOWN		AREA	
	cents/km	$/hr	cents/km	$/hr
time		14.70		23.36
distance	105.4		104.5	
time & distance	36.2	9.66	54.2	11.24

iv) <u>payload (tonnage) rate</u> From a basic time and motion Study a reasonable estimate of time in transporting a capacity a given distance tonnage can be made, to this is added loading and unloading times. Utilizing the known time and distance and the time and distance rates, a set of differential tonnage rates may be constructed.

Obviously, circumstances will vary with the type of work and will determine which type of rate is most appropriate. Submitting quotations and tenders for future work can be particularly difficult in periods of high inflation. Clearly, it is unwise to agree on a fixed rate for an extended period unless due allowance has been made for probable cost increases. Sensible alternatives would be iether the inclusion of an escalation clause or the placement of a time limit for the rates.

In summary; records properly kept, and analysed give clear indication of an operations profitability. Central to the operators degree of control is an understanding of costs and costing. The major controllable, cost dependent operational elements are:-

repairs and maintenance: through programmes

wages: through labour utilization

vehicle utilization: payload, hours, kilometres

rate charged

quantity of work.

SESSION V
PAPER b(ii)

FINANCIAL PLANNING FOR A LOG LOADING BUSINESS

G.C. WELLS
Research Forester,
LIRA.

INTRODUCTION

Every year in New Zealand many small firms go out of business. Some of these are logging contractors. While there are many causes, by far the most common is bad financial management.

Owners and operators of log loaders are generally very competent at the technical side of their business, but when it comes to record keeping and accounting, some tend to ignore it or leave it to someone else.

However the penalty for failure to plan finances may be more serious than failure to co-ordinate men and machines in production. At worst it may mean bankruptcy. At best, unnecessary losses, business wories and the necessity of raising extra money at very high cost.

This paper is concerned with the planning and control of finances for a log loader owner-operator. It begins at a point where a person is considering buying a loader to get into business, or buying a new loader to replace an old one. Contractors with existing machines will be more concerned in the second and subsequent stages of the discussion.

A series of questions is asked, the answers to each leading on to the next. This can form a logical planning sequence for a contractor. The sequence is summarised as follows:

1. *Can I afford to buy the equipment necessary to get into the business?*
   If no, you must reduce capital requirements or raise more capital until you can buy the necessary equipment. If yes, go onto the next stage.

2. *What job rate can I expect for this work?*
   The first stage detailed the equipment required for the job and its cost. This is used in the calculation of the job rate when work conditions are known.

3. *At that job rate, will my income be sufficient to meet my expenses?*
   The expected job rate is calculated without regard to your individual method of financing the equipment. At this third stage you must take into account your actual costs. If actual costs are greater than the income expected, then it is necessary to either reduce your costs or increase your income.

4. *How can I keep track of the financial progress of my business?* With the operation underway, it is necessary to periodically compare your expected result with your actual result. In this way any unusual variations can be dealt with before they cause real problems.

In order to answer the above questions, it is necessary that the contractor has a complete picture of his financial situation, either current or expected. While it may be best that an Accountant produces the picture, the contractor has the responsibility for providing the relevant information and making the proper requests to the Accountant. Record keeping then becomes an essential part of business management.

As a final introductory point, it is useful to keep in mind your overall position in the industry. As well as you the loader owner, the customer for whom you work, the machinery supplier, the servicing agent, your Accountant, and the financial supporter, all have the objective of making a profit. Each must understand that the others need to do reasonably well financially in order for any of them to survive. A contractor with a thorough understanding of the financial side of his business will be in a much better position when it comes to communicating with the other interested parties in the logging industry.

CAN I AFFORD TO BUY A LOG LOADER?

It is essential to ask this very simple question in order to see if the money you have, or can borrow is sufficient to get you and your loader on the job, ready to work. If you have or can get sufficient money, then you can get on with the next step in the planning process. If you can't, then you should look at your requirements again. Would a smaller or lower cost loader do the job? What about a good used model? Can you re-negotiate with the financing company or supplier to get a better deal? Would leasing be possible?

The question is answered by making up a list of all your necessary expenditure. This list is often called a capital budget, and must include all items, large and small. With this done you can look at the money required and how you are going to raise it. An example is given in *Figure 1*.

WHAT JOB RATE CAN I EXPECT FOR USING MY LOADER?

If you have calculated that you can afford to buy the equipment necessary to get into the business of log loading, or to change your loader, you will need to calcualte a rate for the job. If you are currently working with a loader, you will know what your existing rate is. However, you may want to try to re-negotiate your rate because of certain price rises, or because you are going to change the nature of your work. In either case you need to know how to calculate a rate for the job.

The job rate may be based on time, (dollars per hour or dollars per day), or on production, (dollars per tonne, or dollars per cubic metre loaded out). This section deals briefly with the calculation of a time-based rate. This can be converted into

Figure 1. Capital Budget

This capital budget has been worked out for a log loader owner-operator who wants to trade in his existing machine for a new model.

EQUIPMENT	TOTAL VALUE	EXISTING EQUITY	CASH PAYABLE	AMOUNT ON HIRE PURCHASE
Loader	$73,000	Trade Value of old loader →	$24,000	$49,000
Delivery Costs	2,500		2,500	
Operator Transport	6,500	4,000		2,500
Maintenance Equipment	500	500		
Chainsaw	400	400		
SUB TOTAL	82,900			
WORKING * CAPITAL	1,100		1,100	
TOTAL CAPITAL	84,000	4,900	27,600	51,500

* Working Capital: Cash required to keep operation going for one payment period - e.g. salary, fuel, insurance, etc.

METHOD OF FINANCE

Existing equity	4,900	
Own cash	24,000	
Bank overdraft	3,600	
Hire purchase	51,500	36 monthly repayments of $1,845
Other finance	Not required.	
Total	84,000	

In this example the owner must borrow from his bank to raise the cash for delivery costs and for working capital. This, together with the amount raised on hire purchase, gives him sufficient to go into business.

a production-based rate when productivity is known or can be estimated. This basis differs from that commonly used to estimate a rate for trucking as trucks need to be costed in two stages: that of travelling on the road, and that while being loaded or unloaded. A loader on the other hand tends to remain at one location for most of the time and therefore does not need to be costed on the basis of distance travelled.

The first step in estimating a job rate is to break the total cost down into basic parts. A cost is then calculated or estimated for each part. Finally the cost for each part is added together to give the overall job rate. *Figure 2* shows a typical job cost breakdown.

If you consider the costs which individual contractors must meet over the next six months or year of their work, it is obvious that there will be many differences. These differences arise even with machines of the same size doing the same kind of work. In part the differences are due to the way machines are financed. Some contractors have to borrow a large part of their capital and have heavy hire purchase commitments, while others own their own machines outright. For others with new machines, repair costs may be low, while those who own older machines may face a higher repair cost for an overhaul job in the near future. Under these circumstances it would be very difficult to establish what was the proper 'rate for the job.' If it turned out that people with older machines could always do the job for less than those with new machines, then who would ever buy a new machine? To overcome these difficulties, it is generally accepted as sound practice to average certain costs over the whole life of a machine. The particular costs in question are the costs of repair and maintenance, of interest charges, and of depreciation. This approach brings some degree of standardisation to costing procedures, but still allows scope for variation according to the needs of individual owners. What is the correct 'rate for a job', will depend on individual ideas on such things as the correct rate of interest, or the best method of calculating depreciation.

This paper is not the place to go into detail of how the individual costs are estimated or calculated as it would consume too much space. An example of such a calculation is shown in *Figure 3*.

The job rate as commonly calculated contains few factual pieces of data. Many of the inputs are based on accepted rules of thumb, which may not consider the specific details of your machine. The job rate reflects everyone's costs, but equates with no ones'. It could approximate the average cost for a company operating many machines, but is unlikely to be the same as your actual costs as an owner-operator. However for these reasons it does provide a standard basis for job rate negotiations.

It is possible to test the effect of the assumptions made in arriving at the job rate, by varying inputs and recalculating the rate. Some examples are given in *Figure 4*. Obviously, some assumptions have a greater effect than others. The biggest problems arise with those factors which have a big effect and are difficult to estimate accurately. In this category machine utilisation

Figure 2. The Elements of the Job Rate

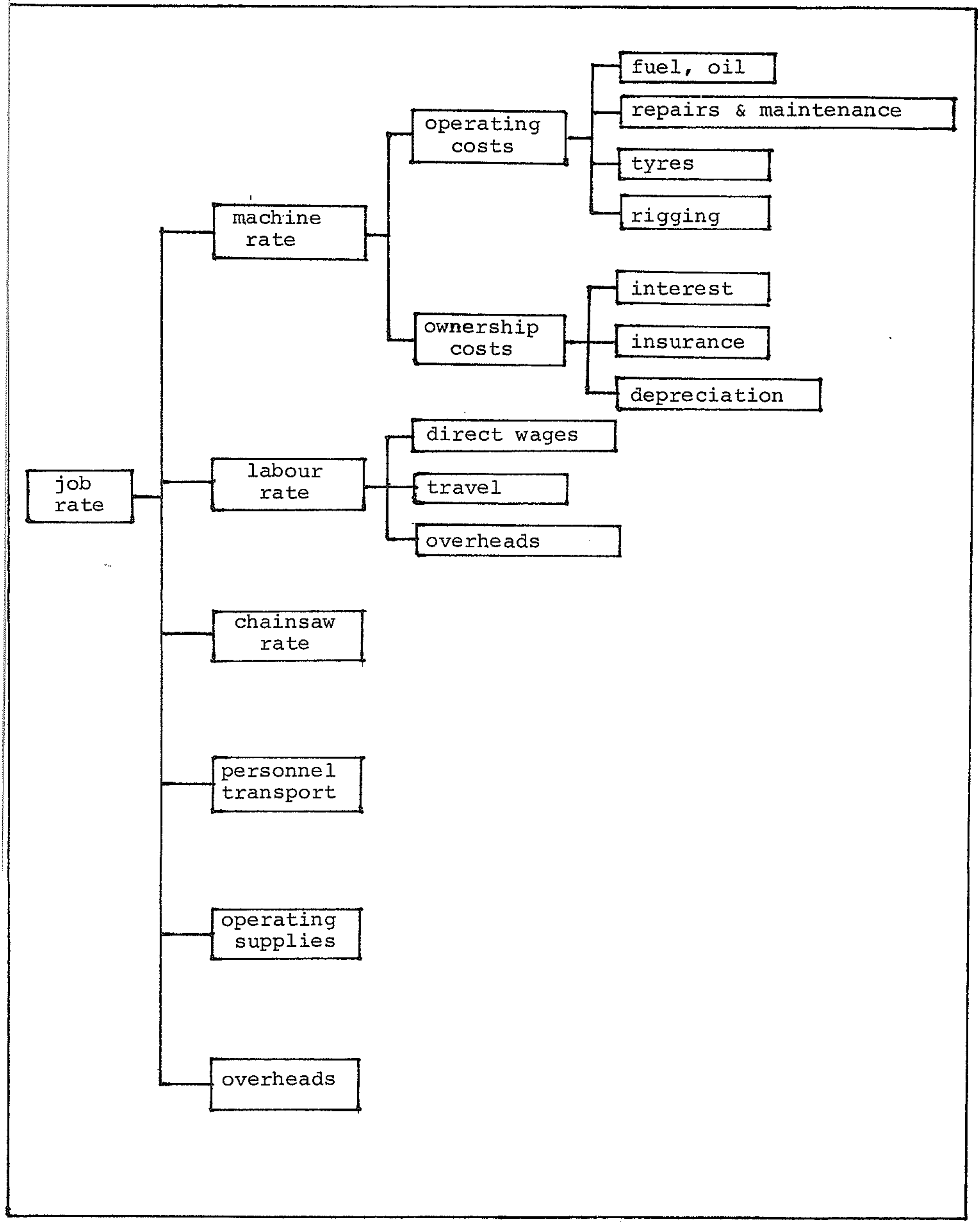


Figure 3. The Rate for the Job

Loader required for 8 hours on job, estimated to work 6.5 hrs/day.

Loader:

Operating costs:		
Fuel	$2.00/hr	(12.2 litres/hr)
Oil	0.31/hr	(0.45 litres/hr)
Repairs & Maintenance	6.48/hr	(100%of depreciation)
Tyres	0.49/hr	(5000 hours with re-lug)
Ownership costs:		
Interest	4.40/hr	(13.5% of ave. annual investment)
Depreciation	6.48/hr	(resale value 20% of purchase price, 6 year life)
Insurance	0.65/hr	(2% of ave. annual investment)
Sub Total:	20.81/hr	x 6.5 hrs/day = $135.27/day

Operator:	(based on salary of $9000/yr allocated to 230 working days)	39.00/day
Operator Transport:	(60 km/day @ $0.20/km)	12.00/day
Chainsaw:	(For occasional use)	5.00/day
Operating Supplies:	(Maintenance equipment, fire equipment,etc.)	2.50/day
Management Overheads:	(Postage, stationery, garaging, Accountant's fees, etc.)	6.40/day
	TOTAL	$200.17/day

Note: Because of assumptions made, this calculation is not accurate to the last cent. It would be reasonable to round this off to $200 per day.

Figure 4. What Happens If....?

Using the job rate calculation from *Figure 3*, these examples of the effect of changing certain factors have been calculated.

1. If fuel price increases 10%:
   the job rate increases 0.75%

2. If the purchase price of the loader increases 10%
   the job rate increases 5%

3. If the labour rate increases 10%
   the job rate increases 2%

4. If hours worked per day increase 10%
   the job rate increases 3%

   If hours worked per day decrease 10%
   the job rate decreases 3.5%

stands out, and also machine life - i.e. hours use per year and total machine hours. Operator wages or working owner salary, is a category of input which has a large effect but can be estimated reasonably accurately. Oil cost is an input which has a small effect and is often not accurately estimated.

Two important considerations come out of this discussion on job rate calculation. First, there is always room to argue - or negotiate - about any calculated job rate. The more you know about what goes to make up the job rate, the better your negotiating position will be. Second, it would be dangerous to leave your financial planning at this point. It is essential to go on and find out if the income which the job rate generates will be sufficient to meet your actual costs.

WILL THE JOB RATE COVER MY ACTUAL COSTS?

At this stage you have decided that you can afford to purchase the equipment needed to do the job and have worked out a possible rate for the job. This rate may be used to tender for new work or to re-negotiate a rate for existing work. However, this rate was worked out without taking into account your individual financial position. The main purpose behind doing so was to arrive at a job rate which is both realistic and widely acceptable. It is now time to determine whether or not that rate will provide enough revenue to cover your expenses in the future.

This comparison is carried out by making up a list of all expected expenditures and income for some time into the future. This is called a cash flow budget. The cash flow budget should extend for the period of time during which you have hire purchase commitments. Shorter periods of time can also be used where there are expected variations in either income or expenditure related to such things as seasonal work shut downs, or major equipment repair bills.

The main differences between the cash flow budget preparation and the job rate calculation are as follows:

1. Depreciation is not considered as it is a non-cash cost. However if tax liability is calculated, it is included at the rates allowed in the taxation schedule.

2. Actual interest and capital repayments are used. This would include not only hire purchase commitments, but also the cost using any other borrowings, such as a bank overdraft.

4. The actual repair and maintenance costs for the budget period must be estimated. These will be different from those used in calculating the job rate as in that case they were averaged over the economic life of the machine. In prepearing the cash flow budget, it would be expected that the repair and maintenance costs for a new machine will be less than those for an old machine. If it is known that any major overhaul such as a track renewal job will be required, this should be included.

4. The owners salary can be altered to suit the circumstances. A small drawing may be made if you are in a tight financial situation, while a large drawing may be appropriate if you require this for your life style, and your financial situation is able to stand it.

The only difficulty not yet encountered involves estimating repairs and maintenance for the period of the budget. As very few records are kept, this may pose some difficulties, but assistance could be sought from a machinery supply company, especially for new equipment. An example of a cash flow budget is given in *Figure 5*. Company and personal tax have not been calculated in the example , as it can be a long and complex procedure. However, tax is a real cost and cannot be neglected in real life.

Figure 5. Cash Flow Budget

This cash flow budget is calculated for years one, two, and three of loader ownership - i.e. the period of H.P. repayment. Income is obtained from the job rate calculation and the H.P. repayments from the capital budget. Repair and maintenance costs are an estimate based on experience.

INCOME:

$200/day x 230 days/year $46,000

COSTS:

	Yr 1	Yr 2	Yr 3
Fuel, oil, tyres; $2.80/hr x 6.5 hrs/day x 230 days/year	4,185	4,185	4,185
Repairs and maintenance per year	2,920	5,255	9,345
Hire purchase; $1845/month x 12 months	22,140	22,140	22,140
Interest on overdraft	300	300	300
Insurance	1,460	1,240	995
Operator transport	2,760	2,760	2,760
Chainsaw	1,150	1,150	1,150
Maintenance equipment, operating supplies	575	575	575
Overheads	1,470	1,470	1,470
Owners salary	9,000	9,000	9,000
TOTAL COSTS	$45,960	48,075	51,920
Cash flow surplus/deficit (excluding tax)	$ +40	-2,075	-5,920

At this level of income and costs, the owner faces a cash crisis in years 2 and 3. After year 3, H.P. repayments cease and there should be a cash surplus. Knowing this in advance allows the owner to prepare for the difficult period. He may, for example, take one or more of the following steps:

1. Arrange additional borrowing in years 2 and 3.
2. Reduce his personal salary.
3. Renegotiate the finance deal.
4. Purchase a cheaper loader (e.g. second-hand).
5. Risk tendering a higher job rate.

HOW CAN I KEEP TRACK OF MY BUSINESS?

What you do not know can and does hurt you. If you operate your loader without reference to the gauges telling you the hydraulic oil temperature, the engine oil temperature, the fuel level etc., you would eventually get caught out with an overheated machine which no longer worked. Similarly with a business, you need to use the gauges available to check its progress. The gauges of a business are the business records.

Your Company may be like many others in New Zealand, receiving a Balance Sheet and a Profit and Loss Account produced several months after the end of the financial year solely for calculating tax liability. This information is too little and too late. Somehow or other this sort of business manages to survive, although the seat of the owner's trousers gets thinner every year.

Information about your business is not just something to request once a year when tax returns are due. If you receive a regular flow of information, you are likely to get the warning signals which will allow you to make changes before serious problems emerge. You will not be embarrassed by a sudden financial crisis and will be in a position to realistically plan for the future.

Keeping track of your business means keeping records and using them. The quantity of information you collect and how you use it is up to you to decide. In many cases it will be necessary to obtain help from an Accountant, but it is you who must tell the Accountant what is required.

WHAT RECORDS SHOULD BE KEPT?

Most information is in fact readily available, but to be useful it must be collected and used frequently. This is of course easier for a large organisation which can afford the overhead cost of clerical and accounting services. A small businessman with only one machine must carefully select information to be collected so as not to over burden himself with book work, but at the same time, to collect useful information. The following paragraphs descride some of the most useful information.

1. Production

   A daily production record is easily obtained from log truck dockets. This information is used to asses actual production compared to target production. Any decline is quickly seen and steps can be taken to improve the situation. Production rate also provides a record of revenue. For machines working on a time rate for the job, this information is not so important

2. Machine Utilisation

   The more a machine is used on productive work the better. More productive hours per day, days per year, or total hours of machine life, generally mean a lower overall job cost. Good records help to improve the calculation of the job rate. They also draw attention to changes in machine use which can indicate problems. This kind of record should be kept whether the loader is being employed on a time or production basis.

Machine use records must be kept on a daily basis. For each day the record should show:

a. Time operator arrived on site.
b. Periods during the day when machine is idle and the reason for not working (e.g. smoko, breakdown, waiting for work).
c. Time operator left site.
d. Reasons for operator not attempting to use machine (e.g. holiday, machine breakdown etc.).

Utilisation is often defined as:

$$\frac{\text{Productive hours}}{\text{Scheduled hours}}$$

Productive hours are those when the machine did work. Scheduled hours are those when it could have worked (usually the time the operator was on site, less smoko's). A regularly produced record of weekly, monthly, and yearly utilisation and reasons for idleness is very useful.

3. Loader Costs

The cost of the loader is a major part of the total job cost and deserves special attention.
Fuel, oil, filters, and lubrication use can be assessed weekly or monthly from bulk storage records. Where there is more than one machine using a common stock of these items, it may be difficult to distinguish which machine used what and it may not be worthwhile trying to separate them. Fuel and oil use can be generally related to engine power and this may be used to allocate the use of these items between several machines. Records are normally kept of quantity, and cost is based on current prices when the cost is required.

Repairs and maintenance costs can be assessed monthly from invoices received. Many repairs occur infrequently, for example engine overhauls. Experience over a long period of time or with many machines will be needed to obtain a clear picture of repair and maintenance trends. Another problem with these items is that past costs soon become out of date because of inflation. It is therefore important to record the work done and parts used as well as the total cost.

Ownership costs - depreciation, interest, and insurance - are generally book calculations and can be assessed whenever required. Good record keeping will show for each machine:

Purchase date
Initial cost
Monthly payments made
Progressive balance owing

A useful way of keeping track of payments made is through your cheque book. An account is kept solely for the use of the business. The amount of the cheque, who it was paid to and what it was for are entered on each cheque butt. The cheque butts then provide a record of all expenses incurred in operating the business.

USING THESE RECORDS

1. Improving Planning

   All through the planning procedures described in this paper, inputs were made based on assumptions and rules of thumb. Your records can improve the accuracy of assumption and replace rules of thumb. Often it will be necessary to use records of physical quantities updated to give current costs. Of course you will be basing future expectations on past performances. However, the more you can relate your predictions to your own experiences the stronger will your planning be.

2. Actual Versus Predicted Cash Flows

   In constructing the cash flow budget, which was necessary to see whether the job rate would generate sufficient income to meet actual expenses, a prediction was made as to what your actual costs would be for a future period. This exercise would be of very little use unless a periodic check was made to see whether your actual costs were within those predicted. You could find yourself in a real crisis situation if you arrived at the end of the budget period and only then found that your costs had been much in excess of those expected and you had made a large cash deficit. The frequency of checks will depend on how tight the cash flow situation is. Quarterly checks would normally be sufficient. It is a relatively simple process to list beside the budgeted cash flow figures the actual cash flow figures as a summary for the past quarter. Your Accountant will be able to assist you with drawing up suitable forms and summarising your accounts.

   The action which you might take if a crisis is seen to be coming depends on your particular financial situation. There are however many courses of action which can be taken to either reduce your costs or increase your income at the same cost level.

3. Production and Utilisation Records

   Records of production and utilisation have two important uses. The first is in improving the reliability of the job rate calculation. The second is in monitoring changes with time. The first use is similar to that for cost records. In the second, changes in production and utilisation give important pointers to changes in costs.

   An increase in utilisation should also mean an increase in income through increased production or hours paid for. If it is not, the operation is becoming less profitable. A decrease in utilisation almost always signals a decrease in profitability. The reasons then become important. If it is because less work is available, then the job rate should increase. If it is because of poor mechanical availability, it can be improved by better maintenance, a thorough overhaul, or by replacing the loader with a more reliable machine.

CONCLUSIONS

The introduction to this paper stressed the need for financial planning for a log loader owner. The pilot of even the smallest aeroplane would not take off unless he knew where he was going, how long it would take, and how much fuel he would need. During his flight he will be continually checking his height, speed, and position. Without these simple navigational techniques, flying would be a very risky operation. Many small businessmen take large risks by failing to use the basic techniques of financial management.

Planning ahead is the key to your control, and records are the tools you should be using. This paper has gone through a sequence of planning techniques: from finding out how much it will cost to get into the loading business, to determining a likely rate for a loading job, to assessing if this rate will be sufficient to meet your actual expenses and finally keeping track of the financial progress of your business. The detail in which these ideas have been presented is probably insufficient for you to launch out and use these techniques confidently. Just as in any complex business you will need expert advice. You should not hesitate to seek this. In the years ahead, with inflation as it is, business conditions will become increasingly difficult and competitive. Financial planning is an essential tool for Owner-operators of log loaders who want to remain in the business.

VEHICLE AVAILABILITY AND MAINTENANCE

K. STEEL
Transport Manager
Nelson Pine Forest Ltd

Introduction:

1. This paper is based upon the vehicle operations of Radiata Transport Ltd which is the loading and trucking arm of Nelson Pine Forest Ltd. Logging operations involve exotic timber with a 75km lead and native timber from the West Coast and from farmers blocks in the Nelson district. Daily tonnage for the Chip Mill is 900 tonnes and 350 tonnes for the Timber Mills. This pattern is likely to continue, however the Chip Mill could well be replaced by the proposed Baigents Pulp Mill. With the long hauls from various forests to mills the efficient operation of the transport fleet is a major factor in the profitability of the total venture.

Purpose of Paper:

2. The purpose of this paper is to discuss fleet control, emphasising vehicle availability and maintenance.

Vehicle Availability:

3. Effective use of logging transport requires vehicles to be available to pick-up logs from the forest. This involves a maintenance programme to minimize maintenance down-time and good control of available vehicles. Maintenance will be discussed later.

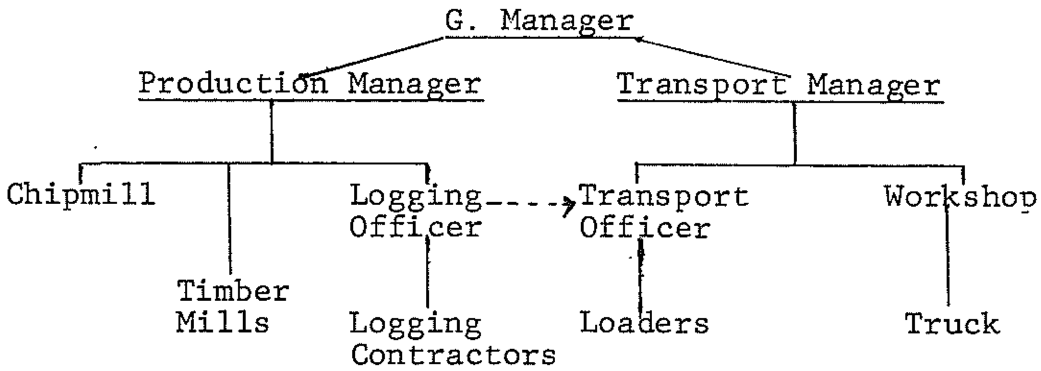
4. Loading sites in the forest are generally small and the roads leading to them frequently narrow and of low standard. It is therefore important to make sure there is no congestion of heavy trucks in these conditions. Our method of control involves a radio network with sets at the main transport base (alongside the workshop) at each skid site in the forest and at the weigh-bridge on the outskirts of the forest. The organisation provides for smooth control of both the skid sites and the individual trucks.

Forest (Skid Site) Organisation:

5. The organisation at the forest involves organising the logs onto the skid and then arranging for them to be loaded on the trucks and transported from the forest. These roles are highly defined and must be kept separate. In the past private contractor loaders were employed, however this was unsatisfactory as there was insufficient company control of both men and machines. Accordingly the company now employs a Logging Officer who deals with the logging contractors and is responsible for ensuring that skid sites are properly organised to allow quick loading onto trucks. The Transport Officer, whose responsibility it is for the trucks to be loaded, deals only with the Logging Officer if there are problems at the site. This system is proving efficient.

Forest Organisation Contd.

The organisation chart is:-



Truck Control:

6. We transport logs out of three skid sites at a time. The Transport Officer and the Logging Officer at the end of each day decide which log sites the three loaders will operate from next morning. Five trucks are then allocated to each site and the drivers notified. The system used is that trucks depart the main base in groups of three, one for each location. The first shift leaves at 4 a.m. and thereafter a group of three leave every half hour until 6 a.m. Sites are varied as required throughout the day and the Transport Officer, located at the weighbridge, controls the trucks to avoid congestion at any point. This method is working well in practise and drivers know their shift times in advance as they spend one week on each start time.

Monitoring of System:

7. To monitor the system a daily operation summary is kept. (copy attached) This summary shows the unit, its cartage, the mileage, driver performance and highlights delays. As a guide for our operating conditions we look for an average driving speed of 18 m.p.h. The summary will pinpoint abnormal driver performance and any problem at loading or unloading points. It is a very useful guide for management.

Current Fleet:

8. TNL Group has made a positive policy shift to purchase the best quality vehicles for the various roles. This policy was adopted as a result of experience in the 1960's, particularly in the logging fleet. At that time low capital cost vehicles were employed and the limitations of these vehicles were highlighted clearing a major windfall. Workshop facilities could not handle the numerous breakdowns. In this period it was not unusual to find 16% of our trucks parked at the workshops or broken down on the side of the road. Since the introduction of the best quality vehicles, maintenance/breakdown down-time has been more than halved.

Current Fleet Contd.

9. The current fleet consists of:-

a. 14 Mercedes 2624 - Loggers
b. 3 Kenworths - Loggers
c. 3 Mercedes 1418 - Chippers
d. 2 Leylands - 1 Logger and 1 Spare

10. The Mercedes 2624 trucks were selected because they were considered to best suit the operating conditions. With native timbers it is a one time operation and roads are thus built to a minimum standard. This makes the 4-wheel differential lock of the Mercedes necessary. Additionally the Moutere gravel becomes extremely soft and is a very poor road foundation, particularly in wet conditions, making the 4-wheel differential lock essential. The 240 horse power motors are adequate as the loaded operation is primarily a down-hill run. The Kenworths are used for the longer hauls to the West Coast. The 1418 Mercedes used as chippers have a dead flat run through a largely residential area and are adequately powered and quiet enough for the conditions.

Maintenance Programme:

11. Repairs and maintenance on every vehicle is noted and a computor record is kept for each truck. Maintenance falls into three basic categories:-

a. Routine Checks (Preventative Maintenance)
b. Certificate of Fitness Checks
c. Breakdown Repairs

12. Routine Checks - A preventative maintenance programme has been introduced. This involves checking vehicles every 30,000 kms. In this system a general check of the vehicle is made and more thorough checks made on components subject to failure. The check list is continually reviewed and items which are found to be satisfactory are removed from the list. Where a failure pattern can be established components may be removed and replaced or serviced before the predicted failure. For example on some units it has been our experience that water pumps fail at 100,000 km. These pumps are now removed at the 90,000 km check. Oil analysis is carried out on an as required basis. Major components are not removed solely as a result of an oil analysis report. In some cases it is more economical to continue operating with a known defect than to remove a component and possibly lose thousands of kilometres of running. The prime requirement in making such decisions is of course experienced mechanical knowledge and good judgement. The vehicles are fitted with tachographs and these records can be used to confirm motor performance.

13. Certificate of Fitness Checks - Before a Certificate of Fitness is due, vehicles are presented to the workshop for a pre-check. Time allowed varies according to vehicle condition and known minor defects.

Maintenance Programme Contd.

14. Breakdown Repairs - Breakdown repairs are carried out as required. Where practicable vehicles are brought to the workshop for such repairs. This may involve some roadside maintenance.

15. Maintenance Cost Recording - A detailed maintenance record is kept for each vehicle and produced monthly. The information for this record is gained from the workshop mechanics time sheets and from the parts store issue sheets. The vehicle is subdivided into a number of areas and the amount spent on each area is recorded together with a brief note of the work done. Where a particular area has been worked on during a month, the computer record shows the past history of that particular area. This makes it a simple matter to quickly research how long since a component was changed and can readily highlight faulty workmanship or components. An example maintenance report for a Mercedes 2624 is attached and it will be noted that this report includes:-

a. Vehicle number and date of purchase.
b. Life to date capital cost.
c. Monthly cost of labour and materials subdivided as outlined above, with a brief history.
d. Year to date and life to date costs in each area.
e. Month, year and life to date mileage.

16. Maintenance Exception Reporting - In addition to the routine reports a monthly maintenance exception report is produced. This report is based upon a guideline cost per kilometre expected in each area. Where the guideline is exceeded in any area the truck shows in the exception report and management can more quickly identify trends. The report is also useful in comparing different makes of vehicles in the same role.

Tyres:

17. Tyres are a major cost and in selecting the application it is important to consider the total economics. This involves not only the cost per kilometre, but also the cost of vehicle down-time through tyre failures. The basic choice is initially between steel radials and cross-ply tyres. The next choice is the type of retread, either by the hot cap method or by the cold cure. In the conditions that we operate in the major tyre problem is stone damage, causing punctures and premature tyre casing failure. The tyres are more susceptible to damage as the tread wears down. In view of this it is our practise to use steel radial tyres on our logging operation and remove them at approximately 50% tread. The remaining 50% tread is then run-out in the comparative safety of the highway on a different role truck. The tyres are retreaded using the cold cure method and our experience is that the hard rubber gives good mileage and is more resistant to stone damage. To be more economical in straight cost per kilometre than using cross-ply tyres it is necessary to achieve at least four retreads per casing, and using the above system this can be achieved. In this way we can enjoy the advantage of radial tyres.

Summary:

18. In log transport operations as with any other transport operations, the objective is to achieve high operational availability at the lowest possible cost. It has been our experience that in the long term the high capital cost of quality vehicles is justified, particularly in the difficult operating conditions experienced in logging operations. Preventative maintenance certainly reduces down-time and helps avoid expensive failures.

COMBINED MECHANICAL WORKSHOP MONTHLY MAINTENANCE REPORT

[illegible]

STATE TRANSPORT [illegible]

REPAIRS TO	MONTH LABOUR	MONTH MATERIAL	MONTH TOTAL	YEAR TO DATE	LIFE TO DATE	PAST HISTORY ON CURRENT ITEMS AND CURRENT COMMENTS
CAPITAL	0.00	0.00	0.00	0.00	40358.01	
TRAVELLING TIME	0.00	0.00	0.00	9.50	32.15	
R & M GENERAL	0.00	0.00	0.00	22.50	113.70	
						80006 14.25 80006 14.25
						80035 4.75
						8/77 65.00 890017 2/78 215.84 600033
FIRST AXLE.WHEEL.SPR	33.25	0.00	33.25	107.20	513.89	8/78 37.95 660014
STEERING.STEERING CL	14.25	0.00	14.25	14.25	39.65	80006 14.25
FUEL SYSTEM	0.00	0.00	0.00	31.50	154.90	
MOTOR	0.00	0.00	0.00	[illegible]	[illegible]	
CLUTCH.TORQUECONUERT	0.00	0.00	0.00	0.00	133.04	
MAIN TRANSMISSION GE	0.00	0.00	0.00	0.00	[illegible]	
AUX.TRANSMISSION POW	0.00	0.00	0.00	0.00	6.00	
DRIVE LINES	0.00	0.00	0.00	0.00	7.20	
						190029 42.75 REMOVE & O/H WATER PUMP
						930026 137.67 W/PUMP KIT CPC
						5/77 28.80 40029 11/78 25.85 940007
COOLING SYSTEM	42.75	137.67	180.42	215.62	281.76	2/79 42.75 190029 2/79 137.67 930026
EXHAUST SYSTEM	0.00	0.00	0.00	19.11	296.66	
MID AXLE.HUBS.SRINGS	0.00	0.00	0.00	0.00	48.35	
REAR AXLE.HUBS.SPRIN	0.00	0.00	0.00	67.44	891.16	
[illegible]						190018 53.32 REP TOW HITCH
						970033 26.38 MACH PINS
TURNTABLE DRAWBARS &	0.00	57.70	57.70	[illegible]	[illegible]	2/79 [illegible] 190018 2/79 26.38 970033
BOLSTER & FRAMES	0.00	0.00	0.00	0.00	232.45	
						80006 [illegible]
						3/77 45.00 500051 6/77 19.71 420012
						11/77 [illegible] 2/78 [illegible]
						3/78 17.00 190001 3/78 17.00 190014
						[illegible]
						5/78 123.58 630016 11/78 40.95 940007
						[illegible]
TOTALS					CONT..	
km/HOURS						

COMBINED MECHANICAL WORKSHOP MONTHLY MAINTENANCE REPORT

[illegible]

[illegible]

REPAIRS TO	MONTH LABOUR	MONTH MATERIAL	MONTH TOTAL	YEAR TO DATE	LIFE TO DATE	PAST HISTORY ON CURRENT ITEMS AND CURRENT COMMENTS
BRAKES.CUMBERS.H/CON	4.75	0.00	4.75	212.66	1720.52	1/79 11.08 830047
						80035 9.50 90024 4.75
CHASSIS.BODYWORK.FRA	14.25	3.57	17.82	253.59	543.96	940006 3.57
TYRES	0.00	0.00	0.00	2954.06	7708.87	
HYDRAULIC PUMPS.RAMS	0.00	0.00	0.00	0.00	3.47	
						90001 42.75 RPR AIR LEAKS
						90024 19.00
						930032 54.49 20028 DISC & HOSE
						930039 7.42 GSKTS CPC
						5/77 26.89 490016 2/79 42.75 90001
COMPRESSORS.AIR VALV	61.75	61.91	123.66	137.16	164.05	2/79 55.59 930032
						80035 28.50 100001 4.75
						110029 4.75 162391 31.04
						930041 17.59 LENS
						940040 18.00 RE CHROME LIGHT
						5/77 31.14- 610002 10/77 43.72 750015
ELECT WIRING.LIGHTS.	38.00	66.63	104.63	127.06	667.97	2/79 28.50 80035 2/79 31.04 162391
BATTERIES	0.00	0.00	0.00	201.45	455.01	
						930030 33.59 OIL P/SW
						4/78 75.00 770043 11/78 52.23 920021
INSTRUMENTS	0.00	33.59	33.59	90.32	243.15	2/79 33.59 930030
ALTERNATORS.REGULATO	0.00	0.00	0.00	87.64	149.04	
						950040 29.36 STROB
ANCILLARY EQUIPMENT.	0.00	29.36	29.36	29.36	374.08	2/79 29.36 950040
COF & WOF CHECKS	14.25	0.00	14.25	36.75	220.00	100001 9.50 100031 4.75
						100022 4.75 180023 4.75
LUBE	14.25	0.00	14.25	149.50	1378.09	250021 4.75
STEAM CLEAN OR WASH	0.00	0.00	0.00	0.00	16.65	
HUBODOMETERS	0.00	0.00	0.00	29.62	29.62	
TOTALS	237.50	390.43	627.93	4925.04	18790.96	
km/HOURS			5167	45056	359378	

RADIATA TRANSPORT LIMITED — DAILY LOG TRUCK OPERATIONS SUMMARY — DATE: 4 · 4 · 79

UNIT		(16) CARTAGE			MILEAGE			DRIVER PERFORMANCE															
										NOTIFIED DELAYS - HOURS													
										WAITING													
TRUCK Nº	NAME OF DRIVER	Nº OF LOADS	TOTAL DAYS TONNAGE	AVERAGE TONNAGE PER LOAD	PRIVATE MILES RUN	TOTAL MILES RUN	AV. LOAD MILES	DRIVER HOURS WORKED	DRIVER MPH WORKED	PLACE	LOAD	PLACE	UNL'D	GREASE SERVICE	TYRES P'TYRE	LOAD B/DW	IN N/SUP	OTHER		TOTAL (HRS)	DRIVER HOURS DRIVING	DRIVER MPH DRIVING	NOTES
410	D Scott	2.	44·50	22.2	122	308		10.5	29.3					1			1			2	8.5	36.2	162
411	C Chisolm	2	42.79.	21.3	73	251		9.	27.8	K3	.5			1.5						2.	7.	35.8	129.
412	F [illegible]	4	90·90	22.7.	59	327		12	27.2	[illegible]	1.									1	11.	29.7	164
414	R [illegible]	2.	51.41	25.7.	6	433		11.	39.3								.5			.5	10.5	44.2	216
417	S Thompson	2.	45.75	22.8	122	296		9.	32.8												9	32.8	213
418.	R [illegible]	3	71.69.	23.8.	120.	351		12	29.2												12	29.2.	174.
420.	B D Scott	2.	42·48	21.2.	65.2	203.		7.5	27.6												7.5	27.6	103
429	C [illegible]	3.	75.08	25.2	120.	335		11.5	29.1												11.5	29.1	167
134	E [illegible]	1	19.55	19.5	61.	163		4.5	36.2					.5						.5	4	40.7	75
192	[illegible]	1	23·44	23.4	6	340		7.	48.5												7	48.5	169
220	D [illegible]	3.	52.64	18.8	122	388		12	32.3												12.	32.3.	197
~~220~~	~~J [illegible]~~					~~303~~																	
~~221~~	~~J. [illegible]~~																						
227	R Walker	2.	37.70	18.8	122.	303		7.5	40.4												7.5	40.4	145
223	W [illegible]	1	24.75	24.7	38	90		3.5	25.7												3.5	25.7	45
38	[illegible]	2	50.44	25.2	65.2	239.		9.	26.5					1						1	8.	29.8	239
K82	E [illegible]	2.	38·43	19.2	12	212		10.5	20.1	[illegible]	.5			1			1			2.5	8.1	26.5	214
~~[illegible]~~	~~[illegible]~~																						
43	J Boyd	3	76.79	25.5	63.2	261.		9.5	27.4	[illegible]	1						.5			1.5	8.	32.6	132
TOTALS		35	792·34	22.5	1176.6	4500		146.0	31.2		3			5			3			11	135.0	33.6	2544

AVERAGE LEAD MILES: 64.2.

DOWNTIME = 7.5 %

SUMMARY OF SESSION V BY CHAIRMAN

(W. WITHERS)

Thankyou gentlemen for the papers presented. I can't see that there is any summing up to do as the paper discussions indicated that we have all got a lot of work to do to improve our operations. The research people speaking in the earlier session II, said that our costs must be kept down to make our exports viable. The four papers just presented show many angles and many ways of doing this.

Savage's paper, read by Peter Olsen, on "How much to invest in a log truck", highlighted the problem in studying this subject, as many truck operators do not produce adequate truck cost or use records. This aspect generated much discussion.

The following paper by Ray Harlick on "Costing trucking operations" was thus pertinent and it provided excellent guidelines for truck operators.

Geoff Wells outlined the basics of "Financial planning for a log loading business", and in discussion the importance of the contractor having a job cost calculation done prior to any contract was pointed out.

Kevin Steel's paper on "Vehicle availability and maintenance" led discussion onto the pros and cons of high horsepower. Interestingly, his firm's experience was that higher powered trucks did not out-perform alternatives, in both operating cost and hauling performance.

- SESSION VI -

TRANSPORT AND LOADING SYSTEMS - PART I:

Chairman - V.F. Donovan, Research Officer, Logging Industry Research Association.

"STANDING TIME AND INFLUENCES ON PRODUCTIVITY IN LOG CARTAGE"
(M. HOWARD - Forest Ranger, New Zealand Forest Service)

"THE EFFECT OF ROAD STANDARDS ON LOGGING TRUCK PERFORMANCE"
(C.T. CORNELIUS - Superintendent - Planning, N.Z. Forest Products Limited)

"DEVELOPMENT AND OPERATION OF A TRUCK SCHEDULING SYSTEM"
(G. SPERRY - Transport Supervisor, Fletcher Forests Ltd.)

SESSION VI
PAPER a

STANDING TIME & INFLUENCES ON PRODUCTIVITY IN LOG CARTAGE

MARK HOWARD
Forest Ranger (Work Study)
New Zealand Forest Service

INTRODUCTION

In essence, if the wheels of a truck are not turning and loaded the truck is not earning money.

Truck operators are paid to cart wood from A to B - not to carry out all of the other elements that are contributing to that main aim.

From this it is obvious that the more wood that he can cart from A to B each trip, the more trips that he can make each day, and the more days he can work each year, the higher his earnings will be.

Maximising pay loads has been covered in another paper.

The other factor of maximising trips per day, or more correctly the daily distance travelled loaded, has two distinct parts, travel speed and standing time.

TRAVEL SPEED

Truck speed are influenced by many factors, only two of which can be controlled to any extent by the operator.

These are the power of the truck and the payload that it carries.

On reasonably flat open roads of reasonable length a 20% increase in kilowatts from 200 (270 hp) to 240 (320 hp) would tend to provide an increase in travel speed of about 11% loaded and 8% empty.

The above increases in speed have the theoretical effect of increasing the annual kms. travelled by 2800 kms. and 6400 kms. for leads of 50 and 150 kms. respectively.

In practice this size benefit is not realised as it is seldom that this sort of saving enables a further trip to be made, daily.

Payload size has little effect on speed until around 26 tonnes from which point upwards it has an increasing effect. From a base of 24.5 tonnes an under load of 15% produces an increase in speed of 1% while a 15% over load decreases speed by 3%.

Any increase in travel speed without sacrificing payload must be bought by the higher capital expenditure needed for more powerful trucks + usually higher tare weight.

NON WHEEL TURNING OR STANDING TIME

This is any time when the wheels of a truck are not moving and for our purposes we will only consider the hours when a driver is being paid. Around the B.O.P. this averages out at around 11.0 hours per day.

Standing time is of two types:

(a) Daily, which is independent of lead and generally occurs outside the productive day.

(b) Per trip, which is dependent on the lead and occurs during the productive day.

DAILY STANDING TIME

Most of this occurs at the depot and includes preparing the truck in the morning, refueling and parking at night, lunch and also garaging. Although garaging is not strictly standing time it is outside the productive day and must be accounted for in the paid day.

The time for these make up 9% of the day and are as follows:

Prepare truck		8.8 mins
Fuel up		5.0 mins
Park		3.6 mins
Garaging		24.0 mins
Lunch + smoko		17.0 mins
	TOTAL	58.4 mins

TRIP STANDING TIME

These are times that occur each trip at four different locations:

i At the bush.
ii Weighbridge.
iii Mill, wharf or railyard.
iv During the journey.

This averages 51 minutes per trip.

AT THE BUSH

The elements that occur here and a common time for each are listed below:

Position for loading + prepare rig	1.4 mins
Unload trailer (longs only)	2.1 mins
Wait	10.7 mins
Load	8.9 mins
Chain up and collect docket	2.2 mins
TOTAL	25.3 mins

Most of these times do not vary much but the loading and waiting do.

The loading time quoted is an average of hot and cold deck and longs and shorts. These times vary from 7.1 mins. for cold deck longs loading to 10.2 mins. for hot deck shorts loading.

If an inexperienced loader driver is encountered the loading could take considerably longer.

The average loading time observed in Canterbury during the windthrow recovery was around 23 minutes.

> That is an increase in loading time of 160% caused by lack of expertise.

The only data we have on Boom loading is from 1973 and that indicates loading times of around 16 mins. for longs and 33 mins. for shorts. Maybe things have improved since then.

The average waiting time on a boom loaded skid is 26 minutes.

WEIGHBRIDGE

The weighbridge element times are as follows:

Wait	1.0 mins
Weigh + collect docket	1.9 mins
TOTAL	2.9 mins

Weighing time is reasonably standard but waiting again varies considerably depending mainly on the time of day. If the loads are being tallied instead of weighed, the waiting time would be 7.6 mins. and tallying would take around 9.8 minutes.

MILL, WHARF OR RAILYARD

Common times experienced here are:

Unchain load	1.3 mins
Wait	4.7 mins
Unload	5.4 mins
Prepare rig for road	1.0 mins
Load trailer on truck (longs)	6.9 mins
TOTAL	19.3 mins

Waiting time varies considerably from place to place. At a mill where the driver releases the stanchions to unload, waiting is nil. If a Wagner is available waiting is .9 minutes. At the wharf or railyard the average wait is 2.2 minutes while if you are going to be unloaded at a Mill by a rubber tyred loader you will wait on average 13.0 minutes per load. This is usually caused by mill's apparent inability to keep the loader going over smokos and lunch periods.

Unloading also varies considerably, Wagners being the fastest at 3.12 minutes for short and 1.0 minutes for longs.

The drop stanchion unloading time is 4.6 minutes, and this is for longs only.

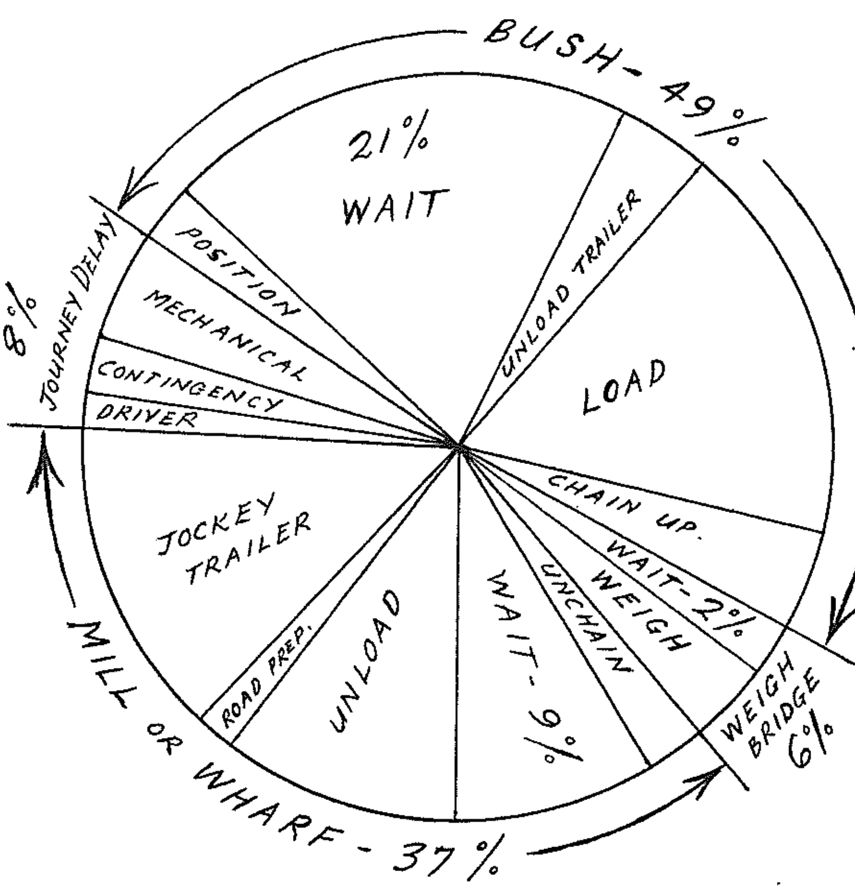
Rubber tyred loaders were the slowest at 10.7 minutes for shorts and 7.4 minutes for longs. Again inexperience takes its toll with times in excess of 30 minutes being observed at Lyttleton.

JOURNEY DELAYS

These have been divided up into delays caused by mechanical breakdown, including punctures, contingency delays, which are any other necessary delays, e.g. checking load or types, and drivers delays that are caused by the driver, but do not come into lunch or smoko time. These are set out below:

Driver		.7 mins
Contingency		.9 mins
Mechanical		2.4 mins
	TOTAL	4.0 mins

Figure 1 shows the breakdown of trip standing time.



DISCUSSION

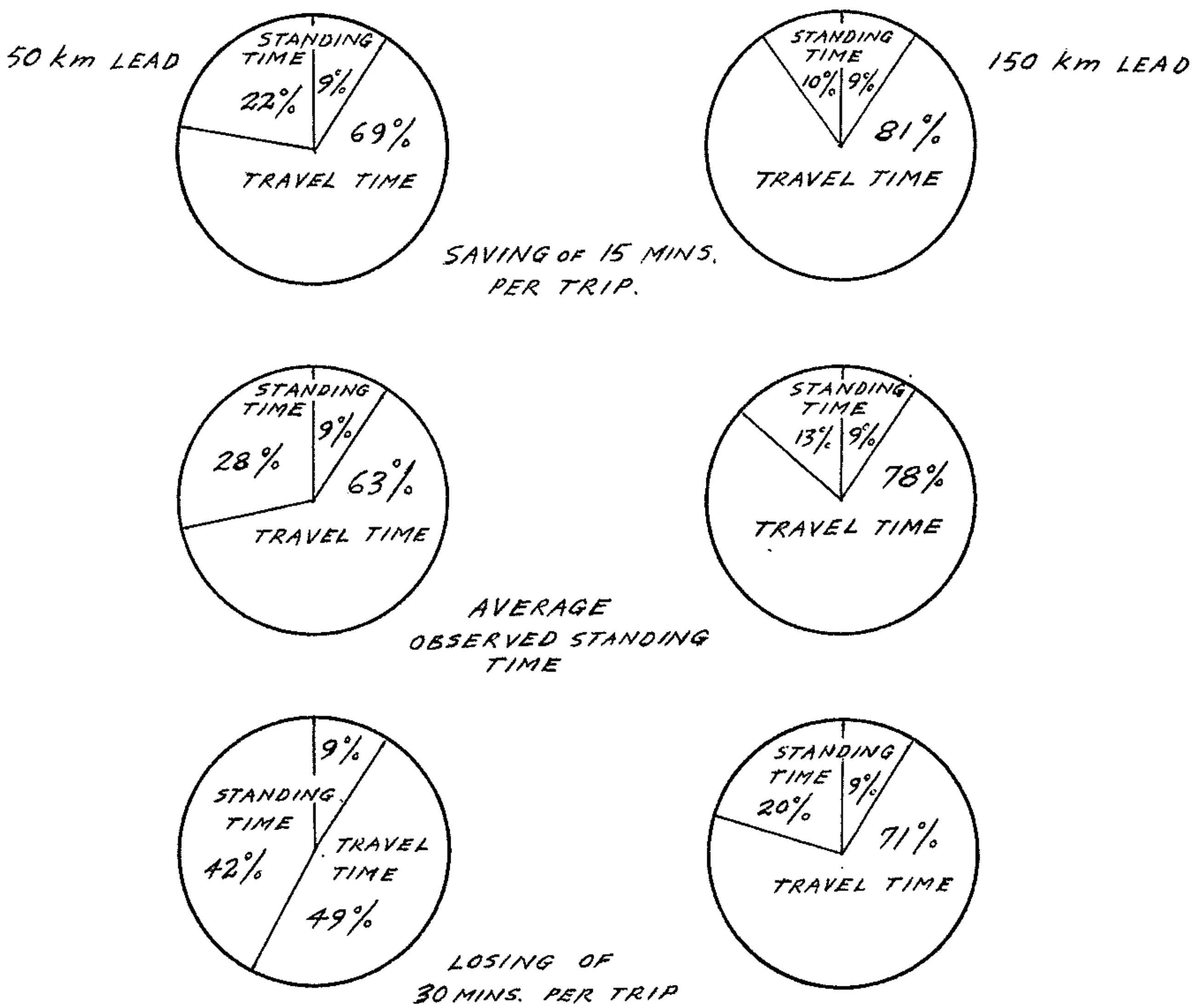
As can be seen from Figure 1, a staggering 32% of the standing time is waiting and most of that occurs in the bush.

It is obvious that this is where the greatest loss or saving of time can occur.

Figure 2 shows the effects of a saving of 15 minutes and a loss of 30 minutes per trip on the proportion of the total day that is spent carting compared with standing.

The dramatic effect at shorter leads is lessened as the lead increases.

FIGURE 2:



TIMES ARE EXPRESSED AS PERCENTAGES OF TOTAL DAY.

The table below shows the effect of this on the annual distance travelled, and also compares these with the theoretical gains of higher travel speed.

	Kilometres	
Lead	50 km	150 km
Saving 15 mins per trip	+ 8100	+ 4600
Losing 30 mins per trip	- 12700	- 8900
Increase of kw from 200-240	+ 2800	+ 6400

Almost half of these kilometres are loaded and being paid for.

Two related factors that appear to have the greatest effect on waiting time are scheduling and communications.

Without adequate scheduling queues form and the available day is unlikely to be fully used.

Effective communication is needed between all parties; forest owner, fleet operator, despatcher, drivers, loading contractors and weighbridge.

The easier these lines of communication the less hours will be eaten up in waiting time.

THE EFFECT OF ROAD STANDARDS ON LOGGING TRUCK PERFORMANCE

C.T.Cornelius
Superintendent - Planning
N.Z.Forest Products Limited

Introduction

The design standard for forest roads is very dependent upon the area of forest to be served - hence the number of truck trips - and the topography.

At N.Z.Forest Products Limited in the early 1960's we had 5 road design standards each with its own very detailed specifications covering maximum adverse and favourable grades, minimum grade, curves, sight distance, super elevation, speed value, curve widening, and cambers. Later, towards the end of the 1960's, we reduced road classes to 3, arterial, secondary and stub. At this time we increased the speed value from 56 km/h to 64 km/h for the arterial roads.

Today, we aim for a speed value of 70 km/h, the road specifications are simple, and only maximum grades, the minimum grade and widths are specified. See Appendix 1.

These later design standards are consistent with the following

1. secondary and stub roads account for 90% of length roads used to harvest the forest

2. secondary and stub roads are greatly influenced by the logging method and the topography with little latitude to optimise truck performance.

3. secondary and stub roads are not in continuous use (for harvesting).

4. arterial roads account for 10% of the forest road length but carry approximately 80% of the loaded tonne-km.

Therefore, it is important that arterial roads are designed to as high a standard as possible and should not be unduly influenced by logging requirements adjacent to the route.

The purpose of this paper is to look at effect of geometric road standards on logging truck travel times.

1. Lane and Shoulder Widths

At N.Z.Forest Products Limited the arterial roads are constructed to an overall width of 9.5 metres, water table to water table.

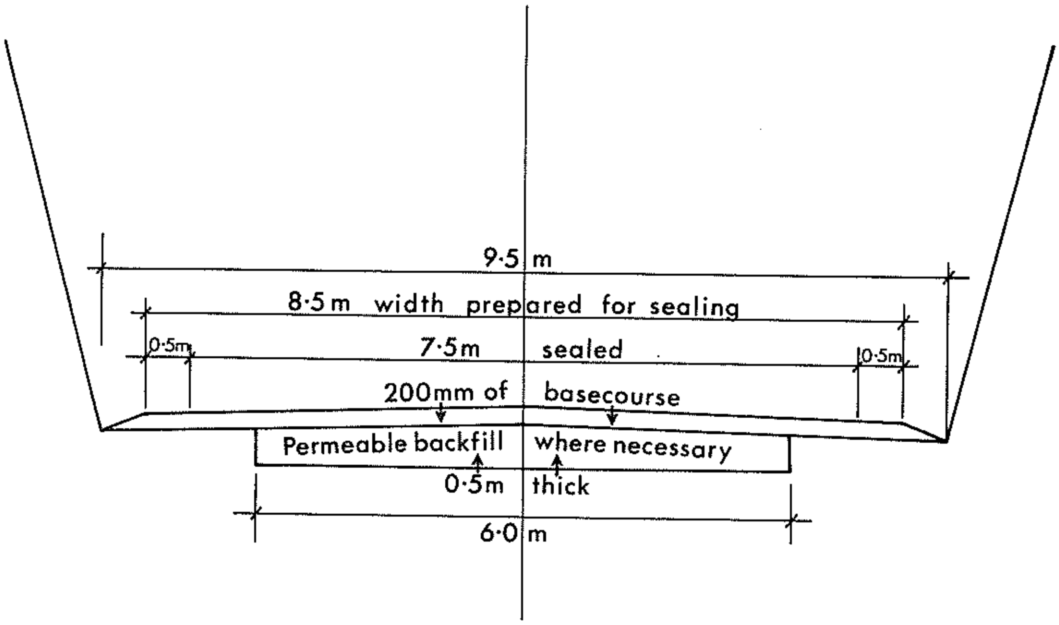


Fig. 1. Typical Road Cross Section

The optimum lane width for two-lane roads is the overall loaded vehicle width plus 1.22 m.[1] Reduction in lane width may be expected to cause some reduction in vehicle spot speeds (as much as 1 km/h for each 30 cm reduction) and in vehicle speeds when passing or meeting other vehicles (as much as 1 km/hr for each 5 cm reduction. Also, the shoulder width should not be less than 1.22 m to ensure no adverse effect in vehicle speed.[1] Speed can be expected to drop by 1 km/h for each 6 cm reduction in shoulder width.[1]

At N.Z.Forest Products Limited we have both 2.5 m (8 ft.) and 2.75 m (9 ft.) wide logging trucks operating on a two-lane arterial road with a sealed surface of 7.5 m - lane width 3.75 m.

Consider the larger truck (2.75 m)

2.75 + 1.22 = 3.97 m
Reduction due to 22 cm under width
∴ Reduction in spot speed = 22/30 x 1 = say 0.7 km/h

Consider possible reduction in speed due to meeting or passing other traffic (1 km/h for each 5 cm)
Reduction in speed = 22/5 x 1 = 4.4 km/h

Consider reduction in speed due to shoulder width of 0.5 m (optimum 1.22 m) 1 km/h for each 6 cm.

$1.22 - 0.5 = 0.72$ m
$72/6 \times 1 = 12$ km/h

∴ Reduction in spot speeds due to lane width ≃ 1 km/h

∴ Reduction in meeting or passing speeds due to lane and shoulder width ≃ 16 km/h

This reduction is greater than I have noticed in the field - maybe the berms constructed on the sides of our arterial roads give the drivers confidence to keep moving without an appreciable reduction in speed.

Secondary and stub roads are of intermediate and single lane width which together with the roadway shoulder allow safe passing at the lower design speeds.

Roads should be widened on tight radius horizontal curves to allow for the off-tracking of the truck and trailer. The amount of widening required is dependent upon the radius of the curve and the length of the trucking rig.

<u>Super elevation</u>

As a vehicle travels around a curve, the centrifugal force generated tends to make the vehicle move sideways and towards the outer edge of the road. This centrifugal force is balanced by the friction between the tyres and the road surface, and on a super elevated road by the tilted road surface.

The coefficient of sliding friction varies with the road surface, the condition of the tyres, and to a small degree the speed of the vehicle.

The magnitude of the super elevation on a given curve is dependent on vehicle speed and the coefficient of sliding friction; higher the speed the greater the super elevation. However, there are limits. Where horizontal grades occur on steep grades the actual running speed is well below the curve design speed, the centrifugal force is considerably reduced, and because of the high super elevation the sliding friction may work in the opposite direction to normal i.e. the resultant force on the vehicle may push it to the inside of the curve rather than the outside. Considerable "over-steer" results, and this can be particularly dangerous where ice or frost occurs. For this reason, and the fact the logging trucks have a high centre of gravity, leads to the super elevation on forest being limited to 5 cm/m in severe winter areas overseas,[1] and in New Zealand should be limited to 10 cm/m. The relationship between design speed radius of curve, super elevation, and coefficient of sliding friction may be expressed by[2]

$$V = \sqrt{127 \times R(e \pm f)}$$

where V = design speed in km/hr
R = Radius of curve in m
e = superelevation (decimal form)
fs = coefficient of sliding friction

Because the coefficient of sliding friction varies little with speed, it is usual to take a uniform value in the above formula.

Consider a curve with	Radius	100 m
	Superelevation	0.05
	Sliding Friction	0.15

$$V = \sqrt{127 \times R(e \pm f)}$$

$$V = \sqrt{127 \times 100\ (0.05 + 0.15)}$$

$$V = 50.4 \text{ km/h} \quad \text{(design speed)}$$

Consider same curve without superelevation

$$V = \sqrt{127 \times 100\ (0.15)}$$

$$V = 43.6 \text{ km/h} \quad \text{(design speed)}$$

A decrease in speed of 6.8 km/h.

Two other curve dimensions that greatly affect truck performance are the curve radius and the number of curves.

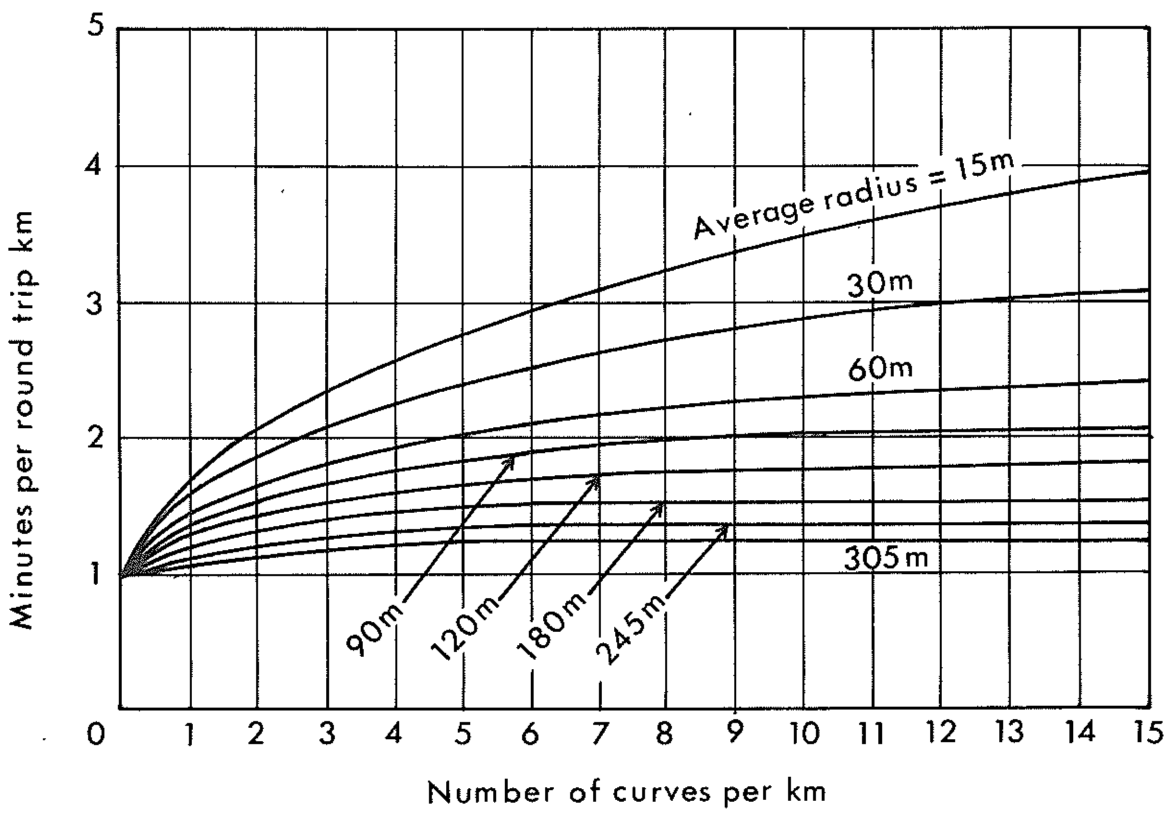


Fig. 2 The effect of curves and curve radius on loaded truck travel [3]

From the above graph the relationship between time and curve radius is more critical than the relationship between time and the number of curves.

Site Distances

All forest roads should be provided with an adequate Non-passing sight distance corresponding to the selected design speed. This distance is based on the distance the vehicle travels while the driver recognises an obstacle in his lane and applies the brakes, plus the distance taken to stop the truck.

∴ non passing sight distance = perception and reaction distance plus braking distance

This distance can be approximated by the formula[3]

$$S.D. = 1.25\,V + \frac{V^2}{255\,(f \pm g)}$$

Where

S.D.	=	non passing sight distance in m
V	=	Vehicle speed in km/h
f	=	Coefficient of traction
g	=	grade (decimal form)

In the forest situation the sight distance often changes through the cycle of forest i.e. from the initial planting or clearfelling through the number of thinnings to clearfelling. Where the sight distance drops below that required for the selected design speed consideration should be given to pruning, thinning or clearfelling the affected area or the corner sign posted at a lower speed.

Grades

Both steep adverse and favourable grades quickly reduce truck speed below the desirable design speed of the road. In general a strong effort should be made to construct roads with as easy a grade as possible to maintain high truck travel speeds.

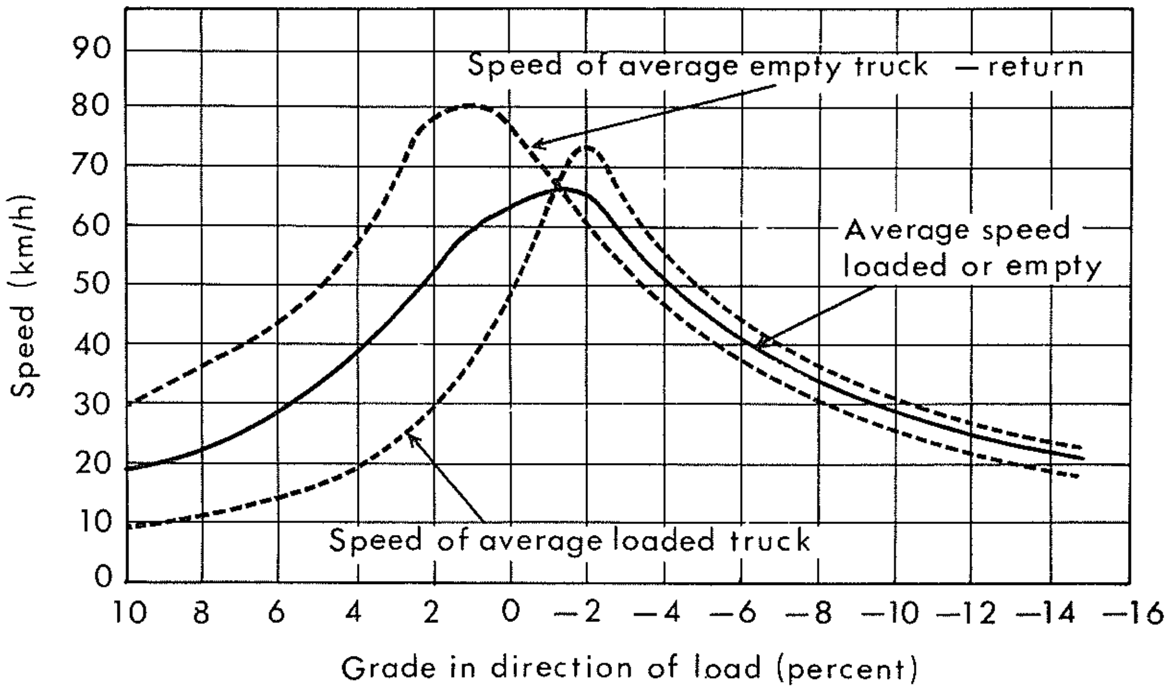


Fig. 3 Graph showing logging truck speed versus road grade for metal roads [3]

From the above graph the loaded truck quickly increases speed as the adverse grade becomes less than 6%; it reaches maximum speed at a 2% favourable grade and then speed drops very quickly as the favourable grade increases.

On arterial roads, which have a high volume of trucks, the aim should be to keep both adverse and favourable grades to less than 6%.

The maximum adverse grade which can be climbed without wheel slippage (the critical grade) is important too. Nothing reduces truck speed quite like a truck that has run out of traction half way up a steep adverse grade - and the speed of those trucks behind. The critical grade depends on the coefficient of traction and the proportion of gross vehicle weight on the driving wheels.

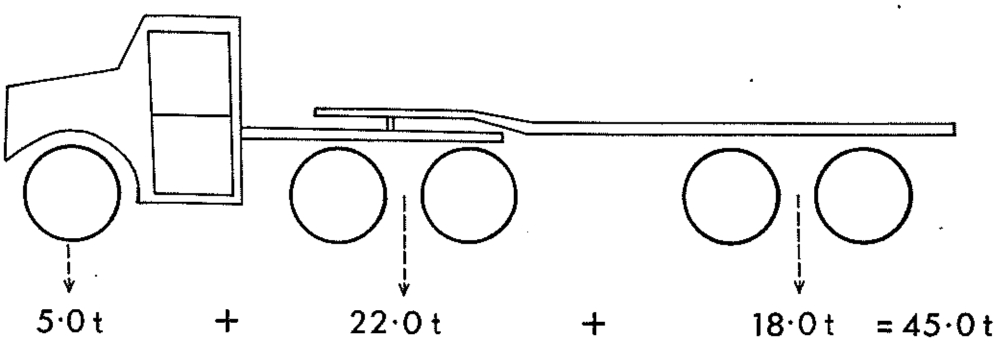
Its value may be closely approximated by the formula:[4]

$$GR = \frac{f \times AW \times 100}{GW}$$

where GR = grade percent
f = coefficient of traction
AW = weight on driving wheels
GW = gross vehicle weight

Note: In this formula rolling resistance is not taken into account.

Consider a 5 axle logging truck as shown below:



Coefficient of traction 0.20 (slippery road)

$$GR = 0.20 \times \frac{22}{45} \times 100$$
$$= 9.8\%$$

Therefore if adverse grades are greater than 9.8% then more weight must be placed on the drivers or a better road surface provided.

Consider the effect of reversing the above loadings on the driver axles and the trailer axles. A similar effect is obtained by the use of a 3 axle trailer

$$GR = 0.20 \times \frac{18}{45} \times 100$$

$$GR = 8.0\%$$

The critical grade is now only 8.0%.

Surface

The road surface characteristics have a significant influence on truck speed. A poorly maintained surface will reduce truck speed due to the need for increased stopping distances, less driver comfort, and the fear of increased truck maintenance. Conversely a change from a metal surface to a sealed surface (all geometric standards remaining constant) will increase truck speeds, with additional gains from the absence of dust, less deterioration of the surface during adverse weather and less rolling resistance.

One case study at N.Z.Forest Products Limited between a sealed and metal surface on a short length of road showed an increase of between 7-8% in truck speed after sealing. Nearly all of this increase could be attributed to the improved surface as the geometric standards were not altered.

At N.Z.Forest Products Limited the overall average loaded speed on our sealed roads is 50 km/h and on metal surfaced roads 36 km/h.

In practice forest roads are sealed due to the economic considerations of road maintenance and truck maintenance and not on the benefits in truck performance.

In conclusion I have endeavoured to show the effect of geometric road design standards on truck travel speeds, and an insight into the need for our three design classes of forest road. The road design standards adopted must reflect a balance between construction cost, road maintenance cost and the truck transport cost in relationship to the area served. For this reason it is very important to identify the arterial routes early in the life of the forest and design to a high standard.

On a fixed haul each truck's productivity, tonne-km per day, is governed by the average payload (constant within small limits) and the number of trips. The number of trips can be maximised by making full use of time. Arterial routes, which are only 10% of the length of forest roads but carry 80% of the tonne-km run, with high average travel speeds make the best use of time over a large portion of the truck travel sector.

It is only on these high volume roads where relatively small increases in truck speed will result in a substantial cost benefit to the transport operation.

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APPENDIX

N.Z. FOREST PRODUCTS LIMITED

FOREST ROADING

SPECIFICATIONS AND GUIDELINES

Planning and Location

Roads are to be located so as to avoid undue earthworks, particularly at the planting stage where only a limited length of the final roading is to be carried out. Wherever possible the route chosen should adequately serve the planting operation, require the least earthworks, and result in the lowest roading density and be to the lowest standard commensurate with the efficient performance of establishment operations.

In areas with existing roads or logging tracks every endeavour must be made to utilise these roads or tracks and incorporate them in the final roading system. Upgrading of such roads or tracks is to be kept to a minimum consistent with the Forest Operations Guidelines and operational requirements.

Planting roads are to form part of the final roading pattern and are to be constructed on the alignment of the final roads. In no cases should land clearing tracks be upgraded to roading standards to form additional planting access.

In compliance with the Forest Operations Guidelines tracking must be kept to a minimum and temporary tracks should be adequately protected from scouring and when finished with, blocked off and planted.

Planning is to be based on the best available topographical information so as to conform to present and predictable future logging methods having regard to the following points:

(1) Avoid unstable soil areas, springs, previous slips, and slump areas

(2) Locate roads, where possible, on natural benches, ridge tops, flatter slopes and on stable areas clear of streams

(3) Borrow and waste areas to be placed so as to avoid harmful effects on drainage and water flow

(4) Stream crossings to be located where channel and bank disturbance will be minimal

(5) Toe of batters to be kept clear of gully bottoms and permanent streams

(6) Long continuous grades to be avoided

(7) Wherever possible a strip of undisturbed soil should be kept between the road and any gully bottom or stream to which it is parallel.

GRADIENTS

The following maximum gradients should not be exceeded:

Arterial Road	10%
Secondary Road	11%
Short Spur Road	13%

To reduce road maintenance and to improve vehicle performance, grades should wherever possible be well below the maximum limits. However, in steep and difficult country the maximum grades may be exceeded for very short lengths.

Minimum gradients

To facilitate surface drainage 1%

Widths - including water tables

Arterial Road	9.5 m
Secondary Road	8.0 m
Short Spur Road	6.5 m
Planting Road	4.5 m

(for future upgrading)

Earthworks

Earthworks must be planned with a view to later maintenance. Extensive earthworks usually require extensive maintenance and in sensitive areas alignment can be sacrificed to avoid later conservation problems and expensive protection works.

In all cases the disturbance to existing ground must be kept to a minimum. The clearing of topsoil and debris from the roadline is to be confined to the area of the formation and should involve no more disturbance of soil than is necessary to remove all organic material from the formation.

Filling is to be placed by such methods as will ensure that material is compacted from toe to toe and from natural ground level through to formation level.

To avoid erosion all batters on fills of a greater height than 3 m are to be covered with topsoil (where available) to promote grass growth, or planted in Pines or other similar vegetation.

Fill batter slopes to be no steeper than 67%. Batters for cuts may be varied to suit the material and should be benched or rounded where necessary to avoid slipping.

Earthworks are not to be left in an uncompleted state for any longer than can be avoided. Partially completed roading is vulnerable to water damage and costly repairs can result.

In planting areas where extensive cuts and fills are unavoidable the road should be formed to the final grade and width particularly where stream crossings are involved. This will enable the earthworks to be incorporated in the planting and provide greater stability.

However, where no serious problems are associated with later widening to logging standards the planting road can be reduced to minimum width, for both earthworks and metal surfacing.

Drainage

Where possible the grading of roads shall be such that water can be intercepted before fills. Water is to be directed through cuts in the solid to points well clear of fills. Should a low point occur on a fill, it must be drained by means of flumes discharging down the sides of the fill clear of the toe.

In all cases fillings shall be protected by substantial shoulders or berms.

Culverts shall be not less than 300 mm in diameter, placed on solid ground, and in the case of concrete pipes, jointed with rubber rings.

Culverts will generally be made long enough to avoid the need of headwalls. Outfalls must be protected adequately, either by properly placed spawls or a concrete apron.

Outfalls from graded water tables to adjoining country off the road alignment should be provided at intervals not exceeding 60 m.

On long slopes water tables must have particular attention to control scouring and the resultant deposit of material in streams. Scouring can be minimised by the use of introduced rock, grassing, the placing of concrete half pipes and the close placing of culverts, with outfalls where possible on solid ground or discharging into flumes.

Stream Crossings

Stream crossings should be avoided where possible. However, where they are essential the structures shall be designed to cope with predictable flood flows and earthworks should be completed so as to provide adequate protection. Large culverts and bridges are expensive structures and every precaution must be taken to protect them.

Calculation of run-off must be based on a realistic assessment of ground cover. Culvert location and depth should be selected to give non-scouring discharge. Velocities should be minimised by adoption of flat gradients.

Where it is necessary to cross fish spawning streams care must be taken to ensure that fish can negotiate the culvert in both directions.

Surfacing

Roads are to be surfaced with material of a quality and in a quantity appropriate to the volume and type of traffic catered for. Surfacing should be carried out as soon as possible after the completion of the earthworks.

Road Maintenance

Regular maintenance will be carried out to ensure that the road surface remains in a usable condition, and that culverts and water channels remain open and function efficiently.

Maintenance should follow quickly behind construction. Scouring and the movement of flumes is most likely to occur shortly after construction.

Maintenance in erosion prone areas is best handled on a "little and often" basis.

Following the grading of roads steps must be taken to ensure that all "run-offs" and flume entrances are clear. Slips should be cleared quickly and the material should not normally be dumped over side cuts but should be removed to stable areas.

SESSION VI
PAPER c

DEVELOPMENT AND OPERATION OF A TRUCK SCHEDULING SYSTEM

GRAHAM SPERRY
Transport Supervisor
Fletcher Forests Ltd.

SUMMARY

This truck scheduling system has been the major instrument in increasing our truck productivity by up to 30%. Productivity before the system was introduced was below standard by almost 20% and is now consistantly above the old standard by 7%.

The system utilises known truck cycle times, speed, delays and truck configurations to plan truck movements in advance of the truck becoming available and incorporates a "Truck Monitoring Device" plus a simple numerical scoring system which enables weighbridge operators to quickly assess the fleet or individual truck productivity at any given time. Results have provided a cash saving of at least 5% of our total trucking costs.

INTRODUCTION

This scheduling system was introduced mainly as a result of requests from our principal trucking contractors to improve utilisation in order to hold costs. At this time there was no documentation by Fletchers to measure particularly whether each truck employed was in fact uplifting its fair quota of wood. The existing system at this time was to allocate a certain number of trucks to a specific logging crew and its loader, the number and types of trucks to match the number and types of loads being produced daily. Generally speaking, five or six trucks were employed full time carting on a 50 km round trip to our Taupo factories, both pulp and sawlogs, and the remaining trucks carting export to Mt Manganui, a round trip of 351 km. The trucking prices at that time were based on a truck achieving 6 loads to Taupo plants per day, or alternatively 2 trips to Mt Manganui per day. According to our truck owners, these tallies were not being achieved.

DEVELOPMENT

Accordingly, we set about investigating why these targets were not being achieved, and with the co-operation of the drivers themselves made detailed time studies of the majority of trucks and their working day.

A record form similar to the headings below was used; by a passenger sitting in the truck with the driver.

Time - Place - Odometer - Lost Time.

Recorded information was similar to this:

Truck No.18.

12.15 pm	Weighbridge	324 (miles)
12.28 pm	Mill Gantry	331 (miles)
12.34 pm	Unload	
12.37 pm	Trailer-up	
12.45 pm	Weighbridge	338 (miles)
12.58 pm	Cpt 34/124	344 (miles)
2.00 pm	Loaded	

Two trucks waiting ahead of us because loader driver having lunch. The loader then went to another skid to load the same trucks. Started loading us at 1.50 pm.

2.20	Weighbridge	351 (miles)

By collating large amounts of information similar to the above we were able to establish the following:

"Travel times" for various road conditions and distances, i.e. speeds.
"Loading times".
"Trailer-up" time, i.e. lifting trailer back onto truck.
"Smoko" times.
"Puncture" time.
"Transport Department weigh-up" time.
"Unloading" time.
"Factory/Destination/Delivery Point Opening and Closing" times.
"Mechanical and Other Down time".
"Truck and Fleet availability".
"Payloads/configuration".
"Weighbridge, weigh-up" time.
"Mt checkpoint scaling" time.

We have standardised on some of these times and can now calculate a theoretical cycle time for any of our log deliveries.

Example:

A truck is to travel from our weighbridge, to a logging crew, load up with an export load, return to weighbridge, weigh-up, travel to Mt. Manganui, unload, and return to weighbridge. (Standard times are marked with "S").

Weighbridge to Gang. 12km at .95km per minute ("S")	=	12.63	minutes
Trailer off and load. ("S")	=	21.21	"
Gang to weighbridge at .7km per minute ("S") loaded	=	17.14	"
Weigh-up at weighbridge ("S")	=	1.00	"

Travel to Mount. 161km at 1.12km per minute ("S")	=	143.75	minutes
Scale at checkpoint ("S")	=	6.00	"
Unload (log stacker) ("S")	=	3.20	"
Re-mount railer (gantry) ("S")	=	4.40	"
Return from Mount to weighbridge, 145km at 1.29km per minute ("S")	=	112.40	
	SUB TOTAL	321.73	
Transport Department weigh-up allowance		3.22	
	SUB TOTAL	324.95	
Smoko allowance = 324.95 x .094 ("S")		30.54	
	TOTAL TIME	355.49	

= 5.92 hours (5 hours 55 minutes).

On the same basis, the cycle time for a truck delivering wood to our mill averages 100.38 minutes = 1.67 hours (1 hour 40 minutes).

The Mill/Tauhara forest cycle was our most common wood delivery run, so we decided to use this as a base measure of truck and driver productivity by giving it a value of "1" (one), which we called a "Mill Load Equivalent". That is, a log truck and driver working productively for 1.67 hours. By dividing the calculated cycle time of any other run by 1.67 hours we could arrive at a numerical value which was related to both truck/driver hours, and a delivered load.

Example:

The cycle time for 1 load from our bush to Mt Manganui averages 355.49 minutes.

355.49 ÷ 100.38 = 3.54 Mill Load Equivalents

(we use in fact 3.5 M.L.E's as the value).

The maximum hours per day we expect our trucks to work is 14 or 840 minutes. However, within this time the truck has to be driven from Taupo to our weighbridge, refuelled during the day and so on. Allowing for this we believe a 13½ hour productive day is reasonable and in fact our daily fleet target of 7.5 Mill Load Equivalents is a theoretical 12½ hour productive day, but with no allowance for punctures.

ADMINISTRATION OF THE SYSTEM

All the most common truck cycles we analysed in the above fashion and subsequently allocated a M.L.E. value, including backloads. By multiplying the rated M.L.E. for a trip by 100 and dividing by 60, the weighbridge operators were able to predict with reasonable accuracy when a truck was due back at the weighbridge, and more importantly which other loads he could best accomplish in the remaining day in order to achieve or better the target of 7.5 Mill Load Equivalents.

In theory this was fine, but we found that we had difficulty keeping track of trucks throughout the day by memory and pencil and paper alone. Also, when a truck broke down for some length of time, his M.L.E. achievement went for a skate through no fault of either the driver or the weighbridge operator. Obviously, the availability of the truck had a lot to do with his ability to achieve target. We therefore divided the 14 hour day into tenths and kept a record of duration of down-time per truck per day for anything exceeding 3/4 of an hour. Then, we were able to relate M.L.E's achieved to portion of day worked (i.e. portion of day the truck was in fact available), and still arrive at a true fleet M.L.E. achievement. The next step we had to take was to find a way of constantly monitoring the whereabouts of the trucks for the benefit of the weighbridge operators, and also other forest road users. We found the answer in a board that was developed by the work study section of N.Z. Forest Products Ltd., which they had made obsolete by manufacture of a more sophisticated one. (The original board was made in 1964.) The board is basically a series of moving steel wires, each wire moving at a constant very slow rate and all parallel to each other. Each wire represents a cycle, for example from the weighbridge to a bush gang and back, or weighbridge to Taupo Mills and back, or weighbridge to Mt Manganui and back. The wires are mounted on pulleys which are driven from an electric stepping motor by way of a gear driven shaft. The speed of the moving wires can be adjusted to match the cycle time of the truck. Each truck is represented by a small square of Balsa wood with its number displayed, and has a small magnet glued on the back. When the truck is despatched from the weighbridge to say "A" gang, the appropriate balsa wood model is attached to the start of the "A" gang wire. By the time the wire with model attached has moved to the other end of the "A" gang slot, the truck is due back at the weighbridge loaded, and ready to be sent to Mill or elsewhere. As this is done, the model is switched to the appropriate new slot, e.g. weighbridge to sawmill and back. Currently we run 30 trucks on this system, and have run 50 at times, loading from 14 gangs and delivering to 7 market points.

The other major facet of the administration of the system is knowledge by the weighbridge of all available load types and localities, and locality of loaders. Good radio communication with loaders is critical and in our case we verify our known "in bush" log stocks several times daily. Loaders which are loading export normally start work at 3.45 am each day and work eleven hours, finishing between 3 and 4 pm. Generally, loaders are informed when there is a lull in incoming trucks, during which time they either take their smoko or sort and stack logs. They are also informed of incoming trucks, and in turn keep the weighbridge informed of any new hazards, e.g. roadside falling or similar.

Two weighbridge operators are employed, one to weigh trucks and process weighbridge dockets, the other to plan truck movement and record daily events on a per truck basis. We are currently converting documentation of both jobs onto computer but up till now this is the system we have used.

"TRUCK MOVEMENT"

Truck	Start Time	Load	Gang	Load	Gang	Load	Gang	M.L.E.	Portion of Day Avail	Reason for Downtime
18	3.34	Xpt	B	Mill	D	Xpt	A	8	1	Nil
26	3.45	Xpt	E	Xpt	B			7	.9	1 hour 3 punctures

"WOOD AVAILABILITY"

Gang	Loader	Loads	No.	Gone	Loads	No.	Gone
V	Nick	Mill	3	**	Xpt 39	3	***
		Plyco	2	X	Xpt 26	3	*X
		O/S Pulp	2	X	Xpt Shts	1	X

To explain, as the weighbridge operator despatches a truck to pick up a load of say mill from "V" gang, he marks a cross in the "Gone" column. When the loaded truck arrives back at the weighbridge he makes the cross into an asterisk. In this way he can at all times see how much wood has gone out of the forest, or how much is in the process of being uplifted, and how much remains in stock. He has also recorded on the "truck movement sheet" what load the truck is uplifting and from where, and also knows the exact position of the truck by referring to the truck monitoring board.

ADVANTAGES OF THE SYSTEM

In terms of "gross dollars earn't", our major truck operators earn't 30 percent more in the five months after the scheme was introduced, than the five months previously. Productivity in terms of Mill Load Equivalents increased 13 percent in the first month of operation and is now consistantly 40% better than it was before the scheme started. Less trucks are now employed to cart the same amount of wood over the same routes. Truck productivity on which cartage rates are based has increased 7 percent over the recognised productivity prior to the introduction of the scheme. This has mean't considerable financial savings to us.

The scheme, because the number of trucks employed is carefully balanced to log production targets tends to highlight deficiencies in logging or loader productivity very quickly therefore enabling corrective decisions to be made sooner than they otherwise might have been. It also highlights the good and bad trucks, configurations and operators. Our operators currently average around 96% availability. The way the system is run also tends to eliminate queues of trucks at skids and keep the bush roads to the minimum possible traffic density. Essential requirements of the scheme are:

A. Top class weighbridge operators.

B. Good steerers

C. Good trucks

D. Good R/T communications between trucks, loaders and weighbridge.

E. Good loaders

F. Steady wood productivity

G. Good co-operation between all parties.

H. Forethought and planning.

SUMMARY OF SESSION VI BY CHAIRMAN

(V.F. DONOVAN)

First of all, Mark Howard emphasised the significance of truck standing time, and I don't think that there is anyone here that can argue with that importance. We have a daily standing time of some 9%, which is one hour a day, on garaging, refueling, and lunch etc. He highlighted the waiting times that occur both at the bush and at the mill, and showed that we can improve our overall efficiency by decreasing waiting time. He gave examples showing the effect of a savings of 15 minutes per trip on total overall tonne-kilometres carried. Similarly, he showed the affect of increases in wait time by 30 minutes per trip.

Colin Cornelius, in his paper, showed us the importance in planning the roading detail. Road width can affect travel speed by up to 16 k.p.h. depending on the type of truck. Super-elevation affect figures were given in his paper, as was the affect of sight distance on travel speed. I think that sight distance is one of the important things; it is the safety factor when operating in winding roads. The affect of grade and the need to have weight on the drivers to overcome some grades is also important. Surfacing can increase travel speed by up to 8%. It is good to know that when roads are being put in, that this type of planning is being done and that roads are'nt being established in a haphazard manner without such things as width, super-elevation, grading, etc. being considered, because it does affect the trucking operator.

Graham Sperry in his paper gave us an indication of their truck scheduling with a fleet of 30 trucks. He said that they've actually handled up to 90 trucks operating out of 14 gangs for 7 different destinations. I think you could see that without a truck monitoring board, where they are able to control and see where each truck is, they would have some difficulty in keeping good truck scheduling. He indicated to us that truck productivity increased by 30% and that the forest owner, Fletchers, made cost savings of up to 5%, and that's a big cost saving, through introducing this truck scheduling system. An important thing that was bought out was good radio communication. It probably goes a bit further than just weigh-bridge to mill or loader communication. It comes back to good communication between management and operators right down the line, so that if there are hitches anywhere, they can be quickly solved.

- SESSION VII -

TRANSPORT AND LOADING SYSTEMS - PART II

Chairman - V.F. Donovan, Research Officer, Logging Industry Research Association.

LOADING AND UNLOADING SYSTEMS - Following the presentation of some relevant background slides by the chairman, the Seminar split into groups, each consisting of approximately 15 people (pre-selected to give a balanced coverage of knowledge).

Each group discussed two only of the following topics:

- Common log truck and separate loader and unloader systems.
- Rail wagon system needs for loading and unloading.
- Preloading, packaging, palletising, bundling systems.
- Self-loading log truck systems.
- Chip transport options for loading and unloading.
- Waterborne log barge or rafting needs.

The separate groups had leaders to control and lead discussion, these being:

V. Ibbotson	-	*Kaingaroa Logging Company*
C. Marshal	-	*Logging Contractor*
F. Bradshaw	-	*Direct Transport Ltd.*
G. Wells	-	*Logging Industry Research Assoc.*
R. Peterson	-	*New Zealand Forest Service*
J. Gaskin	-	*Logging Industry Research Assoc.*
R. Gray	-	*Logging Industry Research Assoc.*
J. Spiers	-	*Logging Industry Research Assoc.*
G. Byron	-	*N.Z. Forest Products Limited*

The following sheets record the general findings of each group discussion. Group leaders briefly summarised these to the Seminar at the end of this session.

IBBOTSON'S GROUP

COMMON LOG TRUCK AND SEPARATE LOADER/UNLOADER SYSTEMS:

Our discussion centered mainly around the generally two known types - the rubber-tyred front-end loader and the conventional cable crane loader. The rubber-tyred loader, we felt,was a valuable tool as it had a high degree of flexibility and it is able to move readily from one skid to another. It also has the ability to do other jobs such as, cleaning up on the skids, and assisting in getting trucks moving if ground conditions are poor. To its disadvantage, we felt that the rubber-tyred loader possibly has much higher repair and maintenance costs; it has a considerable shorter life; and unless ground conditions are reasonable, it isn't able to function as a tool at all.

On cable-operated cranes, the advantages that our group saw were, that they are able to work with much more efficiency on poor ground, and life is considerably longer than for a rubber-tyred loader. The crane's disadvantages were, that it required a fairly highly skilled operator (whereas the majority of truck drivers or skiddees, or anyone else, are able to use a rubber-tyred loader), and its ability to handle a large number of log sorts is limited.

We concluded that rubber-tyred front-end loaders cost around $140,000 and have a 3 to 5 year life, compared to rope-crane loaders, at around $160,000 for a 10 year life. The cost of loading logs we put at 40 to 60 cents per tonne.

RAIL WAGON SYSTEM NEEDS FOR LOADING AND UNLOADING :

Most of our discussion here compared the two conventional methods, of the standard fixed gantry and the conventional rubber-tyred log stacker. Our group's opinion of the gantry was that it had a higher capital cost, but its maintenance costs were considerably less and its life longer. It also had the advantage that it didn't need an extensive yard system and yard maintenance would be considerably lower than any other method of unloading logs. Its disadvantages, are that it's not able to cope with high stock piles unless the gantry is a mammoth structure, and it's not able to cope with handling various types of logs and keeping them separate. A rubber-tyred log stacker has the flexibility that is quite often needed in modern mills that require a variety of logs to be fed into them at the appropriate rate. It is faster in unloading trucks and, we feel, that it is able to feed onto rail at a faster rate than a gantry. They do however have higher machine and yard maintenance costs.

Unloading equipment for an average size mill, we felt, would cost from $300,000 to $750,000, and it would have a life of from 10 - 40 years. Finally, our group indicated that it didn't really matter, what type of unloading method you had, provided that it was matched closely to the mill's capacity with a little bit more (to the order of 25%) to cope with changes.

MARSHALL'S GROUP

COMMON LOG TRUCK AND SEPARATE LOADER/UNLOADER SYSTEMS:

Our findings were on a parallel with the previous speaker. We found that the rope-crane today is fast becoming obsolete in that the world trend is towards hydraulics. Rubber-tyred front-end loaders are more readily available. Hydraulic cranes at this stage we ruled out because of their high capital cost and high maintenance cost, but probably there is going to be a time in the future when we are going to need a closer look at them.

Rubber-tyred front-end loaders in use cost from $120,000 to $130,000, and we see them as giving a life of 1 - 2 years. Their loading time is 10 - 12 minutes per load. It costs in the vicinity of $10,000 today to train an operator for a crane-type loader and this probably is not the same for a rubber-tyred machine. Ground conditions govern what type of loader is suitable, with rubber-tyred front-end machines being restricted by poor ground conditions and limited area. They are more mobile and we consider that they suit operations where loading is integrated with trucking operations rather than the logging operation. However we preferred crane-type loaders for high production rate logging operations.

On unloading we were virtually unanimous that the stacker type of unloading system was best in high output operations where good sites are available. The gantry method definitely is a suitable way particularly where it is part and parcel of a large mill operation and included in the fore-planning, however we see them as creating more truck delays. Drop skids cause more truck damage and are more dangerous, They are becoming a thing of the past, as small mills would seem to be fading by the wayside.

PRELOADING, PACKAGING, PALLETISING, BUNDLING SYSTEMS:

On preloading, packaging, Multililift systems etc., we considered the concept of packages as a good idea. You reduce the number of lifts to load. We are going to haveto look closely at this because there is so much more smallwood coming on in New Zealand. An aspect that came out in discussion was that the packaging - palletising system has got to be controlled by individuals who have complete control of the logging operations, the stacking operations, the loading operations, and the carting operations.

BRADSHAW'S GROUP

COMMON LOG TRUCK AND SEPARATE LOADER/UNLOADER SYSTEMS:

I could more or less say the same as the last two speakers. It came out of our group discussion that the rubber-tyred machine, especially on high density loading-out operations, was far ahead of the others, but again with rough skids, you run into problems. However they are better at cleaning up odd pieces of wood on the landing to make it easier for trucks, and due to their normally low replacement age, they have a comparatively good resale value. Where small contractor operations are only producing two log types, we thought that the rope-crane type machine was better, however they are limited where a larger number of sorts is needed. There also tends to be fewer trained crane operators available and this is a disadvantage. Other than that, our findings were more or less the same as the last two speakers.

SELF-LOADING LOG TRUCK SYSTEMS

On the self-loading truck systems with knuckle-boom cranes, we considered them suited to small scattered isolated pockets of timber, particularly where it's required to sort lengths from 2 m to 6 m.In this type of work it was considered that the knuckle-boom loader fitted to a truck was more efficient than a rubber-tyred front-end loader. On where a self-loader crane should be located on a truck, we considered it is best at the back, so that you can load the trailer as well.

WELLS'S GROUP

Our group was asked to discuss both chip handling and log handling by conventional means. Rather than discuss the specific items, we looked at the two taken together, where you would use one and where you would use the other. It seemed that we would really only use chip handling where you needed to. In other words, it's not an alternative to log handling. The reason we came up with this conclusion was because in-woods chipping has not yet proved sucessful in New Zealand, so that chipping is only done at an installation such as a mill, and then you do it to utilise waste, rather than handling it in the woods as an alternative to log transport.

CHIP TRANSPORT OPTIONS FOR LOADING AND UNLOADING

A feature of handling chips is that you are handling a small but uniform piece size which allows tipping, conveying, etc. to be done. There is one main way of loading chips and that's using the hopper. It's fairly simple (truck loading time approx. 1 min.) but expensive, however its life is long. When it comes to unloading chips there is a much bigger range. You can simply have trucks and trailers with hydraulic tipping on them to dump chips on the ground, where they are handled by a scoop of some sort (unloading time approx. 5 mins. per truck). You can go from that, which is relatively inexpensive, to machines which tip whole trucks and trailers, and pneumatic devices which are much more expensive. In either case the loading and unloading is very very quick.

One interesting thing pointed out was that in the three months around Christmas, 11 chip trailers came loose from the trucks on the roads around New Zealand. That gives us cause to wonder as to whether something has gone wrong with this system on the transport side.

COMMON LOG TRUCK AND SEPARATE LOADER/UNLOADER SYSTEMS

When we looked at log handling, it would seem that this is most common (as against chip handling) unless something special is called for.There is an enormous range of options which you can use for log loading or unloading, depending on how much volume you are required to handle in the room available and how much you can afford to invest. You can choose a system to suit the circumstances, ranging from the low cost drop-skid operation, to the $250,000 machine operation which requires high utilisation. However, our group felt that the common truck with separate loader system, is likely to give the least cost compared to alternatives.

Loading equipment costs from $60,000 to $120,000 for rubber-tyred front-end loaders, and more for cranes. Unloading equipment costs for gantries and log stackers range up to $600,000, and they unload in approximately 10 minutes per load. Log loading rates, we consider, depend a lot on the operator, so it is hard to give good standard figures.

PETERSON'S GROUP

COMMON LOG TRUCK AND SEPARATE LOADER/UNLOADER SYSTEMS:

The group decided that the scale of operations determined machine choice first of all. They suggested that rubber-tyred front-end loaders had lower capital cost, were easier to operate, had good mobility for moving from one area to another, were more flexible in an operation, and you could use it as a grader to clean roads and do all sorts of things. As a New Zealand constructed item, the repairs would be less, the parts would be readily available, and the taxes would be less. It has the ability to readily service more than one extraction unit within a given area, and it has greater versatility plus is quicker in unloading. They are however hampered by poor ground conditions and small landings. Someone suggested that they provided good transportation for union delegates within an area!

Rope cranes had a longer life, possibly due to lower utilisation, and they are more suitable on muddy conditions or small landings. We felt that cranes possibly load more tonnes per litre of diesel. We note that marine certification is needed on rope-crane loaders and problems occur there. We supported the comments made by Cliff Marshall in relation to the operator training problem. On hydraulic-crane loaders, we thought that they had limited capacity, and that operator training was also a problem. However, when mounted on a rubber-tyred carrier, they would be fairly manouevreable.

We considered that the standard Allis 645 sized front-end loader would cost in the range of $85,000 - $100,000. An equivalent type of crane could be of the order of $230,000. The likely life of loading equipment, we thought, was best set by market opportunity. Rubber-tyred front-end loaders take approximately 12 minutes to load a 25 tonne load, and result in a loading cost ranging from $0.50 to $2.50 per tonne.

WATER-BORNE LOG BARGE OR RAFTING NEEDS

Our second topic was to look at water-borne, log barge, or rafting system needs in transferring logs to and from this transport mode. Within the group there was no-one who had any great experience on this. We considered that water could be the cheapest form of transport, due to the bulk of material that can be involved and the distances that can be covered. For environmental reasons, barging is probably the best means of water transport, and for barges, loading off a beach with rubber-tyred loaders may be best if the sand is fairly stable. Cranes have certain abilities where loading from a fixed wharf is required.

GASKIN'S GROUP

COMMON LOG TRUCK AND SEPARATE LOADER/UNLOADER SYSTEMS

It has all been said. Rubber-tyred front-end loaders are more flexible or versatile, and easier to operate. One thing though, with cranes, you don't need as large a landing as you do with rubber-tyred front-end loaders. Cranes are also more suited to rough landings. For unloading, there is nothing cheaper than a drop skid but it's pretty hard on trucks, and they have limited stockpile ability. Gantries have a low operating cost and long life, but you can only get so much under them and they are not very flexible. It appeared that stackers are the most efficient, most flexible, and easiest on trucks. Maintenance cost though is high. One point that came out was that if we had a bit more pre-planning before mills were built, unloading might run more smoothly.

With equipment costs, we have a 645 Fiat Allis at $78,000 (5 year life) and a crane at about $180,000 (8 year life). Capital costs for unloading equipment range from about $600,000 for a Waipa-sized gantry (30 year life) to $256,000 for a stacker (10 year life), which you would need two of, so they work out about the same. On log handling rates, loading can take anything from 1/4 hour to 3/4 hour per truck, depending on the operator.

PRELOADING,PACKAGING, PALLETISING, BUNDLING SYSTEMS

We saw the features here as being able to operate from small landing areas, no separate loader is required, and that turn-around times for trucks are minimised. Against this though, there is a higher truck tare weight, and as in the multilift system, good supervision of the large number of cradles is needed to keep them up to the logging operation, and also prevent loss. Loading a palletised load is a one-man operation and this may not be acceptable in terms of safety. A multilift system, we estimate, would cost $13,000 to install on a truck. The palletised system, we think, readily suits smallwood operations. With a preloading and transfer system, this could be used to relay logs to a public road by off-highway transport.

GRAY'S GROUP

RAIL-WAGON SYSTEM NEEDS FOR LOADING AND UNLOADING

Our discussion here revolved around stackers and gantries only. We considered gantries had a limited stockpiling area, and with a gantry, the turnover of wood is slower, so that logs put in the gantry first may sometimes get sap-stained. A gantry also required rail wagons to be continually shunted through.

Stackers, we considered, were more flexible for sorting and stock-piling prior to rail loading, however they require a much greater area and a good firm even base on which to operate. Usually more than 1 stacker is used, so a stacker breakdown is not too much of a problem compared to a gantry breakdown.

Wagon loading rates with a stacker take up to 15 minutes from the stockpile, compared to 3 minutes if loading straight from truck onto wagon. Stackers can cost from $110,000 to $350,000. They give a life of around 5 years, compared to 40 years with a gantry.

SELF-LOADING LOG-TRUCK SYSTEMS

We think that these systems are mostly suited to use in thinnings and smallwood lots. The advantages are that a separate loader is not required, so it is suited to small landings or roadside loading. The trucker is also not dependent on someone else to load, so can operate anytime, anyplace.

The main problems include, a higher truck tare weight, and the fact that no cab for the operator exists for safety and protection from the weather. The grapples on these loaders have a habit of swinging around too freely, and if dampers could be put on, this could give some advantage. The life of knuckle-boom cranes tends to be mostly governed by operators causing damage rather than wear and tear. Better training for operators is thus needed.

Knuckle-boom cranes cost around $20,000 and take around 45 minutes to load 22 tonnes of thinnings. They thus tend to suit operations putting out a low number of loads per day (4 loads per day).

SPIER'S GROUP

PRELOADING, PACKAGING, PALLETISING, BUNDLING SYSTEMS

We weren't able to look at all of these. Initially, we looked at the multilift bunks and felt one of the advantages was that they could be associated with short pulp operations with forwarders and would work quite well. They were flexible in that you could separate your bush operation and your trucking operation. You could improve truck utilisation with them because the truck is in control of its own loading and unloading, so he shouldn't have any delays in that area. You also can get away from the standard landing situation and this could be important in thinnings. The problems that our group saw, were that you might have high tare weights in comparison with the normal type of rig, and would therefore be limited to short runs. You may also be limited to carting short pulp only and therefore would depend on the mill being able to accept this type of material.

No one in our group was too sure of costs, but we think that a installed Multilift bunk for a truck would cost around $16,000 with somewhere over $1,000 for every extra set of bunks. The life of this loading equipment should be fairly long (except if you lose them), at about ten years. Loading time appears to be around 5 minutes to load a 12 tonne multilift bunk. The group felt that they suit thinning operations because of piece size, and because roads in thinning areas restrict the use of bigger trucks.

We briefly discussed preload trailer systems and felt that they would give better utilisation of trucks and avoid truck delays, as the turn-around time to hook on such a trailer would be about 10 minutes.

However, with semi-type preload trailers, they have a high tare weight and would cost about $26,000 each. If you had a few of those stacked around the bush, you might get better utilisation of your truck units, but you've got a problem in getting good utilisation of the capital tied up in the trailers.

SELF-LOADING LOG-TRUCK SYSTEMS

On self-loading truck systems using truck mounted knuckle-boom cranes, the advantages we saw were, flexibility for small operations such as farmer's woodlots, and dealing with scattered isolated areas. The group saw mainly disadvantages though: High maintenance problems, (this is backed up by records of the Hiabs in Canterbury, and one of our group experienced the Prentice and Husky loaders overseas, and apparently maintenance problems are very real), limited reach, they must have logs handy to them, they have limited lift capacity, the truck has to carry the loader each time, slow turn around and slow loading times, and they are limited to short length logs. Apparently there are considerable structural problems with them, because when you try to keep the tare weight down by building to weight, you run into problems.

Costs for that type of knuckle-boom unit are $20,000 to $25,000 and their life is fairly short, at about three years. Their loading times range from 45 - 90 minutes for a 25 tonne load. The system does have an advantage though in roadside loading, where you've got restricted areas for landings, and it's probably best suited for short distance hauls.

We think that this system could be improved by better steel and construction, and very strictly controlled operator training. The operator training is very closely connected with the maintenance problems that might arise.

BYRON'S GROUP

SELF-LOADING LOG-TRUCK SYSTEMS

We believe that these systems are suited to small piece size and small production rate operations, such as thinnings. A high cost loader is not required, however you have a higher truck tare weight (lose up to 20% payload), and a higher truck cost by approximately $10,000. The system suits areas where landings are restricted in size or have poor surfaces, and is ideal for picking up scattered loads. It is generally only suited to the shorter hauls though. There is a problem with operator training and the operator technique is really important in this area. It was mentioned that, overseas, the training of the operator is built into the cost of the machine at purchase. On safety, you've got one man working on his own in an isolated area and there could thus be union problems. A point made was that a self-loading truck could be laid out like a general carrier with the appropriate loader, and this could give better truck utilisation. We generally considered that these systems are compromise systems,not good in all facets, but fairly reasonable overall.

A suggestion was made; why not have a clip-on type knuckle-boom crane, where you could either clip it on to your truck or trailer? Leave it out in the bush, and it's not part of your overall load while carting logs. Someone mentioned that perhaps we shouldn't use them at all, with high unemployment. We stack posts by hand - why not load posts and thinnings by hand?

CHIP TRANSPORT OPTIONS FOR LOADING AND UNLOADING

The general concensus here was that the hopper was probably the best for loading. For unloading,hoists limit your payload, so perhaps a bottom dump could be an option for unloading. One of our group mentioned that chip trucks and trailers tip over when chips become jammed during hoist unloading, or in running over a heap that is not level or firm. Chips lend themselves to pneumatic handling to put the chips where you want them. A disadvantage of this is that it is energy intensive.

We thought that perhaps chip trucks could be improved with tapered bodies, so that the load comes out easier. Possibly an improvement in the aerodynamic design of particular chip transport bodies is also needed to reduce the buffeting of other vehicles when passing on the road. A suggestion made was that where we've got chips available in a coastal area, instead of trucking chips long distances, we should consider loading by pneumatic conveyor to ships off shore to save transport costs.

- SESSION VIII -

EQUIPMENT OPTIONS:

Chairman - J.L. Wilson, Consultant, J.G. Groome and Associates.

"LOADING EQUIPMENT OTIONS - Criteria for Selection and Application of Log Loaders"
(R.D. GORDON - Research Engineer, Logging Industry Research Association)

TRUCKING RIG LAYOUT OPTIONS - A session with questions from the Chairman, and from the floor, being answered by a panel of industry personel. Panel members were:

S. Williamson	-	*Stan Williamson Transport Ltd.*
F. Oosten	-	*Log truck owner operator*
N. Peterken	-	*Road Runner Trailers Ltd.*
C. Marshall	-	*Logging Contractor*
G. Hogan	-	*Carter Oji Kokusaku Pan Pacific Ltd.*

A reference paper is included along with the results of the panel discussion.

SESSION VIII
PAPER a

LOADING EQUIPMENT OPTIONS

(Criteria for Selection and Application of Log Loaders)

R.D. GORDON
Research Engineer,
LIRA.

INTRODUCTION

The range of options available in both equipment and methods for loading logs onto a means of transport is extensive. This paper concentrates on the loading of trucks, as occurs most commonly in New Zealand, and presents information on equipment options relevant to the largest number of current operations.

Loading can be performed under the following broad categories:

- Manual systems
- Cross hauling systems
- Guyline and spar systems
- Mobile front-end loaders
- Mobile crane-type loaders
- Self-loading truck systems

The first three options are mainly historical in New Zealand, although are still used in a small number of cases, particularly where either log sizes are small, (e.g. post loading operations which handle 100-200 pieces per day at approximately 50 kg per piece), or the number of logs loaded per day is small, (e.g. some indigenous logging operations which handle 10-20 pieces per day at 5,000 kg - 15,000 kg per piece). They are well outlined along with the other methods above, in a range of good general reference books as listed at the end of this paper, and I will not detail them further. This paper concentrates on the latter three categories listed above of mobile front-end loaders, mobile crane-type loaders, and truck-crane options for self-loading trucks, all of which are basically used where a high rate of handling numbers of logs is required. (i.e. exotic logging operations handling from 100-1,500 pieces per day at 100 kg - 2,000 kg per piece).

COMMON CATEGORIES OF MACHINES

For mobile front-end and mobile crane-type loaders, the following basic options exist in formulating a machine to perform the log loading operation.

- Action type
- Carrier type
- Reach-arm type
- Log holding device type

Examples of each of these are shown in *Figure 1*.

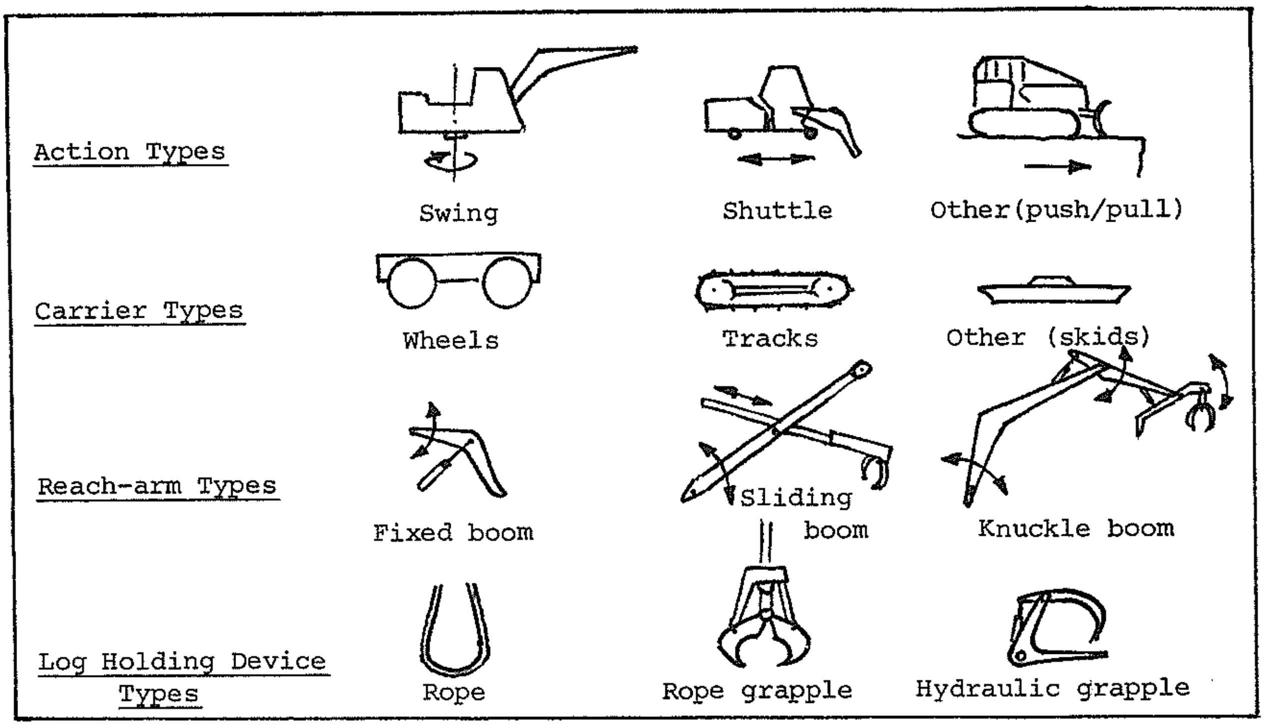


Figure 1. Basic Options for Machine Layout

Although the above options can produce numerous different layouts, there is in practice only a small number of combinations in common use and these 5 basic categories are illustrated in *Figure 2*. The basic reason for this is that log loaders in general are adaptations of roading and construction machines.

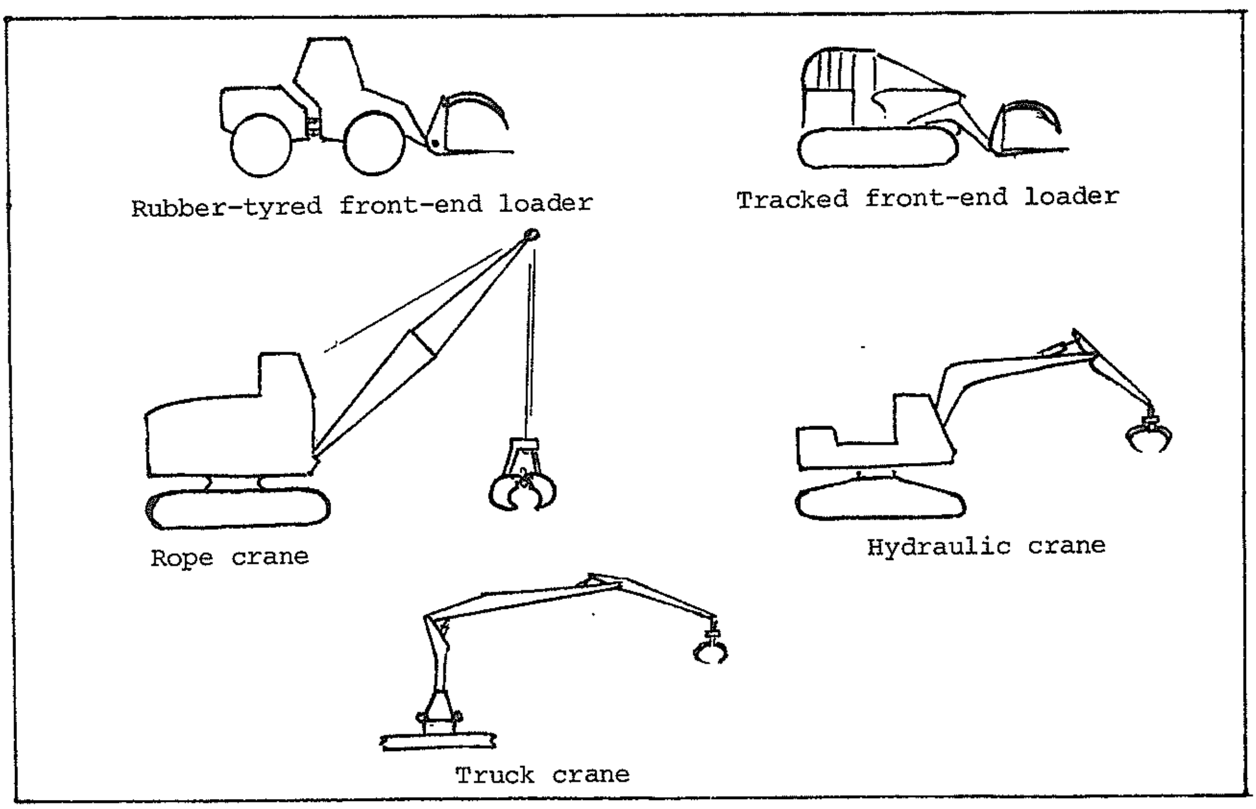


Figure 2. Common N.Z. Log Loader Categories

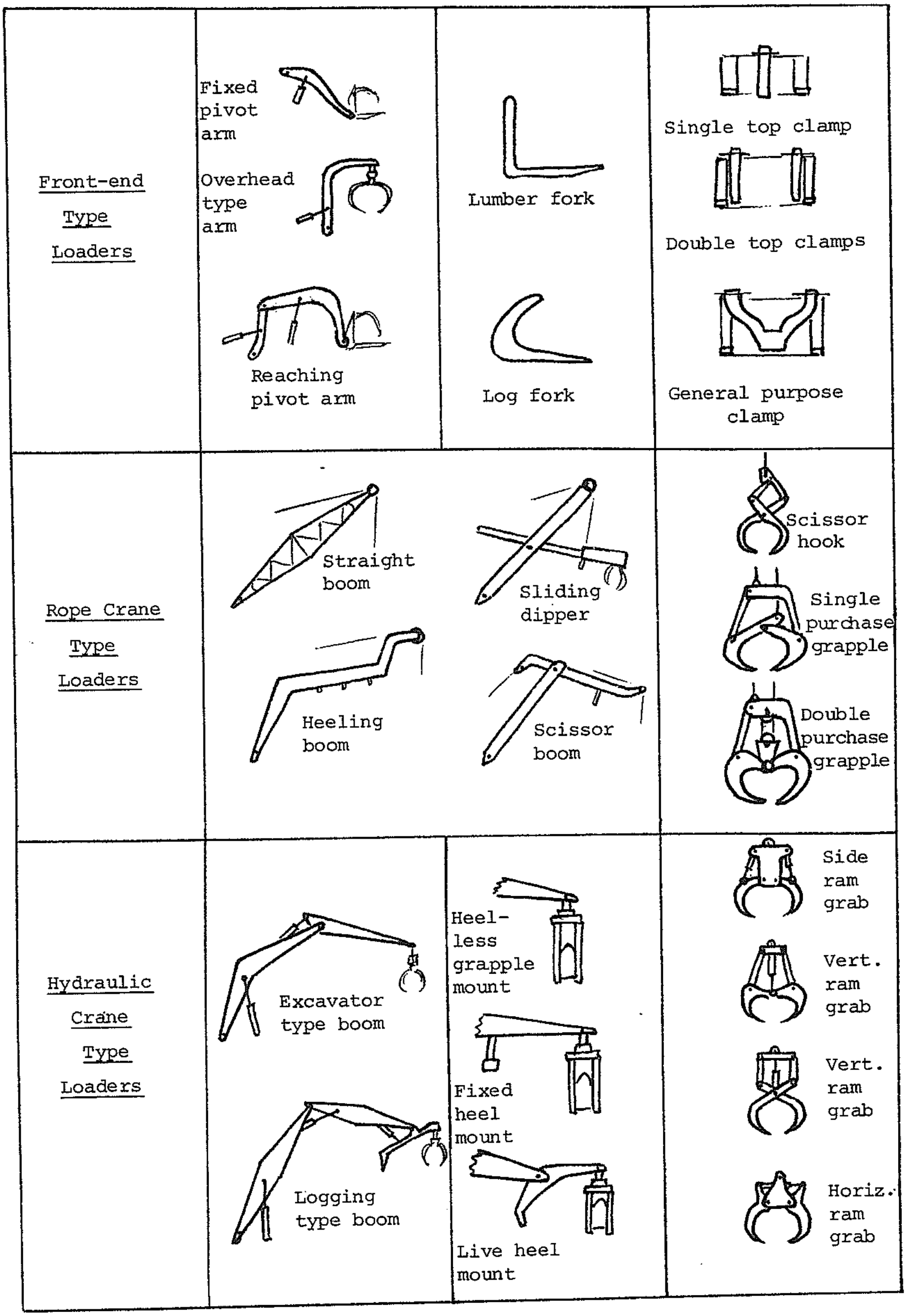


Figure 3. Alternative Log Handling Devices

Many machine brands are available in each of the categories shown, and some are listed in the attached appendix.

The range of machine sizes offered in each category by each manufacturer, can be extensive.

Within the different categories, there is also a wide range of grapples and lift-arm types available. Some of these are illustrated in *Figure 3.*

PHYSICAL CHARACTERISTICS OF MACHINE CATEGORIES

The physical characteristics of the five common machine categories, determine to a certain extent, the types of operation in which the machines are best suited.

To compare performance characteristics of the machine categories, an extensive collection of equipment specifications (continually collected over the last three years by LIRA's library), have been referred to. These specification brochures, were considered to reflect relatively up to date information on the majority of machines available throughout the world, and were used to compare the following specifications between categories of machine:

(a) Maximum load and reach abilities
(b) Load capacities
(c) Travel speeds
(d) Power ratings
(e) Machine costs

(a) Maximum Load and Reach Abilities

For loading work,of primary interest are either the maximum load capacity, or the reach ability, or a combination of both. The range of machines available in terms of load capacities and reach abilities is indicated in *Figure 4.*

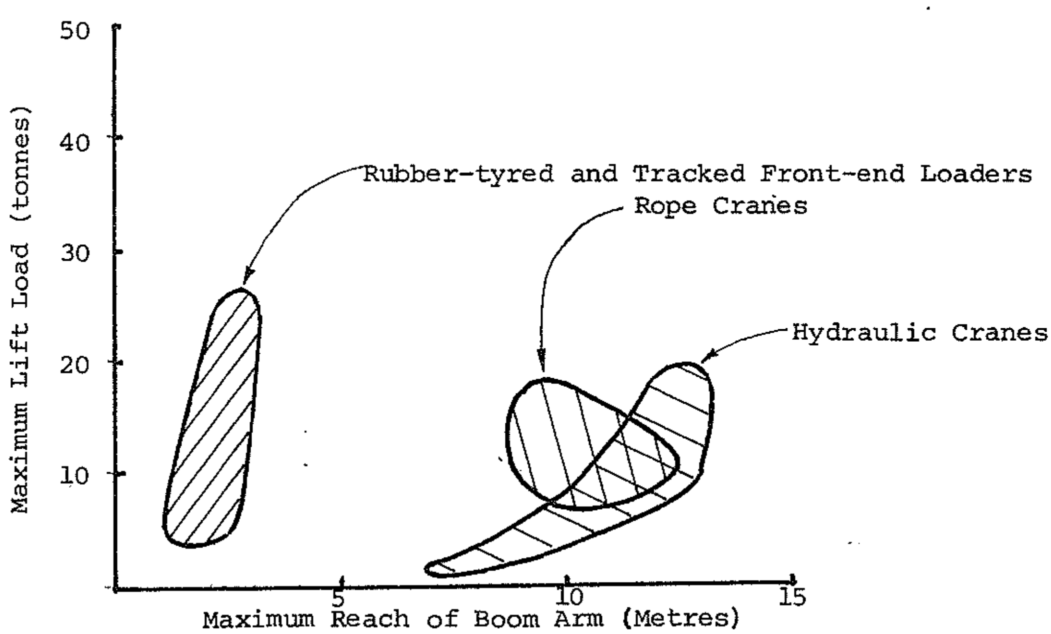


Figure 4. Graph Indicating Range of Machine Sizes Commonly Available in Terms of their Maximum Lift Load and Reach Ability

While many crane-type and front-end type machines are available with lift capacities up to approx. 20 tonnes, the crane-type machines by virtue of their layout, offer the ability to reach up to five or six times the distance of front-end loading machines.

Maximum lift ability or load however varies with the reach, thus a more accurate comparison of lifting abilites must take reach into account.

(b) Load Capacities

Load capacities (generally determined by tipping, but also by structural strength), are best compared in terms of the tipping moment, (i.e. maximum load times reach for this load). The tipping moment rating of a machine is determined to a large extent by the machine weight, as all machines use similar base spreads about which tipping occurs. The load capacity patterns for loaders available in the different categories is shown in *Figure 5*.

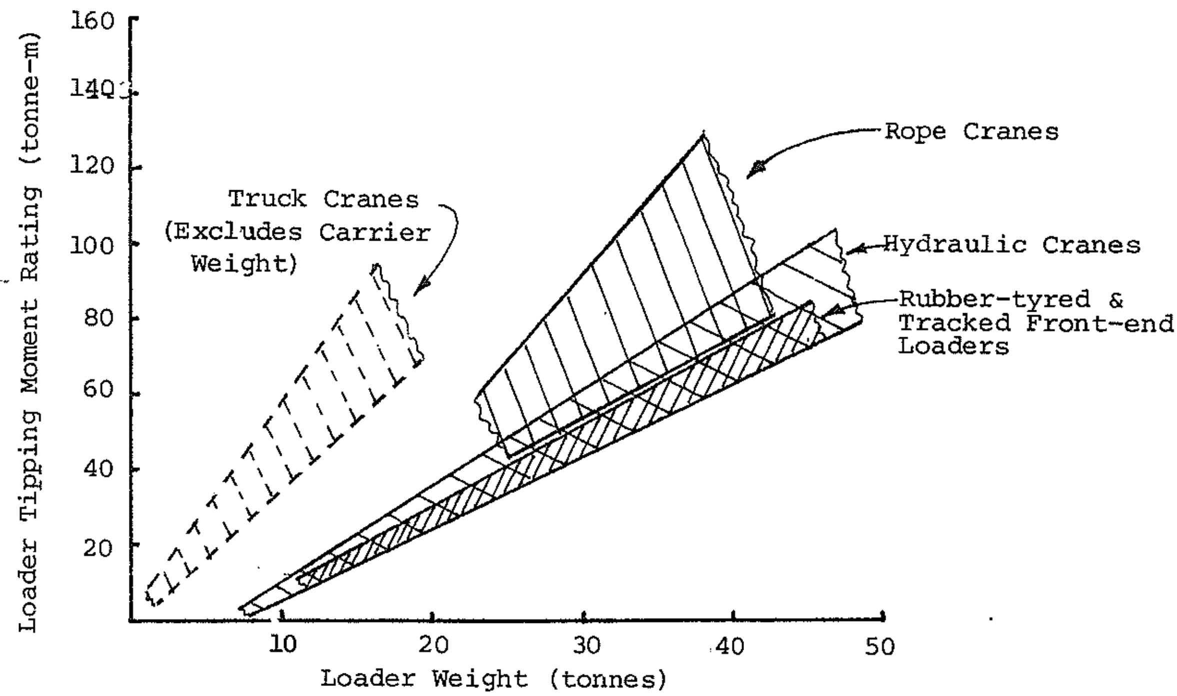


Figure 5. Comparison of Tipping Moment Ratings

The patterns in *Figure 5* indicate the following:

1. Rope crane loaders tend to have the best tipping moment performance characteristic for equivalent machine weight. These loaders however are available in a smaller range of sizes than alternatives.
2. Hydraulic crane loaders and front-end loaders (both rubber-tyred and tracked), have similar tipping moment performance characteristics through the range of machine sizes.
3. Truck mounted cranes have a similar tipping moment performance characteristic to hydraulic crane loaders if you take into account the weight of the truck or carrier unit.

(c) Travel Speeds

In looking at travel speeds, the survey of specifications indicates that generally in a particular machine category, no noticeable difference occurs in the maximum travel speed with increasing loader size. Between categories however, there are differences as follows:

Rope operated cranes on tracks............up to 2 kph
Hydraulic operated cranes on tracks.......up to 4 kph
Rope operated cranes on wheels............up to 40 kph
Hydraulic operated cranes on wheels.......up to 40 kph
Front-end loaders on tracks...............up to 12 kph
Front-end loaders on wheels...............up to 45 kph
Truck cranes on a truck unit..............up to 80 kph

(d) Power Rating

The power rating of a loader reflects to a degree, the initial cost and likely machine operating cost. It is also associated with higher loading performance. *Figure 6* shows, for available equipment,how power rating varies with machine size in the different categories. It indicates that front-end loaders, have a higher power requirement than crane-type loaders. This is undoubtedly due to the fact that they travel with the load compared to cranes which in general don't.

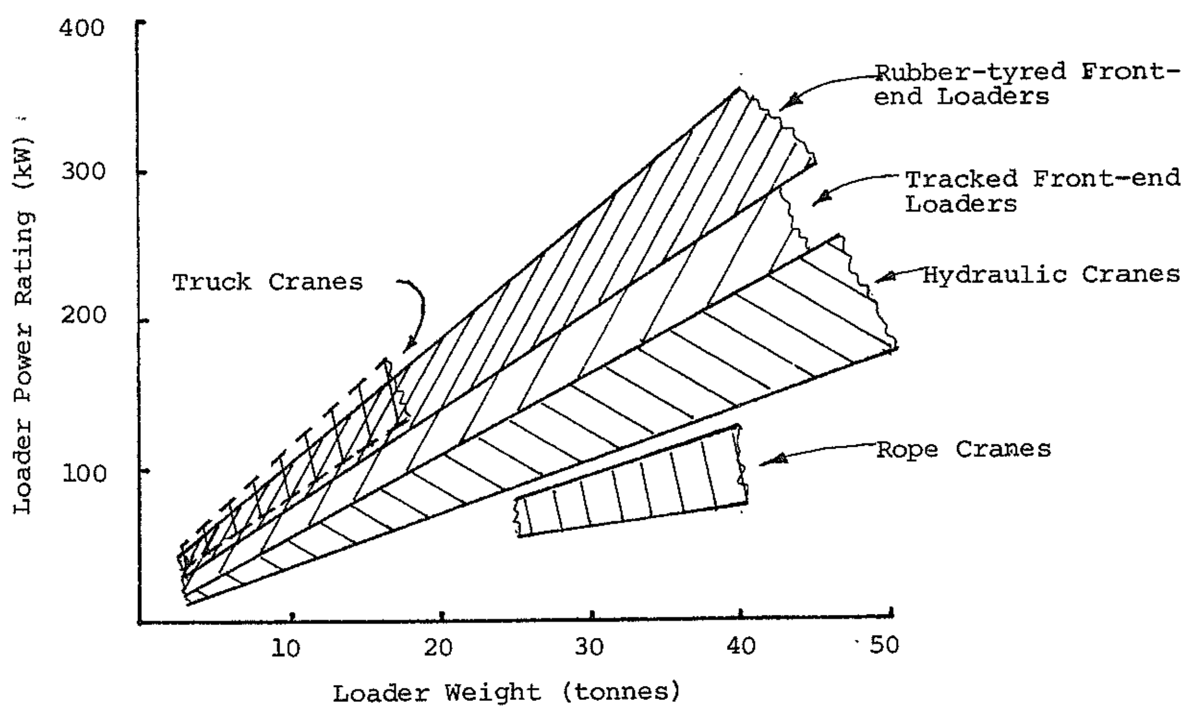


Figure 6. Comparison of Power Requirements

Figure 6 also indicates that rope cranes have a lower power for size requirement, than hydraulic cranes. Also, tracked front-end loaders have a lower power for size requirement than rubber-tyred front-end loaders. If the likely carrier weight for truck-cranes was added, their power for size requirement would resemble that for other crane categories.

(e) Machine Costs

The costs of loading machines in the different categories is shown in

Figure 7 and this indicates that all machine categories have a similar capital cost per unit weight. If anything, rope cranes are slightly cheaper than the rest, on a weight basis.

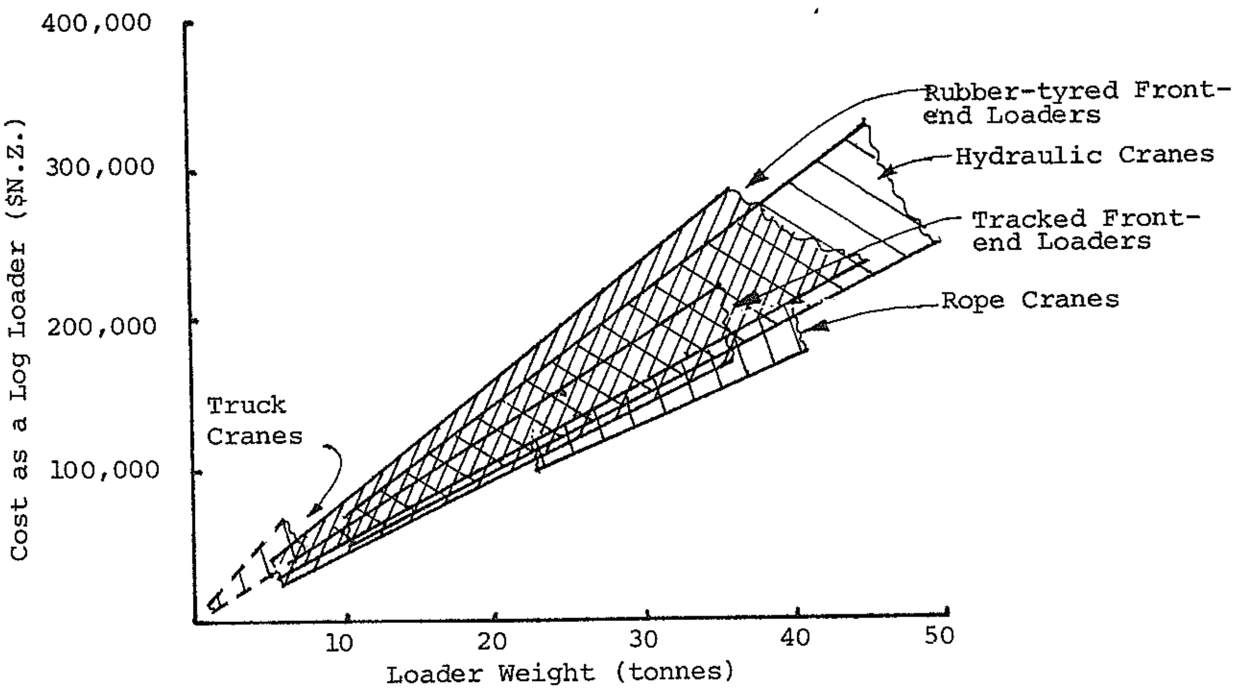


Figure 7. Comparison of Log Loader Capital Costs

In comparing the physical characteristics I note that, on a machine-weight basis, rope cranes are slightly lower in cost than the rest. They also have a greater tipping moment rating, and a lower power requirement, and this must make them very competitive in the appropriate operating conditions,compared to alternatives. It should be noted however, that they tend to be available only in a limited range of sizes.

Between the other machine categories (rubber-tyred front-end loaders, tracked front-end loaders, hydraulic cranes,and truck cranes), the differences in lifting capacity, power rating, and machine cost are not marked. Best choice of machine thus tends to fall back on a consideration of operational characteristics.

OPERATIONAL CHARACTERISTICS OF MACHINE CATEGORIES

Any log loading machine operates under the following three important influences:

(a) The material being handled (log diameters, lengths, weights, forms, etc.).

(b) The ground conditions worked on (landing size, layout, surface conditions, etc.).

(c) The logging system in which the loader fits (type of log extraction and transport units, rate of log handling required,operator considerations, extent of management and maintenance available, etc.).

A discussion of how these factors influence machine performance follows. The information comes from a wide range of general reports as detailed studies of this subject are few.

(a) The Material Being Handled

Log diameters in N.Z. are relatively uniform over the 10 cm to 80 cm range. Common grapples on front-end loaders and hydraulic cranes are suited to handling these log diameters in multiples, however on rope cranes some difficulty is experienced in grabbing multiples of small diameter logs. It is important from a loading or stacking production rate point of view, to ensure grapples are filled to the maximum with each grab during log handling. For sorting operations though, where the handling of single pieces occurs frequently, the rope crane grapple has few problems but some of the front-end loader grapples do have problems, due to them not closing far enough.

When considering log lengths, front-end loaders in general have difficulty handling lengths over approximately 15 m, while it is in this area that crane-type loaders have few problems.

The handling of large and heavy logs can impose significant stresses on loaders, particularly crane-type loaders. The N.Z. experience with rope operated grapples indicates that ropes tend to have a better capacity to absorb and prevent shock-loads from being transferred to the base machine, than do hydraulic operated crane grapples.

(b) The Ground Conditions Worked on

Crane-type loaders can clear from an extraction machine and easily sort and stack to a limited number (approximately 4 or 5) of different stock piles in a comparatively small area. With an appropriate landing layout they can readily load out from here also. It is important though with crane-type operations to minimise the crane travel required during operation as this reduces log handling rates. Ground surface conditions are not important if a minimum of crane travel is attained.

While front-end type loaders, particularly rubber-tyred units, can effectively sort and stack to a larger number of stock piles, they require comparatively larger landing areas as well as good surface conditions for effective performance. Landing layout for front-end loaders is not as critical to performance as it is with crane-type loaders, but never-the-less is still important.

(c) The Logging System in which the Loader Fits

Where a loader is required to work with an extraction machine to clear logs from successive drags, both front-end and crane-type loaders are suitable. Crane-type machines however through their better reach ability are more suited to working with hauler operations to clear logs from beneath ropes, particularly where the landing size is small and production rates high. Rope cranes tend to have a better reach ability than hydraulic cranes and truck cranes as an experienced operator can throw the grapple beyond the boom reach.
For machines that are involved in loading operations only, at a

number of landings, a rubber-tyred loader is most mobile. Actual truck loading rates of both front-end loaders and crane-type loaders are similar, both commonly ranging from 0.5 to 1.5 mins per tonne.

Most log trucks in N.Z. carry their empty trailers and require the log loader to off-load the trailers. While both front-end and crane-type loaders can perform this function, it is often the heaviest load they are required to lift (2-axle trailers weigh from 3 to 4 tonnes and 3-axle trailers from 4 to 5 tonnes). It is noted that where rubber-tyred front-end loaders are used purely for sorting and stacking, machines in the 75 - 85 kW range are most common, compared to machines averaging 100 kW where all functions (clearing lànded logs, sorting and stacking, loading trucks, off-loading trailers) are performed.

Information available does not indicate any significant difference in daily log handling rates between crane-type and front-end type loaders. Differences however do occur due to the different operating conditions each type of machine is more suited to. From an operator consideration point of view, it is much easier to train operators for front-end type loaders (both rubber-tyred and tracked) and hydraulic crane loaders, than for rope crane loaders.

WHAT HAPPENS IN PRACTICE?

While so far this paper has outlined my interpretations of the important aspects in the selection and application of log loaders, it is pertinent to reflect on what actual N.Z. loader owners consider important when choosing a machine. In a 1978 LIRA survey, 23 factors for machine choice were noted for loader owners to rate in terms of importance. For the most common loader categories the results indicated very high importance rankings for the following factors:

Loader Category	Reasons for Machine Choice with Highest Importance Ranking.
Front-end Type Loaders (Mainly rubber-tyred)	Ability to sort and segregate logs. Service and parts availability. Maintenance consideration.
Crane-type Loaders (Mainly rope cranes)	Ability to sort and segregate logs. Log handling rate. Operating cost expected. Log sizes and types to handle. Purchase cost.

To some degree these results confirm the indications of important "criteria for selection and application of loaders", as established from an analysis of the subject. For the other 16 factors for machine choice, the survey showed however, condiserable conflict of opinion as to their importance.

SUMMARY

This paper high-lights that a wide range of options exist for log loading machine layout. While the possibilities are numerous, the range of machine types commonly offered by equipment suppliers is relatively small.

An analysis of the physical characteristics of common machines tends to indicate that all categories of machines are reasonably competitive in potential performance, and that the operating conditions play the biggest part in indicating the best machine type choice.

While operating conditions are seen to be the most significant factors to consider in selection and application of loaders, a detailed technical understanding of this area is considered to be lacking.

SOME GENERAL REFERENCE BOOKS WHICH OUTLINE LOADING METHODS

1. S. Conway 'Logging Practices - Principles of Timber Harvesting Systems'. 1976 A Miller Freeman Publication.

2. J.K. Pearce & G. Stenzel 'Logging and Pulpwood Production'. 1972 Published by the Ronald Press Company, New York.

3. 'Timber Transport & Handling from Forest to Sawmill'. 1964 Published by the Organisation for Economic Co-operation and Development.

4. W.S. Bromley 'Pulpwood Production'. 1976 Published by the Interstate Printers & Publishers Inc.

5. 'Planning Forest Roads & Harvesting Systems'. 1977 Published by the Food & Agricultural Organisation (FAO)

APPENDIX

Table of Some Machine Brands Available (World wide)

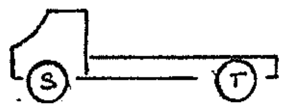
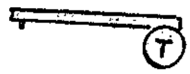
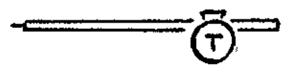
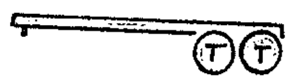
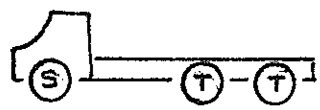
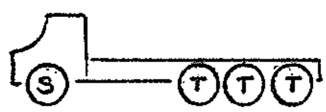
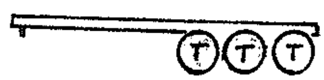
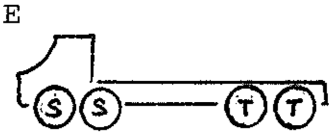
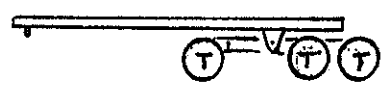
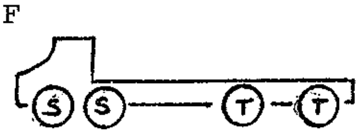
Loader Categories	Rubber-tyred Front-end Loaders	Tracked Front-end Loaders	Rope Operated Cranes	Hydraulic Cranes	Truck Type Cranes
	Bray	Case	American	American	Atlas
	Case	Caterpillar	Hitachi	Atlas	Barko
	Caterpillar	Fiat Allis	NCK-Koehring	Barko	Cranab
	Clark	International	Northwest	Bucyrus Erie	Dunham
	Fiat Allis	John Deere	Poclain	Caterpillar	Fiskars
	International	Massey Ferguson	Priestman	Dixie	Hiab
	John Deere	Komatsu	Ruston Bucyrus	Drott	HMF
	Patrick		Washington	FMC	Gafner
Some	Pettibone			Ford	Husky
	Rossi			Hitachi	Jonsered
Brands	Terex			Hymac	OSA
	Timberjack			Ishiko	Palfinger
Available	Volvo			J.S.W.	Prentice
	Yale			Kato	S.A.P.
				NCK-Koehring	Savage
				Lokomo	United
				Lorain	
				Massey Ferguson	
				Nicholson	
				Nikko	
				Northwest	
				Poclain	
				Ruston Bucyrus	

Refer to the annual New Zealand Forest Industries Directory for the brands available in N.Z. & their agents.

TRUCKING RIG LAYOUT OPTIONS - REFERENCE PAPER

A reference paper outlining some layout options, trailer costs and tare weights, and highway legal restrictions. This is aimed at assisting the panel discussion in this session.

(R.U.C. implies Road User Charges)

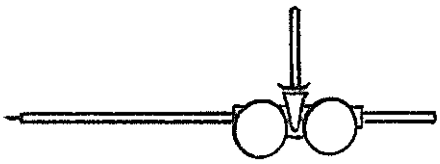
TRUCK LAYOUTS	SEMI LAYOUTS	TRAILER LAYOUTS
A  R.U.C. licence categorie 2	A  R.U.C. licence categorie 12	A  R.U.C. licence categorie 12
B  R.U.C. licence categorie 7	B  R.U.C. licence categorie 17	B  R.U.C. licence categorie 17
C  R.U.C. licence categorie 7	C  R.U.C. licence categorie 16	C  R.U.C. licence categorie 17
D  R.U.C. licence categorie 9	D  R.U.C. licence categorie 23	D  R.U.C. licence categorie 16
E  R.U.C. licence categorie 9	E  R.U.C. licence categorie 22	E  R.U.C. licence categorie 22
F  R.U.C. licence categorie 9		F  R.U.C. licence categorie 24

CURRENT TRAILER COSTS AND TARE WEIGHTS

LIRA SURVEY OF LOG TRUCK AND TRAILER EQUIPMENT (JAN/FEB 1979)

The following are average costs and tare weights as derived from information supplied by three different New Zealand trailer manufacturers.

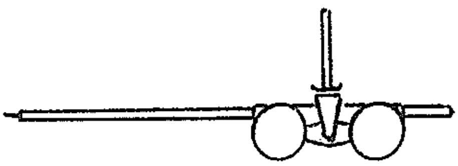
1. A two axle on/off highway logging jinker, single 2.4 M bolster and staunchion arms, 10 tonne axles at1.4M spacing, and walking beam type suspension.



Cost *Ave. $10,925*

Tare *Ave. 2.95 tonnes*

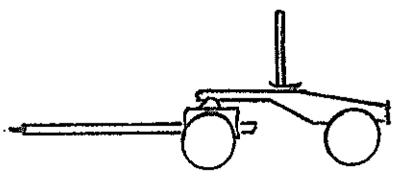
2. A two axle on/off highway logging jinker, single 2.4M bolster and staunchion arms, 10 tonne axles at 1.85M spacing, and walking beam type suspension.



Cost *Ave. $11,820*

Tare *Ave. 3.14 tonnes*

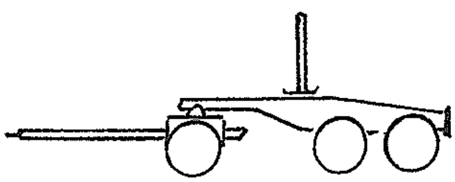
3. A two axle on/off highway spaced-axle log trailer, single 2.4M bolster and staunchion arms, 10 tonne axles at 2.50M spacing and spring type suspension, (or other if stated).



Cost *Ave. $11,945*

Tare *Ave. 3.28 tonnes*

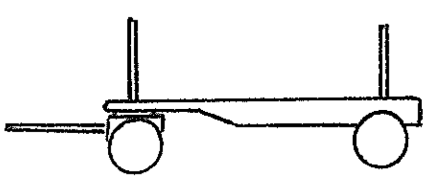
4. A three axle on/off highway spaced-axle log trailer, single 2.4M bolster and staunchion arms, 10 tonne axles with single axle at front and rear axles close spaced giving an approximate 3.1M wheel-base, suspension to suit.



Cost *Ave. $15,550*

Tare *Ave. 4.35 tonnes*

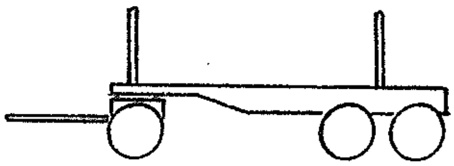
5. A two axle on/off highway short-log trailer, twin 2.4M bolsters and staunchion arms, 10 tonne axles at approximately 4M spacing, and spring type suspension.



Cost *Ave. $12,485*

Tare *Ave. 3.47 tonnes*

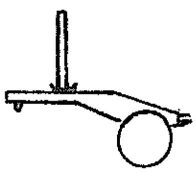
6. A three axle on/off highway short-log trailer, twin 2.4M bolsters and staunchion arms, 10 tonne axles with single axle at front and rear axles close spaced giving an approximate 4M wheel base.



Cost *Ave. $15,945*

Tare *Ave. 4.46 tonnes*

7. A one axle on/off highway trailing logging dolly, single 2.4M bolster and staunchion arms, 10 tonne axle, 5th wheel attachment to truck, for use with a towed spaced-axle log trailer.



Cost *Ave. $7,530*

Tare *2.19 tonnes*

8. A tag axle unit with suitable suspension for on/off highway logging, 8 tonne capacity, added to the tandem group of a 6 x 4 3-axle log truck to give a 4 axle truck.

Cost Including Fitting *Ave. $6,500*

Added Tare *Ave. 1.30 tonnes*

9. A single tyred steering axle with suitable suspension for on/off highway logging, added to the front axle of a 6 x 4 3 axle log truck to give a 4 axle truck.

Cost Including Fitting *Information not supplied*

Added Tare

10. Modifying the rear suspension of a 6 x 4 3 axle log truck to set the tandem drivers at a 1.85M spacing.

Cost Including Fitting *Ave. $2,500*

Added Tare *Ave. 0.07 tonnes*

CURRENT HIGHWAY VEHICLE LOAD & DIMENSIONAL LIMITS

MAXIMUM VEHICLE AND AXLE WEIGHTS

METRIC KILOGRAMS

1000 kg = 2,200 lb
1 metre = 39 inches

AXLES	Class I	Class II	
Ⓢ	5 400	5 000	Single Tyred Axle - two single tyres
Ⓣ	8 200	7 300	Twin Tyred Axle - four tyres or two tyres larger than 1300 x 24 or 1400 x 20
④	9 500	8 200	Oscillating Axle - four separate wheels

WHEELS:

Ⓢ and Ⓣ $\frac{1}{2}$ axle limit +500 kg
④ $\frac{1}{4}$ axle limit +250 kg

GROSS and maxima for any grouping of axles

Distance from first to last axle of any group: (Metres)	Maximum Sum of Axle Weights Class I	Maximum Sum of Axle Weights Class II
16.0 or more	39 000	39 000
14.4 "	38 000	38 000
13.0 "	37 000	37 000
11.8 "	36 000	36 000
10.8 "	35 000	35 000
10.0 "	34 000	34 000
9.4 "	33 000	33 000
8.8 "	32 000	32 000
8.2 "	31 000	31 000
7.6 "	30 000	30 000
7.0 "	29 000	29 000
6.4 "	28 000	27 000
5.2 "	26 000	23 000
3.6 "	21 500	19 000
2.4 "	17.500	15 000
1.8 "	15 500	13 500
1.0* "	14 500*	12 500*
Less than 1.0	Limits as for one axle	

BRIDGE LIMITS (Gross and maxima for any grouping of axles)

Percentage of Class I					
80%	70%	60%	50%	40%	30%
31 200	27 300	23 400	19 500	15 600	11 700
30 400	26 600	22 800	19 000	15 200	11 400
29 600	25 900	22 200	18 500	14 800	11 100
28 800	25 200	21 600	18 000	14 400	10 800
28 000	24 500	21 000	17 500	14 000	10 500
27 200	23 800	20 400	17 000	13 600	10 200
26 400	23 100	19 800	16 500	13 200	9 900
25 600	22 400	19 200	16 000	12 800	9 600
24 800	21 700	18 600	15 500	12 400	9 300
24 000	21 000	18 000	15 000	12 000	9 000
23 200	20 300	17 400	14 500	11 600	8 700
22 400	19 600	16 800	14 000	11 200	8 400
20 800	18 200	15 600	13 000	10 400	7 800
17 200	15 100	12 900	10 800	8 600	6 500
14 000	12 300	10 500	8 800	7 000	5 300
12 400	10 900	9 300	7 800	6 200	4 700
11 600	10 200	8 700	7 300	5 800	4 400

*Note: If axles in this distance include a single tyred axle paired with a twin tyred or oscillating axle, special limits apply:

	Class I	Class II
ⓈⓉ	12 000	11 000
Ⓢ④	13 000	12 000

Maximum Vehicle Dimensions

Maximum width	2.50 metres
Maximum height	4.25 metres
Maximum overall length	19.00 metres
Maximum length between towed vehicles	4.00 metres
Maximum rear overhang beyond rear-axis	4.00 metres
Maximum forward length	8.30 metres
Maximum combination forward lengths	(7.40 metres with 4.7 metres)
	(6.80 metres with 5.5 metres)
	(6.20 metres with 6.2 metres)
Maximum turning circle	25.00 metres

CURRENT ROAD USER CHARGES

(New charge rates effective 1 April 1979)

CHARGE RATES FOR DISTANCE LICENCES

Dollars per 1000 Kilometres (621 Miles) of Distance to which Licence Relates

Maximum Gross Weight (in Tonnes) to be Specified in Licence	Licence Category of Motor Vehicle 2	7	9	12	16	17	22	23	24
1	5.01	5.01	5.01	0.53	0.53	0.53	0.53	0.53	0.53
2	5.57	5.55	5.55	1.18	1.07	1.07	1.06	1.06	1.06
3	6.20	6.11	6.09	2.23	1.67	1.66	1.61	1.61	1.60
4	6.98	6.70	6.65	4.13	2.38	2.33	2.20	2.19	2.15
5	8.05	7.37	7.24	7.54	3.27	3.16	2.84	2.80	2.72
6	9.55	8.15	7.87	13.33	4.47	4.23	3.56	3.49	3.32
7	11.66	9.09	8.56	22.48	6.08	5.65	4.40	4.27	3.95
8	14.62	10.23	9.34	36.26	8.26	7.54	5.41	5.17	4.65
9	18.69	11.66	10.23	56.05	11.20	10.04	6.62	6.25	5.42
10	24.15	13.43	11.26	83.44	15.10	13.33	8.12	7.54	6.28
11	31.34	15.64	12.46	120.23	20.17	17.56	9.93	9.10	7.25
12	40.60	18.37	13.87	168.38	26.65	22.97	12.16	10.99	8.36
13	52.35	21.73	15.52	230.03	34.83	29.75	14.87	13.24	9.63
14	67.00	25.82	17.48	307.54	44.98	38.17	18.14	15.95	11.09
15	85.04	30.76	19.76	403.43	57.44	48.45	22.06	19.18	12.79
16	106.94	36.68	22.43	520.45	72.53	60.89	26.74	23.01	14.73
17	133.24	43.70	25.55	661.46	90.62	75.80	32.26	27.51	16.96
18	164.53	51.98	29.17	829.58	112.11	93.47	38.75	32.78	19.52
19	201.38	61.66	33.34	1028.08	137.38	114.26	46.33	38.91	22.45
20	244.45	72.91	38.14	1260.44	166.90	138.50	55.10	45.99	25.78
21	294.39	85.88	43.63	1530.31	201 10	166.58	65.21	54.14	29.57
22	351.92	100.77	49.88	1841.53	240.46	198.89	76.78	63.45	33.86
23	417.77	117.75	56.96	2198.12	285.51	235.84	89.98	74.05	38.71
24	492.74	137.02	64.95	2604.32	336.75	277.87	104.93	86.05	44.14
25	577.60	158.80	73.94	3064.53	394.75	325.42	121.81	99.57	50.23
26	673.22	183.28	83.99	3583.33	460.06	378.95	140.77	114.75	57.03
27	780.46	210.68	95.23	4165.52	533.30	438.98	161.97	131.72	64.59
28	900.25	241.24	107.71	4816.04	615.09	506.00	185.61	150.62	72.99
29	1033.51	275.20	121.55	5540.07	706.06	580.53	211.87	171.59	82.27
30	1181.24	312.81	136.83	6342.94	806.89	663.13	240.92	194.80	92.50

TRUCKING RIG LAYOUT OPTIONS - PANEL DISCUSSION

With paper VIII(b) as a reference paper for this session, questions were concentrated on the areas where little information is documented, such as:

Manufacturing problems in different layout options.
Modification possibilities in existing equipment.
Operational differences between layouts such as drive-ability and versatility.
Likely major problem areas in layouts.
Suitability to loading and unloading operations.

The questions put to the panel and the answers plus discussion, were as follows:

Question

For a vehicle that is required to cart both long and short logs and chips, what type of axle configuration is the most versatile and suited in New Zealand, and why? On Class I and Class II roads, and then off highway.

Williamson

I think the brief answer is in what is now commonly known as the Bailey bridge. I think the Bailey bridge can best be described by looking at semi-layouts D and E (reference paper) fitted with four bunks. This takes care of the short log situation. I don't know how you would get on as far as chips are concerned, but I believe that there is scope for further engineering development in these semis, insomuch as they could perhaps have at least one retractible axle. I believe that there is further development required in using high tensile materials and looking at unit configurations. We also should be looking at getting rid of springs.

Oosten

I'd take that further and just look at semi-layouts D and B (reference paper) for cost reasons. With E having turntables and self-steering systems, these do wear out. For carting chips, the bolsters could have container type locks on them which can be taken off and a built up container locked onto the unit and the chips carted in that. With that system you could load up and use it off highway without worrying about overloading.

Question

Do you both see the Bailey bridge type unit as being suited to both Class I and Class II?

Williamson

Yes, I could see them suited to both Class I or Class II.

Question

Are there any particular design constraints relative to doing what has been suggested?

Peterken

There is no problem in designing and building with high tensile materials providing people want to pay for it. You are talking of at least double the price for any high tensile steels. The Bailey bridge is a very versatile type of trailer. It has the possibilities of being able to cart long and short logs, and also sawn timber, and can be back loaded for say carting slab wood. It is the only type of rig that you can take to any logging company or any mill and be sure of getting a load straight away.

Question

A high proportion of gross weight is tare weight. This question relates now particularly well to the way the other question was answered. This tare weight we don't get paid to cart, and we also have to take it back empty. Where would it be feasible to reduce this tare weight on the common layouts in redesign and in any other way?

Hogan

In logging you have a lot of impact all the time and therefore you have to restrict how much you can lighten any of your gear. Truck wise, you can look at lightening up some of your gear like running tubeless tyres, possibly going into fibreglass cabs, and looking at engines that will give you a better power/weight ratio. In your bolster gear, you can go into very high tensile steel but you are going to pay for it. You've got to make sure that the steel will withstand the impact from loaders hitting staunchions etc. So really there are not very many areas where you can pull your tare weight back.

Peterken

It gets back to the cost of steel and other materials to bring weight down. You can design wonderful things if people are prepared to pay for them, but when you relate the costs to what operators are getting paid for their cartage, in a lot of cases, it just isn't worthwhile to use high tensile steel.

Question

We already have standard rigs which are a little different from those we've just heard of as being perhaps preferences. What is involved in modifying a standard two-axle spaced trailer to a three-axle trailer, and what is the likely cost?

Peterken

First of all the cost.With a normal two-axle 2.4 m spread trailer, you are looking at approximately $5,500 - $6,000 to put an extra axle on it. The work involved usually includes modifying completely the chassis itself, altering the bolster bed position because it is in the wrong place for axle loadings, adding the extra axle wheels and tyres, and generally beefing up. In my own view it is not recommended, as I feel that a trailer is originally designed by the manufacturer to carry the load at a best point. In N.Z. at the moment we are having a lot of trouble with alterations to equipment to suit road user charges and various other problems that have been thrown at us. I don't feel that it is economic to alter existing two-axle 2.4 m spaced trailers, as there have been very few built in the last three years so any trailer to be modifyed is usually pretty old and not worth playing around with.

Williamson

An alternative is to go to a slightly different trailer. As just stated, there have not been a lot of 2.4 m spread trailers built in the last three years. However, the 1.8 m spread trailer has been recently introduced with beam suspension, and it has achieved two things. You can build it a lot lighter and you can almost get as much payload on it as you can on a 2.4 m spead because of its tare weight. A possibility is that you can add a dolly at the rear of this 1.8 m type logging trailer, instead of between the truck and the log trailer as normally done. It seems to be a good possibility.

Question

The next question relates to the larger three-axle trailers that we will want to carry in piggy-back fashion. What are the problems in off-loading the heavier, and slightly larger three-axle trailer using rubber-tyred front-end loaders and boom-type cranes?

Marshall

For the existing rubber-tyred loaders and cranes, I see no problems. Most of these trailers wouldn't exceed 6½ tonnes weight. Providing the hinge point is in the right place and that the lifting strop has swivels fitted, there is no problem as far as I can see. Crane type loaders would have a slight advantage over the rubber-tyred front-end loaders.

Oosten

As a truck operator, I am not keen on three-axle trailers, for the simple reason that you can get sent to a gang where a bloke drives up in a 605 Fiat Allis loader. Then you start scratching - how are we going to get the three-axle trailer off? I use a two-axle trailer now for that reason.

Question

Would a three-axle trailer with the close axles at the front have any advantages over a three-axle trailer with the close axles at the rear? In cost of manufacture; in transporting different log lengths; in improving payload; in drive-ability.

Peterken

Last week in Canada I had an opportunity to look at this very thing which is the type of trailer talked about earlier. It involves an extension to a normal two-axle tandem jinker where the bolster is removed and a rear extension added. The Canadians are moving that way because they have various bridge loading formula similar to ours, where they need the overall length,and this trailer appears to work alright. I can see some advantages, they appear to be a very versatile unit. I don't see that there would be any necessity to put springs on the rear with the way it would oscillate. The cost, I don't think, would be any different from the cost of the present three-axle trailer. In carting different log lengths, it has an advantage because the tandem is at the front and that brings your bolster closer to the truck, so therefore you can still get a reasonable sort of group loading with short logs. I don't see any possibility of getting a great deal more payload and I think it could possibly hold the road a little better than a conventional three-axle trailer. There has been a trailer of this design operating in New Zealand and I think it was fairly successful.

Oosten

I have looked at this one. The three-axle configuration in this one has only got one advantage, that is that the truck and trailer bolsters are closer and you would get your 16 m overall wheel base when carting 8 m logs. Disadvantages out-weigh this completely. With our regulations allowing 5.4 tonnes at the front axle, you would have to sit the trailer on the truck back to front, to get it off easily and keep the front axle light enough. In the mud, I would say that this type of trailer would slew a lot more when you are trying to turn on the skids, due to the four wheels being up the front, on the pole, and you could lose loads. As well, you have got to have most of your butts on this type of rig on the trailer and this comes back to the point raised in an earlier paper about weight on your drivers. I have seen more loads lost on three-axle trailers going up hills, where the truck drives out from under the load and the whole lot goes down, than with the two-axle trailers. This is one of the reasons why I'm not keen on three-axle trailers at all.

Question

Some overseas countries use rigs capable of uplifting and dropping off their own trailers, mostly with one or two-axle jinkers. Can this be done with larger three-axle trailers behind three-axle trucks, or would it be best to use a four-axle truck with a two-axle trailer to enable this to be achieved with a six-axle rig?

Peterken

With present road user charges, I can't see how a four-axle truck with a two-axle trailer would be an advantage over a three-axle trailer. On self-dropping and loading trailers, the Australians have a concept where they lift their tandem jinkers on to the back of the truck by mechanical means. Three-axle trailers are pretty difficult to load because you have got to get past the bolster, so you have got to fold in the side arms and turn the bolster to a position where you can run the trailer forward. I can't see it being an easy thing to do, as you either end up with winches, or a crane, or something which is added tare weight and added cost. The only hopefull thing is that at every skids there is a loader capable of lifting the trailer off.

Williamson

I'm also left with a fairly large gap in my mind as to how you get a three-axle trailer onto or off the back of a truck without a loader. No doubt there is a way, but at this stage it looks pretty difficult.

Dixon

Self-loading and dropping jinkers are popular in Australia. Two-axle jinkers are used as with our regulations there's no real advantage with three-axle trailers. When loaded piggy-back style, the trailer bogie is set well back on the tractor unit, either on top of the drivers, or slightly behind the drive axles, so that there is no excess weight on your steering axles.

Crowe

The two-axle trailer talked about a minute ago with 1.8 m spread axles would suit this system ideally.

Question

What component areas, on the trailers used at present in New Zealand, create the highest maintenance costs and down-time?

Hogan

In our operation we have found that most wear and tear occurs in our cup and saucer arrangement, through continual movement in this area. Another area is the drop-arm and bolsters where we've got pins and bushes to hold the arms.

Oosten

On my fairly easy run, the only thing that I would add is tyres. They cause the most down-time on my rig.

Williamson

In my case tyres are the greatest cost, but next to tyres, it's got to be springs.

Question

Could someone describe what the cup and saucer area is please?

Hogan

It's the area under the bolster pivot pin where the bolster sits. You get a certain amount of wear from continual pulling or slowing down in operation.

Question

What is the approximate weight of one of these Bailey bridges, the three-axle set up, semi-layout E of the reference paper?

Peterken

With four bolsters and three axles, it is 7.8 tonnes approximately.

Deadman

I've been running one of those Bailey bridges for a couple of years, and I think a point that has been missed, is the very high maintenance cost on those trailers, especially with springs, self-steering, and bits and pieces like that.

Question

Is there any other operator here who has had considerable experience with the Bailey bridge type rig that would like to comment?

Medlicott

It's not my own one that I have dealt with, but Dave Jackson's one has the same problems - major spring trouble and turntable and gooseneck problems. They are built strictly for about a 38 tonne gross weight and once you get over loaded, they are right-offs.

Question

Would you two gentlemen cheerfully trade your Bailey bridge rigs for other conventional gear if you had the opportunity?

Deadman

Not really, because being a fleet operator, I need this versatile type unit. On ours, we cart right down to 2.4 m lengths. The only length we don't cart are 8 m lengths for export, as they sit in the middle of the chassis and may give chassis bending problems.

Medlicott

Once more I am speaking on Dave Jackson's rig. He's got a very versatile type unit, carting short and long logs into the mill, and carting slab wood back out again on the same day

Question

Has anyone considered,on a logging operation which is strictly on highway and you don't have to cope with off highway conditions too much, getting trucks built with alloy chassis, alloy wheels, and alloy suspension beams. That is, all those things that save weight and cost money. Has anyone worked out the additional payload you could carry and if it would be worth it?

Hogan

In our case we haven't, but we should be looking at that now for any replacement vehicles that we might put on the road in the next few years. It is something that we will be looking at to see if we can make savings.

Question

Is spring steel quality suspect? Where do they come from?

Peterken

At the moment all springs for trailer suspensions are made in New Zealand and we certainly don't get the quality that we would like to see. There are a few exceptions like on taper leaf springs, that are still imported. Poor quality appears to occur in runs of springs. A thing that a lot of operators are guilty of, is that they break one leaf and they only replace that one leaf. That's useless as the chances are that the next leaf down will be partly fractured. Take the whole spring out and get the whole thing redone.

Medlicott

I have fitted all my two-axle trailers with Aeon rubber blocks which engage as soon as the trailer gets down to approximately half load. They seem to take the shock out of the springs and probably nearly double spring life. We still get breakages, but not as frequently.

Dixon

I am not aware of any particular spring problems in Australia, however, a while ago we used to cart short wood on Bailey bridge type trailers, with heavy chassis beams, and there were a number of spring problems associated with hauling these units back to the bush on rough roads, unladen.

Deadman

There is one way that you can overcome the spring problems. That is to grade the roads a bit more frequently

Question

We have had comment on the use of twin-steer units. Where do they have an advantage over single-axle steering trucks and where do they perform well and why?

Williamson

A four-axle twin-steer truck, compared to a three-axle single-steer truck, has a very definite advantage in road user charges, however as soon as the road conditions become anything less than good, you are in fairly serious trouble with steering a twin-steer unit. Because you've got a twin steer, you've got more load in the front and you get more sledging under wet road conditions. The total cost and benefit however, is certainly on the advantage side with running a twin-steer unit. A serious cost disadvantage though, is the inability for the driver to be able to tell when he's got a flat tyre on his second axle and in fact I've seen trucks on the side of the road on fire, because the driver had no way of telling that he had a second-axle puncture.

Question

What are the main problems from a manufacturing point of view, in coping with the spreading of close-spaced tandem-drive sets to the wider 1.8 m spacing, and what types of problems may crop up in use?

Peterken

Some trucks are pretty easy to convert. The big problem is that if you reduce the distance from the centre tandem to the front-steer axle too much, you get sledging and are not able to control the truck. Anything with the forward length greater than 6.7 m (that's the distance from centre bogie to front axle), doesn't give any trouble, but I certainly wouldn't like to recommend a very short forward length. Some suspensions lend themselves to easy alteration. Hendrickson is very easy to alter and anything with a single point multi leaf suspension can be done. There are many that have been done in New Zealand and have been successful, including a few done out to 2.4 m and they seem to operate O.K. Providing trans-verse radius rods are fitted, there doesn't appear to be any major problems in use. These are definitely necessary otherwise you are putting a terrific strain on the suspension. Hendrickson in Canada make a standard suspension with 1.8 m walking beams.

Question

What is the affect of wide-spaced drive-axles on tyre wear?

Hogan

Our operation has no wide-spaced drive-axles. The only thing I can think of would be that in very winding road conditions you could get more tyre wear. On normal road conditions I shouldn't think there would be much difference. I think a lot of tyre wear that does take place is created by ourselves or our drivers, by not checking tyres to pick up those that are down a bit

Williamson

I see the 1.8 m spaced-drive set as being easier on tyres. It's a fact that vehicles on the road spend in excess of 94% travelling in a straight line. Because of that, spread-fixed axles on a truck or trailer should travel in a straight line giving less tyre wear. Conversely however, a trailer with a steering axle will weave all the way down the road and have higher tyre wear. A second point is that because the axles are spaced slightly wider apart, they do not jump on the road and scuff, and this gives a better tyre life.

Question

It appears that perhaps the biggest disadvantage could be in wear on the road. Can anyone comment as to whether there is greater road wear by spacing the axles out?

Stewart

Basically, the further spread the axles are, the more flexing there is caused to the road. Close-spaced axles tend to give a single jolt to the road, whereas two wide-spaced axles give two jolts to the road. This is why close-spaced axles are on a lower road user charge rate as there is an increase in road wear with wider spaced axles.

Williamson

A company in Tokoroa spread a vehicle's drive axles out to 2.4 m, and that truck had almost three times as much traction than when it was standard with drivers spaced at 1 m. The truck would go up the side of a mountain simply because it had a greater spread which allowed the wheels to stay on the ground and get better adhesion. In that sense, I believe that road wear should be less.

Comment from Floor

A few years back we were testing a road with a balancing beam. With two close-spaced axles, the road never returned to shape by the time the second axle hit it. With two wide-spaced axles, I'm pretty sure that you'd find that the road will return to shape before the second axle arrives.

Evans

Surely the road user charges are based on the fact that wider-spaced axles cause less wear, as they can carry more load.

Chairman

I have always understood that with a wider axle spacing you actually reduce the fatigue loading on the road because you've got time for recovery from the stress in the road structure. Therefore we are allowed higher axle loading with the wider spacing. I thought that this was borne out by reduced road user charges on wide-spaced axles, but it does not seem to be the case. Perhaps this can be taken up with the M.O.T. by LIRA.

Question

Perhaps we've nearly had this answered already, but what are the differences in truck drive-ability, stability, and traction, between close-spaced and wide-spaced axles?

Oosten

I can only go on heresay about drive-ability. There was a stock truck here a few years ago where with the drive axles at a 1.8 m spread. The biggest problem was trying to get it around corners, because it was inclined to go straight ahead. As far as logging goes, I think that the standard close-spaced drivers that we are running now are all we need. We are putting nine tonnes down in one place on the chassis. If you spread your axles out you increase that up to some twelve tonnes, which I'm sure must cause extra tension in the chassis. On a general carrying truck the load is spread along the chassis rather than pushing down in one place all the time, and it's probably alright if you start spreading axles.

Question

Coming back to cartage of smaller lengths and smaller material. Post lengths and short pulp can be carted with the logs either transverse across the chassis, or longitudinal along the chassis.

What are the problems and features of each method, in cost of setting up, tareweight and payload, loading and unloading?

Marshall

It's not my speciality, but in my mind the longitudinal loading system is the more expensive, and requires a separate loader. Tare weight and payload on the longitudinal type, I think is not as good as with the transverse type. The transverse way brings to mind the flat deck truck, which is more versatile and can be used for many other things apart from carting short wood. I feel that the transverse load is also safer. For unloading, the transverse load is much easier as you can drag off or dump the load whereas the longitudinal load brings to mind other machines being involved to unload. I think that for short pulp, transverse type loading is best.

Williamson

A point to note on this with respect to safety, is that with small timber, it's greasy, and because it's greasy it will move easily and takes a lot of holding down. I am not experienced in this timber, but there is a large forest of this type of timber coming up and it's something that the industry has got to come up with some answers for.

Crowe

Transverse loading of pulp has its limitations in the log length that you can use it on, and for that reason it has mostly gone out from one area in Australia. I agree that it is a lot easier to unload, but it is more difficult to load logs across the truck using the conventional front-end loader.

Gilooly

We had a job recently where we had to cart quite a bit of 1.8 m and 2.4 m material. We carted it across the deck and found that we had to 'up' the rate, from $3.21 (which we were paying on normal cartage) to $3.75, largly to cover the load/time factor.

Question

I would just like to ask the panel their reasons for preferring the Bailey bridge as apposed to 8 wheelers and three-axle trailers. I'm asking this question because we operate several Bailey bridge type units and also 8 wheelers with three-axle trailers. I think that there are disadvantages with the Bailey bridge units - the road user charges are a lot higher; you can't carry it on return trips; and back loads are not readily available. Also the forestry people are talking about getting the size of the loading or landing areas down, and that restricts Bailey Bridge rigs.

Williamson

I favour the Bailey bridge, as the question initially posed was, "for a vehicle that is required to cart both long and short logs and chips". That is the reason that I came up with the answer of a Bailey bridge.

Oosten

My reason is the same. You are getting up to a seven-axle rig if talking 8 wheeler and three-axle trailer. I think the cost on tyres today would just about outweigh the road user charge savings. That is my feeling.

Smale

It was earlier stated that twin-steer trucks have more punctures. In our operation the incidence of punctures on the second steerer is very small compared with the rest of the truck. It is not impossible to tell if you have got a puncture. I've also seen many trucks alongside the road with tyres on fire, that are not 8 wheelers

Question

The speaker is obviously experienced with twin steer. I understood that, in fact, you got improved steer-ability with the twin steer because of the extra load and the two axles. I think a panel member said that in the wet you got excessive sledging. Would you like to comment on that particular aspect?

Smale

You do have a slightly greater problem with traction on an 8 wheeler than you do with a 6 wheeler. Sledging is no problem though, and stability on an 8 wheeler is far greater than on a 6 wheeler. A 6 wheeler will sledge just as much as an 8 wheeler. As far as tyre wear is concerned, you get better tyre wear on an 8 wheeler at the front, than on a 6 wheeler. On road user charges, comparing an 8 wheeler with a 6, on 100,000 km saved me $1600 a year on the truck alone.

Medlicott

I would like to make one comment in support of 8 wheelers. Any truck driver will know that if you are driving a 6 wheeler and you blow a front tyre, you are likely to go through a fence. In an 8 wheeler, you just slow down and park it.

Question

I would like some clarification on the three-axle trailer around the wrong way. What implications are there on tare weight in doing this?

Peterken

The three-axle trailer with single axle at the rear, should weigh about 4.35 tonnes. I don't see any difference between the three-axle trailer shown in figure 4 (reference paper) and a three-axle trailer back to front. A point I would like to make as we are talking a lot about three-axle equipment, is the road user charges favour a three-axle grouping at 3.6 metres. There is no advantage to a three-axle trailer of any sort in going out beyond that 3.6 metres. All manufacturers to my knowledge have bought their three-axle self steers down to within that 3.6 metres, with the exception of the combination shorts/long trailers which are now becoming increasingly popular. This is a three-axle trailer which has a central bolster plus front and rear bolsters which can be folded down out of the way. The unit has an 'A' frame type tow-bar with a telescopic pole. It is a fairly versatile trailer on which the operator can cart long logs one way and slabs or short wood the other way.

Deadman

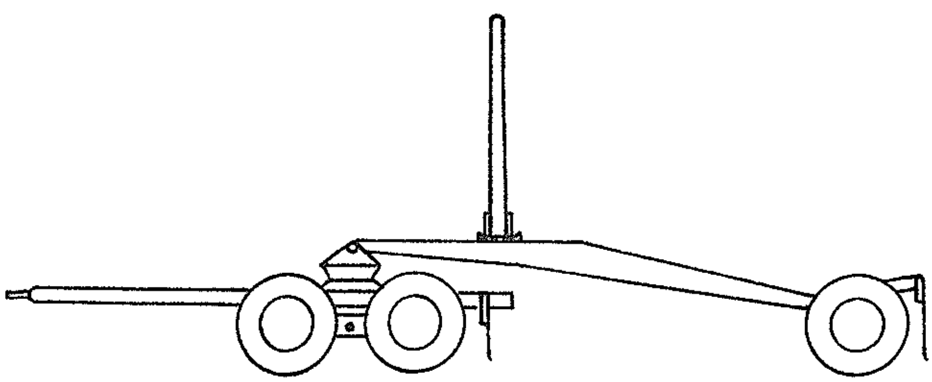
We were earlier talking about four axles on the truck or three axles on the trailer to make a six-axle rig. It is very hard to put four axles on a truck with a long bonnet out the front, and it sounds very costly. I think we have got to go the cheaper way of remaining with the same gear we have and I thus favour the three-axle trailer. You can then put this extra axle on the back and carry it when empty, whereas with a four-axle truck, you can't carry the extra axle.

<u>*Question*</u>

I would like further clarification on that dolly trailer used in North America. Is the booster axle a fixed part of the three axle unit or is it something that you can remove at will and hence change from a two-axle to a three-axle trailer?

<u>Peterken</u>

Knights Manufacturing, who call it a 'Dog logger', came up with this concept using the normal tandem jinker. The bolster is



<u>*Alternative Three-Axle Log Trailer Layout*</u>

removed and a frame is made with a cup and saucer on it. It has outriggers which pick up the bolster wear pads. They have a very cunning way of getting the trailer booster axle off as they don't have a pin but have a special lock. They just turn the frame around 90 degrees to the tandem and lift the thing off and the same with their bolster. The trailing pivoted frame with suspension and single axle, has a bolster bed fitted in the appropriate position. Because of the proportion of load that you want on the bogie, the bolster is ahead of centre.

I can't see any reason why a configuration like this can't be done without a spring suspension, because the amount of movement in the back axle is very similar to a lot of walking beam type transport suspensions. For any movement up and down at that back axle, the load is moving very little and I think there would be enough flex in the frame to absorb any shocks. The Ministry of Transport and Ministry of Works might disagree.

<u>*Question*</u>

Are there any problems lifting it to load onto the back of a truck without it falling apart ?

<u>Peterken</u>

They sit the tandem bogie behind the truck bolster and they have a frame across the tandem chassis about half way back, which rests on the truck chassis. They are not positioning the trailer ahead of the truck bolster so they leave the rest sticking out the back end.

<u>*Question*</u>

We were talking about self-loading trucks earlier, and the issue that *was not raised, was the panel's preference for configuration of a self loader. I think that we should get some clarity on that issue.*

Marshall

For hydraulic knuckle-boom loaders on self-loading trucks, the most important things are the position of the loader, which has already been discussed, and the capability of that loader unit. I think too many times one chooses a loader looking at the weight of the loader unit rather than its capability of doing the work required. Axle weights and cab-over-engine or long bonnet cabs, are other things that have to be looked at closely. Versatility of the unit is also important. Is it adaptable for other use other than carting wood.

Peterken

I agree that the mistake that most people make when looking at anything of this nature, is that they normally under specify the loader, and in every case that I know, there have always been problems if the loader is too small.

Question

Should the loader be right in behind the cab, say on a twin-steer unit,or should it be on the tail of, say a three-axle driving set truck?

Oosten

I would go for a three-axle drive set unit with the loader on the tail so that you wouldn't have to unhook the trailer to load logs if working a truck and trailer system. If using a single-steered twin-drive tractor unit with articulated trailer, then I would have the crane on the back of the trailer.

Williamson

I would go along with the same type of configuration. An important point is that we have got to get away from the driver standing on the ground to do the work. He has got to sit up on top so that he can look down on his wagon and load much safer. I prefer the loader at the back of the truck, as when you get beyond a 20 to 30 kilometre lead (that is when you start getting the tare weight over-ruling your charge rate as far as getting compensation is concerned), you are going to have to look very closely at the clip-on loader and cart the loader from skid to skid.

Crowe

I would like to say that some of the knuckle-boom cranes that are very successful in Australia, have been used independently from the log truck, either truck mounted, tractor mounted, or skidder mounted. There are an intermediate range of crane sizes between the ones that you fit to log trucks and the larger separate units and I think they need a lot of thinking about.

Gilooly

If you do a sensitivity analysis on what costs you dough in this log-trucking game, and you increase some of your factors by 10%, it is amazing what turns out. If we increase the current road user charges by 10%, it gives you a 0.6% difference in rate. If we increase purchase price by 10%, it is a 4.3% difference in rate. This is where I wonder if it pays us to chase an action to try and save on road user charges. I think people want to really look closely at this, as they may be only shooting at shadows.

SUMMARY OF SESSION VIII BY CHAIRMAN

(J.L. WILSON)

The whole subject of loading was very well covered by Bob Gordon, and I refer you all back to his paper. I suggest you take it away with you and look at the factors that Bob refered to, the most important being the operating conditions and the actual volumes that are to be handled. All owners and operators of loaders could well re-read and re-use it again as a reference.

On configurations for road transport, it appears from our panel discussion, that there is an inclination towards Bailey bridge rigs because of their versatility. However, the conservatism and the existing requirements of our large volume log transport industry, suggest that what we have at present is going to be with us for quite a long time. I won't try to sum up all the other aspects as they will come out in the seminar proceedings.

On the aspect of road wear by spaced and close axles, and which are in fact the hardest on our roads, I would ask that LIRA have that sorted out with the M.O.T. and published. We see an awful lot of road damage and would like to know which way we should be going on axle spacing.

On safety, perhaps we are not looking carefully enough at our designs, as our twin-steer people suggest to me that there are aspects which are worthy of looking at from a safety point of view, without sacrificing costs.

- SESSION IX -

SEMINAR SUMMATION

FURTHER RESEARCH NEEDS IN TRANSPORT AND LOADING
(J.J.K. SPIERS - Director, Logging Industry Research Association)

SEMINAR SUMMATION
(A.L. CAMERON - Harvesting Research Group, C.S.I.R.O., Australia)

FURTHER RESEARCH NEEDS IN TRANSPORT AND LOADING

(J.J.K. SPIERS)

Although road transport is probably the most sophisticated phase of logging with an advanced technology adopted from other transportation industries, the fact that it is half the total logging cost, means that even slight improvements in this phase could have significant savings.

Ian Johnson of the R.T.A. outlined the problems facing the N.Z. transport industry and said that the sophistication and effectiveness of transport was an indicator of a country's effectiveness. He pointed out some of the problems facing the industry and indicated that some of these would probably get worse, i.e. higher capital costs, fuel and labour costs, therefore there was a great requirement to improve our efficiency.

The basic figures from the Forestry national planning model showed terrific expansion potential, but there were problems facing N.Z. forestry. Difficult terrain, remote location, and the smaller tree sizes of the future, would pose disadvantages. The industry was definitely export oriented and therefore must be cost effective to survive in a world market.

Currently the transport and loading sectors cost from 25% to 60% of the total logging costs. Therefore, it is important to identify the work LIRA should be doing and what LIRA as a research organisation, should have learnt from this seminar.

LIRA's objective was to present to you, all the possible information and opinions of the known experts, and put these to discussion. LIRA needs to learn from the proceedings of this conference to formulate its research programme

No dramatically new areas for investigation were apparent. The proceedings confirm that we should continue investigations along the same lines as currently, i.e. concentrating primarily on costing and fleet utilisation with some investigation of items that might influence equipment selection.

A major objective in costing would be to get better information put before all parties. We are currently working on a logging costing handbook and when this is completed it could be adapted for the transport area. However,it is necessary to get good figures and thus we need better access to information. There are obviously problems in getting cost information and we need the industry's co-operation to get these. It must be realised that LIRA is an impartial organisation serving all sections of the industry and thus individual cost information from specific sources is kept confidential, but overall analysis and combined figures are used to benefit the whole industry. Unfortunately we have been unsuccessful in getting good data from the smaller operators to date and thus we will probably have to depend on the information compiled on the big truck fleets, although some of these figures are not typical of smaller fleets.

On truck utilisation, Mark Howard's paper identified the unevenness of the delay factors and pointed out that good scheduling of trucks was essential. Graham Sperry showed the dramatic improvements possible from better control of scheduling. Thus the principles from these two papers need to be applied more widely in the industry, and it is LIRA's role to spread the necessary knowledge that would help in improving truck utilisation.

The discussions on equipment selection covered many aspects. It is apparent that we need to conduct further case studies, particularly on loaders, to give better indications of the criteria to be used in equipment selection.

With regard to the equipment itself, it would appear that some more detailed investigations of the following would be profitable:

- Self off-loading trailers
- Integral weight scaling devices on trucks
- Bailey bridge type trailer rigs and their need due to load flexibility
- Trailer dollys or boosters on two-axle trailers
- Clip-on units as an option for knuckle-boom loaders on trucks

Two areas for possible investigation are the comparative tyre wear between different types of rigs and an examination of the material used in springs for trailer assemblies.

There was no evidence of interest in other modes of transportation, but if I was to pick an option that has possibilities, the Russian type overhead loader seen on film may have potential for fast loading on restricted landings.

If there are any major points that you think I have missed please raise them, as we will use the input from this seminar to guide our future programme.

DISCUSSION

Sperry

After our trip to Waipa yesterday, it struck me that the wood coming out of the Kaingaroa State Forest is not only split in three ways as far as the control of trucks and loaders is concerned, but it is also split between Fletchers, Pan Pacs, and K.L.C. etc. Do you think that there are any possibilities for the resources of the five or six control groups to be pooled together along with the trucks available, with possible gains to everybody? I think there is a lot of room for back loading within Kaingaroa.

Spiers

That is a very good point. One can't help but be impressed by wood going in different directions around this area with loads of wood of the same type crossing in various places. A lot of transport appears to be used inefficiently because it is under the control of different authorities and there is probably room for better co-ordination without creating another administrative body. I am not quite sure that it is LIRA's field, but we will look into it. There are one or two other people around here that should be taking note of that.

SEMINAR SUMMATION

(A.L. CAMERON)

It is very good to see the attendance that you have got here, not only in quantity but also in quality - you're a pretty vocal bunch. I think that without being vocal we are never going to get any information exchanged. You are very fortunate in having an organisation such as LIRA which has been a catalyst in this exchange of information. On the seminar itself, Jim Spiers has covered most of the points, although there are some things that I would like to highlight.

You are becoming increasingly dependent on export for your markets. It has been pointed out that this is a pretty significant challenge, and your presence here suggests to me at least, that you are prepared to have a go at that challenge in spite of the constraints that you have got.

Although a lot of the time at this seminar has been devoted to looking at equipment design, a number of the papers have convinced me that machine management may be just as important. In fact, I think it will give you faster results. One thing about machine management, is that as new machine designs arrive, the same management will continue on through it. If you develop a machine without management systems to get maximum machine efficiency, then every time you produce a new machine, you're back to square one as far as management is concerned.

One thing that Kevin Steel mentioned that you don't often hear in this Australian/New Zealand part of the world, is down time costs. The North Americans are very conscientious of this and the costs are frightening. I think he mentioned 30 cents a minute for down time on a typical truck. The larger organisations tend to be aware of this cost, the smaller ones don't, but proportionately they are probably just as bad off.

In the machine management/cost control area, I think the time is coming where operators will be required to produce factual information when they claim rate increases, because the squeeze is pretty tight and companies are going to require this. The Woods and Forest Department of South Australia, at the start of every year, sit down and draw up rules. They argue about every element of cost and once they agree, they work out the rate for the year. Everybody's chasing information all year.

One point raised in Chris Savage's paper, was the very important area of the man/machine system. In fact, one thing that we haven't done very much on here, is talk about systems, although in the group discussions we got close to it a couple of times. You can't develop an element in this process of harvesting wood in isolation. The way the tree is loaded on the truck may very well affect the way it is handled in the bush, in fact, it most frequently does. When we speak of machine productivity, what we are really talking about is the productivity of a man/machine system and you can't spend all your time developing a machine and forgetting the man. You'll have a tremendous machine but nobody capable of driving it or wanting to.

A number of papers highlighted the need for factual data regarding performance and costs. I would like to suggest that if the medical field had as much information as we have for our decisions, hospitals would be a very dangerous place to be! That situation has to be improved if you are going to remain competitive and this style of seminar is a step in the right direction.

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- Those who chaired or summarised sessions, led group discussions, and participated on the panel.
- The N.Z. Forest Service for the field trip arrangements.
- All those persons who attended the seminar, and subsequently contributed to an exchange of information and ideas.

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