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Information and Communication Technologies in the Finnish Forest Sector

Final report

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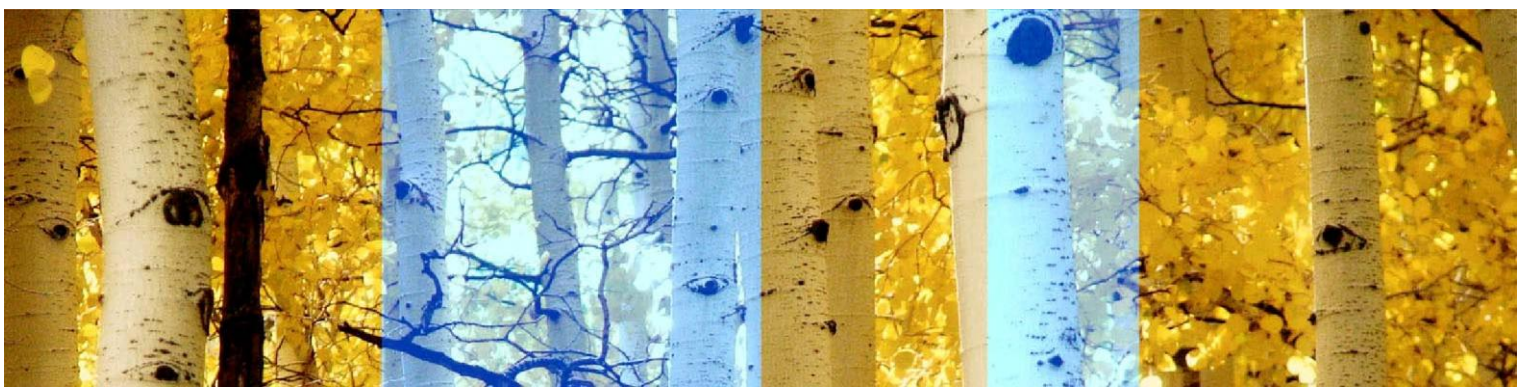

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ABBREVIATIONS

ELB	Estonian Land Board
EU	European Union
EUR	Euro
FFCS	Finnish Forest Certification System
FMA	Forest Management Association
FMU	Forest Management Unit
FOA	Forest Owners Association
FSC	Forest Stewardship Council
GIS	Geographical Information System
GPS	Global Positioning System
ICT	Information and Communication Technologies
LiDAR	Light Detection and Ranging
MAF	Ministry of Agriculture and Forestry
Metla	Finnish Forest Research Center
Metsähallitus	State Forest Enterprise
Mha	Million Hectare
MTK	Central Union of Agricultural Producers and Forest Owners
NFI	National Forest Inventory
PEFC	Program for the Endorsement of Forest Certification
RFC	Regional Forestry Center
RFID	Radio Frequency IDentification
SADe	Program for enhancing the development of government's eServices and eAdministration (Sähköisen Asioinnin ja Demokratian vauhdittamisohjelma)
Tapio	Forestry Development Center
Tekes	The Finnish Funding Agency for Technology and Innovation

KEY RESULTS

Finland is one of the world's leading countries in applying Information and Communication Technologies (ICT) across all levels of society and different economic sectors. This is evidenced in the large share of the population that has access to the Internet, the high number of mobile phones in use and the great amount of publicly available Internet-based information.

Forestry has held a remarkable role in Finnish society for over a century. Alongside the rapid overall development of ICT, forestry sector actors have actively developed and applied different ICT solutions to improve efficiency. Conventional ICT applications are developed to support decision-making and to improve the efficiency of the wood supply.

During the past decades, the importance of communication between forestry actors and the general public has become an emerging requirement, and new solutions have been introduced to respond to the needs in this area. Public participation and transparent distribution of information are viewed as essential to democracy. As a result of this, the scope and extent of ICT solutions applied in forestry and forest industries have become wider than ever before.

ITC-solutions in Finland are currently in transition period to second generation solutions. A large proportion of solutions and e-services are currently being revised and improved. Major drivers for this are the change in the operating environment and rapid development of hardware and communication possibilities.

ICT-solutions cover increasingly also forest sector services. The key drivers are on the one hand the overall need for improved cost -efficiency and on the other hand need to reach wider user groups than the traditional non-ICT channels.

The initial investment need in ICT-solutions range from EUR 20 000 to several hundred thousand Euros depending on the scale of the solution. The majority of the total investments in the Finnish ICT-solutions is directed towards the initial outsourced software development.

The maintenance costs can be divided into i) system and ii) data maintenance. The system maintenance of large-scale solutions is in most cases carried out by companies internal support personnel. The most challenging technical maintenance is usually outsourced to developer companies. In the case of small-scale solutions the development and collaboration with the software developer is usually more continuous and often include technical support. In case the software development is not continuous, system maintenance is in most cases carried out by internal personnel. In general, the readiness for ICT-solutions in Finnish forestry sector is high. This reduces the need of capacity building and technical support in introduction of new solutions. In solutions like national forest inventory and forest resource management solution Aarni a clear majority of the maintenance costs consist of data acquisition.

According to Finnish experiences, the key success factors on ICT-solution development and application processes are involvement of the stakeholders, adequate capacity building and effective communication to the users. These are required to take the full advance of the solutions. Comprehensive requirement analysis and a testing phase are common to successful solutions. Piloting with a smaller user group has been found beneficial for the final product quality and user involvement. Introduction of incomplete solutions has in several occasions worsened users attitude towards new solutions. On technical side, there is no common factor between different types of solutions. In general, technical difficulties have been resolved or avoided with i) realistic and well developed targets, ii) adequate development budget and schedule, and iii) skilled solution developers.

The table below describes the main dimensions of the interface between forest governance and ICT solutions in the Finnish forestry sector.

Table 1 General descriptions of the role of ICT solutions in good governance in Finland

Dimension of good forest governance	Achievements	Challenges
Transparency, accountability and public participation	- Public National Forest Inventory (NFI) data on forest resources has increased transparency. - Open ICT-supported communication on forest governance is reflected in the legislation. - A program concerning improvement of e-services is underway, with promising results. - Advanced ICT-supported participatory methods and solutions are applied in forest management planning. - The majority of the general public have access to forestry information and the possibility for more effective communication because of ICT applications. - ICT solutions have facilitated the provision of diverse information to the general public.	- ICT solutions can complement conventional participatory tools such as public hearings; however, they cannot fully replace them. - The latest ICT solutions used in participatory processes do not reach the entire public due to limited ICT readiness. - Participatory forest management planning and the gathering of stakeholder opinion present the challenge of having to make compromises on different management decisions. However, this is considered a part of open democracy.
Stability of forest institutions and conflict management	- Institutions that distribute information using ICT-based solutions have built up stability and improved their level of organization. - ICT solutions in participatory management planning have improved managers' ability to manage conflicts in a proactive way. - ICT solutions have enabled decentralization of forest institutions, ensuring local participation and decision-making.	- The development and introduction of second-generation ICT solutions is ongoing, and there has not yet been much experience gained from the new approaches. - The structural change in the Finnish forestry sector has caused some instability in the sector over the past five years. This has affected effective application of ICT solutions.

Quality of forest administration	- Forest and forestry monitoring is based on the latest state-of-the art technology, and the outcome is highly reliable. - Effective ICT tools have increased transparency, and possibilities for corruption in the Finnish context are marginal. - Both state and private forest organizations have the readiness to apply ICT-based solutions.	
Coherence of forest legislation and rule of law	- ICT solutions are applied effectively in law enforcement. - New ICT-based applications enhance communication and transparency of law enforcement processes as well as data availability needed for law enforcement.	
Economic efficiency, equity and incentives	- Forest resource planning and management as well as wood supply forecasts are well supported by ICT solutions. - New solutions are utilized to enhance the governmental law enforcement processes. - Applications of ICT solutions have generated employment among small-scale service providers.	- Decentralization of forestry administration and the fragmented structure of the sector still cause overlapping efforts in planning and management.

1. INTRODUCTION

1.1 Background

The role of Information and Communication Technology (ICT)-based solutions in enhancing and supporting forest governance is widely recognized as important. Being an advanced country in the field of ICT, Finland has highly developed ICT systems and solutions in use in the forest sector. Traditionally, the objectives of ICT solutions used in this sector have been to produce information on operations and forest resources and to increase the transparency of national forest policy through the availability of information. During the past decades, the role of ICT solutions in communication has been enlarged to enhance and activate communication between forest managers and the general public.

As the development of the solutions has followed the specific demand of national forestry goals, the ICT solutions used and developed may differ from the ones needed for supporting forest governance in developing countries. However, Finland provides valuable lessons on different types of solutions. Despite the differences in information and services needed, Finnish experiences can serve as benchmarks to be used in countries experiencing lower readiness and having different types of requirements for ICT solutions. This report presents a general description of the ICT-based solutions used in the Finnish forestry sector and includes some overseas examples.

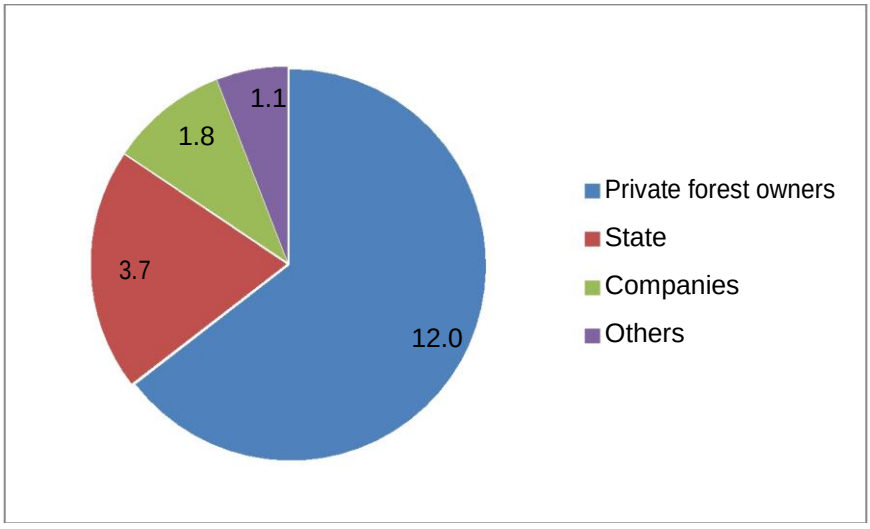
1.2 Forests and the forest ownership structure in Finland

The forest ownership structure is rather fragmented in Finland. The total area of forest land is 26.3 million hectares (Mha) of which 18.6 Mha is available for wood supply. The distribution of the total area of forest available for wood supply among the different ownership categories is shown in Figure 1.1.

The biggest area of productive forest land is owned by private forest owners, who are primarily families and private citizens. The average property size is generally small - 24 to 34 hectares - depending on how the property is defined. The total number of privately owned forest properties is around 440 000.

The category ‘others’ consists mainly of municipalities, cities and other communities.

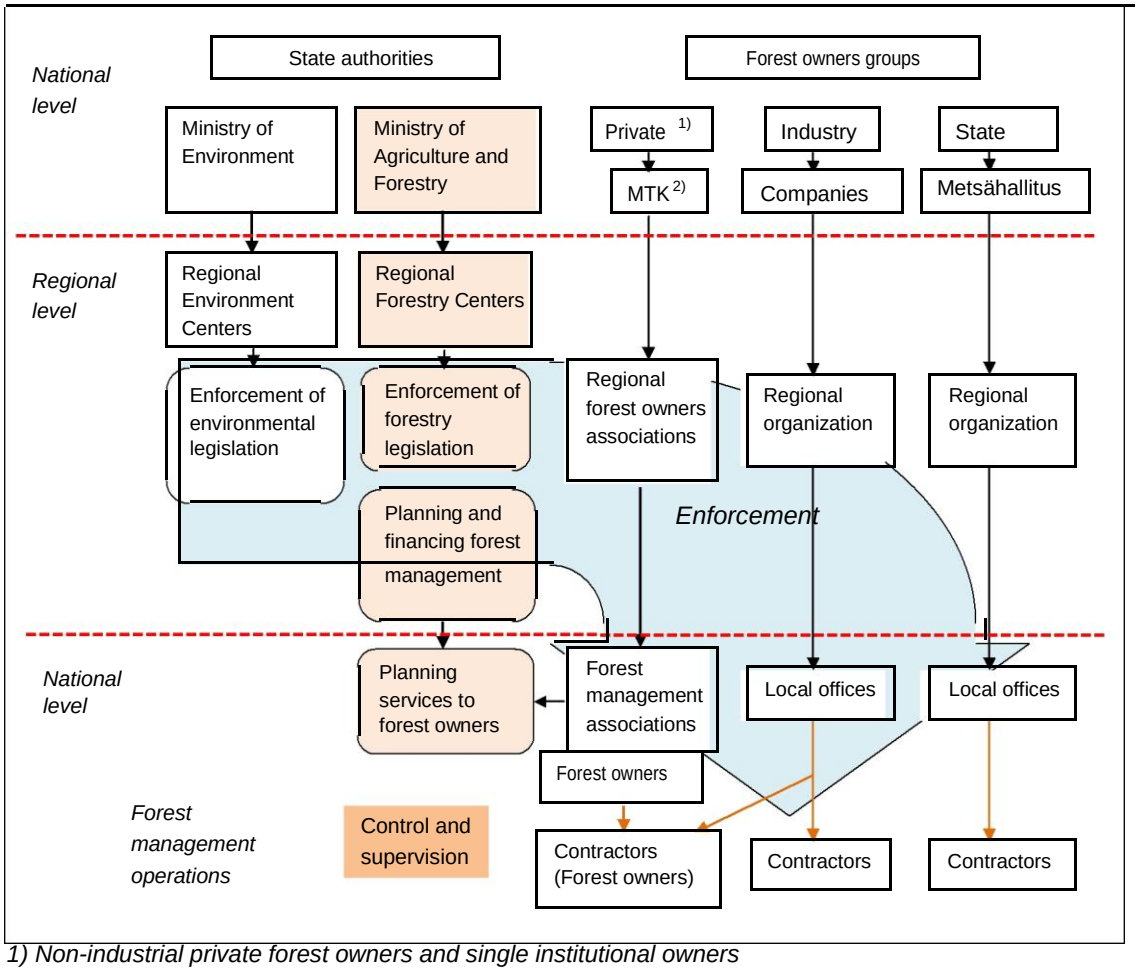
Figure 1.1 Different forest land ownership categories in Finland (Mha)



1.3 The organizational framework in Finnish forestry

Forestry and forest legislation is the responsibility of the Ministry of Agriculture and Forestry (MAF). Regional Forestry Centers (RFCs) in 13 regions have separate departments for the enforcement of forest legislation and for the development of forestry in the region (see Figure 1.2). The RFCs control conformity to legislation in all forest management in the region regardless of the ownership status of a forest area, and support the sustainability of the forest management. The activities of RFCs are supported by the Forestry Development Center (Tapio). Tapio is an indirect public administration organization that is not a government body, but functions under the supervision and funding of the Ministry of Agriculture and Forestry. Tapio has statuary public tasks set in order to support effective and sustainable forestry in close collaboration with RFCs and the Finnish Forest Research Center (Metla).

Figure 1.2 Organizational framework for national and regional forestry in Finland



1) Non-industrial private forest owners and single institutional owners
2) Central Union of Agricultural Producers and Forest Owners (MTK)

Protected areas and legislation on environment, water protection, etc. are under the Ministry of Environment. At the regional level, Environment Centers enforce legislation and consult with forest management organizations, especially concerning issues related to draining, water protection and protection of threatened species in forestry.

The Central Union of Agricultural Producers and Forest Owners (MTK) represents non-industrial private forest owners at the national level. Regional-level Forest Owners Unions provide training and consultation to forest owners and act as an applicant for group

certification. Local-level Forest Management Associations (FMAs) assist forest owners in practical forest management by providing assistance in planning, implementation and timber sales. There are 136 FMAs in total, with around 330 000 private forest owner members. Together with the RFCs, FMAs prepare the majority of forest management unit (FMU)-level forest management plans for private forest properties.

State forestry and forest industry each has its own national, regional and local level organizations. State forests are managed by the state forest enterprise Metsähallitus. Municipalities either have their own forestry departments or buy the services from RFCs and FMAs.

Most timber sales in private forests, about 80% of harvested volumes, are stumpage sales, where the buyer is responsible for the planning and implementation of the harvesting work. The felling and transport is done by contractors commissioned by the buyer, who then also supervises the quality of the work. Industry and state forestry also contract mostly private contractors for the different forest management activities.

1.4 Characteristics of forest policy and legislation regulating forestry

The objective of the Finnish forest policy is to ensure the welfare of people depending on the use of forests and to preserve the diversity of forest nature by means of sustainable forest management, including economic, ecological, social and cultural dimensions. The tools of the forest policy are legislation, public subsidies and information.

The main elements of Finnish forest policy are defined in the National Forest Program 2010, while the regional objectives are written down in the Regional Forest Programs. The long-term planning of forest policy is supported by the Future Forum on Forests. This is an academic forum operating under MAF. It aims in predicting structural changes in Finnish forestry sector in coming decades. The forum is complemented with representatives from different stakeholder groups, e.g. forest industry.

The state subsidizes forest management undertaken by private forest owners. The aim is to safeguard the continuous growth and health of Finnish forests in the long term as well as to provide the forest industry with an adequate timber supply.

Forest management planning is implemented at several integrated levels. The MAF uses regulatory framework and incentives to guide the planning, so that the objectives set forward in the national forest program may be reached. Regional forest programs interpret the national priorities within a regional context and provide input regarding regional interests to national forest policy-makers. Currently, the planning objective is to satisfy the multiple targets set for sustainable forest management and to integrate the different, sometimes partly conflicting interests into the management regime.

State forestry makes landscape-ecological plans that allocate areas for timber production, wildlife management, species protection and watershed management for the sub-regional level. The plans are well integrated into the regional nature resource plans, which are prepared in a participatory process with local stakeholders.

Detailed medium- and short-term planning is done at the forest management unit-level, and for individual operations at the forest-stand level.

One of the key elements in the forestry legislation is the law on the destruction of forests in the very first Forest Act of 1886. Currently, this prohibition means that within five years after the end of the rotation period and final harvest, a new forest must be established to replace the one felled. It is also prohibited to start felling for regeneration until the trees are sufficiently

large or the stand age is sufficiently old, unless any external reasons for felling like storm or insect damage appear.

The legislative system for forestry in Finland is not based on penalties; rather, the cooperation of forest owners is sought. Furthermore, the Finnish government introduced economic incentives in the 1960s to promote timber production in forests. The aim of promoting silviculture is two-fold: (i) to maximize the yield of the most valuable roundwood in the forest, and (ii) to enhance employment in the forestry sector, especially in remote areas.

In the late 1990s, the forestry sector adopted a voluntary forest certification system that has since been endorsed by the PEFC Council. Currently, about 96% of production-oriented forest and scrubland is certified for conformity to the FFCS standard. FSC certification in Finland is based on an interim standard and is being implemented in a very limited forest area of about 10 000 ha. The national FSC forest management standard has been under development for years, but has not yet been fully endorsed by the international FSC organization. However, the area certified under FSC is expected to grow rapidly once the standard is endorsed. As requirements of both PEFC and FSC certification standards are built on compliance with national legislation, the auditing for certification is considered to support law enforcement in the forest sector.

In Finland, forest taxation is based on net income from sales of timber. The state supervises taxation through forest owners' annual obligatory tax reports. If deemed necessary, these reports are further compared with, for example, the reports provided by organizations buying timber from forest owners.

Compliance with forestry and environmental legislation is considered to be high in Finland. Obligatory forest use notification provides information about the planned harvesting and outlines the plans for forest regeneration. A nominated authority in the Regional Forestry Center is responsible for the enforcement of both the environmental and forestry legislation. RFCs conduct annual sampling-based monitoring to evaluate the level of compliance, and they perform a site-specific audit if nonconforming activities are suspected. RFCs allocate forestry-related subsidies and monitor for appropriate use. Conformity to regulations is a baseline requirement for subsidized activities.

2. ASSESSING, STORING AND DISTRIBUTING FOREST RESOURCE INFORMATION

2.1 Legislation on forest resource information

The single most important issue regulating and guiding the assessment, use and distribution of forest resource data is the law on personal data (523/1999). The objectives of the law are to (i) implement the protection of private life and other basic rights that safeguard the right to privacy in the processing of personal data, and (ii) promote the development of and compliance to good processing practices.

By law, the property-level forest resource information is comparable to banking secrecy and is to be treated confidentially. The forest resource information and related unit- level management plan on private properties are available only to state officials and the property owner, unless the owner authorizes officials to provide the information for other indicated purposes.

The legislation on the availability of data has considerably affected resource assessment and the ICT solutions used in forest resources management. Most forest sector actors have created individual forest resource information systems for their own purposes and for the management of data to which they have access. In general, there is no common database or GIS system that would include all the data used within the sector.

2.2 ICT applications related to forest resource information

The most important ICT application related to forest resource information is the National Forest Inventory (NFI), which is presented in Box 2.1.

Box 2.1 National forest inventory

General information on national forest resources is provided in the National Forest Inventory (NFI), carried out by the Finnish Forest Research Institute Metla. Since the 1920s, NFI has been carried out regularly in five- to ten-year cycles, and the current 11th inventory is scheduled to be completed in 2013.

At present, the inventory utilizes multisource sampling methodology, whereby satellite image interpretation is supplemented with extensive field sampling and digital maps. The data produced in NFIs is public and available to all actors in the forestry sector at the cost of the data provision, as the government funds the data collection. The nature of the data is to provide information on large areas, and it is not intended to be used for operational forest management planning. By law, the data is limited to covering only forest resources and does not include any information on forest property ownership if the area is not owned by the state.

The forest resource data produced in NFI is used for several purposes:

1) To provide reliable statistics on resources for the purposes of forest policymaking at national and international levels
2) To carry out regional and national forest management planning
3) To assess sustainability of forest management on a regional basis
4) To evaluate greenhouse gas emissions and changes in carbon storage
5) To assist in research
6) To support planning of forest industry investments on a strategic level
7) To base information for the forest industry on timber supply planning

The ICT solutions related to NFI have been developed over several decades. NFI has been utilizing ICT-based approaches since the first generation ICT application came available. The annual budget for Metla's public authority tasks, including NFI, is around 8.5 million Euros. ICT-solutions have facilitated significant cost savings both in the NFI process and in the public authority tasks in general.

More information on Finnish NFI can be found at: *www.metla.fi/ohjelma/vmi/nfi.htm*

The ICT application focusing on private forests – the management of forest resource information on private forests (Aarni) and the service to improve services for private forest owners (Metsään.fi) – are presented in Box 2.2 and Box 2.3.

Box 2.2 Aarni – Management of forest resource information on private forests

Due to several reasons, one of which is the fragmented structure of the privately owned sector, the management and assessment of forest resource information is considered complicated, inefficient and partly overlapping. To improve the situation, Tapio is currently developing a new forest management planning system, called Aarni, consisting of the collection and assessment of the resource data as well as the management, updating and distribution thereof. The solution is designed to improve productivity, cost efficiency, and cooperation between organizations, including data procurement and two-way dataflow. Aarni replaces old forest resource collection and management system Solmu. The old system was based on field inventory with an assessment cycle of 10-15 years.

The development project is funded by the state through the Ministry of Agriculture and Forestry. The primary end -user of the planning system is the Forestry Center. However, one of the main objectives of the project is to ensure an even availability of information to all actors based on the legislation and permission given by private land owners. Tapio anticipates that 400 users will interact with the data. Eventually, Tapio hopes to expand the user group to 850 people, who will access GIS for forestry law supervision, forest extension service, forest management planning, and forest improvement projects.

The maintenance of the database is divided into two phases: (i) forest inventory and data collection, and (ii) updating of the data between assessment times.

The inventory is conducted using an extensive multi-source inventory with an assessment cycle of 9-10 years. The target for the annually assessed area is 1.5 million hectares. The methodology is built on LiDar-data interpretation supplemented with aerial images and extensive field sampling data. By using LiDAR-based methodology and modern field measurement methodology, assessment can be carried out with 40% lower total costs compared to the methodology used earlier. In addition to the direct inventory, information is gathered from old forest management plans, property registers, registers on sites with high cultural value and databases on sites with high environmental value.

Forest resource information is collected compartment-wise. Once the information has been collected, a simulation and optimization routine is carried out for each compartment in order to produce a general management plan for the whole area. This will be done solely based on Tapio's recommendations on sustainable forestry and stand resource information. These calculated management recommendations can be further utilized when preparing management plans for properties.

Updating of the database is done in three ways: (i) by using obligatory announcements and subsidy applications, (ii) by giving forest owners some rights to update information on their properties and (iii) by simulating forest growth and development.

The simulation process is carried out by integrated simulation software, SIMO. This open-source software was originally developed at the University of Helsinki as a cooperation between public and private forestry organizations. It has been replacing to a growing extent the previously dominating simulation software MELA that was developed and is still maintained by Metla. Since its initial software development, SIMO has been further developed and maintained by the small Finnish company Simosol.

For the primary users of the information system, the GIS-database will be operated though a user interface built on Esri's ArcGis-software. The software development related to the information system is carried out by Tieto, a Finnish software house.

The development work of Aarni has proceeded to an operational phase. The first area was remote sensed in 2009 and is currently in the second phase of the inventory process, the complementary field inventory. The GIS-system is still being further developed, but in general, the system is operating in the Regional Forestry Centers.

Box 2.3 Metsään.fi – Software package to improve services

Tapio is simultaneously developing a software package in order to improve the services and accessibility to the information produced by Aarni. Metsään.fi is an Internet-based service portal for:

1. Law enforcement
2. Private forest owners
3. Forestry service providers
4. The forest industry.

The basic ideas behind the service being developed are to (i) provide the information produced from public funding to all actors in the sector at the same cost and under the same conditions, (ii) enhance the market activity by providing information and ways of direct communication between service providers and forest owners, (iii) develop capabilities for new modes of electronic communication for state officials, and (iv) increase transparency of law enforcement processes.

The availability of the forest resource information will depend on the authorization of the private owners. As part of the service, the forest owner will have tools for selecting what information is provided to different users or user groups. The structure of the data provision is designed to even out the differences in the availability of data to service providers. The market competition will thus be opened, which presumably will have a positive effect on the service provisions and employment possibilities in the forestry sector. Alternatively, the forest owner may make openly available his/her information and service requests and allow tendering for the services.

Law enforcement will benefit from the more accurate and updated information on forest resources as well as from the improved electronic communication capabilities. For forest owners and service providers, the interface with official operations allows for the capability to monitor the processing of legal cases.

The development of Metsään.fi service is currently ongoing and will be operative for forest owners in 2011 and for all stakeholders in 2012. The scale of initial investment requirement for introducing a similar solution is around EUR 200 000 – 300 000. The development work has been carried out in four years period. Long development period has increased the investment costs, but has also enabled a possibility to test the service and developed data structures prior to official launching of the service.

The demand for this type of service reflects the fragmented organizational structure of private forest owner structure. Characteristic to the demand is that the most challenging part of the developing work is to design the system to cover needs of all stakeholder groups. For the service to fulfill its expectations, the developers should get all stakeholders involved in the process. At the moment, forest industry sector has not been involved in the process in large extent. The main reason for this is that the services are mostly developed to serve small scale actors on the field. Other challenge is to involve actors under MTK in the process. This is mainly due to the fact that FMA's compete with RFC's and small scale forestry service providers for the same forestry services.

In addition to the Finnish experiences on forest resource information, an interesting example of a public Internet-based solution on a forest resources database in neighboring Estonia is interesting due to Estonia's quite different historical evolvement of the forestry sector (Box 2.4).

Box 2.4 Example from Estonia: Public internet-based solution for a forest resources database

As a part of Estonian national IT policy, several types of OpenGIS projects have been carried out by the Estonian Land Board (ELB) in the 2000s in order to bring the spatial data infrastructure better in line with the EU INSPIRE directive and e-Government principles. The general objective of these development projects is to support environmental policies and policies or activities that may have an impact on the environment.

The Estonian forest sector has gone through major changes since the new land reform in the early 1990s. Large-scale alterations were made to the old Soviet-based forestry structure in both land tenure and privatization of forest industry. During the privatization and modernization process, the government's strength in law enforcement was reduced, even as illegal logging (for example) was reported on a rather large scale.

In projects carried out to support forest governance, a variety of different spatial databases were made publicly available on the Internet, including forest registers and cadastral information. At the moment, cadastral data is public, and everyone has the right to access the data, except the information on ownership, which is regulated by law under the Public Information Act. In the public forest register GIS solution on the Internet, the same principle is applied to forest properties, and a summary of an obligatory forest management plan, including information on forest resources, has been made public.

The development processes were funded by the Estonian state and the European Union. The scale of the investment is around 1 – 2 million Euros. The first results of the projects have been promising. The improved quality of and better accessibility to the data has enhanced the forest governance, and partly as a result of the data-assisted improved governance, the illegal logging has been reduced. The share of illegally harvested volume of the total harvested volume has declined from 1.7% to 0.005% between the years 2002 and 2009, according to Indufor sources. Another clear sign of better transparency in the sector can be seen in the forest property transactions within the country, where free and transparent information on properties has enhanced the property markets.

More information on the Estonian OpenGis solutions can be found at:
Geoportaal.maamet.ee and http://register.metsad.ee/avalik/

2.3 Governance impact

The role of the NFI in the Finnish forest sector has been remarkable since its inception. It has provided policymakers with information on the resources to support decision-making and development planning. In addition to clearly supporting governance, public and comprehensive forest resource data increases the transparency of governance.

The newly developed forest resource database Aarni has several links to different main buildings blocks of good governance. It provides state officials with accurate and easily accessible data on the forests under their supervision and enhances the efficiency of law enforcement by providing more effective communication in electronic form as well as by simply gathering the needed information into one database.

The new assessment and management-planning methodology taken into operational use reduces the costs of the assessment, all the while increasing accuracy timeliness. The well-designed information distribution interface will support the objective of creating a forest resource platform for several information users in the sector.

Metsään.fi is an example of the new generation ICT applications. Its main link to good governance is through effective communication and in the objective to make available access to data and service provisions to all market operators. However, the fragmented structure of the Finnish forestry still remains as a challenge for this type of solutions.

3. PRIVATE FOREST OWNER ORGANIZATIONS

3.1 General structure

Private forest owners are one of the intended user groups of the previously discussed Aarni and Metsään.fi, but especially so for the latter. However, private forest owners are highly organized in Finland, and this organizational structure produces most of the services needed by the private forest owners. A clear majority of forestry activities are channeled through FMAs, despite the fact that RFCs also provide services for private forest owners. In this view, RFCs and Tapio mainly play a supportive role in developing and providing services for private forest owners.

MTK is the central union of forest owners. It is active mostly in the political sector, but is also active in the ICT sector. Currently, MTK is developing an electronic timber-trading site on the Internet. The main idea behind the site is to allow forest owners to publish harvesting sites within the site and tender the timber on the markets. The solution is considered to increase transparency in the timber markets as well as to provide information for forest service providers. The service is also considered to support the structural changes in the Finnish forest industry sector through clear and transparent timber pricing and through lowering the costs of the timber supply. The development project aims to establish the service in the year 2011. Half of the development project is funded by MTK. MTK is seeking the rest of the funding from public funding sources, such as from the Finnish Funding Agency for Technology and Innovation (Tekes) or from state subsidies. Thus far, the forest industry has not participated in the development work.

Most of the ICT solutions used either by FMAs or private forest owners are developed by Silvadata Oy, a company jointly owned by MTK, forest management associations, forest owners associations and an association of employers of private forestry sector service providers. The main objective of the company is to provide its owners with ICT solutions needed in forestry activities. Silvadata has 30 programs, which are designed according to the intended user groups. The basic idea is that all programs are compatible with one another and each client can build the needed software package according to his/her needs.

Silvadata has established a new net-based GIS application for private forest owners. The application, Silvanetti, is designed to enhance the communication between the forest owner and the FMA. Compared to other similar type of solutions, Silvanetti enables owners to participate in the management planning, and the software includes, for example, the possibility of drawing areas on the base map, which are then further transferred to the FMA. One of the objectives during the development phase was to allow several users access to the property data in the system. The change in the ownership structure emphasized this feature, as a growing number of properties are owned by estates or are owned and managed by several individuals for some other reason. Silvanetti received an award from the Meridian Awards 2010, especially on its functionality, design and layout. However, as a service, it provides the forest owner with rather similar services as the solutions hosted by other market actors.

Silvanetti was launched in the beginning of 2010. Thus far, it has been taken into operational use by around 70 of the total 109 of the FMAs, and the number of forest owners using the application is reported to be growing.

3.2 Governance impact

The development of an electronic marketplace supports timber markets and increases transparency in timber trading. Software developed in order to meet the needs of the end-users supports activities carried out by forest owners. A large user base of the ICT solutions provides benefits to the whole sector. An increasing amount of information processed

electronically improves the efficiency of the activities as well as assists in increasing transparency in the sector.

A fragmented sector with several somewhat overlapping processes reduces the efficiency in general, as to some extent the same work is done redundantly. However, a balanced forestry sector with several major actors and organizations increases the stability, efficiency and transparency in the sector. On these grounds, modern communication technologies provide good channels for open discussion on the status of the sector as well as on the development needs for the future.

As a result of the change in the ownership structure of the private forests and of the growing number of jointly-owned forest properties, the new software has been developed in a way that allows access and management possibilities for several individuals. Experiences gained from these solutions can be utilized also in community forests in other countries. However, solutions are typically highly dependent on the information and communication network, which reduces their applicability in developing countries.

4. PARTICIPATORY FOREST MANAGEMENT

4.1 Background

In the 1990s, mainly the state forest enterprise Metsähallitus introduced participatory forest management planning into Finnish forest management planning. The primary objective of participatory planning is to enhance social sustainability. In general, this generates employment for local people, improves the living standards of indigenous people and increases the overall acceptance of the selected forest management plan.

Generally, participative forest management planning consists of four stages: (i) collecting information on the different objectives, (ii) creating and evaluating different management options, (iii) selecting the most suitable option, and (iv) informing stakeholders on the selected management option.

Traditionally, evaluation of the different viewpoints and collection of feedback were carried out in face-to-face meetings and discussions with the stakeholders and steering committees. Since then, new methods of communicating with the stakeholders have been introduced in order to enlarge the number of people participating in the processes and to lower the threshold for participation. New ways of communicating and collecting feedback on different options have arisen via the Internet and mobile phones.

Probably the most challenging part of participative management planning is how to take all the different views into account and how to evaluate and communicate the different options and their respective impacts. Box 4.1 presents one solution for evaluating and visualizing different options.

Box 4.1 MESTA: An internet-based decision support application for participatory strategic-level planning

MESTA is open-access Internet software developed and funded by Metla. It was first developed to serve as a tool for Metsähallitus for participative forest management, but has later become available also to private forest owners for evaluating different growing strategies.

It is developed for the purpose of holistic evaluation of different decision alternatives. It is based on the definition of so-called acceptance borders for decision criteria (e.g., the minimum income from the forest cuttings). The holistic acceptance border definition is continued until the decision maker finds the most suitable decision alternative from the pre-defined alternatives within the scope of Metsähallitus'/ the owner's jurisdiction.

The strength of the software is that it can facilitate the illustration of the effects of different strategy alternatives at the stakeholder meeting. The better understanding of the different alternatives and corresponding results assists in accepting the needs of another stakeholder group. Through the evaluating process, the stakeholders will get information concerning potential costs and benefits.

MESTA has been utilized in participatory forest management of Metsähallitus in Eastern and Western Lapland, where the decision-making often requires difficult compromising on different objectives and needs such as combining logging with nature-based tourism.

Compared to other methodologies of evaluating different management alternatives, MESTA provides the possibility to study the alternatives with less input information and knowledge on the subject. Therefore, it is considered to be efficient, especially when communicating with stakeholder groups having less direct contact with forestry.

More information at *http://mesta.metla.fi/index_eng.cfm*

In addition to the state-owned forests, participatory planning processes are developed and used in other areas central to the interests of the public. A good example of forests with a broad scope of different management objectives are urban forests. Most cities in Finland own forest areas within and around the city areas. Combining both commercial forestry and multiple forest use has been found difficult and has caused conflicts. Most cities have used participative planning methodology in order avoid and solve these conflicts and to involve local residents better in the management planning. Box 4.2 presents one Internet-based solution that is used for facilitating the participation of the stakeholders.

Box 4.2 Netforestcity: Internet-based solution for distributing information on forest management plans and collecting feedback from the stakeholders

Tapio's NetForestCity was likely the first GIS solution for participatory forest management planning that was accessible through Internet browsers. It was first developed in the early 2000s because of the need to reduce conflicts in the management of urban forests.

The software has been used in two steps:

1) During the planning process, it allows the stakeholders to view the initial management plan through a GIS solution on a compartment level and provides a new route for giving feedback on the activities planned.
2) After the planning process has been completed, the management plan can be left on the Internet for the stakeholder to see the plan, upcoming activities and resources they are interested in. It is also possible to give the stakeholders the possibility to communicate with the operators and the planner through the Internet.

The acquiring cost of the service for the client's is around EUR 10 000, plus minor costs for maintenance. Despite the fact that the software is based on aging technology, its functionality is still desired on the markets. Tapio has not made any decision concerning updating the software to be compatible with modern IT-technology. The service is currently in use in the cities of Jyväskylä and Heinola.

According to the feedback collected from the stakeholders and management planners, the use of the software has reduced conflicts and assisted the managers in taking the residents' wishes on forest management into account. Once the actual planning has been finalized, the software has been a good channel to inform the stakeholders about the activities implemented in the area.

Most of the conflicts regarding the urban forestry are related to incomplete information on the planned activities and unsatisfactory opportunity to participate the discussion on intended use of the area. The use of this type of solutions does not necessarily mean that the power of decision is more distributed. However, the enhanced communication and possibility to discuss the different management possibilities often times reduces most severe conflicts as the reasons and drivers for selected activities are better known.

According to general experiences on the solution, communication is the key success factor to effective use of the solution. In the first place the stakeholders have to be aware of the possibility to participate the management planning. Once the public has found the service, communication between the stakeholders and planning organization has to work in a way that the stakeholders stay motivated to the process.

More information at *http://www.netforest.fi/jyvaskyla/* (In Finnish)

4.2 Governance impact

It is acknowledged that the use of participatory forest management planning has helped in avoidance of conflicts in forest management, especially in areas that have multiple interests. The most important benefits are gained through the following:

1) improved informing of stakeholders on activities that are about to be carried out
2) ability to include different objectives into the management
3) improved relations among the stakeholders
4) greater perception of different needs and opinions
5) increased transparency of forestry activities in certain areas

Participatory forest management and decision support systems have been studied actively for more than a decade in Finland. Metsähallitus in particular has long and extensive experience in participatory management planning. This knowledge can also be transferred and utilized globally in developing countries.

The ICT-based solutions used in the procedures have rather high requirements for ICT readiness, especially among the stakeholders. Therefore, the global importance of this field might not lie in the ICT solutions themselves, but rather in the knowledge and experiences in the field of participatory planning methods.

5. ICT SOLUTIONS USED BY FOREST INDUSTRY ENTERPRISES

5.1 Large organizations and forest industry companies

In general, all the major large forest industry companies (UPM-Kymmene, Stora Enso, Metsäliitto and Metsähallitus) in the Finnish forest sector have similar ICT solutions for supporting wood supply operations. Common to all the systems is that they have been developed on a need basis by either Tieto or Fifth Element, two main Finnish software houses in the forestry sector.

Typically, the development of the system has been continuous, and new solutions have been introduced into the old system as evolving technology has provided new possibilities. The investment need into these solutions is difficult to estimate due to the nature of the development process and the large coverage of the solutions. However, the initial investment need is around EUR 200 000 – 400 000. In general all the companies have their internal technical support unit. The most challenging technical support is outsourced to the software developers as the malfunctions are often times related to structural and operational issues in the software.

The fact that every actor in the sector has their own information data management system causes some problems, especially for small forest service providers operating under several companies. However, it is not the number of the systems that is considered to be the main issue, but rather the fact that there is no common exchange interface between the systems.

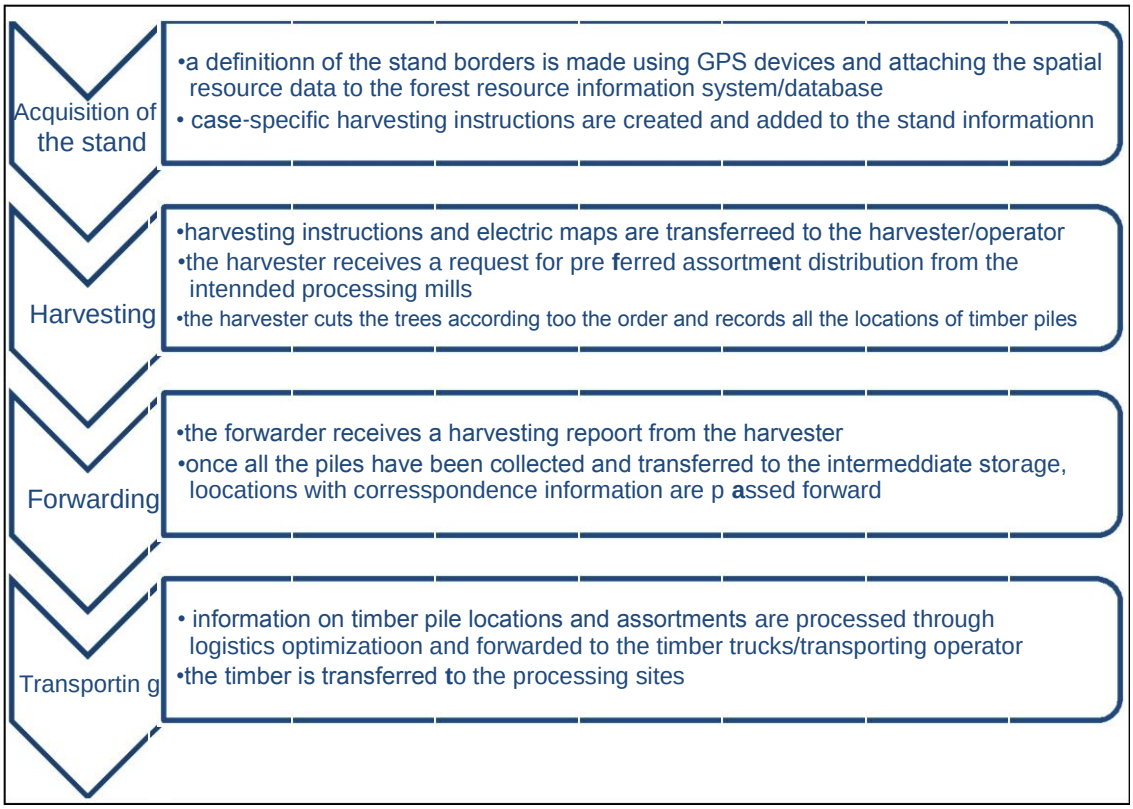
The information management and related ICT solutions in large forest industries comprehensively cover all the processes related to wood supply and the whole chain the timber goes through. Between the different stages, the information is managed in the main database and then passed along in electronic format to the following stage.

The information systems are based on mobile and Internet data transfer, which enables information to be quickly and easily disseminated between offices, wood trucks and harvest machines. This allows transferring of work instructions and spatial information between the office and service operators, for example.

Hand held GPS devices and field computers are used to record and transfer data directly from the forest into the forestry system and to use this data for planning. During each work phase in the field, information collected by the planner, buyer or vehicles can be used as the base data when planning forestry operations or timber transport.

Timber tracking is not used for locating individual stems, but spatial locating is used through the chain-of-custody at all stages from the acquisition of the stand to the transportation of timber. Tracking is done on a timber-stand basis or on a pile basis. Figure 5.1 describes the steps and information sources used in each step.

Figure 5.1 Description of the information chain throughout the timber supply chain



5.2 Medium- and s mall-scale enterprises

In general, small-scale wood supppliers and traders have developed their information databases and manage ment systems more from off-the-shelf solutions. However, in practice, all companies use similar types o f timber supply solutions utilizing GIS syste ms, GPS positioning, hand-held devices in the field and digital information exchange ove r mobile networks or the Internet.

5.3 Mobile solutions in Finnish forestry se ctor

The number of mobile pphones per inhabitants is one of the highest in the World in Finland. The popularity of mobilee phones annd rather comprehensivee mobile ne twork coveraage have expedited the development and provision of moobile services. Currently public mobile based solutions cover a large vvariety of both governmeental and private services. Most solutions are created in order to provide more efficient ways to communicate innformation via SMS-messages oor mobile phhones intendded web pages. Anotheer remarkable branch on mobile solutions is mobile payment services that are widdely used e.g. on public transport and parking payments.

The rapid development of mobile phhones' computing ability has decreased the gap between smart-phone s and traditional hand hheld devices. The combination of da ta transferring ability and modern integrated accessories like GPS and digital camera provide a possibility to reduce the number of devices needed on field. The posssibility to use only one deevice is considered to decrease booth initial investment cossts into equipments as well as labor costs throuugh more efficient field work.

The Finnish forest sector and especially its largest operatoors are currently developing and testing smart phone based solutions. These solutions are planned to substitute traditional field

computers. In general mobile GIS-solutions are based on similar solutions as used on field computers with minor alterations. Possibility to build the solutions on existing software reduces costs compared to developing new programs from scratch. However, the development work is in general carried out operator wise by outsourced software houses. There is not real supply of off-the-shelf software for mobile phones. Another limiting factor with mobile solutions is that that there are several operating systems that are not compatible with each other. In addition to this, especially older operating systems like Symbian are not ideal for this type of third party software. The cost of the software development is typically between 30 000 and 100 000 Euros.

Among the first, Metsäliitto and software house Fifth Element have developed a mobile phone based client GIS-solution that is connected directly into company's main GIS-database. The solution has been taken into operational use and first experiences have been promising. In general the solution proves that modern smart phones serve as sufficient platform for the solutions. The main challenge with the solution is the low data transfer rate, especially on remote areas. This has forced the software developer to search new solutions to reduce the data transfer need. In most cases this limits either usability of the system or compatibility with the company's main database. Other difficulties observed were mostly related to phones' low battery durability and general ruggedness in demanding field conditions. An adequate computational ability for this type of mobile solution is available only on the latest smart phone models.

Another good example of mobile solutions used in forestry sector is developed for forestry service company Silvesta. Silvesta is a forestry service company owned by UPM. The company has developed software mainly for employee management. The system includes applications for work time management, work order transferring, work progress reporting and work quality management. The solution has proved out to be a well functioning and it has not suffered for capacity limitations as badly as the previously described solution. The main benefits for the company are the possibility to reduce management costs and ability to improve the quality controlling.

The experiences gained from these solutions are considered useful for for developing countries. Especially solutions with lower requirements for mobile networks and smart phones' capacity might serve as good benchmarks for World Bank client countries.

5.4 Forest industry companies' e-services for private forest owners

UPM-Kymmene, StoraEnso and Metsäliitto have created an Internet page for private forest owners. The purpose of the pages is threefold: (i) to provide the clients with better services and (ii) to give the companies access to the forest resource data through management plans and (iii) to maintain direct contact with the owners.

In most cases, the service pages have been developed by the same software houses that have developed the information systems for service provisions and that are directly connected with the rest of the information systems. Box 5.1 presents Metsäliitto and its e-services for stakeholders and private forest owners.

Box 5.1 Metsäverkko, Metsäliitto's internet-based service for private forest owners and shareholders

Solution Example 3: Metsäliitto is one of the three large forest industry enterprises in Finland. It differs from the other two, UPM-Kymmene and StoraEnso, in its corporate structure. Metsäliitto is a cooperative owned by its 130 000 private forest owners. The total area of the shareholders' forests is around half of the privately owned forests in Finland.

Metsäliitto's wood supply is based on buying timber from its owner-members; however, the owners are free to sell the timber to the markets. Therefore, all the transactions are completed at the market price.

Metsäliitto has developed an e-service application to provide its shareholders with better service and to hold on to their timber and forest resource information. Metsäverkko was first introduced in the early 2000s to allow private forest owners and cooperative stakeholders the possibility to manage and view their forest management plans on an Internet-based GIS application.

Since then, Metsäliitto has developed the service, and at the moment, the Internet solution covers all the main activities needed between the forest property owner and the timber trader. The site also has functionalities that allow users to collect all the necessary information for the tax-report in e-form and to produce the report themselves.

In addition to providing the main functions needed in the timber trade and to managing the resource information, the Internet solution is used to communicate information to the members. This information consists mainly of market information, produced by the company as well as by others, and of sector and company news.

By enlarging and improving the site, Metsäliitto has been able to double the number of people using e-services. Through the activities transferred to the Internet, the company has been able to reduce the costs of its services. This is mainly due to the fact that traditional services are rather expensive to produce. However, it is recognized that there is still a need for services in a traditional form. Majority of the timber transactions are still carried out in face-to-face negotiations with the forest owners. However, the most important outcome from these solutions for the companies is the improved contact with the wood producers and shareholders. Therefore the key success factor is to develop the system to meet the target users' needs.

More information at h*ttp://www.metsaverkko.fi/Pages/default.aspx* (In Finnish)

5.5 Governance impact

A transparent, well-organized and functioning timber market is considered to increase the stability of the forest sector and to support the national goals on forestry. Developed information management and communication systems used in the forest industry reduce the workload and related costs, both for companies as well as for the other stakeholders in the supply chain.

Due to the change in forest ownership structure in Finland, the forest industry and government must introduce new and more active solutions to secure the wood supply. Internet-based services have proved to be good communication methods for activating the forest owners to manage and sell timber from their properties, which is needed to reach the targets set in the national policy for the forest industry.

In a global context, the information systems used and developed by the Finnish forest industry can serve as a benchmark for comprehensive systems combining a large set of functionalities with data sources. The newly introduced mobile solutions prove that modern smart phones are capable for replacing previously used expensive field computers. The experiences can be utilized in development of second generation timber tracking solutions also in developing countries.

6. SOLUTIONS FOR DISTRIBUTING INFORMATION ON FORESTS AND FORESTRY

6.1 Different approaches used in Finland

Traditionally, private forest property owners consisted primarily of farmers carrying out most of the silvicultural activities within the forests by themselves. Traditionally, wood sales have provided the necessary funding for the investments required for running agriculture operations. During the past decades, the ownership structure of private properties has changed, and the farmers' share of all private properties has decreased to 20%. As the forest owners have no direct connection to the forests and are economically more independent from harvest income, new procedures are needed to activate the timber markets and to secure adequate timber supply for the forest industry as well as to support government policy on forestry.

Another challenge for a growing number of urban forest owners is how to secure the productivity of forests and sustainability of forestry. The knowledge of forest owners on forests and forestry has declined, which has in turn decreased the extent of silvicultural activities carried out on properties. During the past few years, there have been several projects (e.g., Metsä-tv described in Box 6.1) that have aimed at increasing public knowledge on forests and forestry. Projects have been funded by the state and forest industry as well as by NGOs and forest owners associations.

Box 6.1 Metsä-TV, a forest-owner targeted educational tv-program on forestry and silviculture

Metsä-TV (Forest-TV) is an educational Internet site that is aimed at forest owners and the general public. The idea behind it is to provide high-quality short videos on forestry and silviculture for free over the internet to the public.

The programs introduce relevant issues for forest owners in a way that does not require earlier knowledge on the subject. The programs are produced by professional television crews, and they can also be ordered in television format. The majority of the programs are in Finnish, but some are also translated into Swedish and English.

The site is registered by the production company Imageworks Ltd. The production and site maintenance are funded through program cooperation agreements. The first series of 30 episodes, The ABCs of Silviculture, was funded by the Forest Owners Associations, the Forest Centers, Stora Enso, Metsäliitto and the Finnish Forest Foundation, which also participated in the production.

This type of solution is considered to encourage the private forest owners in economic exploitation of their forest properties. The provision of basic information on forestry activities has also increased forest owners ability and willingness to carry out basic silvicultural activities. The low knowledge on the importance of these operations is often times the most important driver for delays and defaults. In this view, the educational approach has a remarkable affection for the quality of the timber produced as well as to the sustainability of forest sector. The cost efficiency of these solutions is considered to be really good.

The key success factor for this type of solutions is the quality of the produced material. This solution is a good example of improving the quality by combining know-how of professionals from several fields.

More information at *http://www.metsatv.fi/*

Private and public forestry organizations have been developing their e-services and ICT-based services over the past decade. As part of the national ICT policy, the state launched a four-year development program (SADe, Sähköisen asioinnin ja demokratian kehittämisohjelma) in the year 2009 to promote e-Services and e-Administration in public governance as well as promote democracy through easy accessibility and transparent information distribution. The

objective of the program is that the most relevant services for the public will be available on an electronic basis by the year 2013. Some ten years ago, Finland was rated to be one of the leading countries in providing e-services for the public. Since then, the development has not been satisfactory. This project aims to bring the Finnish services back to the top international level.

Through the project, the state will expand the services to be wider than what is now provided. Box 6.2 describes one solution that is used for forestry purposes.

Box 6.2 Otakantaa.Fi: The government's public discussion forum on the internet

Otakantaa.fi is a government-hosted site for public discussion on issues being handled by the government. It was first launched in the year 2000.

The objective of the site is to (i) gather public views, opinions and expertise on issues being decided, (ii) increase communication between the public and government and (iii) improve the quality of case preparation for the decision-making.

The forum is operated with the following procedure:

1. As the government starts a new project, project managers decide whether the decision-making would benefit from public consultation.
2. If a forum is warranted, the managers decide which key issues will be discussed, what the background information package attached to the forum will be, and what the timing and length of the discussion period on the forum will be.
3. The forum is typically open for 2-4 weeks. The public may participate freely in the discussion, but all the messages go through a peer-review process before publishing.
4. As the forum is closed, the material gained is analyzed and summarized. The summary and the entire discussion are made public, along with information on the subsequent discussion and outcome.
5. The summary is taken into account in the decision-making, and information regarding its effect on the decision is posted on the forum.

As the forestry legislation was under renewal in 2009, it was observed that there was a need for more open public discussion on the subject. A discussion forum was opened on the otakantaa.fi-site, with a comprehensive background information package on the issues and different possibilities in the law being renewed. The forum was kept open for 4 weeks. During this time, the forum gathered 150 messages from the public.

At the time Otakantaa.fi was first introduced in the 2000, it was one of the first applications on the Internet that aimed at increasing public participation and providing opportunities to influence political decisions made in the world. However, since then, the development has not matched pace with the growth of the Internet and rapidly developing technology.

According to the experiences gleaned from the site and feedback from the public, the site has not attained significant publicity, nor has it gained in popularity in governmental activities or with NGOs or with the public.

The main problems in these applications are considered to be that they are still rarely used and that the connection to the actual decision-making is perceived as weak. The communication on the service is not carried out in an effective manner. This may also be due to lack of knowledge within the governance itself. Well coordinated communication on the service is the key success factor for this type of solution to be distinguished from the large information and service mass. The development work has also concentrated on the technological side, neglecting the actual user experience and opportunities for participation.

More information at *http://www.otakantaa.fi/*

6.2 Governance impact

The need to broaden the concept of democracy to encompass requirements in electronic democracy is widely recognized in Finland, and this change is already visible in the forestry sector. Links to e-democracy can be perceived in several solutions already operating or under development. These requirements, more simplified processes and improved accessibility to government or public information, are directly emphasized in solutions like Aarni and Metsään.fi, but indirect activities promoting electronic democracy have also been implemented in other solutions. Likewise, activities developed to educate the public on forestry, especially through television, have reached the public and have managed to fulfill their prior expectations.

7. TIMBER TRACKING SOLUTIONS

As there has not been a need to use a more sophisticated and detailed timber tracking system on a large scale, a great majority of all the industrial timber traded and transported in Finland is tracked with similar solutions and at the same level of intensity as what is presented in Chapter 5.

Despite the fact that the need for tracking timber at the level of individual trees has not been articulated, solutions that are applicable to this have been developed. This chapter describes two recently developed ICT solutions for tracking forest products. Box 7.1 describes a development project entailing a detailed timber tracking solution, and Box 7.2 presents a currently operational tracking system for harvesting residual bio-energy wood.

Box 7.1 Indisputable key, EU-funded project for development of RFID-based tracking systems

Indisputable Key was a three-year multinational EU-funded development project with a total budget of EUR 12 million. It was launched in 2006 and held its final seminar in March 2010. It had 28 partners from five European countries, including seven companies or organizations from Finland.

The primary objective of the project was to decrease the proportion of timber that is wasted or used for lower-value end products than the initial timber quality would have warranted. This demonstrated the prerequisites for extracting as much as possible from the wood raw material at a lower environmental cost, at the same time raising the quality of the end product. The data management is based on Individual Associated Data (IAD) methodology. According to this methodology, each felled tree has a unique code through an embedded microchip connected to a database. The chip or tag can also include information about the log parameters, felling location and time of felling. This information is further used in subsequent stages of the production chain to optimize process exploitation.

Within the project, a new type of RFID tag was developed. By using new, pulping-compatible raw material, the tag does not affect any of the used processing options. In addition to the tag itself, the project resulted in the development of transponders that are suitable for reading and modifying the data in harvesters and in such tools as large metallic saws, the latter of which had earlier experienced problems. The developed products and system used to read and process the data written into the tag are designed to be usable in all field conditions existing within the EU area, from the northern icy and cold conditions to the southern warm and dry weather conditions.

The increased efficiency of the timber supply is achieved through the ability to source the raw material from the harvesting point all the way to the most profitable producing unit. Currently forest industry consumes timber in a bulk manner without taking the full advance of timber characteristics gained from different origins. By being able to identify different sources, the differences in timber quality can be taken into account in the processes. The quality aspect can also be notified in the market transactions through premiums for better timber quality.

The project has resulted in applications additional to the original objective of reducing timber waste. The methodology and technology behind the developed system are fully transferable to any other geographical area. The ability to store and modify comprehensive amounts of information throughout the chain- of-custody provides new tools for reducing illegal logging and the stealing of timber, including in developing countries and in the tropics.

More information at *http://www.indisputablekey.com/*

Box 7.2 Metka, RFID-based tracking system for bio-energy wood

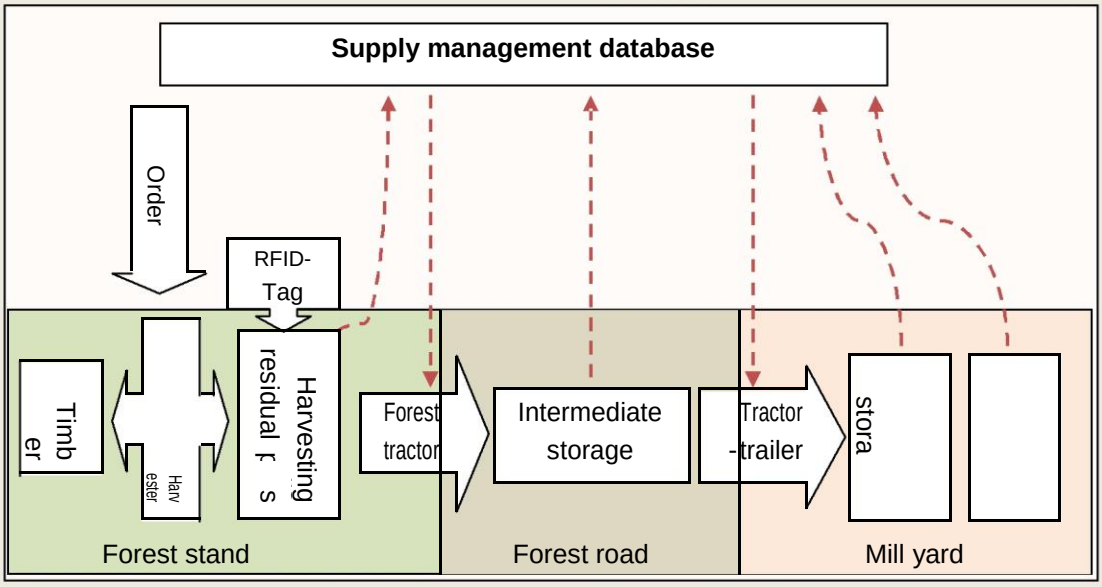
Metka is a development project whose goal is to create a RFID technology-based tracking system. The responsible leader of the project is the Forest Management Association of Päijät- and Kanta-Häme. The objective of the project is to develop an operational tracking system for local bio-energy supplier Vattenfall. The majority of the project funding is public (80% comes from the EU and the municipalities in the region), whereas the remaining 20% plus the software development has been funded by the end user Vattenfall.

The project produces benefits for the state and municipalities as well as for the company, being that it is the end-user of the system. On the governmental side, the project aims to improve employment in the forestry and energy sectors of the region as well as to support private markets in bio-energy production. The actual client, Vattenfall, benefits from increased profitability and feasibility of wood-based bio-energy production.

The project budget has been kept reasonable by utilizing existing technology solutions. The software developer, Protacon, built the information database behind the system on existing Oracle-based stock management software. The tracking system is built on RFID tags attached to the bio-energy wood piles when harvested. The cost efficiency of the system is gained by using cheap low capacity bulk tags. This allows the possibility of tracking also low value items.

The tag allows the company to follow the chain-of- custody more carefully and to optimize the processes in order to reduce the transporting costs. Another benefit from the information behind the tags is the ability to optimize the drying time for harvesting residuals in order to minimize the transportation costs and maximize the calorific value per transported units. This has a remarkable effect on the chain profitability.

The system has been taken into operational use by Vattenfall. At the moment, the system is in use in the areas of two forest management associations and by two operators. The total number of vehicles and forest tractors using the system is around ten. The operational principle of the solution is described in the chart below. Red arrows present wireless data transferring at different stages of the chain.



The most demanding issues on the development side of the work were practical in nature and related to technical issues of the tracking system, as the system was built on existing equipment and communication networks. The single most challenging issues were related to the use of mobile communication networks as well as to the difficult field conditions, which caused problems in devices reading the information from the tags.

Along with other countries, Finland has agreed to reduce its carbon emissions remarkably in coming decades. The use of bio-energy as an energy source is considered as a potential source of alternative and renewable energy. To enhance the collection and use of bio-energy, a new energy policy announced in 2010 provides significant subsidies to the bio-energy sector. One of the most economical sources of bio-energy is the burning of forest residuals that can be collected in tandem with forest harvesting. However, the different type of supply chain and the optimization of the transporting, storing and burning processes have generated a need for better chain-of-custody tracking solutions.

7.1 Governance impact

In general, the main purpose of tracking solutions is to assist in monitoring and verifying sources of timber and in combating illegal logging. Solutions used and developed in Finland are created mostly to increase efficiency of the wood supply; however, they could also be implemented as a system for law enforcement purposes in other countries. Even if the solutions have been developed in order to increase the efficiency of the wood and bio- energy supply, they can be utilized to provide governance with more detailed information on timber when needed.

The solutions have been primarily developed for the needs of the industry, but the increased efficiency can also be beneficial for forest governance. The resulting more vital industry and service sector is able to better assist in meeting the government's social targets. By broadening their scope, solutions like Metka can enhance markets and industry, even industry that operates outside of forestry but has similar requirements. As a solution, Metka provides a good example of the utilization of existing solutions for building new cost-effective solutions into new applications.

A N N E X E S

ANNEX 1

Summary of presented solution examples

Indufor

Annex 1

Summary of presented solution examples

Case	1: Mesta	2: NetForestCity	3: Metsäverkko	4: Metsä-TV, Forest-TV	5: Otakantaa.fi	6: Indisputable key	7: Metka
General description	An Internet-based decision support application. The application assists users in evaluating different scenarios and provides them with information on different solution options and the relation of those to defined objectives.	Internet-based GIS application for participative forest management planning. The application is mostly utilized in urban and community forests.	Metsäliitto's Internet-based information management system for private forest owners.	A privately managed Internet site for educational television programs on forests and forestry.	A discussion forum of the state on the Internet.	A multinational development project for a detailed timber tracking solution.	A tracking system for bio-energy wood.
Information management	Different management objectives are collected from stakeholders. The scenarios evaluated in the process are compiled from forest resource databases and simulated according to the management objectives, using a stand simulator.	The forest management planner inputs suggested management plans into the system, where shareholders can see the plans and leave public or private comments. Once the plan is completed, the general public may still communicate with the operator through the system.	Information is managed in the company's information database. The main source for forest resource information is the management plans of forest owners.	The programs are developed in close collaboration with several forestry sector actors. The Internet has proved to be a good channel for distributing the programs.	The state provides background information on the subject to enhance discussion. All public discussion is collected into summaries after the discussion period. The summaries are used in decision-making.	The solution is based on a new type of RFID tag. Information stored in the chip can be modified and complemented in each processing phase.	Bio-energy wood information is collected through (i1) simulating from the stand forest resource data, and (ii) the harvesters. The data is tracked through the chain in RFID tags and databases from the forest to the end-user's mill.
Users	The application is utilized in participatory forest management planning, mainly by	The software is currently being used by the cities of Jyväskylä and Heinola. Intended	Metsäliitto's shareholders and other private forest owners that are selling timber for Metsäliitto. The	The Internet site is open to the public. In addition to the distribution on the Internet, the	The service has not reached the expected user base, as the number of users	The most important end-user of the solution will be the European forest industry sector.	The tracking solution is used by bio-energy company Vattenfall in the areas of two forest management

Annex 1

	1: Mesta	2: NetForestCity	3: Metsäverkko	4: Metsä-TV, Forest-TV	5: Otakantaa.fi	6: Indisputable key	7: Metka
	Metsähallitus. However, it is available free of charge on the Internet for all interested actors.	users of the system are the inhabitants and other stakeholders.	share of e-service users has increased rapidly, but traditional communication still remains more common.	company distributes programs on DVDs, for example for teaching materials for schools.	has remained rather low. However, it is still used to provide support in decision-making by the government.	However, it is likely that the solution will at least in part be exported to other continents.	associations. The field solution is currently used by around 10 machines.
Technology	The publicly-funded application was developed at Metla to support participatory management planning.	At the time the solution was introduced, the technology used was new, and it was one of the first solutions providing GIS applications over the Internet. It was based on existing data infrastructure and complemented with a public interface that was developed for that purpose.	The application has been improved and expanded during the past 10 years. The latest version of the application was created by software house Fifth Element.	The most notable barrier in the solution is the requirement for Internet connections.	The solution is based on fairly simple and already existing technological solutions. The most challenging part of the solution is not technological; the challenges are to efficiently use the information gained in the decision-making process and to get people involved in the service.	The solution was designed to be functional in all European weather conditions and to be fully operational in all machines used throughout the chain of custody. Meeting these objectives called for the development of new technological solutions.	Metka utilized mostly existing technology in the solution developed. This has caused some practical barriers, for instance in accessing mobile networks from the forests.
Outcome	The user-friendly and easily accessible application has been considered successful. In addition to the original target users, it has been used by other users and user groups. The experiences of	The application has been well accepted by stakeholders and has achieved the expected outcomes. The application has been found beneficial in avoiding conflicts in forest management planning.	As the application has been further developed, the number of people using it has increased remarkably. The solution has been considered successful by both the company itself and the forest owners.	Programs have achieved wide publicity. The improved general knowledge on forests has enhanced especially silvicultural activities.	The service has not met the expected outcomes. However, the solution belongs to the set of new programs that aim at developing e-based services. Even though the site has not reached its	The project ended at the beginning of year 2010. One of the main objectives of the project was to provide the markets with a new European solution for timber tracking. From now on, the companies	The development project is still ongoing and the final project reviews have not yet been published. However, the experiences gained from the field operations have been positive, and the system is considered to have

	1: Mesta	2: NetForestCity	3: Metsäverkko	4: Metsä-TV, Forest-TV	5: Otakantaa.fi	6: Indisputable key	7: Metka
	users of the application have been positive. The role of forestry specialists in the process is considered substantial.				objectives, the experiences gained from it can be used when developing new solutions.	involved in the project will market the solution by themselves.	met its expected outcomes. The solution has improved the profitability of collecting bio-energy wood.
Costs and scaling up	The application is available free of charge. It can be scaled up in the developing countries with a low investment need. *Development cost estimate:* Investment need for similar web-solution ~ EUR 20 000. The most expensive part of the development has been the scientific background for decision making.	Acquiring costs are around EUR 10 000 plus maintenance costs. As the software is getting outdated, Tapio is considering whether to modernize it. Market demand for similar products exists. In general the solution or similar solutions have potential in scaling up in the developing countries. *Development cost estimate:* Modern similar solution investment: ~EUR 30 000 - 60 000, Minor recurrent costs.	The development is fully funded by Metsäliitto. The total amount is not publicly available. Continuous development has decreased the costs, as new services have been built on the existing framework. *Development cost estimate:* Development cost for similar solution ~EUR 40 000 - 70 000. Recurrent costs: ~EUR 15 000 / year	The production and site maintenance is funded by program cooperation agreements. *Development cost estimate:-* Investment ~ EUR 40 000. Recurrent costs: depend on programs produced	The service development relies on public funding. The state has a development program to expand e-services. In general the service provides good experiences for scaling up also in the World Bank client countries. *Development cost estimate:* Investment ~ EUR 30 000. Recurrent costs ~EUR 10 000 / subject	The project was funded by the EU. The total budget was around EUR 12 million. The tracking system developed in the project can be utilized in other countries and in developing of a timber tracking systems in the tropics. *Development cost estimate* for timber tracking solutions using the project outcomes: Investment costs ~ EUR 100 000– 300 000.	80% of the project funding was publicly financed by the EU and local municipalities. The remaining portion was funded by participating companies, mainly the end-user Vattenfall. The technological infrastructure is a commercial solution of the participating software house. The system can be scaled up at minor cost as the business area grows. *Development cost estimate:* Investment ~EUR 50 000. Recurrent costs EUR 10 000 / year.

ANNEX 2

References to ITC-solutions

Annex 2

References to ITC-solutions

The following people were interviewed for the report:

Tapio	Tapani Mäkinen
	Esko Välimäki (Aarni)
	Suvi Karjula, Päivi Eerola (Metsään.fi)
	Raisa Snell, (NetForestCity)
MTK	Lasse Lahtinen
	Lea Jylhä
Silvadata	Esa Holappa
Koskitukki	Jussi Joensuu
Metsäliitto	Ville Sileäkangas
Metsähallitus	Risto Laamanen

For more information and examples of internet-based applications:

Net ForestCity:
http://www.netforest.fi/jyvaskyla/ (In Finnish)

Mesta - Decision support tool:
http://mesta.metla.fi/index_eng.cfm

Silvanetti:
https://www.silvadata.fi/silvanetti/SilvaNetti_RIA.html
A demo of the application can be viewed using the following codes:
User: Metsamaa, Password: Mustikka (In Finnish)

Metsä-TV:
http://www.metsatv.fi/

Metsäverkko: h*ttp://www.metsaverkko.fi/Pages/default.aspx*
(In Finnish)
A demo of the application can be viewed using the following codes:
User: Metsaverkko, Password: Salaisuus123 (In Finnish)

Otakantaa.fi:
http://www.otakantaa.fi/

Indisputable Key:
http://www.indisputablekey.com/

Estonian OpenGis solutions:
http://geoportaal.maaamet.ee/
http://register.metsad.ee/avalik/

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