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EVALUATION OF ASICAM FOR TRUCK SCHEDULING IN NEW ZEALAND

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ABSTRACT

ASICAM is a truck scheduling programme developed in Chile and currently used by seven forestry companies. This report briefly describes the system and how it is operated in three companies; Bosques Arauco, Forestal Rio Vegara, and Forestal Bio Bio. The system would work in New Zealand with few modifications. The additions of links to Geographical Information Systems (GIS), Global Positioning Systems (GPS), electronic data transfer to trucks, and company information systems are options that should be considered.

INTRODUCTION

The ASICAM name translates to Assign Truck. The program produces a daily plan in advance for individual trucks by assigning loads and trips, whilst satisfying supply and demand constraints. The objective is to minimise total transport costs for the firm. An important consideration in minimising costs is to minimise the size of truck queues at supply points and destinations, hence the program also schedules the work program of loaders.

The first version of ASICAM has been used by Bosques Arauco for over a year,

and a second upgraded version has been released. The advances in the new version are the use of pull down menus and incorporation of data entry and editing in the main program, rather than the use of a separate database system.

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DESCRIPTION OF THE ASICAM SYSTEM

Inputs that are considered are; the amount of each log product available at each forest origin (loader), the trucks of different types and classes available, the loading, unloading and travelling times, and cost parameters which include operation and utilisation of trucks. Trucks are divided into types and classes. Type reflects mainly load capacity, and class refers to engine characteristics which indicates the possibility to travel with loads on certain roads. Other considerations are also included, such as defining a lunch break, having drivers start and end their schedule close to home, assigning priority to some

products, fixing specific origins or destinations to some trucks, etc.

The simulation replicates how and where the timber moves during the day, given heuristically designed scheduling rules. Thus, for example, the simulation starts at 6.30a.m. assigning the first trucks. The assignment rules are based on the following criteria:

- Fulfilling demands has the highest priority. In addition the demand must be satisfied regularly along the day (e.g. 4 trucks arriving every hour).
- Supply at origins. If some products are not moving fast enough from an origin, a truck should be sent there.
- For administrative reasons, total income in a month should be similar for all trucks of the same class and type. This implies assigning the most profitable daily schedules to specific truck owners who have not been favoured in previous trips.

During the planning, the heuristic rules assign each truck after unloading to its next destination in an optimal way. In order to avoid near-sighted decisions, the scheduling looks ahead one hour, and firmly schedules decisions of the simulation for the first 15 or 30 minutes. This is carried on through a moving horizon from through to the end of the day.

A detailed description of ASICAM can be found in a separate document "A Truck Scheduling System for Forest Operations" (Weintraub et al, 1991) held in the LIRO Information Centre.

IMPLEMENTATION

The system is written in FORTRAN and C for use in personal computers. It

requires 640Kb RAM and functions better with a hard disc. An information system is used to input data daily, in an efficient and user friendly way. At present, the simulation process has the capacity to handle 200 trucks, 50 origins, 20 destinations, 20 types of products, 15 classes of trucks and 4 home nodes where drivers spend the night. These dimensions are enough to handle current problems, but can easily be increased.

The computer requirements are moderate. Using a PC/AT with a math co-processor, the larger problems require about 20 minutes to solve. The software generates daily schedules for each truck and loader. For example, truck 1 start at 7.32 a.m. in origin C, after loading leave at 7.50 a.m. to destination 4, arrive at 8.57 a.m. unload, etc. For a loader for example, 6.45 a.m. load truck No. 62, 7.05 a.m. load truck No. 5, etc.

Several reports are produced :

- an overall summary of utilisation of trucks and loaders, logs delivered and outstanding deliveries to customers.
- summary statistics for each origin and destination.
- a schedule for each truck giving arrival time at each origin and destination, product to be moved, service time by loader, destination.
- a schedule for loaders at each origin giving order of truck arrival, service time for each and departure time. The destination and product to be loaded is also given.
- a schedule of unloading at each destination giving order of arrival and service time for each truck.

Schedules are given the day before to truck drivers and machine operators. In

the case of breakdowns or unforeseen events, the operations centre redistributes the work manually.

The key to the system is that the order and times on the plan must be followed. Dispatch men are instructed not to allow a loader to service a truck until the time specified on the plan. If there are any delays, the plan is still followed unless changes are made by the Transport Control Centre.

The daily plan is considered to be a success if 80% to 90% achievement occurs. Some minor modifications are made during the day to overcome any problems. If a problem cannot be overcome, then work is re-scheduled in the next day's transport plan.

Each truck and loader that is controlled by ASICAM carries an identification sign. For trucks the sign is on the top left of the cab guard behind the driver. The identification system is used by dispatch men and weighbridge operators to distinguish trucks. The signs are painted with reflective paint for night visibility.

Initially, there was strong transport contractor resistance to the introduction of ASICAM in all companies. Meetings had to be arranged to explain the system and convince them in the long run that they would benefit. Although the number of trucks used by a company would decline, utilisation and revenue to contractors would increase. Different policies have been implemented among companies on how the costs savings are shared between the company and transport contractors. It is important that a policy on this issue be developed before ASICAM is introduced.

BOSQUES ARAUCO

The Transport Control Centre (TCC) coordinates operations for 50 origins and 20 destinations. About 1.5 million m³

annually is carried by a fleet of 120 trucks. The average haul distance is about 50 km with a maximum distance of 120km to the export port.

Three staff work at the central transport control office at the weighbridge at a central processing yard. At the TCC, one person operates the radio, whilst two others enter data and generate the daily plan. Only two people are required, but an extra one is needed to cover for illness, holidays, etc. There are also 3-4 company employed transport supervisors who liaise with transport contractors in the forest.

Each crane that services skidder crews has a dispatch man with it full time. One dispatch man controls load out from 2-3 yarders. The dispatch men's responsibilities are:

- to provide daily data on stocks and production for each crew
- To fill in dispatch documentation
- To dispatch trucks according to the ASICAM plan
- To secure wood against theft

The dispatch men are employed by the transport contractors. The transport contractors own from 5 to 20 trucks and have their own supervisors who are in radio contact with the TCC. Trucks and loaders are not in direct radio contact with the TCC.

Each day after noon dispatch men start calling in stocks to transport control. They estimate what the stocks are likely to be first thing in the morning, given current stocks, expected production and loadout for the rest of the day. The estimates are based on experience. Dispatch men also notify the TCC of any problems there might be in road access to the area, breakdowns or downtime by the logging crew or loader.

Demand for each mill by product type, is also sent to the TCC via the transport manager. Contractor transport supervisors call in the availability of trucks for the next day's work.

All the data is entered into the ASICAM system. The problem is then run through ASICAM to find an initial plan. The plan is checked to ensure that all demand is satisfied and that there are no major errors. Almost always, more runs will have to be made. The operator has the power to alter and fix routes as necessary, or as he thinks may give a better solution.

The transport schedule for trucks is given to the transport supervisors each night who distribute it to each driver. The dispatch men pick up the loaders' plans from the control office. The schedule for each destination is also sent out.

Benefits to Bosques Arauco

ASICAM has been successful in reducing queues and improving truck and loader utilisation. This has reduced the number of trucks and loaders required. ASICAM has achieved the following results :

- in unloading areas, loaders were reduced by 40 %
- 16% lower queuing time per truck
- 10% to 20% decrease in truck fleet
- unproductive trips reduced by 20%

Bosques Arauco estimates that it costs an additional \$US 0.08/m³ to use ASICAM. The only additional cost to the company at installation was hardware (radios and personal computers) and employing people at the TCC. The dispatch men were not an additional cost as they were already employed.

FORESTAL RIO VEGARA - NACIMIENTO

Forestal Rio Vegara (Forvesa) has used ASICAM to schedule daily since February, 1991. Annual production from company forests is about 700,000 m³/year, most of which is processed through the central processing yard at Nacimiento. The average haul distance is about 70km. Forvesa use 120 trucks to carry wood from eight origins to seven destinations.

Eight staff are employed to manage transportation. Two staff work in the Transport Control Centre. One is the principle operator of ASICAM. He enters ASICAM data, mans the radio and generates the plan. The other operator is an assistant who is there to cover for the main operator. He helps to collect data and statistics for the system and does other tasks for the transport manager. In the forest there are six dispatch men. Four are located at exit points of major forests. They fill in dispatch documents, control service order and act as security guards. Two others collect and report daily production and stocks. Forvesa currently use 9 Yarders (each with a rubber tyred loader), 30 skidders and 8 crane loaders.

The daily routine for using ASICAM is the same as at Bosques Arauco. Some results of using ASICAM are:

- number of trucks reduced from 200 to 120
- drivers have to work less for more pay
- the transport managers know exactly how much wood is in system
- the company is better able to plan yard closures for maintenance

- the company can use ASICAM to plan truck requirements a season ahead
- more orderly arrival trucks at destination

FORESTAL BIO BIO - CONCEPCION

Forestal Bio Bio had to make greater administrative changes in order to be able to utilise ASICAM. Transport operations prior to ASICAM were controlled by 4 regional transport co-ordinators. Inefficiencies in dispatch were occurring because there was no co-ordination between regions. In order to overcome these problems and to install ASICAM, centralisation of the operations needed to occur. A new senior management position was created with sole responsibility for transport. Previously, transport had been the responsibility of the logging production manager. The transport manager became responsible for the transport operations centre located in Concepcion. Eighteen dispatch men are employed by Forestal Bio Bio as well receivers at each destination.

Forestal Bio Bio produce about 500,000m³ annually from their forests. The wood comes from 20 origins and is carried by 75 trucks to 7 destinations.

Daily procedures are similar to other companies. Stocks are called in after midday and recorded on to a stock sheet. A unique feature of the Forestal Bio Bio approach is that the daily loader schedule is given to the trucking contractor's transport supervisors. The loader's schedule is given to the first truck scheduled to arrive at the forest in the morning. The driver gives the schedule to the dispatch man.

Forestal Bio Bio have a management reporting and control system associated

with ASICAM. Each day the Transport Controller records all events and communications in a log book. At the end of the day, he completes a form that compares planned versus achieved production. The report is delivered to the transport chief each day along with reasons for deviation from the plan. In this way, deficiencies can be quickly identified such as need for more trucks, excessive delays in loading, road closures or access problems. In the future it is hoped to send this report to each transport contractor.

Each day the transport manager also receives a report on volume delivered to each destination, the percentage of the order that has been fulfilled and the daily volume required to meet the order by the date required.

Forestal Bio Bio estimates that it costs \$US0.14/m³ to administer transport operations. Not all of this cost is required to run ASICAM, as the cost of dispatch men includes other duties such as security and documentation.

In order to compare the use of ASICAM with previous operations, statistics for the three month summer period in consecutive summers were collected (Table 1).

Although unit transport costs rose almost 10%, inflation in the corresponding period rose 21%. In real terms, this indicates that transport costs decreased by 11%. The transport costs per unit does not include administration cost.

FUTURE DEVELOPMENT OF ASICAM

There is on-going development of the software. Dr Weintraub and Rafael Epstein are progressively making incremental changes to the software. Future developments that his group are working on are:

Table 1 - ASICAM cost comparison

	Before ASICAM Summer 89/90	With ASICAM Summer 90/91	Difference
Number of origins	17	23	23.19%
Number of trucks	135	55	-53.52%
Volume/month (m ³)	50092	41187	-17.78%
Volume/truck (m ³)	423.3	748.9	43.47%
Transport cost (US\$/m ³ /km)	0.086	0.095	9.80%
Inflation index	116.63	148.25	21.33%

- development of on-line ability to create a modified plan during the scheduled day. This would mean re-running ASICAM to get a new daily schedule that has minimum changes to the original plan (i.e. re-scheduling only part of the truck fleet).
- improving the algorithm that assigns trucks. At present this is done using a series of logic rules.
- developing graphical interactive output that shows results during and after each simulation run and allows modification.
- incorporation of rail transport.
- co-operation of all parties involved
- transport controllers experienced in field operations and the use of personal computers
- accurate database of load, unload and travel times and costs
- a commitment to follow the daily plan

The introduction of computer aided truck dispatch has had benefits to all parties involved. Truck contractors have had utilisation, productivity and profitability increased. Logging contractors benefit by improved clearing of log stocks from landings, thus minimising delays caused by excessive log stocks and loader interference. The forest companies benefit by having lower overall transport costs and better customer service. There is also less conflict between loader and truck drivers regarding fair distribution of work.

CONCLUSIONS

ASICAM cannot be solely seen as a software program but also as an administrative system for transport management. Requirements for successful application are:

- centralised control of transport
- good communications between forest operations, transport contractors and wood buyers

SUITABILITY FOR NEW ZEALAND CONDITIONS

ASICAM does not entirely suit the needs of some potential users in New Zealand. However, others have indicated that it

would be suitable for their needs with little modification. Some New Zealand companies who run large truck fleets are seeking truck dispatch systems that have real time response. Instead of daily planning as in ASICAM, a system is required that will provide information and suggestions for trips when each truck calls up for more instructions. The reason for this is that logging managers prefer to keep stocks low in order to minimise inventory costs and reduce the risk of holding unwanted products if demand or product types change.

In the future, it is expected that truck dispatch will be linked to Geographical Information Systems (GIS) so that positions of trucks and stocks can be located on a screen map. Global Positioning Systems (GPS) would also be a future option.

Truck dispatch systems of the future will also probably use electronic data transfer via cellular phone or radio networks. Instead of voice communications, trucks would use an on-board computer or digital display to send and receive instructions.

As New Zealand companies prefer to use owner/operator contractors, their business survival must be protected. ASICAM would also require modifications to ensure that each truck gets an even distribution of work. The implementation of this additional constraint may imply an increase in transport cost.

Potential users in New Zealand have also expressed a desire that dispatch systems should be integrated with other company information systems. The system would link to weighbridge or scaling records, accounting and payment of transport contractors and loggers, and provide various production reports to managers. ASICAM does not offer this functionality.

REFERENCE

Weintraub A., R. Epstein, R. Morales, J. Seron, P. Traverso (1991) : "A Truck Scheduling System for Forest Industries". University of Chile. Santiago

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