Forest Operations Management

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Introduction

Modern information and communication technology (ICT) is widely used in forest operations management nowadays. In particular large forest industry companies operating globally have developed sophisticated systems to manage their forest operations. Many of the smaller companies are introducing these systems as well. The necessary condition for the use of these systems is a well-developed communications infrastructure in the country concerned. Similar systems are applied elsewhere, too, but maybe not as sophisticated as these.

The basic data on forests are continuously gathered and monitored through inventories at all levels: national, provincial, company, and private woodlot owner. The data are available in digital form which allows use of modern geographic information systems (GIS). The data are based on satellite and aerial images as well as field surveys, i.e., multisource data. This is important for managing companies' own forests and national forests.

Modern tools are used at every level of management and planning, i.e., strategic, tactical, and operative.

Operational harvesting plans are based on these basic data. Maps and other relevant marked information on the stand are shown on the screen of an on-board computer of a harvesting machine. The harvester optimizes the utilization of the tree stems according to a bucking-to-order scheme radioed to the machine. Environmental aspects are monitored through on-line follow-up of the location of the machine warning the operator of the hazards of exceeding the cutting area borders, protection zones, etc. Forwarding follows immediately after the logging, and the location information of the log piles is sent to the database. The performance record of the machine is stored in the memory automatically.

After logging the information is sent to the company's district office, which organizes optimal long-distance transportation schedules given by the optimization routines. The truck fleet can be monitored on-line with global positioning systems (GPS) and rescheduled easily. There are several vendors for these systems on the market.

These systems have intensified wood procurement and cut the costs of operations considerably. Another advantage is that the environmental risks of traditional harvesting can be minimized, thus increasing the acceptability of direct commercial use of forests.

Forest Operations Today

Activities of the woodland division of a forest industry company or an independent wood procurement organization may consist of many tasks that have an effect directly or indirectly on the outcome of the operations and thus need to be taken into consideration when managing these activities.

In the following presentation 'forest operations' are understood as 'technical activities to deliver wooden raw material from the forest to the place of utilization continuously and the supporting tasks to maintain this flow.' A supporting task could be forest road construction, for instance. The term 'wood procurement' is used often as a synonym for 'forest operations' although its meaning is more restricted. Another quite frequently used expression is 'supply chain.' A supply chain does not include similar supporting activities, as forest operations does.

Forest operations management is an activity to steer the outcome of forest operation towards a desired goal. In modern wood procurement information and communication technology plays an essential role. The tools provided by the ICT are GIS, GPS, the World Wide Web, mobile phones or cellular phone networks such as NMT, GSM, and UMTS, to mention a few.

Wood procurement is basically a logistic process that can be managed with the above mentioned tools. Proper management requires measurement of the efficiency of the organization. This means that planning of activities as well as monitoring is needed at every level of management. Planning can be strategic, tactical, or operative. The management structure can be a hierarchical, functional, matrix or teamwork type organization. The modern solution seems to be in most cases a functional, teamwork-based organization. When dealing with its interest groups different levels of partnership may be applied by the companies. This varies from purely owned operations to complete outsourcing.

In the following account, forest operations are dealt without the supporting activities, i.e., as wood procurement activity. This excludes public organizations working, say, on afforestation or road construction as falling outside the scope of this article.

Wood Supply

The wood supply chain is shown in **Figure 1**. It forms the framework for forest operations management.

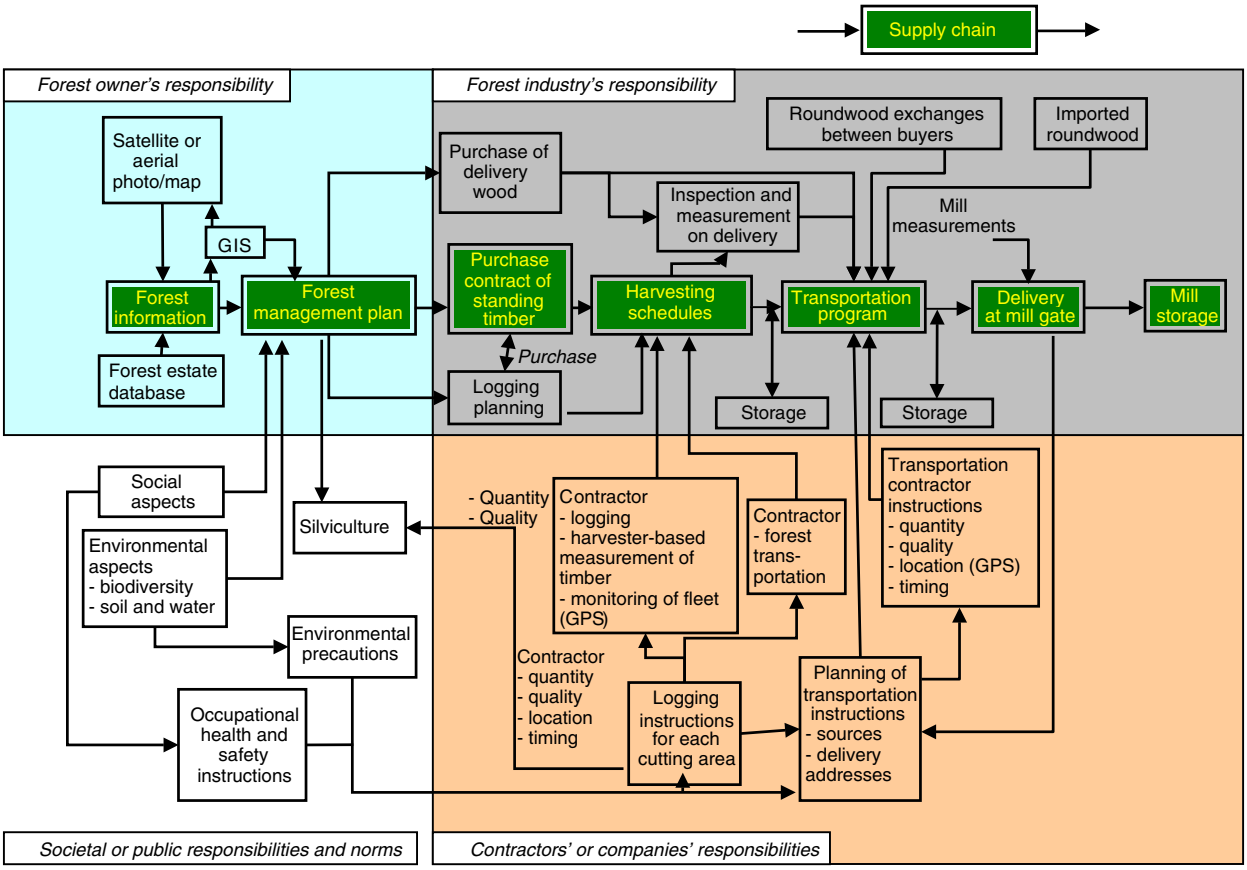

Figure 1 Framework of forest operations management.

The arrows in the figure show the relations between the activities and auxiliary activities. Auxiliary activities are needed to help carry out the actual forest operations more cost efficiently. Such an activity is wood measurement, for instance.

There are basically four independent actors in the wood supply activity. They are forest owners, forest industry, contractors, and public authorities as well as organizations of citizens (these four are shown in **Figure 1** as differently colored blocks).

Harvesting in these examples is supposed to be carried out using shortwood or cut-to-length (CTL) systems which is typical in the Nordic countries. Of course, similar types of structure can be found in any wood supply system.

Forest operations management starts with an annual strategic wood procurement plan based on pre-orders of the mills drawn from market development estimates for products. From that information a tentative wood purchase plan as well as a preliminary transportation plan can be developed. These plans allocate the volumes of different assortments needed to the procurement districts, and calculate the other resources required to carry out the task. At this stage just a small portion of the stands to be cut is known, most likely only the geographic area where they are supposed to come from. This is due to the fact that the raw material needs to be bought from the free timber market in the form of premarked stands. Only a small portion comes from the company's own forests.

In countries where the state owns the forests and sells harvesting concessions the approach might be different as regards planning.

These provisional plans are revised quarterly to become the tactical plans. At this stage the stands have been bought and full information on them is available. In the sales contract the forest owner and wood buyer agree upon the length of the time period during which the harvesting must be completed.

In the next step monthly and weekly operative plans are developed including the harvesting and transportation schedules for the stands to be harvested.

Wood Purchase

Procurement

Buying of timber on the free market is the most important activity in conditions where the public

supply of timber is insignificant. In a team-based organization this activity is carried out by a specialist who knows the local conditions very well. In the wood procurement team there is also a substitute who can do the task if the specialist is not available at that moment. The information on the stand characteristics from the sales contract is transferred into the information system of the company for further planning activities.

The reliability of this information is crucial, because all the following management measures are based on this. Forest owners' forest management plans are a very important source of information for this purpose. However, they are confidential and controlled by the forest owner.

Forest Ownership

Own forests are a minor source of wood for Nordic companies but worldwide this is rather common. However, companies have long-term forest management plans for their own forests. Nowadays these utilize modern planning tools such as GIS. From these data the actual harvesting schedules can be defined and carried out. Companies tend to use their own forest resource to balance the timber flow. One typical trend today is to outsource the forest property and forestry to separate companies due to the low return on investment expected from traditional forestry. Owning the forests would decrease the return on investment figures of the actual forest industry business.

Silviculture

Silviculture operations must be carried out due to strict forestry laws and environmental aspects. This guarantees the new growth and sustainability of forestry after harvesting.

Planning and Management of Operations

As was presented in **Figure 1**, the raw material flows from the forest to the mills and management information basically flows in the reverse direction. In **Figure 2** the planning levels for forest operations management are presented. (More detailed descriptions are presented in **Figures 3**, **4**, and **5**.)

Strategic Planning

Strategic planning is carried out both at company's woodland division and district levels.

Tactical Planning

Tactical planning concerns basically logistics, i.e., how to get the raw material most efficiently to the mills. These plans are made at district level except for imported wood which is handled at woodland department level. These plans are updated quarterly.

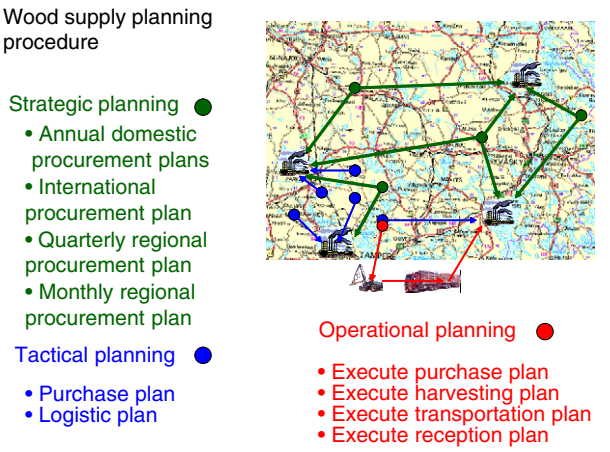

Figure 2 Typical tasks in wood supply planning.

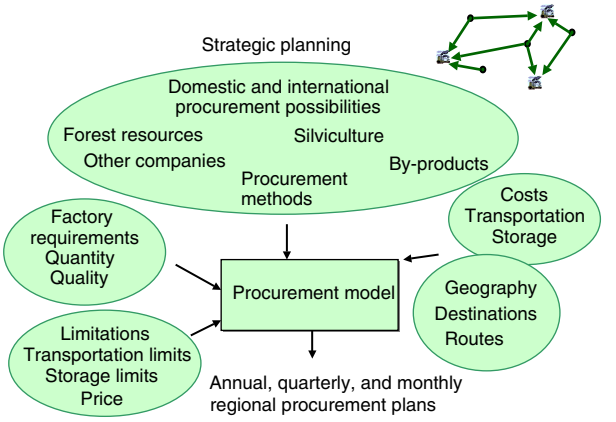

Figure 3 Concepts in strategic planning for managements of operations.

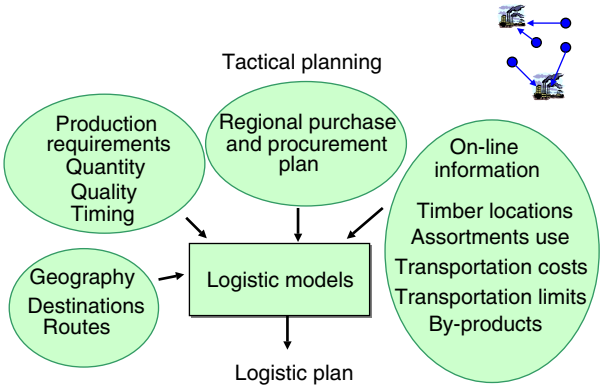

Figure 4 Concepts in tactical planning for managements of operations.

Operational Planning

Operational plans consist of the actual instructions by whom, how, and when the operations must be completed.

Once the company has obtained the authority to cut the stand owing to sales contract and the information is passed to the planning system, the operations management, i.e., harvesting and transportation plans are prepared. These include the selection to be made, the destinations for each type, schedules of the actions and other necessary plans such as precautions for environmental risks. These are then adjusted to the other stands information purchased from the same area to optimize the use of resources available. The plans are then converted to day-to-day instructions for the contractors available for the task. The companies have outsourced their forest operations to contractors almost to 100%.

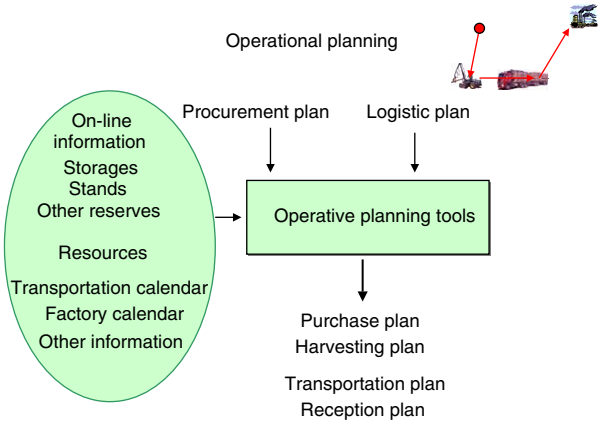

Figure 5 Concepts in operational planning for managements of forestry operations.

Monitoring Monitoring of the operations produces daily and weekly reports of the progress of operations. If something goes wrong, the team can quickly intervene in the situation by smoothly adjusting instructions.

Harvesting Harvesting of the stands includes logging and hauling. Logging is almost completely mechanized with harvesters in company operations in the Nordic countries. To some extent chainsaws are used, especially in thinnings and special wood logging, as well as in small-scale forest owners' logging. Regardless of the level of mechanization, the shortwood system is applied.

Transportation Off-road transportation is carried out by forwarders, which carry the load to the roadside. Skidding is a very exceptional operation in the Nordic countries. Long-distance transportation is carried out mainly by full trailer trucks.

Role of ICT

Modern wood procurement relies heavily on quick and reliable transfer of information. Tools are GIS, GPS, mobile phones, text messages, and wireless communication (**Figure 6**). There is a lot of information technology in a modern harvesting machine. They are equipped with an on-board computer that in addition to wood measurement functions also monitors the state of the machine operation itself.

From the operations management point of view the correct wood measurement and cross-cutting instructions are essential. At this point a wrong decision might destroy the value of the timber. This is

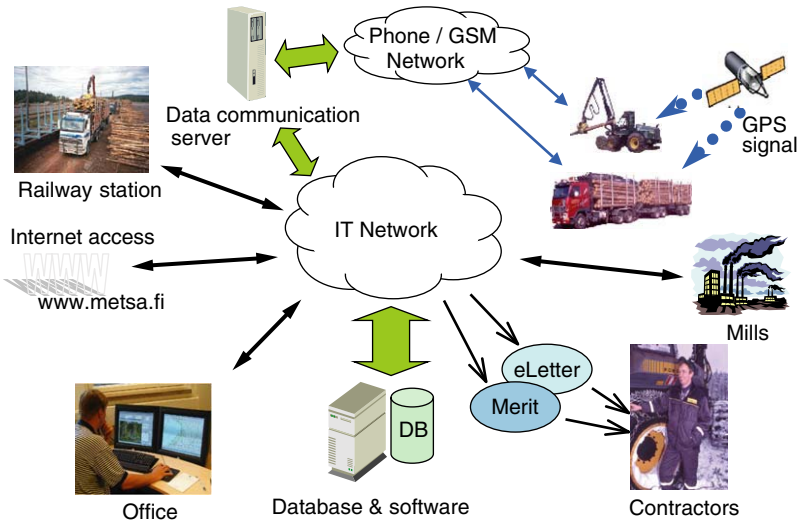

Figure 6 Data collection for operations management. Courtesy of the Finnish Forest Service (Metsähallitus).

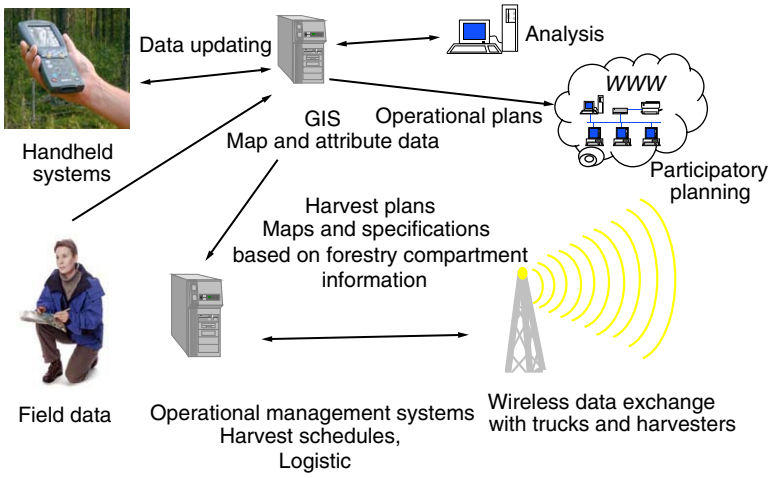

Figure 7 An example of information and communication technology application for forest operations management. Courtesy of the Finnish Forest Service (Metsähallitus).

because a customer-oriented approach is used. Bucking instructions for individual trees are defined by the bucking-to-value tables or bucking-to-order tables from the sawmill or plywood mill using the logs. These tables are transferred to harvesting machines wirelessly almost daily, according to the needs of the customer. Because of the variety of wood types and sometimes the requirement for a large quantity of special wood, a group control system for the management of a fleet of harvesters has been developed.

Productivity

Production and productivity figures can be followed continuously as well as the location of any machine through GPS. Once the location of the next harvesting site and the stand characteristics in addition to the selections to be made are known, the contractors can work independently. They only report daily to the team's office the state of the work and the finishing of the site. This information is used to define the readiness for transportation of the harvested wood. Coordinates of the log piles are also available for the route optimization routines of transport scheduling programs.

A well-functioning mobile communication network is a must for efficient data transfer between the harvesting equipment and supervision of the work (**Figure** 7).

Development of the Work Organization

The forest companies seem to pursue an ideal of having their own organization as light as possible. This has brought outsourcing into the management of operations. If someone can offer a better cost efficiency than the company's own operations would provide, they are willing to change. For instance, the measurement of wood at the mill is outsourced to specialized companies; only the information is transferred to the end users.

As mentioned earlier, modern organization for forest operations management is based on teams that cover a certain geographic area. Otherwise teams are quite independent; they report their performance to the district office and select the means to reach the goals set by the next organization level.

The supply chain for industrial wood has become faster and shorter, such that already at the stump the destination of the harvested wood is known. Delivery is as quick as possible and the running capital is kept as low as possible.

We will see even better management in the future once automation advance. This will allow even higher productivity, remote monitoring of the operations, and better utilization of raw material, and at the same time will protect the valuable production environment, nature itself.

See also: **Harvesting**: Forest Operations in the Tropics, Reduced Impact Logging; Roading and Transport Operations; Wood Delivery. **Operations**: Ergonomics; Logistics in Forest Operations.

Further Reading

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Small-scale Forestry

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Introduction

This article reviews various aspects of small-scale forestry in the world, with an emphasis on industrialized countries. Definitions and demographic information on small-scale forestry are discussed. Aspects of administrative structures and policy instruments for small-scale forestry are presented. In particular, the importance of forestry to social welfare is noted, and the role of small-scale forests in conducting environmentally and socioeconomically sustainable forest management is discussed.

Small-Scale Forestry in the Center of Interest

Forestry has traditionally been conducted in most countries mainly by the public sector on public land or by industrial companies on large-scale natural forest areas or plantations. On the other hand, private nonindustrial and small-scale management of forests has been dominant in Western Europe and Japan, where forests may remain in the ownership of the same family for centuries. In recent years, there has been a trend to move gradually away from large-scale forestry towards landholder-based small-scale forest management. This trend is especially clear in developing countries in Africa and in Asia, as well as in the former socialist countries of Eastern Europe.

Small-scale forestry has been recognized as a promising tool in achieving the multiple forest-related objectives of society, as well as in addressing the various global environmental issues of today. Regardless of the fact that the demand for forest industry products is continuously growing, environmental considerations and recreation have become increasingly important, often competing with financial considerations and wood production. Around the world, loss of biodiversity has become a major concern in the management of forest lands. Substantial deforestation has taken place in many developing countries. The wide range of social, economic, and ecological objectives of forest management are seen to be better met by small-scale forestry rather than by large-scale forest management.

What is Small-Scale Forestry?

It is apparent that small-scale forestry means different things in different parts of the world. There is no simple or consistent definition of what constitutes small-scale forestry. A farmer operating with a woodlot of 5 ha would certainly be a small-scale forest owner, whereas an industrial company with thousands of hectares would be large. But in between these examples there exists a wide variety of sizes that can be considered either small or large depending on the viewpoint taken.

There is no comparable or consistent statistical information about the amount of small-scale forests in different countries and continents. According to the latest United Nations Economic Commission for Europe/Food and Agriculture Organization statistics, private forest ownership plays a significant role in Japan (59%), Europe (55%), North America (37%), and New Zealand (31%). However, it is important to make a difference between small-scale forestry and private forestry, as private does not always mean small.

The terms 'small-scale forestry,' 'nonindustrial private forestry,' 'family forestry,' and 'farm forestry' are parallel and they are used rather synonymously to separate this type of forestry from industrial or public large-scale forestry. Small-scale forestry differs in many ways from large-scale forestry, for example, in aspects such as motivations for the establishment and management of forests, social and economic objectives of forestry, and the likely markets for wood and non-wood forest products.

Appearance of Small-Scale Forestry in Selected Countries

In the USA, the term adopted for small-scale forests is nonindustrial private forests (NIPFs) referring to forestlands owned by farmers, other individuals, and