# SOME TRENDS AND NEW IDEAS ON LOGGING AND TRANSPORTATION

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## Introduction

Productivity in forestry has increased dramatically over time due to a number of factors of which the mechanisation is the overall most important one. An example from my home country shows that the number of m3 per manday has increased from 7 in the early 70s to 16 in the early 90s. The mechanisation has enabled fewer people to procure the industry with more wood to a lower cost, and to meet a number of increased demands on quality. Large-scale forestry in Sweden is now mechanised to 100%, and still, the productivity curve is pointing upwards. The driving forces today are due to a situation of system stability, that has enabled trimming and slimming of methods, techniques, personnel and organisation. When these opportunities of trimming are fully exploited, we have to be prepared for the next step.

What remains to be done within the existing systems? And what can we see beyond today's systems? I will try to point out some examples, most from far ends of the world like Europe and America, of what I think might be important.

## Some trends

### *The environment*

Increasingly, people not involved in forestry put demands on how we act in our operations in terms of impact on the environment. There is an obvious, ongoing global trend in forestry to meet these requirements in different ways in order to gain, or at least not lose, market shares. Different certification organisations are lined up to provide the world's forestry with the right labels. Securing the sustainability and the biodiversity in managed forests is, of course, a general task, but specifically, the work we have to face within the area I represent concerns e.g. emissions and fuels, soil impact, lubricants, but also ergonomics.

To reduce the fuel consumption of the machinery we use in our forestry operations is not only a matter of environmental friendliness, but also a potential to significantly reduce the costs for fuel. As the productivity of logging equipment has steadily raised, the proportion of the costs representing fuel and maintenance has become more and more apparent. The fuel

consumption and the emissions can be reduced through more effective components (mainly hydraulics) that work together in systems that are designed with these matters in mind. On harvesting equipment most attention should be paid to the harvesting unit (e.g. the head), whereas on hauling equipment it is the power sources and transmissions together with the tara weight/payload proportions that should be focused on.

What regards the soil impact, there are a number of ways to address that, from which system to be chosen down to tyre level. In western Canada, FERIC is looking on the "soft footprint" of a cut-to-length system as compared to a more conventional logging system with whole trees. Other examples of how the system can be adopted to especially difficult site types are shovel logging or line yarding on very wet sites in the U.S.. The choice between wheel or track based machines is of course also affecting the soil impact.

The operator's environment, i.e. the ergonomic factors, is also growing more and more important. As the equipment used is getting more sophisticated we are facing injuries on the operators, mainly shown as ache in necks and shoulders. We must therefore not forget the ergonomics when we discuss environmental issues. In the Nordic countries, a new set of ergonomic guidelines has recently been introduced in order to serve as a help for machine designers and for machine buyers.

## *Flexibility or specialization?*

As contracting is becoming more and more common, it has become quite clear that contractors, in order to be competitive, either has to be rather specialized to a niche, or, be so flexible that they can undertake a variety of jobs in terms of stand types etc.. In my opinion the flexible contractor is the most dominating type. By being flexible you can also more easily avoid periods of low or none utilization of the equipment. The flexible contractor might have better conditions for growing bigger than has the specialized.

Within the cut-to-length technology there is a movement from a number of different harvester types and sizes towards a few models of base machines, that individually can be used in a wide spectrum from thinning to clearfell. Thus, it is mainly the heads and the software that is optional for, basically, two different machine sizes. For example, some years ago the major machine manufacturers Timberjack and Sisu removed the smallest, stand-operating harvesters from their program. Most small diameter thinnings are today operated by medium-sized single-grip harvesters using 18-30 m distance between the striproads. Trees in the intermediate zone (at striproad distances exceeding about 20 m) are felled motor-manually (not so common anymore) or by the machine operating from ghost trails.

An example of both flexible and specialized logging contracting is from Washington, eastern U.S.A., where a contractor has specialized on steep-

slope logging. He invested in a system based on a Hitachi EX 300-3, a shovel machine that can function as a swing yarder, loader or shovel logger thanks to an innovative systems configuration. This is completed with a motorised carriage, which – according to the contractor – facilitates quality in thinning operations. Altogether, this contractor has the ability to perform large clear-cuts and small thinning jobs.

Of course, there is no easy way to tell which way to go in order to be the most competitive contractor in this respect. However, I believe that they who are successful in either of these directions can have an obvious advantage in comparison with them that have not yet set their strategies.

## *Cut-to-length (CTL)*

The CTL technology is gaining ground in the world, for example in Canada and South America. One very clear sign of what is going on is that Caterpillar, a very large company, has decided to compete within this segment. When going into a new market, Caterpillar seriously aims at a market share of approximately 30 percent, which takes quite an expansion from zero! At present the manufacturers consider the world market of wheel-based CTL machinery to be about 2500 pieces per annum. Forecasts says that it is mainly through expansion on new markets that three large manufacturers – i.e. besides Caterpillar, Timberjack and Sisu – can still survive. The established CTL manufacturers seem to look upon the new competitor as an allied in selling the CTL method around the world, and hence expand the market.

An advantage with CTL is that it may take less pieces of equipment per operation and it has a big potential to be fully mechanised. The single-grip harvester has also proved to be successful in its work since most of the work elements are overlapping each other which enables high productivity. Furthermore the harvesters and forwarders are sophisticated and comparably comfortable, which makes for operator friendliness. The operator, if properly trained, has a good opportunity to choose the right cross-cutting alternatives, since he is the only one seeing the tree in the stand. With the help of the advanced bucking computer he has the best possibilities to make an optimum bucking according to the current prize list.

On the other hand, the sophistication can be a disadvantage when introduced to new markets, where the distance to service centers etc. is long. The machines also requires well trained operators which takes some time. In places where labour is cheap it is not certain that the quite expensive CTL machinery is the right alternative. Another restriction for the method is the tree size. Single-grip harvesters are at present unable to handle too large trees, with a stump diameter of, say, 70-80 cm. When changing method the rest of the supply chain also has to be adopted, maybe together with parts of the industry.

## IT

In several places in the world, GIS and GPS implications are becoming used in practical forestry. They are used integrated with planning, logging and transportation in parts of Scandinavia. In Finland and Sweden there are examples of forest companies that uses GIS and GPS in the operative planning for logging/regeneration. In a "field-GIS" the forester can mark certain objects of concern or importance, and he can always use the GPS to be sure of where he is. The map data bases can rapidly be up-dated, and readable, detailed instructions can be sent to the logging crew together with geographical data. On a trial basis harvesters has been equipped with a GPS receiver in order to be able to see the position in the stand and to give instant feed-back to the operator on the removal and/or thinning intensity. Automatically collected data on diameter, basal area and volume are stored together with geographical information. In theory, although not fully tested yet, the logging team can send back a report based on automatically and manually collected data from the computer in the machine when the site is finished. At the district's office the stand register and map data base can readily be updated. At the end, data on extracted volumes, assortments and geographic location can be used by the transporting organisation, which is the case at some companies in Finland. Each truck is equipped with a PC and a GPS receiver, so that the driver with short notice can change routes and easily find his way to the wood.

The North Americans has for a long time been skilled in using rather advanced GIS applications. So far, the applications have been used mostly for different analyses regarding e.g. land use, landscape planning and bio-conservation on a larger scale. Trials have been started on using GPS technology in connection with scarification and harvesting operations.

Software for various calculations or analyses has been developed by research organisations and private companies. Interface and OTTO, developed by FERIC, and SkogForsk Calc, developed by SkogForsk are only three examples. The use could be for machine cost calculations, transportation costs, analysis of single operations or whole systems. This type of software can be useful tools for contractors, staff at the forest companies or researchers.

## Central Tyre Inflation (CTI)

CTI *per se* is nothing new. It has been a feature on military vehicles for a long time. However, a number of forestry research organisations has put up CTI implications on the agenda. In North America, CTI on trucks has been used for quite a while, but in Europe testing has just started. Trials and experience tell that CTI on trucks can be a very profitable investment. However, the pricing for transportation must be made with respect to CTI equipped vehicles if any trucker would pay the investment for a CTI system. One big advantage lies in increased accessibility and flexibility during bad seasons due to rain, thawing of frozen soil or others.

Another advantage is the savings in terms of lower wearing on private and public roads.

We have also tried CTI on a forwarder with the purpose to gain accessibility to worse terrain sites, lower impact on sensitive soils, increased traction force and better operator's comfort. The trials have been fairly successful, but of course with a few problems: 1) it takes some time to change the pressure in the tyres, and when it can not be done in the same time as productive work it causes downtime; 2) naturally, the prize for a prototype too high for practical use. However, the first commercial CTI-equipped forwarder is about to be delivered to a Swedish forest company.

Introducing CTI on trucks and forwarders brings, though, an addition of some kilos to the vehicle. A general (urgent) strive for us involved in forestry R&D should be to reduce the amount of iron and "dead weight" in order to maximise the payload on all hauling equipment. This is necessary in respect of both costs and fuel consumption.

# New(?) ideas

## *The combined harvester-forwarder*

Almost every step in the mechanisation process has resulted in that work elements carried out by man, animal or machine has been incorporated with another machine's work cycle, or put together into entirely new machine concepts. One example is when the feller-buncher and the processor was replaced by the two-grip harvester in Swedish final fellings in the late 70s. As a logical consequence, at least with cut-to-length systems, maybe it is now time for the combined harvester-forwarder. The idea itself is not new; Koehring produced a combined harvester-forwarder, however of a totally different design than what we can see and use today, several decades ago. Some prototypes and a few early serially produced machines are out operating in Scandinavia.

The combined harvester-forwarder is most competitive in small-diameter thinnings with few assortments and on small sites. The reason is that the machine is at present not as productive as its "parents" individually. The major advantages in comparison with a 2-machine system lie in: 1) you only have to move one vehicle between sites, 2) you can earn some time on reducing the driven distance and boom manoeuvres if the working method is fully trimmed, especially if processing of the trees can be done directly onto the bunk. As soon as the tree size and extracted volume per hectare grows too big, the proportion of forwarding will be unfavourably high, since the combined harvester-forwarder is more expensive per hour than a forwarder. In addition, a specialised single-grip harvester would be cheaper to use, since there will be more volume to carry the moving costs and so on.

## *Walking machines*

Timberjack's introduction of the walking technology was received with

big interest by many. The idea is great, enabling to replace heavy boogies with lighter and cheaper parts in the "legs". The manoeuvrability would be superior to a wheel-based machine, and the impact on the soil would be far less than track-based machines in heavy turns.

However, the wheel is a sustainable invention and not so easy replaceable. One problem with the walking technology is the speed. A walking machine can not travel as fast as a wheel based machine with the same co· ort. This probably means that the walking technology is –at least for a start– restricted to harvesting, where the travelling speed is of less importance to the productivity and cost. Under which conditions can the wheels be replaced with legs? In my opinion it could be an interesting alternative in steep terrain. If the components, and consequently the whole machine, would be cheaper than a corresponding wheel based machine, it would be even more interesting. This is, however, not the situation today.

Another possibility could be a machine used for scarification and planting. The walking machine would be able to find suitable spots for the plants and perform its operation in the same time as it moves.

## *Future systems*

We have to start thinking on tomorrow's logging and transportation systems. What will replace the single-grip harvester? How shall we transport the raw material to the industry? When looking backwards on the history, it is obvious that the mechanisation will go on over the world's forestry and gradually be transformed into automation and maybe robots, given that it is the same factors that influence costs and productivity. As long as somebody wants fibres from the woods for some purpose, there will be ample scope to get it as cheap as possible to the user!

By using more and more sophisticated equipment, delegating more and more responsibility to the contractors and operators etc. we will in the end need operators similar to fighter pilots. In order to attract these qualified people we can not put them into a machine that will cause injuries to their necks and shoulders within a few years, or provide working conditions with so much stress that their hearts will stop beating too early. It makes more sense to let the machines take over more of the routine work elements (positioning, processing etc.) and let man concentrate on fewer, more complex things (choice of tree, assess the quality etc.). The techniques for most of what is needed for this development already exists, but has to be adopted to forestry conditions.

All this may not help us to solve today's problems, but it certainly helps to think about what we wish for the future before we get there. In order to solve today's problem and to be better in what we are doing we need all of what this conference has been and will be dealing with. We can not make it without smart technology or smart peopleworking in smart organisations using smart control systems. Every detail is useful in itself, but the full benefit will show up when all pieces nicely can be put together.