



PROJECT REPORT

NEW ZEALAND

1988/89 RESEARCH PROGRAMME OF THE FOREST ENGINEERING RESEARCH INSTITUTE OF CANADA

(Report from a visit to FERIC Eastern Division, September 1988)

KEITH RAYMOND



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Project Report

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New Zealand Logging Industry Research
Association (Inc.)
P.O. Box 147,
ROTORUA,
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1988/89

RESEARCH PROGRAMME

OF THE

FOREST ENGINEERING RESEARCH

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Prepared by:

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Association (Inc.)*

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SUMMARY

Of the five research groups in FERIC (East), (Wood Harvesting, Transportation, Woodlot Technology, Silviculture and Design Engineering), the Wood Harvesting Research Group is the largest.

Machine evaluations such as the recent study of the Denis D55 feller director and the project assessing feller bunchers in adverse conditions continue to be of major interest to the New Zealand industry.

Studies of alternative harvesting systems to roadside processing, such as the use of processors and harvesters in the bush, are also of interest in New Zealand.

FERIC plans to also examine operations which produce clean chips in the bush either using flail delimeter/debarkers with roadside chippers or using conventional delimeters and debarkers at the stump.

The comparative analysis of wood harvesting systems involves the on-going collection of productivity and cost information for different systems in typical operating conditions.

Major project work in the Transportation research field continues in integrating the results of previous FERIC research with the instrumented truck.

Another major project of interest to New Zealand is that of maximising truck payload. Work will include investigating lighter trailers and reducing tare weight, evaluating optimum loading patterns and the use of weight scales.

INTRODUCTION

In September 1988, closer contact between LIRA and the Eastern Division of the Forest Engineering Research Institute of Canada

(FERIC) was initiated.

LIRA researcher, Keith Raymond -2- visited FERIC (East) for two weeks and more detailed information on various aspects of FERIC's work programme was gained.

This Report summarises that information.

Similarly structured to LIRA, the Forest Engineering Research Institute of Canada (FERIC) is a non-profit research and development organisation jointly funded by the forest industry and Government. The research work programmes of the Western and Eastern Divisions of FERIC are formulated by each organisation and reviewed by the National Advisory Committee on Forest Engineering Research.

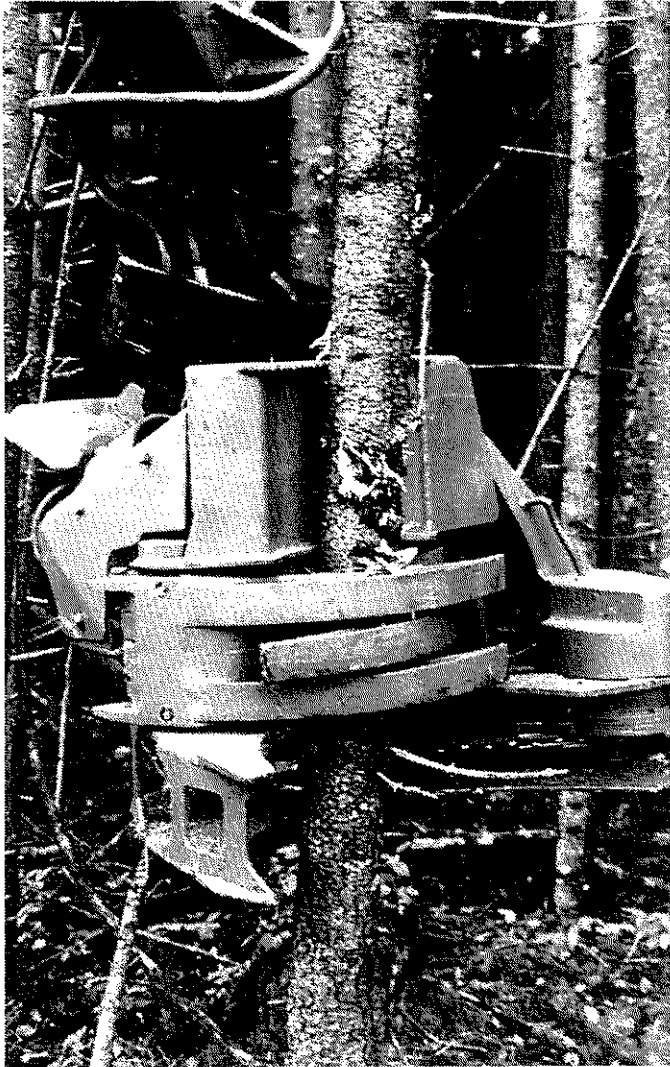
Coordinating each Research Group (Wood Harvesting, Transportation, Woodlot Technology and Silviculture) within each Division is an Advisory Committee. The FERIC Eastern Division Advisory Committee on Forest Engineering Research (ACFER) meets twice a year and is made up of representatives from FERIC's major member companies (east of the Alberta-Saskatchewan border).

The objectives of the ACFER meetings (similar to LIRA's Open Day) are to update member companies on current research projects, present future projects and then discuss and prioritise these projects. ACFER members vote on their priorities for each project to enable the formulation of the following year's work programme. In this way FERIC gains a formal industry consensus on their work programme.

The autumn 1988 ACFER meeting was held in Quebec City on 12-13 September to coincide with the forestry equipment show, DEMO '88. FERIC Western Division were present at the meeting providing an opportunity to update on their current research projects.

UPDATE ON EASTERN DIVISION WORK PROGRAMME

A. WOOD HARVESTING RESEARCH GROUP
(Jean-Francois Gingras, Group Supervisor)



*Figure 1 :
Denis D55 Feller-Director*

Projects:

1. Denis D55 saw felling head

This study involved an evaluation of the D55 chainsaw felling head mounted on a Kubota KH-28L lightweight excavator base (Figure 1). This study is at the field data collection stage at present.

2. Ergonomics of Feller Buncher Cabs and Controls

Feller-buncher carriers are most often modified excavator units, possibly not ideally suited for their felling function. A project is underway to assess the cabs and controls of current feller-bunchers from an ergonomic viewpoint to define their limitations. This project compared a sample of 10 models of feller-buncher and highlighted ergonomic weaknesses.

One highlight was the lack of standardisation of control layouts.

This project will be completed this year and a Report published in early 1989.

3. Reliability and Performance of Saw Felling Heads

10 felling machines were studied using shift level data in both summer and winter conditions. A Report is due out in early 1989.

4. Machinery Evaluation

The 3-wheeled Feller buncher models such as the Bell and the HydroAx were studied. A Technical Note will be published in 1989.

5. Feller Bunchers in Adverse Conditions

This Project, started in 1987, was designed to assess the performance of mechanical fallers working on steep slopes, rough ground and adverse stand conditions. The objective was to determine the relationship between site and stand factors and productivity.

Results showed three important factors:

- Average tree size
- Unmerchantable stocking
- Stand density

A Technical Report will be published in 1989.

6. Whole Body Vibration of Skidders

This Project is terminating this year. The study involved testing skidders on a test-track with different seat configurations.

7. Monitoring of Delimbing Alternatives
(High Speed Delimbing)

Mechanised delimbing remains a high cost phase, particularly in smaller wood since the popular stroke delimiters are essentially single stem. However, batch delimbing typically repre-

sents a trade-off between productivity and delimbing quality.

This on-going project was designed to investigate the applicability and performance of new concepts in high-speed delimbing particularly for smaller trees. Additionally, the design engineering group will promote and assist manufacturers in the development of those concepts of particular interest and if warranted, carry an in-house concept to the model stage to stimulate interest, discussion and possible future development.

No production studies have been undertaken, so far, however chain flail units in Maine, Nova Scotia and North Carolina were viewed. A field note on one of the units was published this year (Figure 2).

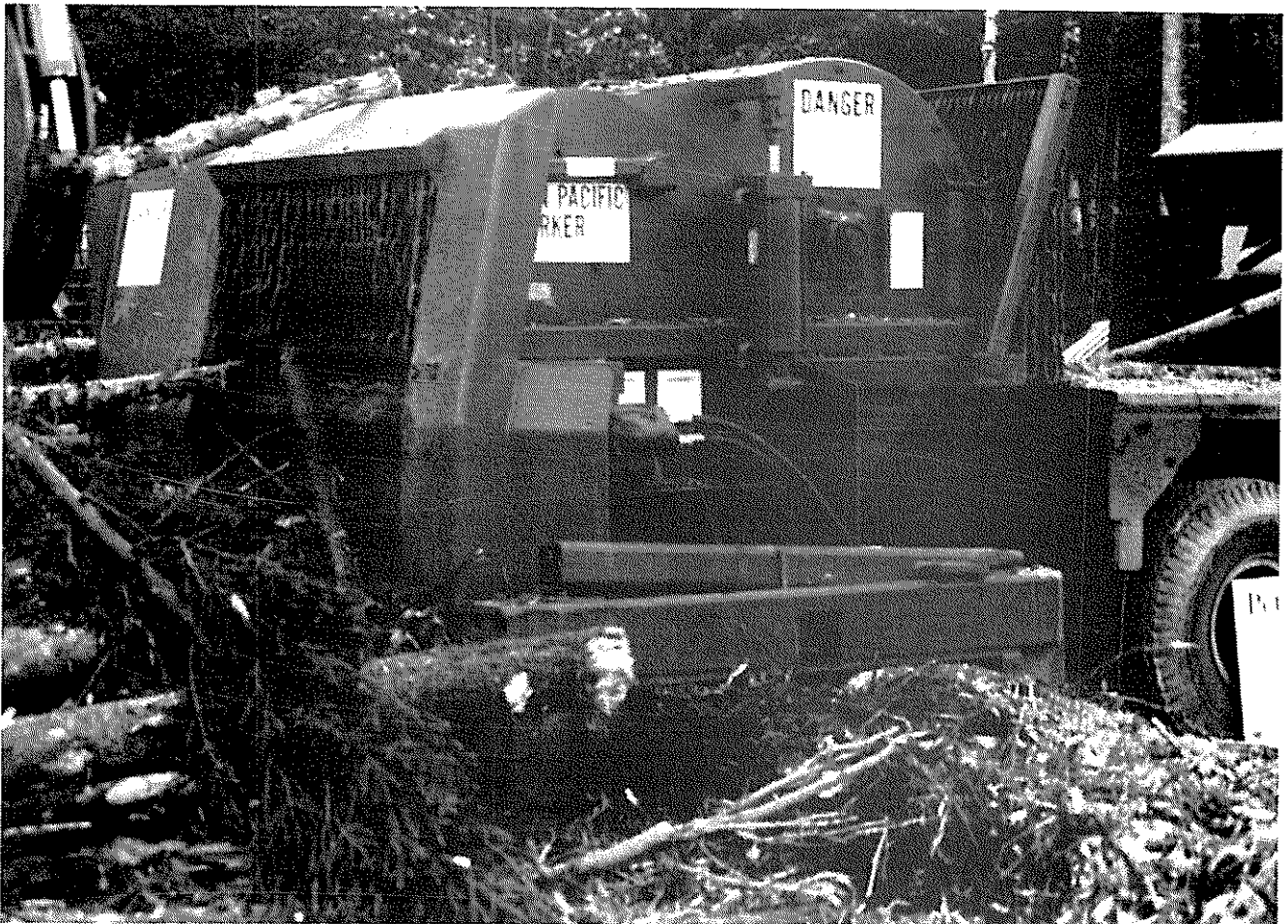


Figure 2 : Peterson Pacific Chain Flail Debarker

8. Review of Off-Road Processing Systems

This project was designed to investigate harvesting and processing in the bush, primarily for high density low volume stands. The objective of the project was to provide alternatives to roadside processing (with the inherent concerns of residue accumulation), and provide information on equipment better adapted for small trees. An in-depth comparison of different Scandinavian processor/harvester system configurations will be provided.

In 1988 4 different models were studied (and 7 models in 1987). A general Technical Note was published this year, and a full Technical Report is expected in 1989 summarising the studies completed in 1988. The project will also look at the feasibility of producing clean chips in bush.

9. Maintenance Information Databank

As a cooperative project with the University of New Brunswick, repair history data have been gathered from companies with computerised maintenance records. The objectives of the study are to identify the parts and labour costs associated with maintaining mechanised logging/transport systems, to determine relative component life and its effect on machine availability and maintenance costs and to isolate the major maintenance problem areas.

Titled the Forest Engineering Maintenance Information System (FEMIS) this project is ongoing. The project includes:

- Maintenance Management System which is ready to set up and install in a company situation.
- Contractor Maintenance Program. A review of current ownership policies and costing. (A Technical Note will be published).

10. Modular Machine System

The transfer of the concept to Canon Inc., Trois-Riviere, was completed in 1988. Modifications to the prototype included installing double oscillating bogies and modifications to the knuckle-boom and diff. position. FERIC will cooperate with the development of a 2nd generation prototype and provide engineering support on a contractual basis.

11. Comparative Analysis of Wood Harvesting Systems - Equipment Cost Model

This project was designed to bring together all previous FERIC productivity and cost studies to formulate a base model comparing various harvesting systems, and a set of correction factors for adjusting production estimates. An attempt is being made to standardise the information collected during field studies as input to the model to enable over time the validation of the functions of productivity etc. As far as equipment costing is concerned there appears to be no standard format (cf. the LIRA costing format) for the industry and one of the objectives of this project is to propose a standard approach to machine costing.

A report on progress to date is ready to be printed and in 1989 it is proposed to update the analyses.

12. Safety and Ergonomic Recommendations for Off-Road Equipment

Looking at:

- Mounting and access
- Cab dimension and visibility
- Air conditioners
- Anti-slip surfaces.

This project will gather literature from around the world, evaluate it in view of Canadian conditions and promote the implementation of those concepts that are applicable.

13. Robotics in Forestry

This is a 4 month exploratory project involving a literature review and interviews of inventors and manufacturers into future trends.

14. Databank on Logging Equipment

In cooperation with the CPPA, an on-going databank on logging equipment has been established, detailing industry-wide machine data, such as:

machine types,
makes,
populations,
locations, etc.

In 1988 FERIC researchers continued to update input data from direct survey of member companies. Since 1987 FERIC have had 25 enquiries/year. The databank holds 4000 pieces of equipment. It is expanding to cover large sawmills and currently includes equipment covering harvest of 30M m³/year. (The Eastern Canadian Annual Harvest is 80M m³/year).

B. TRANSPORTATION RESEARCH GROUP
(presentation by
Jan Michaelson, Reseacher)

Initial impressions are that

the Transport Research programme is a very long term one. It is heavily funded by the Federal Government of Canada due to the applicability of the results to all industries in Canada.

The budgets for many of the projects are large. The position of Group Supervisor is vacant. Daniel Ljubic is the senior researcher. He has worked with the programme for 7 years and previously was with International Harvester when Pacific Truck & Trailer was their off-highway truck Division.

A general overview of the transport programme was given. The FERIC Instrumented Truck was purchased in 1986 as part of FERIC's transportation research programme. The truck is a Navistar International (400hp) with in-built data acquisition system. Experiments have been undertaken using a 6-axle trailer from the Road Transport Association of Canada.

Truck Instrumentation

Temperature is measured by installation of 13 Thermocouples:

- Engine, Transmission and Differential Oils;
- Cooling System;
- Air Intake;
- Exhaust;
- Fuel System.

Other measured variables:

- Accelerator Pedal Depression
- Fuel Pump Rack Opening
- Engine RPM
- Front wheel angle of steer (potentiometer on power steering output shaft)
- Manometers (Pressure transducers on air intake)
- Distance travelled from the back of the

- transmission (to derive road speed)
- Fuel meter
- 5th wheel inclination (to derive road slope)
- Brake pressure indicator
- Wind direction and speed
- Torque meter (on drive shaft)
- Road roughness (using a motorcycle wheel)
- Distance travelled from front wheel (backup transmission distance and calculate slippage)

The sleeper is used to house the instruments and operator and is being redesigned at present.

The heart of the system is the Data Acquisition Computer, a MEGADAC 2200C. It has 128 channels and can measure up to 28,000 HZ. Usually use 40 channels at between 1/10 - 1/1000 second intervals. Data in voltage form is converted to digital and recorded on cassette. The storage computer has 66MB, hence with 40 channels at 1/10 sec have capacity for 11 hours of recording. The system is living proof of Murphy's Law (if anything can go wrong it will !).

Projects:

1. Energy Consumption

Contract with Transport Development Centre. In final reportage stage, the study aims to determine the important factors affecting air and rolling resistances on engine performance.

The study will enable operators to specify road and rig configuration and determine the effect on fuel consumption.

4 aspects:

- Driver Technique
- Road Profile
- Tyre Configuration
- Axle Configuration

and spacing

Testing was done in 2 parts:

In 1986 FERIC tested 36 drivers. This work was presented by Gordon Franklin at the 1987 LIRA Logging Roads and Trucks Seminar. An interim report was published in 1987. Results showed a wide range of drivers and fuel consumption results (from 48-63 l/100km) indicating the difficulty in classifying drivers. This led to decisions on criteria for evaluating driver performance. The objective of the study is to provide guidelines to improve driver performance (eg engine power [KW] vs engine speed [RPM] vs fuel consumption [l/hr]).

Another study involved measuring the performance of a trailer with dual tyres vs super single tyres at varying tyre pressures.

- * 4 grouped axles
- * 4 spread axles
- * 1 self steering and 3 fixed axles
- * 2 self steering and 2 fixed axles

Although fuel consumption was analysed, it was difficult to accurately measure wear and tear on trailer.

2. Whole Body Vibration on Trucks

This area is one of major concern due to back injury and other medical complaints of drivers. FERIC is testing various air suspension seats by measuring the vibration on floor before seat and also vibration on the operator (above seat).

3. Specialty Driveline Oils

This is a cooperative study with 2 oil companies, Transport Development Centre and FERIC.

Oil churning forces are measured to determine oil churning power loss at 80km/hr over a range of temperatures (-30° to +120° C) for two oils, a mineral 80w-90 oil and a synthetic 75w-90 oil.

Other factors are measured such as diff. losses and rolling resistance (through coast down measurement) then oil churning loss is separated to give friction losses.

The Differential Gear Friction Loss (kw) is then plotted against input power (kw) for the 2 different oils.

Tests were done on a straight road (-0.08% grade) at a constant speed (over 20-100km/hr range) for different loads on engine. Tests were done loaded and unloaded, during winter conditions.

Now FERIC will repeat tests during summer and also monitor a new type of oil to test its life.

An interim report is expected in 3-4 months.

4. Secondary Transport Seminars

This is primarily technology transfer of project results to date.

Subjects:

- Effects of grade on fuel consumption
- Graded vs ungraded roads
- Tyre Pressures
- Driver Techniques
- Oil Viscosity
- Diesel Fuels
- On board scales

5. Maximising Payload

Involving a contract with Transport Development Centre, this project is a simulation

exercise and it is expected to start testing in August 1989.

6. Simulating diesel engine performance

Objective is to estimate partial power curves instead of performance at full power. This project is on-going.

C. WOODLOT TECHNOLOGY RESEARCH GROUP

(Mike Folkema,
Group Supervisor)

Projects:

1. Winching, Skidding & Forwarding Equipment

Objectives of management are different for small woodlot owners. They tend towards smaller forest areas, fewer roads and smaller landings. One of the major projects was a review of forwarders. In the past work has concentrated on attachments for farm tractors. Now forwarders are becoming more popular.

- 1) Choice of Forwarder: General report on Loader type power and drive system.
- 2) Review of Forwarders sold.
- 3) Evaluation of TJ230 8 tonne forwarder (around since 1973).

2. Attachments for Skidders - Vimek 30

This Project is looking at the Vimek 30 processor which runs off the PTO linkage. A general handbook on how to install a PTO linkage on skidder will be published.

- ATV Track attachment to 4WD motorcycle
- Hydraulic winch for farm tractors

- Design of small woodlot skidder (60hp), featuring Hydrostatic drive, lower centre of gravity, more stable and narrower for thinning operations.

- Brush rakes on skidders.

3. Producing Fuel Chips and Debarked Chips

Small to medium size chippers: up to 10,000 tonne/yr. Some mills only want chips and not roundwood.

Jingsons combined delimber/debarker/chipper. Bruks also plan to put a model on the market.

4. Bridges for Woodlots

Looking at light duty bridges which are portable (for use over road washouts). Assembly and disassembly by 2 men, transportable in 1/2t Ute.

5. Low Cost Harvesters

Tapio 400 telescoping boom harvester. Plan to study in 1989 (Figure 3).



Figure 3 : Tapio 400 Grapple Harvester

UPDATE ON WESTERN DIVISION WORK PROGRAMME

Marv Clark, Western Division Research Director gave an update on recent work.

The staff totals 31 people (21 researchers and technicians), and 4 have been added since Spring. FERIC (West) is divided into 5 Research Groups:

Harvest Engineering;
Harvesting Operations;
Transportation and
Maintenance;
Engineering Design and
Silviculture Operations.

A. HARVEST ENGINEERING GROUP

- Ray Krag
(Group Supervisor)
- Doug Bennett
- Allan Bradley
- Greg Cox

Projects will concentrate in the areas of harvesting layout and planning in sensitive sites and in road building.

1. Ground Skidding Alternatives for logging steep slopes in the East Kootenays

Studying random skid access vs developed trails, as a result of regulations penalising site disturbance.

2. Road Construction and Equipment Studies

Objectives of this study are to evaluate the performance of new machines and excavator attachments:

- clam bucket
- v-blade
- Sandvik 2000 grader blade (carbide tips)
- Hydraulic drill rigs

3. Winter Groundskidding on Coastal BC Sites

Cooperative study with

Canadian Forest Service and MacMillan Bloedel. Objectives are to compare with conventional grapple yarding in large second growth, evaluate traffic loading with respect to soil compaction, cost and productivity. By monitoring site productivity, the aim is to enable better utilisation of the resource.

B. HARVESTING OPERATIONS GROUP

- Tony Sauder
(Group Supervisor)
- Jack MacDonald
- Rick Kooistra
- Bjorn Andersson
(on contract basis)
- Bob Breadon

1. High Intensity Lighting

Objective is to increase machine utilisation by providing lighting for grapple yarders. Lighting is via 9 lights at top of boom, 1 halfway down and 1 at rear. It may be possible to extend results to feller bunchers and drilling rigs.

2. Harvesting Economics

The objectives are to provide industry with the range of logging costs and productivities as related to tree size, log size, terrain and other factors. Also to develop a method that more accurately estimates the marginal costs of harvesting in order to determine economic utilisation standards for various logging areas.

In 1988, harvesting/economics studies will continue, concentrating mainly on the yarding phase of logging. It is planned to provide summary programmes for member companies.

3. Marginal Pine Harvesting Studies

Studies in Beetle infested stands in the Caribou area of BC. The objective is to determine the best systems and cost and productivity.

4. Equipment Evaluations

- Limmit delimber
- FERIC processor

5. Converting Alder Stands

Objectives to determine costs, productivity, product output and revenue when converting stands to coniferous species.

6. Grapple Yarding Bunched Second Growth

To date have studied 4 different grapples. Results showed that productivity was limited by grapple size. FERIC are undertaking a series of 3 studies:

- Handfall and yard
- Mechanical felling and grapple yarding
- Radio control chokers

C. TRANSPORTATION & MAINTENANCE

- Eric Amlin
(Group Supervisor)
- Eric Phillips
- Tony Wong
- Neil Marshall
- Peter Wild
- Dave Sudul

1. Truck and Loader Scales

Evaluation of commercially available on-board systems. This project is winding down and a Report is due out by early 1989.

2. Economic Analysis of Butt & Top Alignment of Log Loads

Objective is to evaluate the total costs and benefits of mixing butts forward and back on highway loads versus

hauling all butts forward.

3. Haul Route Analysis

Case study inputting road grade and alignment into Cummins VMS simulator and then monitoring actual truck operating performance, compared with projected performance from simulation.

4. Revenue Tracking Model

Objective to make hauling contractors more efficient and enable them to compete more realistically for contracts. The program is available for contractors as a financial management aid.

5. Automated weigh Scaling

Study into unmanned weigh-bridges in conjunction with BC Ministry of Transportation.

6. Non-asbestos brake linings

Evaluation of efficient braking systems for large off-highway rigs (135-140 tonnes GVW).

D. DESIGN ENGINEERING GROUP

- Jim Ewart
(Group Supervisor)
- Shamus Parker

1. West Coast Processor on Cable Log Loader

Designed to process wood from tree length grapple yarding, the processor has only been operating for a short time but successful so far. This is a cooperative project with BC Science Council and Johnson Industries Ltd.

2. Log merchandisers for Stroke Delimbers

This Project involves development of an acceptable measuring device for length and diameter. The objective is to develop optimising capabilities for stroke

delimbers. ENTEC Engineering Ltd are the co-operators and the devices are mounted on machines at Crestbrook Forest Industries.

3. Skidder Operator Restraint Device

FERIC (West) are currently

designing a seat with padded and contoured restraining arms. It was felt that seat belts were inappropriate for skidders, hence looking at a closing arm device with ratchet lock on arm and release lever. The seat pivots to exit either side of the skidder.

PROJECT PROPOSALS FOR 1989 : FERIC EASTERN DIVISION

The usual procedure is that through the Advisory Committee, the Industry presents areas of concern. FERIC then evaluate these in terms of their priority ranking. 1 (High) to 5 (Lowest). Some projects are also generated in-house (eg from field trips and researcher priorities).

In formulating the work programme there is obviously a need to obtain a regional balance and a balance of both research work load and company assistance.

A. WOOD HARVESTING

PROJECTS CONTINUING FROM 1988:

1. Air Conditioner Development

Since 1987, FERIC has been monitoring and assisting the development of a dedicated forestry machine air-conditioning unit based on a hydraulic-only principle.

In 1988, the assembly of the prototype unit was completed and was followed by mechanical resistance tests to assess durability. It was then mounted on a K3B feller-forwarder in July. The air conditioner was found to have good cooling capacity but had unacceptable noise and vibration levels. The prototype was then modified to solve these problems.

In 1989, monitoring of the unit's development will continue and further field tests will be conducted. A technical note summarising the development of the air conditioner to date will be published in early 1989.

2. High Speed Delimbing
(Monitoring of delimbing alternatives)

This project will continue to monitor developments of new

delimbing configurations. These will include various makes and models of flails and feed-roll delimiters. Also, new overall approaches such as using conventional stroke delimiters in the stump area and new designs to facilitate retrieval of full-tree piles will be examined.

Field notes will be published on new developments as they are encountered. A Technical Note on the productivity of flail delimiters is also planned for 1989.

3. Review of Off Road Processing

This project will continue to monitor and evaluate various systems to harvest and process trees in the stump area. In 1989, evaluations will continue on other Scandinavian harvesters, processors and processing heads which are introduced to eastern Canadian operations, especially those mounted on North American carriers.

As well, this project will examine operations which produce clean chips in the bush, using either flail-type delimeter/debarkers in conjunction with roadside chippers or using conventional delimbing and debarking technology in the stump area.

4. Safety and Ergonomic Recommendations for Off-Road Equipment.

In cooperation with the Logging Operations Group of the CPPA, this activity aims at developing a series of recommendations on the 9 safety and ergonomic priority items identified by the Woodland Section Council. In 1988, an advisory group with representatives from FERIC, the LOG, and health and safety

personnel was formed. Also, a joint workshop (FERIC/CPPA) on ergonomic concerns will take place in November 1988. In 1989, the group plans to develop a comprehensive set of recommendations, and work will start with the highest priority item.

5. Modular Machine System

In 1989, FERIC will continue to monitor the fabrication of the new prototype forwarder and to conduct field evaluations if the unit is tested in actual forestry operations. Some engineering support to CANRON may be provided on a contractual basis. As well, some design work will be continued on other configurations of the modular concept. Appropriate dissemination of the modular concept development will be made.

6. Comparative Analysis of Wood Harvesting Systems

The objective of this on-going activity is to compare the productivity and cost of different harvesting systems in typical operating conditions. In addition, it aims at providing guidelines to adjust production estimates in accordance with varying degrees of difficulty of the stands, terrain etc. Since many of the numbers and relationships were based on preliminary assumptions, it is proposed to update the analysis in 1989 with improved inputs as they become available from other field studies.

The information will be organised in a computerised database to allow easy updates and retrieval of productivity data. Further, the organisation and quality improvement of the baseline data will facilitate the development of an operational model of woodland operations.

Eventually, testing the model will involve cooperating closely with a member company to run the model using realistic data (cost, machines, road network, etc.).

WORK PROPOSALS FOR 1989:

In 1989, the wood harvesting group will seek to broaden the research coverage of all phases of the harvesting operation, while consolidating areas in which significant experience has already been acquired.

With this perspective, one major project will consist of taking a fresh look at the skidding phase in an attempt to optimise system configurations to minimise the cost of this component. New developments in delimbing, debarking and processing of both softwood and hardwood species will be examined closely.

Since forest companies are increasingly looking at harvesting techniques to minimise stand reestablishment costs, the work program includes evaluation of techniques and equipment designed to minimise site disturbance and protect advance regeneration.

All of the new information will be integrated into the on-going comparative analysis of harvesting systems. In 1989, special efforts will be made to organise the data in a computerised database format which represents an essential step towards future operational modeling activities.

1. Evaluation of feller delimiters

Equipements Denis & Harricana both have prototypes which are generating interest. The concept is applicable where roadside slashpiles are not acceptable, and where protection of advanced regeneration is a priority (Figure 4).

Also 1/3 of the leave strips must now be harvested hence a long reach feller-buncher is



Figure 4 : Denis prototype Feller-Delimiter

required, avoiding damage to natural regeneration. The Study will evaluate these new machines through both short-term and shift level measurements. Current concerns are with ability to fell trees 50' away (15m). Prospects are exciting: to fell, extract to delimber, delimb and bunch in tree lengths for skidder extraction and loadout.

2. Analysis of Novel Harvesting Concepts

Theoretical exercise looking at swing-swather-forwarder type of concept.

3. Fast moving wheeled Feller Bunchers

Review of what is available, update technology. Difference between large Koehring and small Forano BJ20 type machine. Ability to travel on road but also fast in

bush.

4. A Thinning Feller buncher/ Harvester

Formulating Design Parameters for outrow thinning in rough country. (Re-titled "Appraisal of Felling Concepts for Commercial Thinning").

5. Skidding Optimisation in Mechanical Harvesting Systems

While mechanical harvesting with feller-bunchers and skidders has become widespread, most of the research effort has been devoted to the felling component. Yet, the forwarding of the bunches to roadside is one of the most costly phases of the total system.

This project will attempt to determine the best approach to optimise skidding performance and reduce overall wood cost.

This will include studies of the bunch-slinging configuration using cable skidders in terms of number of strops and their length in relation to bunch and load size and related productivity. The project will also include a study of clambunk skidders in situations of long distance forwarding. Here, since bunch size is a less important variable, the emphasis will be on the operational layout and the work pattern of the feller-buncher and clambunk skidder to minimise loading and travel time.

Some work was done in 1985/86 on grapple skidders and this project will look more in-depth into the feller-buncher/grapple skidder relationship in terms of work pattern, operational layout and bunch size. In this study, variables such as machine operator, forwarding distance and variations in terrain will be controlled as much as possible. The results will be presented either in a large single technical report or in a series of technical notes covering different skidding configurations.

6. Analysis of Choker Types

eg Chains, nylon straps etc (Kevlar). The eastern Canadian forest industry is almost 100% cable strops. Also monitor development of the Johnson radio controlled choker.

7. Review of Wide Tyre Applications

FERIC has had a long-standing involvement in the introduction of wide-tyre technology to Canadian logging operations. While there appears to be adequate documentation on the benefits and operating characteristics of such tyres during skidding, certain con-

cerns remain regarding tyre life, winter performance, suitability for other applications.

This project will review user experience with wide tyres in varying applications particularly as regards to tyre durability. Additionally, the project will be extended to study the performance in snow and to evaluate the tyres suitability to alternate applications (eg 8-wheel clambunk, feller-bunchers, etc). If warranted, studies could be conducted to establish threshold conditions of economic utilisation of wide tyres.

This project is considered a reserve project for 1989 and will be activated if problems occur with another project.

8. Evaluation of Extraction for Commercial Thinning

9. Delimbing & Debarking of Hardwoods

The yearly harvest of hardwoods has increased tremendously in recent years both for pulp and as structural material (OSB, waferboard, etc). These species present special problems to harvesting equipment usually designed for coniferous trees, especially in the delimbing and the debarking phase.

Flail-type delimeter/debarkers or drum-type debarkers may be well suited to handle this kind of raw material. This project will study the performance and yield quality of this equipment working with hardwoods. It is planned to compare winter versus summer performance and also the influence of factors such as species and tree size on overall productivity. The results will be presented in a 1989 Technical Note.

10. Factors Influencing Maintenance Costs

Build on existing parameters.

11. Review of Field Service Facilities

Documentation of modifications and common patterns required.

12. System for Changing Saw Felling Head

13. Harvesting Systems Designed To Protect Advance Regeneration

With the responsibility for putting logged areas back into production shifting from governments to the industry, there is interest in harvesting techniques which protect advance regeneration.

Many companies, particularly in Quebec, have conducted trials to determine if their operations could be economically modified to suit this purpose. This project will review all work done on this subject and, possibly conduct field studies on some or all of the following techniques: predetermined skid trails and turning areas, widely-spaced skid trails, long-boom feller-bunchers, directional bunching, use of wide-tyres, use of feller-forwarders and forwarders.

14. Multiple Product Harvesting

In many areas, more than one merchantable species must be harvested and separated for different end use (eg softwood for pulp and lumber, aspen for waferboard and pulp, other hardwood for lumber or fuelwood, etc). This requires that a sorting phase be inserted somewhere in the harvesting process.

This project could examine the various sorting options

in cooperation with member companies who have to deal with such a problem and determine which is the most viable in a given set of conditions or with different end use requirements.

In addition, sorting affects the logistics of the landing organisation (ie pile position, size, arrangement). Thus some time will be spent studying the way piles are made at the landing and its related effect on delimbing, slashing and loading where applicable.

15. Work Measurement System for Machine Operators

Looking at Rating operators. There are problems as to methods of rating (eg BS100). The alternative is to look at reasons why operators are different.

16. Variations in productivity of Night vs Day Shift

17. Effect of Systems on Fibre Recovery Efficiency

Fibre recovery may be less important than value maximisation.

18. Operational Modelling

Assessing the impact of changes in raw material specifications. Basically a computer project, FERIC have a University cooperator, and are also involved with National Research Council.

B. SECONDARY TRANSPORTATION

Roading is not a major project area for FERIC Eastern Division. They will probably be looking at outside expertise on cooperative projects.

1. Evaluation of Road Surfacing Options

- Mobile crushers etc.

2. Effect of Trucks on Roads

Theoretical analysis of road deformation etc. Work in conjunction with Rob Douglas (University of New Brunswick).

- Optimum log (tree length) loading patterns.
- Use of weight scales.
- Investigation of legal axle and total weight limits.

Expertise in this field will have to be developed at the Eastern Division with the help of the experience of the Western division.

3. Dust Stabilisation on Forest Roads

Mainly a safety problem. In the past options such as waste oil and spent pulping liquor have been tried.

8. Effect of Trailer Configuration on Haul Cost

This project is designed to look at effect on payload and then convert to \$/tonne.

4. Road Construction Techniques

Mainly of in-house benefit to FERIC, the study involves a review of state-of-the-art road construction techniques.

9. Organisation of Control Systems

The objective of this project is to design a truck control system for Eastern Canada.

5. Reduction of Waiting Time during Loading

- Reducing traffic flow around loading site
- Truck : Loader ratios
- Fleet Control systems (eg MB's Truck Monitoring System)
- Self Loaders (removeable?)

10. Log Truck Transportation Simulation

The objective is to develop a comprehensive tool for making decisions regarding haul road construction alternatives or road improvement, selecting optimum tractor or trailer or tractor/trailer combination for a given haul road and assessing hauling costs for any given road, truck and driver combinations. The simulation model will integrate the results developed by FERIC over the last six years (as well as those published by others) and is a logical continuation of the Eastern Division's truck transportation program.

6. Review of Loading Systems

- Grapple type
- Log types
- Species separation, sorting options

There is some interest in merchandising in conjunction with off road processing.

7. Maximising payload

This wide ranging project is generally aimed at optimizing truck transport within provincial weight limits. The specific areas to be addressed will include, but will not be limited to:

- Investigating various (lighter) trailer designs for Eastern Canada (including pole trailers).
- Reducing tare weight.
- Axle number and spacing.

In 1988/89 a model will be developed and subsequently refined as additional road tests are being carried out and as additional data are gathered on other cost factors.

11. Full Tree Transport

Assemble information available.

12. Truck/Trailer Specification Manual

Refine figures to guide purchasers.

13. Truck Suspension Systems

The aim of this study is to evaluate systems in terms of:

- : Performance
- : Durability
- : Stability
- : Dampening

CONCLUSIONS

The Work Programme of the Eastern Division of FERIC is a large one. Several projects have direct relevance to the New Zealand logging industry. From a survey of major industry organisations and companies in July 1988 the following ongoing FERIC projects in Wood Harvesting were identified as being of major interest (in order of priority):

- Comparative Analysis of Wood Harvesting Systems
- Feller Bunchers in Adverse Conditions
- Off-Road Processing Systems
- Contractor Maintenance and Ownership Policies

In Transportation Research, the projects of major interest were:

- Log Truck Transportation Simulation
- Energy Consumption of Heavy Road Vehicles

- Maximising Payload

There was very little interest in any of the Woodlot Technology project areas.

As a way of continuing the closer contact between LIRA and FERIC, an exchange of researchers has been organised between the two organisations.

LIRA researcher Keith Raymond will be working at FERIC (East) in Montreal from April 1989 to April 1990. His work will involve research in the following project areas:

- Monitoring of Delimbing Alternatives (High Speed Delimbing)
- Review of Off-Road Processing Systems
- Comparative Analysis of Wood Harvesting Systems

The details regarding timing and project work of the FERIC researcher at LIRA is still to be confirmed.

WOOD HARVESTING PROJECTS : PRIORITY RANKING

(Ranked 1, highest priority to 18, lowest priority)

	<u>Overall Priority</u>
A. <u>Felling/Harvesting</u>	
1. Evaluation of feller-delimbers.	[5]
2. Analysis of novel harvesting concepts.	[12]
3. Medium-sized fast moving wheeled feller-buncher.	[10]
4. Appraisal of Felling Concepts for Commercial Thinning.	[6]
B. <u>Skidding/Forwarding</u>	
1. Skidding optimisation in mechanical harvesting systems.	[1]
2. Analysis of choker types.	[18]
3. Review of wide-tire applications.	[7]
4. Appraisal of Extraction for Commercial Thinning.	[8]
C. <u>Processing/Delimbing</u>	
1. Delimbing and debarking of Hardwoods. (Peterson chain flail)	[3]
D. <u>Maintenance/Ownership</u>	
1. Factors influencing maintenance cost of forestry machines.	[13]
2. Review of field service facilities.	[14]
3. System for changing felling head saws easily, safely.	[16]
E. <u>Systems/Infrastructure</u>	
1. Harvesting systems designed to protect advance regeneration.	[4]
2. Multiple-product harvesting.	[2]
3. Work measurement system for machine operators.	[17]
4. Variations in productivity of night shift and day shift.	[15]
5. Effect of harvesting systems on fibre recovery efficiency.	[11]
6. Assessing the impact of change in raw material. (Comp. Analysis)	[9]

SECONDARY TRANSPORTATION PROJECTS : PRIORITY RANKING

(Ranked 1, highest priority to 18, lowest priority)

	<u>Overall Priority</u>
A. <u>Roads and Bridges</u>	
1. Evaluation of road surfacing options.	[2]
2. Effect of Trucks on Roads.	[14]
3. Dust Stabilisation of Forest Roads.	[17]
4. Evaluate Road Construction Techniques and Cost.	[5]
5. Improving performance & application of graders.	[19]
B. <u>Loading and Unloading</u>	
1. Reduction of Waiting Time During Loading.	[9]
2. Review of Loading Systems.	[6]
C. <u>Truck Transportation</u>	
1. Maximizing Payload.	[1]
2. Effect of Trailer Configuration on Haul Costs.	[3]
3. Organisation of Control of Truck Transportation Systems.	[7]
4. Log Truck Transportation Simulation. (Transport Canada)	[4]
5. Full Tree Transport.	[21]
6. Power Assisted Trailers.	[23]
7. Mechanical Chip Sampler.	[22]
8. Truck/Trailer Specification Manual.	[10]
9. Driving Techniques Manual.	[11]
10. Investigate New Engine Technology.	[20]
11. Comparison of Truck Suspension Systems.	[12]
12. Evaluation of On-board Event Recorders.	[18]
D. <u>Fuel and Lubricants</u>	
1. Evaluation of New Fuels and Fuel Additives.	[15]
2. Evaluation of Coolants & Coolant Additives.	[16]
E. <u>Truck Repair and Maintenance</u>	
1. Evaluation of Variable Maintenance Costs.	[8]
2. Evaluate Performance & Reliability of Braking Alternatives.	[13]

FERIC ADVISORY COMMITTEE ON FOREST ENGINEERING RESEARCH (ACFER):

Meeting Attendance List

September 13, 1988

Loews Le Concorde, Quebec City

Mr Bob Armstrong - (E B Eddy, Ontario)

Mr Norm Baird - (CIP, now Canadian Pacific Forest Products Ltd)

Mr Ron Dixon - (DOMTAR, Dolbeau)

Mr Peter Jackson - (Stora Forest Industries)

Mr Bill Jonas - (Manfor, Manitoba)

Mr Ed McLeod - (Boise Cascade)

Mr Len Arvelin - (CPFP, Thunder Bay)

Mr Don Myles - (Canadian Forest Service, Ottawa)

Mr Dave Puttock - (Univ. of Toronto)

Mr S Lariviere

Mr Mo Walsh

Mr B Sauder - (McMillan Bloedel, Vancouver)

FERIC StaffEastern Division

Daniel Guimier
Ernie Heidersdorf
Jean-Francois Gingras
Jan Michaelson

Western Division

Vern Wellburn
Marv Clark
Tony Sauder
Eric Amlin
Jim Ewart
Jack Macdonald