The Future of Timber Harvesting in Finland

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ABSTRACT

This paper on the future of Finnish wood harvesting is based on a Delfoi interview study and on the stage of the life cycle of different technologies or methods. Personal views of the author are also included.

Keywords: Timber harvesting, predictions, advanced technologies.

INTRODUCTION

The study of the future is often based on one of these main approaches:
- Studying possible, probable or wanted futures.
- Predicting the future according to the trends in the past [1].

The first approach has been applied by Leinonen [6] in Finnish timber harvesting using the Delfoi method, and this analysis will be utilised in this study. The weak point of this approach is that innovations affect the technical development quite decisively but nobody can predict them. Otherwise they would be no actual innovations. Therefore the latter approach will also be applied. Then, one main concept is life cycles of technologies. Samset [7] has presented the law of discontinuous evolution of productivity. When redesigning Samset's model, we can say that a technical system goes first through the stage of fast development, when it is developed and introduced to replace former systems. Then the stage of stabilising the new technology and the mature stage of slow development follows. At last the reduction stage takes place when other, newer systems replace it and development efforts are no longer profitable.

HARVESTING METHODS

In Finnish logging operations the cut-to-length method is mainly applied, and its share is increasing worldwide. As to the technology itself, it is still in the phase of rather fast development, i.e., harvesting machinery itself and computerised bucking systems undergo intensive development. So, in some respect the method is in the stage of replacing the old method and in some respect in the mature stage when development still continues. On the other hand, the conventional tree-length method in a global view may be seen as being in the mature or even in the reduction phase. For instance, in Russia conventional central conversion plants are a very expensive alternative [4].

Admittedly, new ways to apply the conventional technology may make it more profitable. Such a new way to apply the tree-length method and a central conversion plant is to practise tree-length logging (or logging of sawlog-parts of stems) in the near vicinity of a sawmill and cut-to-length logging where transport distances are longer. The automated conversion plant is used for very exact, customer-oriented bucking by for example tomography technology. This kind of bucking can supplement the supply of different log dimensions and qualities exactly according to the demand. Log inventories can be minimised. Utilisation of slash as fuel can be applied effectively.

The increase of the above mentioned concept is one possible future according to Leinonen [6]. Another possible and probable future is full-tree logging of small-size trees (cut into parts) in thinnings. Then, debranching and debarking may be done with separate machines or a debarking drum.

Both sawlogs and pulpwood may be graded more intensively. The grading of pulpwood into different kinds of grades for pulping and energy production may happen as bolts in the forest or in a mill. Another way would be to grade the wood after chipping or other kind of processing. Separating, transporting, storing and processing of several grades increases logging costs but may result in bigger gains in milling [2]. Possible future development of new wood products may require new applications of logging methods. As an example, the utilisation of round construction timber is under development requiring a new kind of grading practice. Control the colour of wood or production of chemicals and food may be an increasing field to be considered.

The following logging conditions in Finland support the cut-to-length-methods position as a main method (according to the analysis of logging methods by Harstela [5]):

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- Relatively small average volume of stems and long terrain transport distances because of the big amount of small private forest holdings.
- Big share of thinnings in the cutting volumes and big interest in environmental aspects.
- Optimisation of transport from forest inventories to spatially separated sawmills and pulpmills.
- Big interest in good quality and minimum losses of timber. The soil contamination of logs is mentioned as one of the problems of the tree-length method.
- Good waterways for bundle floating and barge transport.
- Long tradition and good know-how in applying the cut-to-length method and building up suitable machinery.
- Advanced logistic systems, including computerised planning and control systems of harvesting operations designed to support prevailing logging systems.

Recent cost calculations in Finland indicate that even in very favourable conditions for the full-tree method, the cut-to-length method is more cost-effective unless slash is used for energy production. Why is it then that the results of North American studies seem to indicate the opposite? We have tried to analyse this. The productivity of harvesters and even forwarders seem to be lower in North America. Therefore, the skill of the operators may be one reason.

LOGGING MACHINERY

Although harvesters and forwarders have a rather long period of development behind them, they are still in the stage of development. Power transmission systems, computerised bucking and control systems, active damping of whole-body vibration and some other ergonomic features, for example, are being developed intensively. Many other smaller improvements in the machines are designed annually. Special machines, such as small-size harvesters and forwarders, multi-stem-processing in harvesters, combined harvester and forwarder for thinnings and for energy wood harvesting, are already on the markets.

Possible futures include special machines for thinnings and for energy wood harvesting [6]. Although walking machines may be an alternative only for use in special conditions (mountains), technical innovation to minimise the slip of tyres, to decrease ground pressure, to grade the timber assortment more effectively, to spray the stumps, to automate some work elements, to support the maintenance and repair of machines by computerised systems and to improve the quality of timber (e.g., small 'curtsy' movement in cross-cutting, tomography detection of rotten wood or other kinds of sensors to indicate the quality for value bucking) may be a reality in near future. Information ergonomics may provide us the way to find the right division of work between a computer and an operator. Machine vision as a video system is already being applied in scaling timber at mills. It may be applied very soon in centralised conversion plants, whereas an application in forestry with real robotics may become available in the longer run. But will there be innovations still unseen? To a high degree, it is depends on the development of engineering sciences.

The maintenance and repair of machines may still benefit from technical development, such as automated or central greasing and lubrication, and automated, preventative indicating of defects. Also, first steps have been taken to build computerised expert systems to support the repair work. At paper mills an operator or a service man may already be equipped with a small video camera in the helmet and his activities are supported in real time by experts via telemetric systems. Why not in the forest of the future?

The main emphasis in long-distance transport will be on truck transport. Bundle floating, barge transport and railway transport are still valid methods in Finland but their proportion is not very big. GIS and GPS are widely used in operational control together with computerised models. More effective use of return trip loads and trucks capable of transporting several materials (timber, chips, peat, etc) is one possible direction of development.

TRAINING OF OPERATORS

As stated above, beneficial application of the cut-to-length method presupposes skilful and motivated machine operators. While in Finland special forest machine schools have educated operators already for years, additional short courses and instructors are needed for update training and for new operators without proper education. Even then school education is too short to give full operational skills. Therefore, new education methods are of interest.

Simulators have been developed for the forest machine schools but they may be most beneficial in export markets where no formal education is available. Simulators for training motoric operating of machines, bucking to value and environmental skills (virtual forest) already exist. Also, maintenance and repair

works may require new simulators.

Our studies indicate that different kinds of simulators are beneficial in different phases of the training process:

- Simulators for training motoric skills are most beneficial in the beginning when automating basic functions. Training on real machines is needed rather soon from the beginning. Otherwise wrong ways to control dynamic forces may be adopted. The simulators can be used even unsupervised in the evenings.

- Simulators for training cognitive skills (e.g., bucking simulator) can be used also in later stages of training, even in the update training of experienced operators.

PLANNING AND CONTROL OF OPERATIONS

This is the area having the fastest development during the last few years. Traditionally LP models have been applied to compile tactical timber procurement plans for big companies. Recently a big step has been taken especially in operational planning. Several OR methods, heuristic and AI models and GIS together with technical tools, such as telemetric information transfer, vehicle computers and GPS, have been utilised in planning of transport and other harvesting operations. The principles of logistics and management 'philosophies', such as JOT and Lean Management have been applied to design customer-oriented management from markets to forest and from the demand of mills to the purchase of timber and bucking for value and demand.

We have no studies directly indicating the cost-effectiveness of these new systems. Studies in some other countries, and lower timber costs at mills in spite of higher stumpage prices, as compared with Sweden and other European countries, suggest that the logistics of timber harvesting is on a profitable level. Development work is continuing. For example, GPS and GIS have many potential applications in updating forest management plans, in work site planning and in controlling operations on a field level. A special attention is paid in purchasing timber according to the demand. As an example, the system to find potential stands for harvesting consists of GIS, satellite images, topographical and forest estate maps and customer register together with marketing support system. Other technical tools, such as a virtual forest for planning landscape and ecological points, are being researched. The Finnish forest industry has adopted the factor-3 philosophy, to make more from less. It means more sophisticated timber flows from forest to the mills, just according to the demand of the mills.

What will happen in this field in a longer run? The development of information technology is so fast that to make any prediction is really difficult. I feel that one development direction is towards interactive and ad-hoc-type decision support systems (DSS). Planning cutting sites and purchase of timber are the fields where the demand of timber, cost-effectiveness of operations, environmental and social factors meet each other. These are typical areas for DSS. Practical planning, monitoring and control systems and programmes will be an international business. Although tailor-made systems are needed for different firms, some elements may have a standard structure.

ORGANISING THE LOGGING

The forest departments of big forest industry companies are slowly moving towards more open or lean organisations. Some tasks, such as forest management planning and computer system support, are being externalised and machine entrepreneurs have been given more and more tasks earlier done by supervisors. The responsible and hard-working forest machine entrepreneurs and their skilful operators may be one explanation of the high cost-effectiveness of the Finnish logging. Workers, contractors and supervisors work as a team and quality management systems are being established.

This development might continue. Competence management will be adopted as being a wider concept than purely training and education. For example, motivation and ability to work as a member of a team must be created. Different kinds of networks of entrepreneurs and firms, based on partnership and equality, will be formed. The average size of entrepreneur firms is increasing. Even purchasing timber may be their responsibility in the future. Then, the educational level of entrepreneurs should become higher, and they may form wider networks of small firms changing not only operational and technical services but also services in business economics, etc. Electronic meeting systems (EMG), including the internet, will help the teams to communicate and facilitate the utilisation of heuristic decision making rules with Dss.

RISK SCENARIOS

The possible futures presented above are rather optimistic, based on the continuation of the present development tendencies. Leinonen [6] presents also risk scenarios. Any loss of the competitive ability of the forest industry on international markets, decrease in the demand of sawn timber and paper products, or drastic decrease in supply of timber from forest owners could restrain development activities in timber harvesting. The first resource for cuttings to be left unused in case of poor profitability is thinnings.

On the other hand, nowadays even raw timber markets are global, which may buffer the disturbances of timber supply in one country. Forest resources are by no means being used to the full. The markets for forest machines and know-how markets are also international. Real risks are involved in connection with a possible global economic depression. The competing of other materials and electronic media may be compensated for by new innovations in wood products from construction materials to foodstuffs.

COMPARISONS

Guimier [3] based his future analysis on the technical, social and economic factors the Canadian forest industry faces and on the development of these factors. That this article presents many similar views may indicate that the same societal conditions prevail in most western countries, but also the intensity of change of knowledge in the western world. Though new ideas spread rapidly, real innovations are, to some extend, unpredictable. My aim in this overview was to formulate the needs, rather than solutions. This may be of help in the first stage, on the way to innovations -identifying a need that one will tackle.

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