SCHEDULING AND CONTROL OF LARGE-SCALE THINNING OPERATIONS

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ABSTRACT

The South Australian Government forests of the south-east of South Australia are used as an example of thinning operations control.

Three stages of control action are used to co-ordinate long term forest development requirements with needs of utilisation plants subject to short term changes in demand.

Existing established harvesting systems and the recent development of greater mechanisation are compared. Alterations in control and scheduling of operations to handle these changes are proposed and discussed.

CURRENT CONTROL SYSTEMS

Control of large scale thinning operations as exercised by the Woods and Forests Department in the south-east of South Australia is a 3-stage process. These forests currently produce 640 000 m^3 annually for locally based utilisation plants.

Basic Control — Cutting Plan

Stage 1 is the production of a longer-term cutting plan (Lewis, 1971). The data for this plan, usually organised for 5-year intervals, is derived from inventory surveys, well established growth trends for the range of silvicultural practice that is acceptable and the forecasted demands of industry.

Continuous recording of data over a number of years from permanent sample plots within a range of thinning intensity that more than covers established practice has built accurate data on yields and growth rates for all sites in the forests of south-east South Australia.

Areas of forest theoretically due for thinning are checked against records of operations to determine inclusion in the proposed programme and desired timing of thinning for silvicultural purposes.

Expected yields from the planned operations are checked through a series of yield plots by marking according to current practice and measurement of the volume of trees so marked for thinning.

Areas are roughly listed in combinations designed to approximate annual demands of total volume and individual product mixes.

The process requires a degree of exchange to achieve the correct balances and is ideally a combined effort by planning and operational staff.

Now with the aid of computers the plan is refined by "growing" each forest area

to its projected time of thinning. There is now no doubt that but for variations in demand levels and forest accidents these plans would require no further adjustment. In fact we could allocate to the utilisation plants involved and take no further action.

Part of the control system necessary to ensure the level of accuracy desirable is the maintenance of records of all exploitation work done. In our situation this is built into recording systems for other administrative control. For the purpose of this explanation it involves regular summarising of output by compartments and products, recording stocking levels after each operation and areas of each operation.

The vital final document is a continuous compartment record with accompanying map showing an outline of each successive operation entered at half-yearly intervals as follows:

Record of Timber Exploited

Plantation | Forest Reserve Cpt. | Species | m^3 | Net Area

Date	Area Trtd	Opn	Pulp	Presn	Sawlog <25cm	Sawlog 25-35cm	Sawlog >35	Total	Total Vol/ha	Stocking/ha	Remarks

Remarks are intended to include items of particular value for future harvesting. These include notes on access and product potential in particular.

The aim is to develop a level of advance information defined as of use for future harvesting operations for incorporation in successive plans.

Stage 2 provides a schedule for the user covering 12 months immediate future work. This is a reasonably recent introduction and is largely the result of cutting plan accuracy now achieved. We have yet to develop stage 2 to the fullest extent, partly because of the need to educate harvesting personnel in its use and partly because our cutting plans are not yet always concurrent for all districts in the region.

Intermediate Control — Review and Breakdown for Application

Stage 2 requires a break up of the coming year's cut allocation to provide individual schedules for each of the utilisation organisations.

It provides an automatic annual review of progress and so emphasises deficiencies either in our operational control or in the plan itself. In exceptional situations, where market conditions have drastically altered or where salvage of a forest catastrophe has intruded it is a stage where a major review of remaining cutting plan data may take place.

It provides advance information to the user of size, quality, accessibility and any other factors relevant to his raw material. He is then able to adjust his intake to meet immediate needs, balance his log costs and programme harvesting according to his desire without unduly affecting forest development inherent in the 5-year cutting plan.

The production of this schedule is done by forest operational staff but finalisation follows consultation with the user who is given an opportunity to request adjustments. Consultation proves to be a valuable exchange of views and encourages a useful degree of advance planning on the part of the user previously unattainable. In our situation where harvesting operations almost always produce combinations of raw material for more than one user this schedule provides updated estimates of each by-product. The user

is able to see clearly the quantity and effort required in production of material in which he has only a passing interest while he harvests his own requirements.

The major by-product in sawlog operations in the south-east of South Australia is pulpwood, which for reasons of economics and acceptable forest utilisation is always extracted simultaneously. The review of pulpwood output as a by-product therefore provides additional information of use to forest management by defining likely progress of planned pulpwood-only thinnings.

Although only major licencees are receiving and using this annual schedule to date, I expect provision to be extended to all users including Departmental mill management and to logging contractors where applicable. To some degree the extension of this planning service will depend on the ability of some of these to make use of it. There is a need for some internal industry education before all involved can be expected to use it to the extent that justifies the effort. It is understood by all involved that salvage operations resulting from fire or storm take precedence over all control plans. Such operations in progress at the time of preparation of annual schedules are included. Subsequent salvage simply replaces the schedule and causes the production of a revised plan in due course.

Consumer Influence on Control

Stage 3 provides for immediate minor variations to plans dependent on market demands. Usually determined on a forward weekly basis with some tentative indications for a forward 4-week period this attempts to cater for fluctuation caused by changes in consumer ordering, and mill production. Most frequently these changes involve alterations in the log product mixture either due to changes in demands by one user compared with another or because changes in total volume involve changes in log dimensions.

The ability of the organisation to adjust rapidly to these short term changes with minimum effect on the longer term plans is essential to both forest and utilisation industry.

Carrying out the State Forest Policy (Woods and Forests Department, 1971) requires an active continuous thinning policy and utilisation of as much stem material as is possible within current economic technology. It is therefore necessary to give preference in our harvesting operations to thinning operations before clear felling (other than salvage of damaged trees).

In the process of developing the forests of this area a complex of utilisation plants has been established using the whole range of log dimensions which are produced from these plantations. Briefly the small dimension log provides pulpwood, particle board material and round material for preservation plants. This absorbs most of the stem between 100 mm and 200 mm diameter and is derived from first and second thinnings predominantly. The range of material from 200 to 350 mm provides raw material for pulpwood and sawlog dependent on stem form with the larger and straighter material naturally directed towards the latter. Production is from second thinning and upper stems of third and fourth thinnings.Alterations in proportionate levels of demand are frequently catered for by adjusting delivery points for material produced in this range. It provides an area of flexibility used in practice to absorb shock changes in total volume demand or relative pulpwood/sawlog demand until labour relocation can be instituted to adjust to the change. Above 350 mm provides sawlog and the minor quantity of peeler material committed, and is produced from fourth thinning onwards to clearfelling.

At present the labour force required to cut log at the rate demanded is in the order of 240 fallers, in south-eastern South Australia's State Forests. This level of labour is approximately that which is capable of producing the average current volume demanded while operating within the areas designated by our prepared plans. We have adopted the practice of adjusting to short term changes in volume demanded by relocation of fallers. This arrangement of altering total output by changing the proportion of labour in areas of greater or lesser productivity has had three benefits:

(1) It removes the difficulty of replacing for peak production labour lost during times of low demand.
(2) It provides sufficient labour to cope with all required thinnings, even the least productive, whenever demands for output are low. Thus it improves the opportunity to maintain balanced forest development through thinning.
(3) It maintains morale in the workforce by providing a level of continuity of employment and earning level.

On the other hand the major disadvantage is that delivered wood cost rises with depressions in demand, the reverse of a desirable profit situation for utilisation plants.

In the process of developing this control mechanism we have learned a considerable amount about factors affecting felling productivity. Information on mean removed stem volume is now being incorporated in cutting plans as an aid to such control. This is a local development of the system earlier established by Whitely (1969). Current productivity levels are 0.5-7.0 m^3/man hour with the variation greatest in the first to fourth thinnings. By the time thinned stems reach volumes of about 2 m^3 little alteration in productivity occurs whether the operation is thinning or clearfelling. Increased mechanisation is lifting these levels and reference to the subject is made later in this paper.

The bulk of operational staff time is taken up defining and implementing stage 3 in the system.

Bearing in mind that stage 1 is based on careful consideration of the requirements of both forest and user and a regular periodic review is covered by stage 2, the greater part of daily effort can be safely devoted to immediate problems arising from a number of uncontrollable reasons. Providing these adjustments are achieved within the stage 2 control system no irreparable damage can be done regarding forest development. One of the problems associated with implementation of this stage is the change in thinking required by staff who in our situation are forestry rather than industry trained. While stages 1 and 2 fall within the area of non-urgent long term thinking inherent in forest management this last area of control requires an urgency more often related to manufacturing and business in our society. The required operational harvesting management staff are therefore ideally "schizophrenic" characters able to operate with an alternating sense of deliberation or urgency.

The urgent nature of our control is entirely related to the need within utilisation plants to react quickly in a variety of changes in circumstances if they are to be profitable. It is probably fair to say that in most plantation forest enterprises action taken to assist the profit capacity of its dependent industries is essential if we are to maintain the economic viability of the whole wood producing industry. Certainly at present when competition for investment is high it is in our interests to make certain we act in a

manner that makes the industry at least one of the acceptable alternatives to investors, government or private.

It is this philosophy that is uppermost when we exercise day by day control in stage 3.

CONTROL OF OPERATIONS

Forest Care

The control mechanics begins with selective thinning of plantations where marking, according to specifications determined at or before stage 1, is done by trained field staff. Although this is a relatively expensive process part of the cost is offset by the degree of control and record data subsequently used as a planning aid. Alternative systems are used only on a trial basis and periodic evaluations are made of their effect on forest development and landed wood costs.

The other extremity of thinning control such as non-selective row thinning or faller selection certainly produce cheaper landed wood in the smaller and less valuable grades. At the same time these systems detract from the capacity to produce larger and higher grade raw material. The economics are therefore complex and in our situation not yet resolved. Meanwhile we continue with the traditional highly selective thinning from below as a standard.

Logging Action

Contractors, who handle both falling and hauling are presented with information on output and delivery requirements with quotas or targets dependent on demand level. Dependent on their capacity to use a stage 2 plan, they require varying degrees of guidance and control over action needed for supply. Where responsibility for organisation of supply is vested in the Forest Department the activities of contractors are recorded daily, through the system of log measurement. The process is semi-automatic and is of use in relating contractor performance to requirements.

Again because of delivered wood cost there is considerable effort devoted to faster methods of raw material measurement. Weighing or electronic scaling are two possible alternatives. Decision on a suitable alternative to the present manual measurement system is very largely dependent on the value of incidental information and control and the cost of deriving that which is valuable by other means. Supervision during, and data collection after, each thinning ensures work is done to specification and records information for future planning.

The established method of thinning in this area involves loading the delivery truck at the point where trees lie, adjacent to the stump. This "truck to stump" principle has been an effective and economical wood handling system for many years but a number of social and economic changes are making the system less viable.

Effects of Mechanisation

Effect of New Equipment

There is now a movement towards greater mechanisation and a division between extraction and haulage, bringing this region closer to work patterns common in more awkward terrain. Such changes are rapidly increasing the capital investment in logging equipment and introducing specialised machinery with high unit productivity. We are now faced with an intensive reassessment of costs and actions influencing control of

thinning operations to a marked degree. It is necessary for economic reasons to ensure each item of logging equipment is used at optimum intensity. Non productive time, travelling from one work site to another, waiting for associated work sequences, etc., has to be reduced to the basic minimum.

Schedule and Control Alterations

Because of this thinning operations which previously were scattered to gain advantages in low traffic density are now being aggregated to cater for individual extraction units. A new planning schedule preferably covering all stages is required to achieve density of operations without destroying the product mix. For instance grapple loading forwarders require closer internal compartment access than cable loaded trucks if effective output and low stem damage are kept at desirable levels.

Some raw material product mixes are less easily separated and will certainly require the introduction of specialised thinning operations to continue supply to some plants. In the area discussed here this is becoming increasingly obvious with regard to preservation plant products, which, until now, have been a selective by-product of first and second thinning pulpwood operations.

Increasingly the move to mechanisation is demanding changes in thinning schedules. The machines available tend to be either specifically designed for mass output of a single product or used in a way that is uneconomic. Otherwise they are so complex as to be expensive in capital and running cost.

Effect on Structure of Industry

This means that contractors themselves must be either very large or very specialised. No longer will we have a group of contractors of all sizes, all performing much the same work in competition. I suggest that acceptance of the very large highly capitalised contractor is not the answer since we lose the expertise, initiative and incentive of the small logger. This group of individuals has been a vital part of the industry in the south-east of South Australia and probably in Australian if not world logging.

The alternative proposal for effective use appears to be a regionally controlled logging system with extraction and haulage co-ordinated into specific contract works designed to utilise each machine efficiently.

In essence in the region under discussion it amounts to a forest owner acting as contractor with machine operation on a sub-contracting basis. In this way there is a possibility of securing the economic advantages of large scale co-ordination without destroying the individual satisfaction or losing the ability of those members of the harvesting force who require a degree of freedom not available to direct employees.

CONCLUSION

The forest area controlled by the South Australian Government Woods and Forests Department in the south-east of the State has been used as a sample of what is taking place in a variety of locations throughout the world.

The process of developing fresh thinning controls necessary to accept changes in industrial technology and social demand is likely to remain interesting and complicated for some years. Harvesters need to be particularly careful not to lose sight of the whole concept while deciding on solutions for each factor involved.

This paper has attempted to assemble comments on a number of related factors as an aid in reminding wood harvesters of them as they tackle each problem in turn.

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