PROFOR

WORKING PAPER

INFORMATION AND COMMUNICATION TECHNOLOGY FOR FOREST LAW ENFORCEMENT AND GOVERNANCE

CASE STUDY: MOLDOVA

OCTOBER 2014

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TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS 5

INTRODUCTION 6

Background 6

Overview and Objectives of the Project 7

E-READINESS AUDIT 12

Current Situation with ICT Resources in Agency Moldsilva 12

Current and Potential Areas of ICT Use 14

Computer Literacy of Personnel in the Forestry Enterprises 15

APPLICATION DEVELOPMENT 17

Possible Applications for Each Category 17

Selection of Applications 19

APVPROD Application 20

PCP Application 22

System and Applications Design 24

Training and Dissemination of the Applications 25

CONCLUSIONS AND LESSONS LEARNED 29

Key Success Factors and Risks for Sustainability 29

Recommendations 30

LIST OF FIGURES

Figure 1.1 Institutional Structure in Moldovan Forestry 10

Figure 1.2 Moldsilva Organogram 11

Figure 2.1 Computer and Communication Equipment in Moldsilva Units 13

Figure 2.2 Assessment of Potential Areas of ICT Technology Application 15

Figure 2.3 Self-Assessment of Computer Literacy across Personnel (Value 3 and 4) 16

Figure 2.4 Assessment of Computer Literacy Level by Staff Position 16

Figure 3.1 Schematic Presentation of the FAQ Portal 18
Figure 3.2 APVPROD Interface 21
Figure 3.3 APVPROD Sheet 21
Figure 3.4 Output from Polar Coordinates Plan 23
Figure 3.5 System Architecture 24
Figure 3.6 ICAS Home Page 25
Figure 3.7 Effectiveness of Training 26
Figure 3.8 Staff Categories That Need to Improve Their Computer Literacy 26
Figure 3.9 Preferable Forms of Training 27
Figure 3.10 Scenes from the Validation Workshop 28

LIST OF TABLES

Table 2.1 Moldsilva's Current Specialized ICT Applications 14

ABBREVIATIONS AND ACRONYMS

API	application programming interface
APV	Standing Timber Evaluation
APVPROD	Standing Timber for Production Evaluation
ENPI-FLEG	Improving Forest Law Enforcement and Governance in the European Neighbourhood Policy East Countries and Russia
FAQ	frequently asked questions
GIS	geographic information system
GPS	Global Positioning System
ICAS	Institutul de Cercetări şi Amenajări Silvice (Forest Research and Management Institute)
ICT	information and communication technology
ICT4D	information and communication technology for development
IT	information technology
LAN	local area network
PCP	Polar Coordinates Plan
REDD+	Reducing Emissions from Deforestation and Forest Degradation ("plus" enhancement of forest carbon stocks)

Introduction

Background

Moldova's new Strategy on Sustainable Development of the Forest Sector was established in 2001 and a General Action Plan for its implementation was enacted two years later. The strategy and the action plan covered various dimensions of sector development, including information management and communication. One of the main objectives of the strategy was establishing foundations for modern information management:

- A consolidated national forest sector information network
- A geographic information system (GIS) for the national forestry resources
- Databases on all forests located in Moldova

Despite the commitments made in the strategy, progress in forest sector information management has been slow and the current information and knowledge management systems within Agency Moldsilva—the national forest agency in charge of managing state forests (81 percent of the total forest area)—is still based on old, ex-Soviet management systems and does not provide accurate and accessible information on the status, use, and sustainability of forests in the country. The forest sector and management of forest resources is currently not supported by integrated information systems that could ensure efficient information flow within the forest administration or between the various sector units with managerial, scientific, production, education, and policy functions. There is even less interaction and exchange of information with other government agencies, not to mention nonstate actors. This is due both to closed administrative systems and insufficient resources in information and communication technology (ICT).

The lack of investment in ICT equipment and development is not because of a lack of policy development. The modernization of the information system of the forest sector falls under the provisions of the law on computerization and state information resources (No. 467-XV of 2003), of the Decree of the President of the Republic of Moldova on establishing an information society in the Republic of Moldova (No. 1743-III of 2004), and of government Decisions on initiating a National Geographic Information System (No. 1298 of 2003) and on approving policy for the creation of the information society in the Republic of Moldova (No. 632 of 2004). However, these decrees have not been fully implemented and there has been little activity in their implementation since the legislation was enacted. In recent years, the most notable forest policy-related development program has been the European Union–funded program Improving Forest Law Enforcement and Governance in the European Neighbourhood Policy East Countries and Russia (ENPI-FLEG, phase I), which started in 2009. In Moldova, the project was implemented by the World Bank and the International Union for Conservation of Nature (IUCN) in partnership with various government agencies and other civil society organizations.[1]

1. See http://www.enpi-fleg.org/. Phase II of the program was launched in 2013.

At the same time that the sector-specific "e-development" policies were established, a national strategy was also developed to promote e-government and to promote efficiency and effectiveness in public administration. The national strategy for the creation of an information society—Electronic Moldova—was developed and approved by the government of Moldova in 2005 (No. 255 of 2005).[2] The strategy is an ambitious program and the Moldovan government partnered with the World Bank in 2010 for its implementation. The strategy's first project was the e-Government Center, created in 2010 with World Bank support. Since 2011, the World Bank has been financing the Governance e-Transformation Project,[3] the focus of which has been mainly on internal government processes and public services, but it has not yet covered the forest sector.

Overview and Objectives of the Project

The Information and Communication Technology for Forest Law Enforcement and Governance Project ("the project") was financed by the Korean Trust Fund on Information and Communication Technologies for Development (ICT4D) and managed by the World Bank (see Box 1.1).

BOX 1.1 INFORMATION AND COMMUNICATION TECHNOLOGY FOR FOREST LAW ENFORCEMENT AND GOVERNANCE

The World Bank, with funding from the government of Korea, implemented in 2011–13 a technical assistance project on the use of ICTs to improve forest governance in the Lao People's Democratic Republic and Moldova. ICTs are essential tools for development, transforming rural lives and livelihoods through computer use, mobile phones, and Internet applications. Many e-government and e-governance initiatives are making governments more efficient and responsive while improving service delivery. This applies to the forest sector as well.* The objectives of the project were to identify and apply ICT applications to improve forest governance and to identify the factors that strengthen the use of ICTs in the forest sector. It also provided field-tested experience for further support by the World Bank and other development partners. It is recognized that the current level of ICT is relatively low, particularly in the countryside; however, at the same time, expanding use of mobile phones has created opportunities for the introduction of new applications. A particular focus was on developing low-cost and simple-to-use technologies.

Project Structure

The project had four phases that ranged from capacity assessment through application development to studying the lessons learned:

i) Brief capacity audit and identification of development opportunities: This component assessed the current ICT capacity in the forest sector and the potential for new applications. The main activities were (a) stakeholder consultations to identify forest governance challenges and how ICTs could be used to address those; (b) developing ICT applications to strengthen forest governance; and (c) building partnerships with potential local ICT innovators.

ii) Development and use of ICT applications for forest governance and REDD+: Based on the capacity audit, applications were developed in both participating countries. This component also included capacity building for information management development.

iii) Ex-post country analysis and in-country dissemination: An assessment of the capacity change was prepared based on the capacity assessment done during the first component. This included identification of the main implementation issues and lessons learned. The report at hand is the output of this phase.

2. See http://www.mtic.gov.md/img/ssc/law/act_norm/005%20Moldova%20electronica.pdf.
3. See http://www.worldbank.org/projects/P121231/governance-etransformation-project?lang=en.

iv) Lessons learned and global dissemination: A cross-country comparison report analyzes the key success factors and how ICT-supported governance reforms can best be supported.

Implementation Arrangements

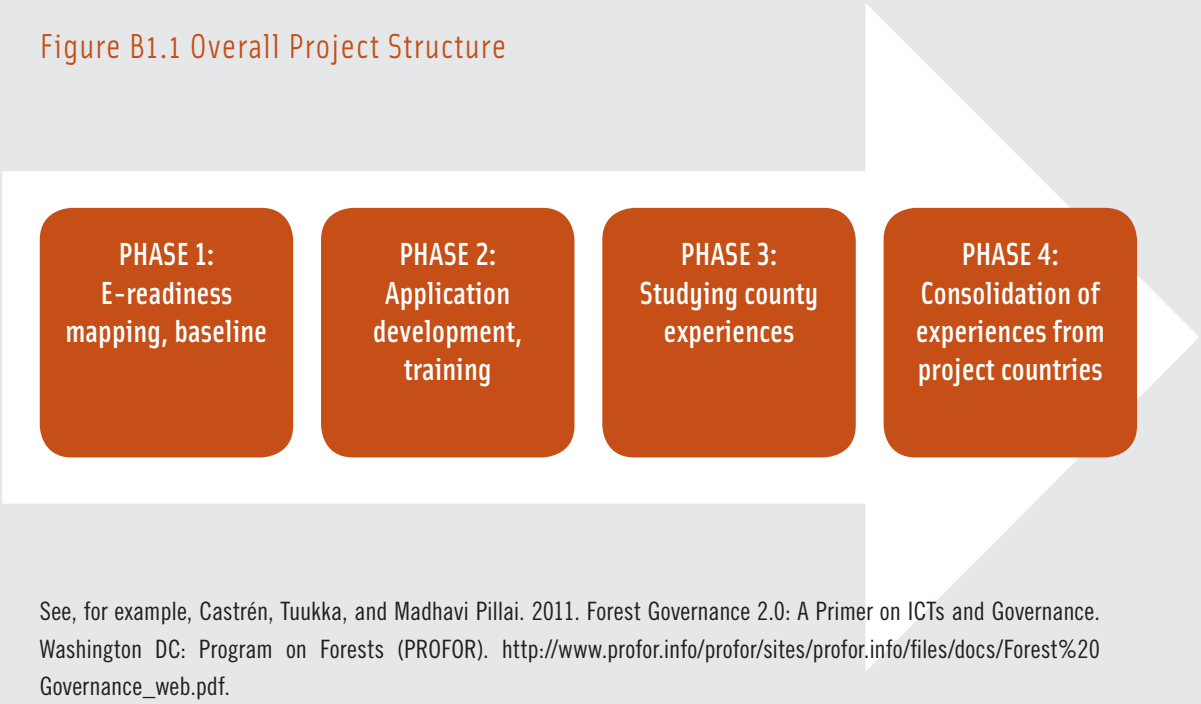
The project was executed by the World Bank, and consultant teams were selected in both countries to provide implementation support. The teams played a central part in the implementation and worked closely with local counterparts in implementing the project activities. The project worked in close collaboration with other ongoing development activities. In Lao PDR, close collaboration was established with the Sustainable Forestry and Rural Development Project (SUFORD), the Strategic and Tactical Enforcement Patrol Program (STEPP), and various bilateral and REDD+-related projects and programs. In Moldova, the project interacted with the ENPI-FLEG Program (phase I) and the e-transformation project on open data.

Project Outputs

The main findings from the project were published in <<full reference to the main report; series and title >> available online at www.profor.info. The report summarizes the country experiences from Lao PDR and Moldova and draws key lessons learned to provide guidance to practitioners. It also discusses a number of technologies that could be introduced by forest agencies to improve communication with forest users and other stakeholders.

The current report describes the work done in Moldova and the situation there in more detail; it has been prepared by the country team in Moldova. A similar country paper has been prepared by the team that worked in Lao PDR. It is also available at www.profor.info.

Figure B1.1 Overall Project Structure



See, for example, Castrén, Tuukka, and Madhavi Pillai. 2011. Forest Governance 2.0: A Primer on ICTs and Governance. Washington DC: Program on Forests (PROFOR). http://www.profor.info/profor/sites/profor.info/files/docs/Forest%20Governance_web.pdf.

In Moldova, the project structure followed that of the overall project, with some added country-specific objectives:

- Capacity audit of Moldsilva's staff and identifying ICT applications to improve forest governance: review of Moldsilva's existing ICT system and capabilities, tasks, and procedures (investigations, inspections, and so on); identification of most relevant stakeholders and the communication channels used between them and Moldsilva

- Developing and applying applications: ensuring that the applications were fit for Moldsilva's internal activities, information distribution, and/or for data collection (for example, evidence), tailoring them as much as possible according to users' needs and feedback

- Identifying the factors that strengthen the use of ICTs in the forest sector; increasing the use of ICT and providing training for it

- Providing field-tested experience from the World Bank and other practitioners; reviewing experiences from the applications field tests and creating a plan for improvement, further development, and sustainability

- The project focused on designing simple, user-friendly ICT applications to develop ICT skills within the forest sector, increasing awareness of these applications and improving forest governance and monitoring systems in the field.

The project was divided into four phases:

- Phase 1: E-readiness (baseline) and identification of development opportunities

- Phase 2: Development and use of ICT applications for forest governance

- Phases 3 and 4: Ex post-country analysis, and discussion and global dissemination of lessons learned

The project counterpart was Agency Moldsilva. Moldsilva is the main state agency in charge of forestry and hunting in Moldova. It has a diverse mandate, ranging from international forest policy to rural employment, sustainable forest management, wildlife management, conservation of biodiversity, professional training, access to environmental benefits, as well as forest research and education (see Figure 1.1 and Figure 1.2). Actual forest management is carried out by 20 forest or forest and hunting enterprises. In addition, Moldsilva has subunits dealing with conservation and research. The direct counterpart for this activity was the Forest Research and Management Institute (Institutul de Cercetări şi Amenajări Silvice, ICAS).

Figure 1.1 Institutional Structure in Moldovan Forestry

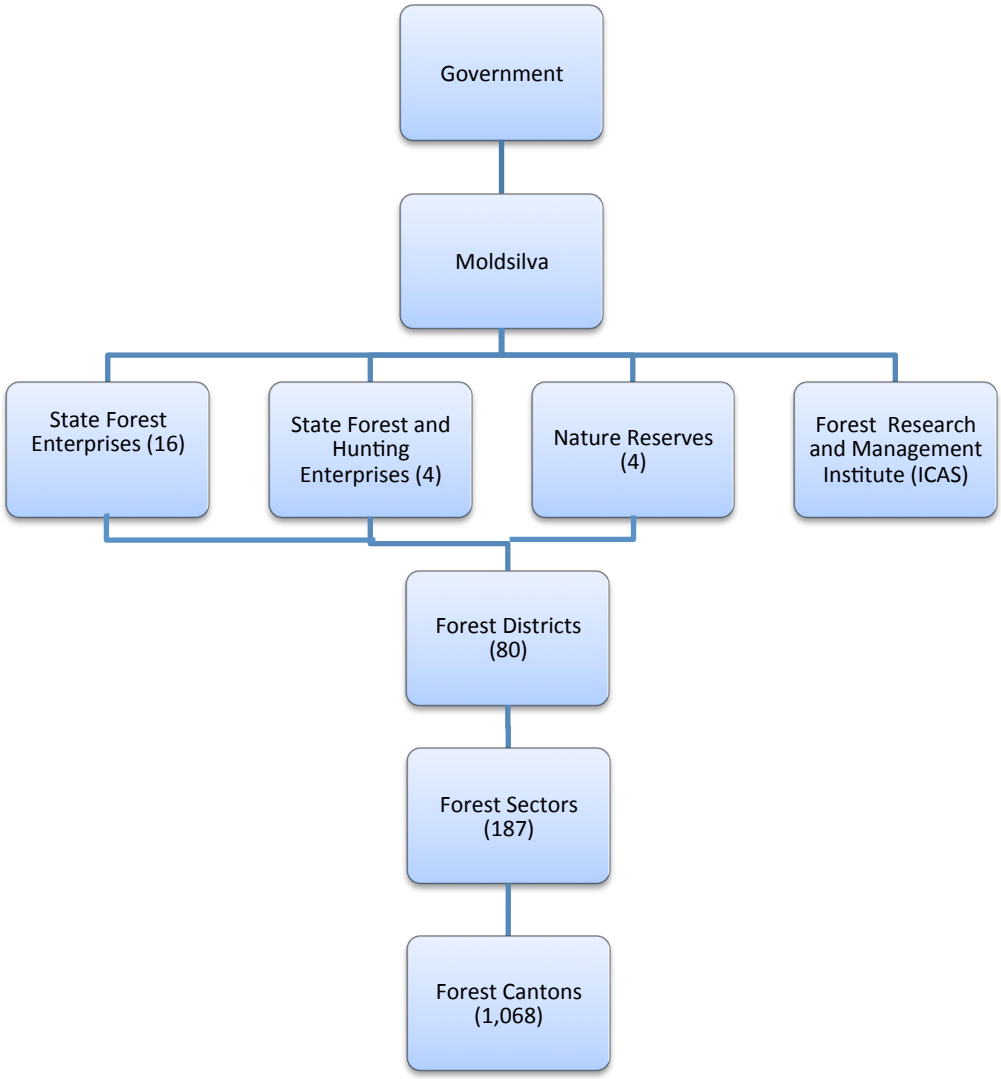
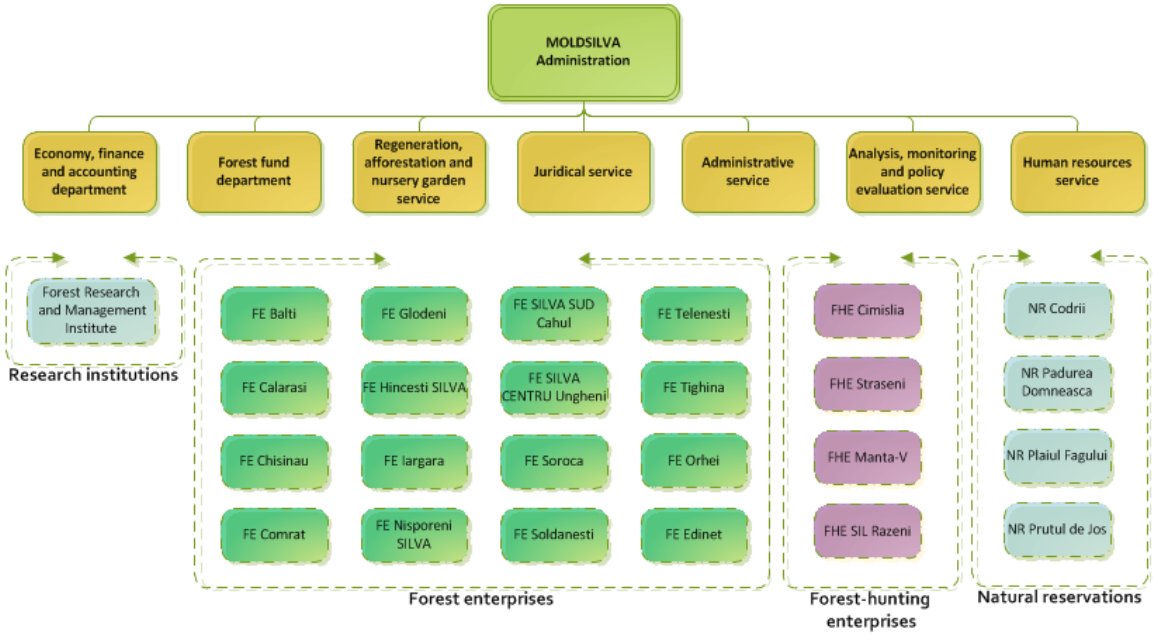


Figure 1.2 Moldsilva Organogram



The project worked with a number of other key stakeholders in addition to ICAS, including forest users, the Ministry of Environment, the State Agency for Land Relations and Cadastre, the e-Government Center and e-transformation projects, and private ICT and mapping enterprises.

E-Readiness Audit

Current Situation with ICT Resources in Agency Moldsilva

Moldsilva's current capacity to use and develop ICT solutions (e-readiness) was audited in June 2012 through a survey with the agency's personnel. The objective was to identify potential areas of ICT applications for forestry activities and to evaluate the existing technical and human potential and readiness of the agency and its staff. The survey was conducted among the staff of 24 forest enterprises and other Moldsilva subunits, including ICAS. The survey collected information on three dimensions of e-readiness and the potential for future development: (1) the ICT capacity by department, enterprise, and unit (equipment and connectedness); (2) skills, capacity, and computer literacy of staff; and (3) identification of possible directions for e-transformation.

The survey involved 603 people from technical and managerial levels. The survey did not include forest rangers and other field staff; the current ICT capacity is concentrated in offices and the field staff use of ICT is limited. However, even if the initial capacity assessment covered only office staff, in the medium to long term it is essential that all levels of Moldsilva staff are included in e-development. Personnel included in the survey:

- Forest enterprise[4] management (director and deputy director of forest enterprise, head of management department, consultant)
- Engineering staff (chief engineer, forest protection engineer, reforestation engineer, engineer of wood resources, forest resources engineer, wood processing engineer, health and labor safety engineer)
- Forest district management (director and deputy director of forest districts, masters of the forest [intermediate level])
- Accounting and legal department (chief accountant, economist, accountant, lawyer)

The survey consisted of three questionnaires:

1. Assessment of technical and computer capacity of the forest organizations: designed for directors of forest enterprises and forest districts, collecting information about the technical equipment and readiness for e-transformation.
2. Assessment of staff capacity and knowledge of information technology: designed for forestry personnel and aimed at defining the level of information technology competence of forestry personnel on the basis of self-assessment of their knowledge.

4. The term "forest enterprise" also includes, unless specifically stated otherwise, other Moldsilva subunits (see Figure 1.2).

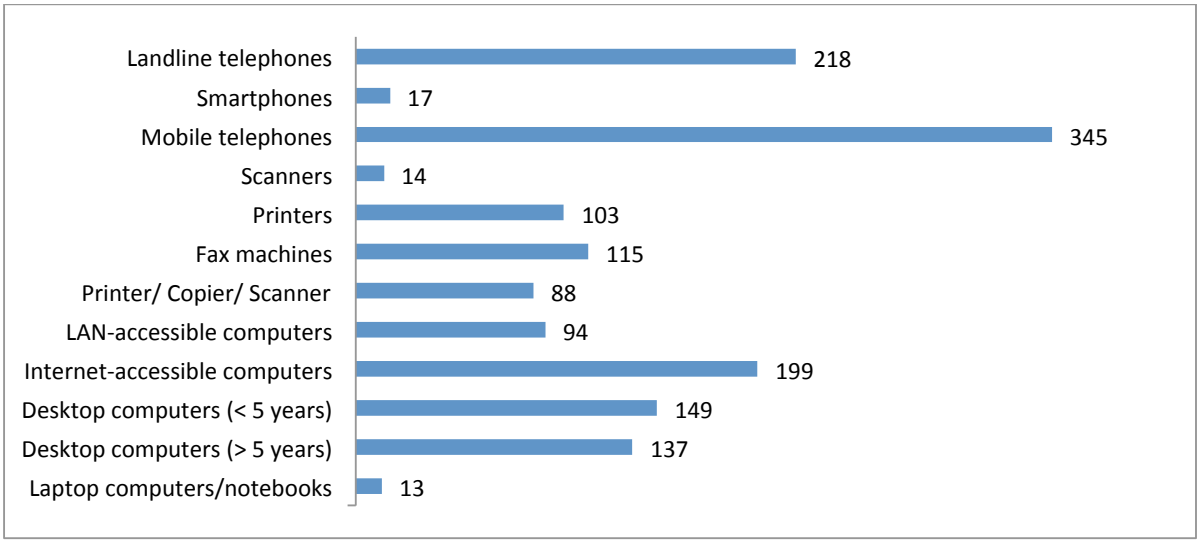
3. Identification of potential areas for e-transformation: designed for all staff in the forestry sector, allowing staff to make suggestions about the direction of the forestry sector, which applications would help them most in their work, and where development needs would be (results discussed in section 3 below).

According to the survey of forestry enterprise directors, out of the 19 forest enterprises that provided information, all had desktop computers and all—apart from one—reported that they had computer(s) that could access the Internet. The number of desktop computers per enterprise ranged from 4 to 27. Additionally, 7 enterprises had laptop or notebook computers.

Almost half (45 percent) of the computers were more than five years old; 51 percent were newer desktops and 4 percent were laptop computers. Sixty percent of all computers had Internet access—the average speed of which was 4.8 Mb/s—and almost 33 percent of all computers were linked to a local area network (LAN) (see Figure 2.1).[5]

The survey results also point to wide variation in computer availability among the different forest enterprises: In some forest enterprises, there is one computer per employee, while other enterprises have one computer per five employees. On average, there is one computer per two employees across all forest enterprises. In total, Moldsilva has a staff of slightly more than 5,000 people, of which about 388 used the computer resources recorded in the survey. In addition to computers, forest enterprises also possess other ICT devices: mobile phones, smartphones, fixed-line telephones, fax machines, and printers.

Figure 2.1 Computer and Communication Equipment in Moldsilva Units



5. There were some inconsistencies in the replies to local network accessibility; thus, the results may be inaccurate.

Current and Potential Areas of ICT Use

Moldsilva and its subunits have been using ICT in number of applications, the main ones being basic office software and some specialized applications developed in earlier projects (see Table 2.1).

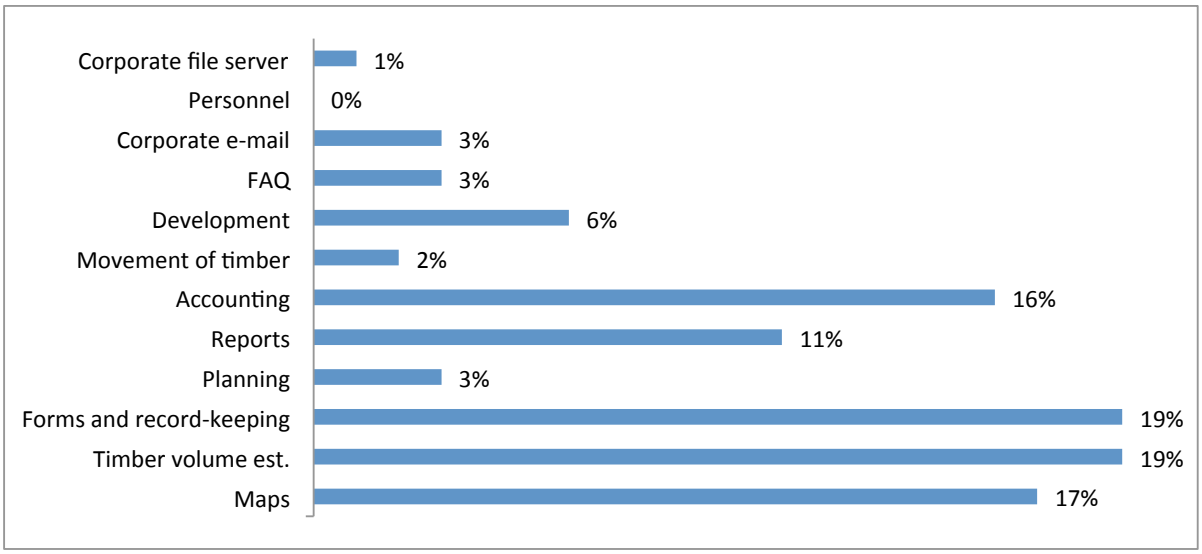
Table 2.1 Moldsilva's Current Specialized ICT Applications

Name	Purpose	About the module
Application "Control Formularul Circulaţ ia ML.23" (Control Form on wooden mass circulation ML.23)	Automation of collecting wood volume information provided on paper forms by forest enterprises. It is used by Moldsilva to streamline data obtained from forest enterprises.	The module is an Excel file and an intermediate module written in Visual Basic for Applications. The application has internal control to ensure the quality of data entered.
Application developed by the Soil Conservation Project	Develop a database containing all the Moldova Soil Conservation Project's electronic data, categorized by data type, including tables, geographic representations, vector data, and digital photos.	The application was developed with Microsoft FoxPro database management system. It contains the following: • An interface for visualization of collected within the Moldova Soil Conservation Project • An interface for writing and editing tabular data, and for updating photos and geographical coordinates • Standard reports The application is in Romanian and English.
Application developed by the Moldova Community Forest Development Project	Data management database for information collected by the Community Forest Development Project. Includes export of tabular data in a format accessible for Excel, for advanced analysis and calculations. Contains links to cartographic data.	The application was developed with Microsoft Access database management system. It contains the following: • An interface for the visualization of data previously and currently being collected for the Moldova Community Forest Development Project • An interface for exporting tabular data, for accessing geographical data in MapInfo
Application for re-indexing GPS coordinates	Automate the coordinates indexation process. Difficulties have been encountered during GPS collection of geographic data for the Moldova Soil Conservation Project and the Moldova Community Forest Development Project. These challenges were the basis for the development of this module.	The application was developed with Borland C++ system, providing a relatively simple interface with certain control elements that enable the following: • Opening the source (that is, a file with geographical coordinates downloaded from GPS) • Establishing the start number for re-indexation of geographical points • Exporting data

The e-readiness exercise surveyed current use of computer and communication technology in Moldsilva and all forest enterprises. The most common uses were using basic office tools (for example, word processing, spreadsheets) for administrative tasks. The most common activities were preparation of reports, estimation of standing timber, forms and record keeping, accounting, and planning. No governance or law enforcement applications were listed. However, the responses covered only immediate job functions and not what the reports were ultimately used for.

The survey also asked respondents about development potential and which activities could become more common in the future. The respondents provided an array of answers, which were divided into 12 main types of activities: maps, estimation of standing timber, forms and record-keeping, planning, reports, accounting, movement of timber, forest management, frequently asked questions (FAQ), corporate e-mail, personnel management, and a corporate file server. The response distribution is presented in Figure 2.2.

Figure 2.2 Assessment of Potential Areas of ICT Technology Application

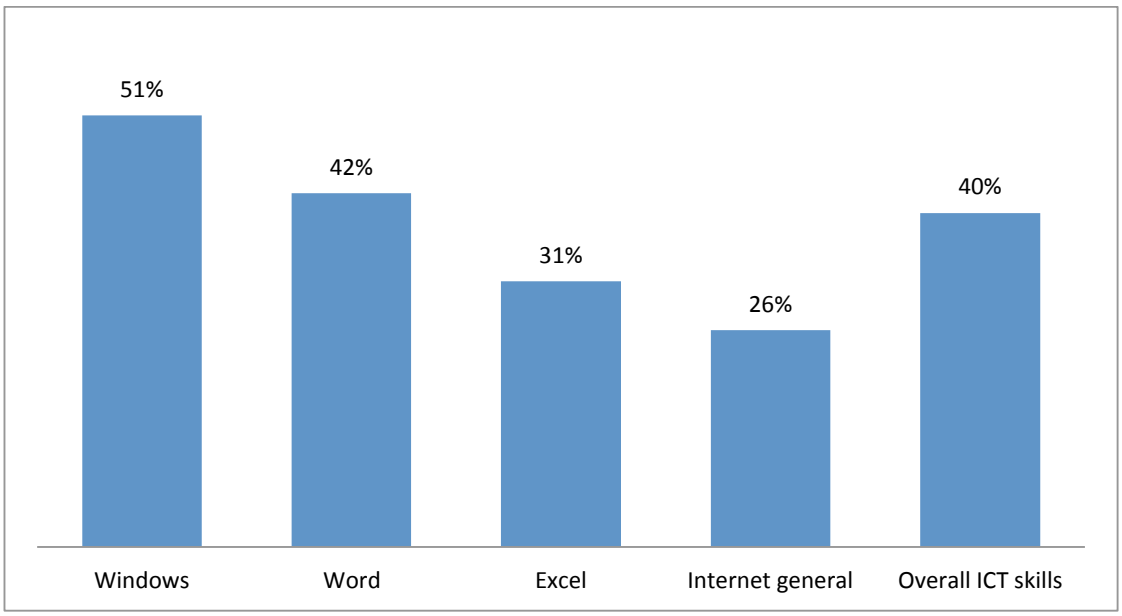


The results clearly indicate that Moldsilva staff members assume that in the future ICT would also be used mainly for administrative duties, reflecting much the current ICT use. There is also indication that the potential of ICT and more advanced applications is recognized; almost one in five identified geographic information as a growth area. Also, the value of computers in ensuring accurate timber volume records was recognized. On the other hand, the value of technology in communication—both within the organization and with outside stakeholders—is not well recognized. This is demonstrated by the relatively small percentage of staff that gave priority to e-mail, file sharing, or public communication (for example, a FAQ service). However, this may be explained by the generally low level of ICT knowledge, which tends to support a focus on existing applications.

Computer Literacy of Personnel in the Forestry Enterprises

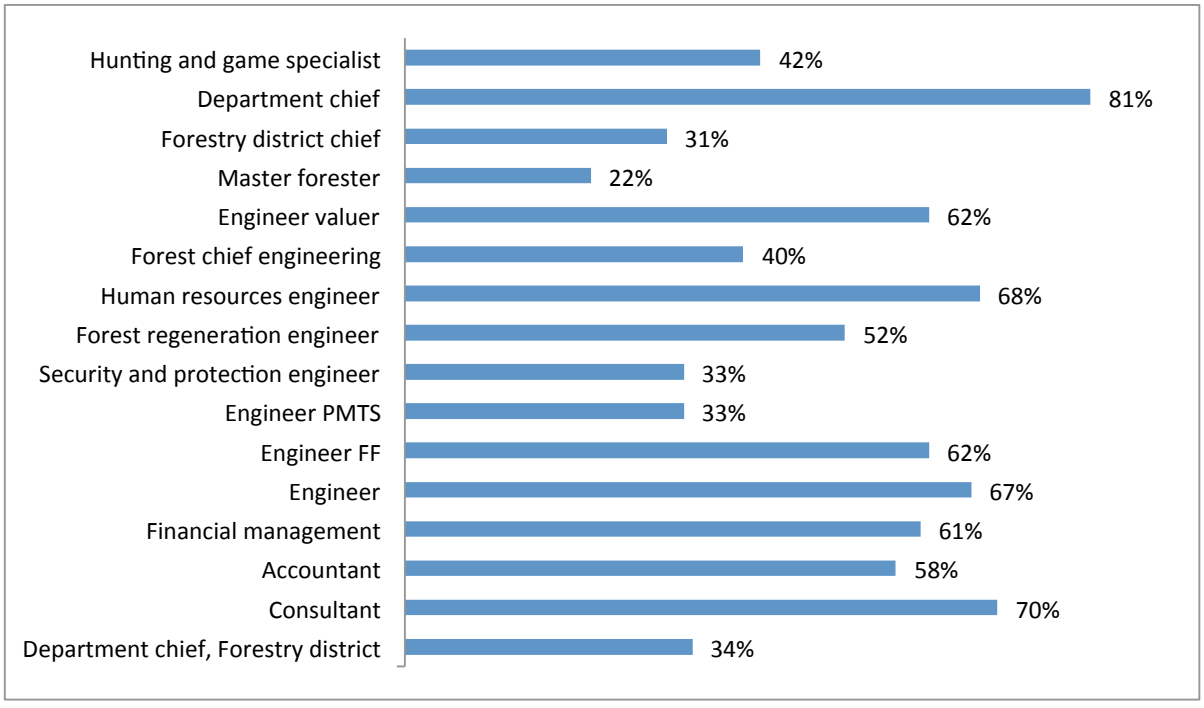
The third component of the e-readiness survey asked staff to self-evaluate their personal ICT skills. Staff members were asked to rate their ICT skills on a scale from 1 to 4. Forty percent of the personnel assessed that they had skills and familiarity in computer use, knew software such as Windows, Word, and Excel, and knew how to use the Internet (see Figure 2.3). This was somewhat at odds with the results when staff members were asked about specific computer programs. In terms of software knowledge, the most widely applied programs were best known: Windows (knowledge rate 51 percent of respondents), followed by Word (42 percent), and Excel (31 percent). Staff members were least knowledgeable about the Internet in general, which received only a 26 percent recognition rate.

Figure 2.3 Self-Assessment of Computer Literacy across Personnel (Value 3 and 4)



Assessing the level of computer literacy by position showed that the most knowledgeable staff were to be found in Moldsilva's headquarters; field/forest enterprise staff did not consider themselves as familiar with ICT. The departmental chiefs of the central office of Moldsilva and ICAS, consultants of Moldsilva's central office, Forest Fund engineers, engineers in Moldsilva's central office and ICAS, and financial management staff and accountants assessed their competence as the highest (see Figure 2.4). The least knowledgeable—based on self-assessment—were the master foresters, chiefs of the forestry districts and their deputies, forest chief engineers, and hunting and game specialists.

Figure 2.4 Assessment of Computer Literacy Level by Staff Position



Application Development

The project team worked with Moldsilva to assess opportunities for initiating advanced use of ICT and strengthening the agency's e-capacity. The current use of ICT formed the basis for any new applications, and it was recognized that the existing, yet relatively low, e-readiness should be the entry point for any reforms and that "leapfrogging" technological development may not be feasible. The selection of applications to be developed was started by first assessing existing ICT use. This included understanding the technical situation in Moldsilva and its subunits; analyzing possibilities of extending existing applications; and weighing the possibility of using results already obtained in the development of current applications.

In consultations with Moldsilva staff, the potential applications to be developed by the project were grouped into three categories of application type based on their objectives:

1. Applications to improve efficiency and effectiveness in forest management and control: mainly for field staff to collect data and help in their daily operations

2. Applications to support and enhance the internal administration of Moldsilva: mainly to improve the efficiency of office operations in both Moldsilva and forest enterprises

3. Applications to inform and communicate with external actors: for communication between Moldsilva, government institutions, and the public.

Currently, most of Moldsilva's ICT use is concentrated in administrative and back-office activities (see section 2). This project focused on applications under the first category because they are the most relevant for forestry professionals. Owing to the relatively low e-readiness in Moldsilva, it is essential that the first applications deployed be closely related to the staff's current work profiles. Consequently, the administrative applications mentioned in the second category were deemed easiest to develop and that they would result in the most improvement in efficiency in the short term. Other uses (for example, field operations and external communications) would require more extensive capacity building among the target audience. The third category, external communications, would have been very important; however, the wider operating environment is not yet adequately developed. The forest sector institutions still mainly focus on internal processes and communication; communication and information exchange with external partners would require other institutional and organizational changes.

Possible Applications for Each Category

The Moldsilva and consultant project team developed initial application concepts in the three categories to be considered for further development. These options were first developed at the schematic level and later the two most promising ones overall were selected for further development:

Applications to Improve Efficiency and Effectiveness in Forest Management and Control

- **Wood volume calculator: APVPROD:** This application would be used for the assessment of wood volume during management planning.
- **Land area calculator: PCP – Polar Coordinates Plan:** This application would be used to determine the area of forestry parcels during management planning.

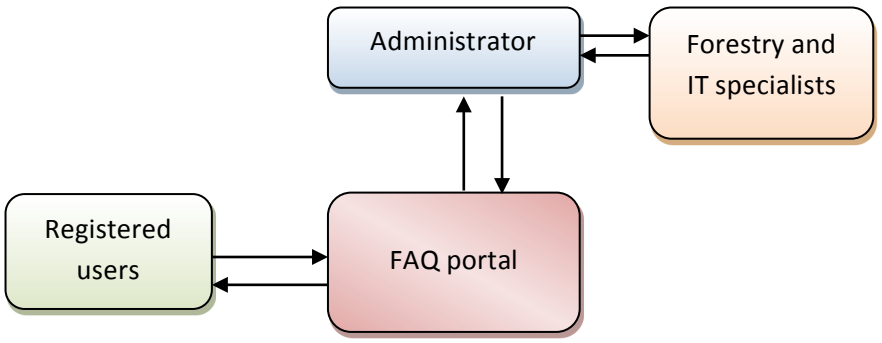
Applications to Support and Enhance the Internal Administration of Moldsilva

- **Frequently asked questions (FAQ) portal:** An FAQ portal could be developed for one of the web pages of Agency Moldsilva or ICAS. The forest and information technology (IT) specialists could use the application to post answers to questions, and to provide guidance for solving problems and links to relevant documents. The general scheme for the question-and-answer flow could resemble the graphic shown in Figure 3.1.

- **Corporate file server:** Moldsilva and ICAS would benefit significantly from improving systematic storage of Moldsilva and ICAS's proprietary files on a server. Access to the server's content should be restricted; different user categories can be predefined and assigned customized and dynamic rights. Such a solution—together with a structuring of electronic documents—would start a standardization process within the sector, leading to quicker access to key information. The increased risk of losing data stored on user terminals, as opposed to the use of a specialized server managed by an IT specialist, makes the creation of this file server a necessity. Another option would be to develop comparable cloud services (see Box 3.1). This would allow connecting to Moldsilva information in a flexible way using commercial service providers. This would also provide safe backups of key data. Even if information were to be stored in such services, it could be accessed and controlled only by authorized personnel.

- **Office automation tools:** Further development use of modern office automation, such as Microsoft Office.

Figure 3.1 Schematic Presentation of the FAQ Portal



BOX 3.1 CLOUD STORAGE SERVICES

Cloud computing has been defined as a "model for delivering information technology services in which resources are retrieved from the Internet through web-based tools and applications, rather than a direct connection to a server. Data and software packages are stored in servers. However, cloud computing structure allows access to information as long as an electronic device has access to the web. This type of system allows employees to work remotely.

"Cloud computing is so named because the information being accessed is found in the 'clouds,' and does not require a user to be in a specific place to gain access to it. Companies may find that cloud computing allows them to reduce the cost of information management, since they are not required to own their own servers and can use capacity leased from third parties. Additionally, the cloud-like structure allows companies to upgrade software more quickly."

Source: http://www.investopedia.com/terms/c/cloud-computing.asp.

Applications to Inform and Communicate with External Actors

- **Corporate e-mail:** This solution requires an e-mail server managed by an IT specialist; the server would act as a basis for the corporate file server. Its advantages–when compared to a free-of-charge e-mail service–are given by data security and access even when the access name and password are lost. This service could also be used to send different types of automated notifications, such as content modification of a file loaded by a user on the corporate file server.
-
- **Moldsilva portal:** This option involves upgrading Moldsilva's website to a fully functional Web portal that informs external actors about the agency's activities, allowing them to search Moldsilva's data.

Selection of Applications

To select the applications to be developed, a workshop was held with participants from the management and staff of Moldsilva and representatives of the e-Government Center. The workshop decided that the project would focus on only one category of applications: applications to improve efficiency and effectiveness in forest management and control. The workshop attendees considered this area most in need of software development and modernization. As seen from the readiness assessment, e-readiness in the administration was high, so less initial awareness raising on ICT would be needed. Additionally, digitizing and collecting basic data on forest management and resources would be the basis for future development in other areas. The selection process was also influenced by other factors, such as the time frame of the project; technical feasibility; amount of information to study (documents, papers, methods of calculation, and so on); and fact that all applications were to be used by existing hardware.

The workshop participants also defined the key criteria, the desired functions the applications would need to meet:

- **Easy access:** Account users would have access to applications on the Internet at the Moldsilva or ICAS websites. The objective was that any authorized user with a Web browser and Internet connection could access applications and documents in the system.

- **Security:** Access to applications and documents created by users would be regulated by a security policy integrated in the system.

- **Dynamic and extensive system:** The applications would be based on a client-server model. Despite being slightly more complicated to develop than stand-alone desktop applications, they have several advantages: when updates and/or extensions are available, users can access the latest version; lower support costs; lower technical requirements for user terminals (Internet and browser); better integration with other systems and databases; and easier development of new modules using the same database.

- **Efficiency and accuracy:** The new applications should enable more efficient working with a decrease in calculation errors.

- **Incentive:** Applications were selected to update the majority of key personnel in data processing, thus preparing staff members for wider and more comprehensive e-reforms at later stages.

- **Economy:** Development activities were to use low-cost options. Open-source solutions for development and maintenance were used when possible (server operating system: Linux Server; database management system: MySQL; Web server: Apache; GIS solutions: Google Maps API; and application development platform: Python + Django framework).

Taking into consideration the listed criteria, survey results from Moldsilva's employees, and human and technical potential of the sector, the workshop attendees selected two applications:

- *APVPROD* – Evaluation of Standing Timber
- *PCP* – Polar Coordinates Plan

APVPROD Application

Current Status

The overall objective of this application is to make volume calculations of standing timber faster and less prone to errors. Calculation of the standing volume is an essential part of forest management, but, at the same time, it is a complex task and needs to be based on accurate measurements and utilization of appropriate volume tables. Currently, calculations are done by hand and several pieces of information are required to calculate the timber volume of individual trees in a forest segment that is to be harvested. Some of the measurements include

- Diameter of all trees to be harvested. This is done in 4-centimeter classes (diameter class of 4-8, 8-12, 12-16 centimeters, and so on);

- Counting the number of trees in each class; and

- Height measurement for three sample trees per species of the most common diameter class.

These measurements are currently entered manually on forms that are then sent to the forest enterprise office. To determine the timber volume, staff use a 300-page manual with tables containing coefficients of timber volume per species, per diameter category, and per height category. Using a pocket calculator or other calculating tool,

staff can multiply the official unit volume in the cubic capacity tables with the number of trees for each diameter and obtain the total volume by diameter category and the volume breakdown by main species for each diameter category. The total volume and the volume by main species for the entire cutting area are obtained by aggregating the volume information across diameter classes.

Justification and Results

Manual volume calculations are prone to error. Additionally, not having a uniform process to transfer the results to Moldsilva databases constitutes an additional layer of manual transactions where errors can easily occur. A computerized system will not remove all potential for error—measurements are still done manually—but it will make the overall process more reliable and reduce risks.

APVPROD also aims to reduce the time required for calculations. Currently, the time required to manually calculate the volume for a single species and a single cutting area is 20 to 30 minutes, depending on the number of trees subject to inventory. This should become notably shorter once APVPROD is in use (see Figure 3.2 and Figure 3.3).

The application fully complies with the official procedure for the trees inventory and the design logic has very much been based on the past operating model and paper form. The application has all official volume tables for all relevant tree species included. Based on these, APV multiplies the unit volume from the official cubic

Figure 3.2 APVPROD Interface

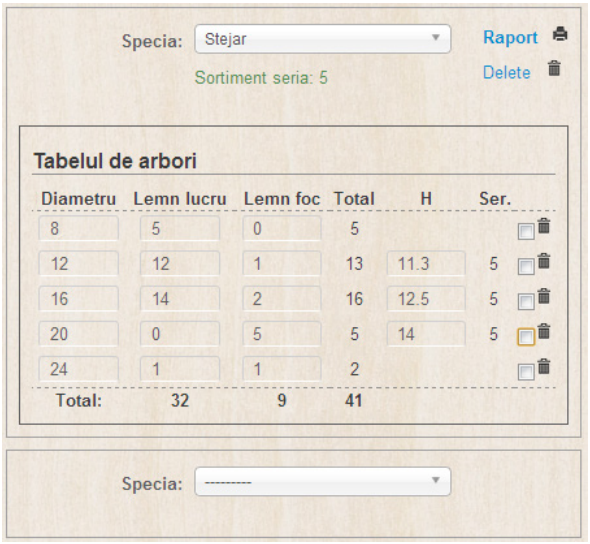


Figure 3.3 APVPROD Sheet

Fisa

evaluarii masei lemnoase din parchetele inventariate integral sau partial

Întreprinderea de Stat pentru Silvicultură ____ Ocolul silvic ____ Secţia de gospodărire ____

Parcela ____ Subparcela ____ Parchet 1 Suprafaţa parchetului ____ ha. Anul inventarierii 2013

Natura produsului ____ Tratament ____ Inventariere: ____

Coeficientul de recalculare la inventarierea parţială ____ Seminţiş utilizabil: suprafaţa ____ ha Specia ____ Numar la ha ____ mii buc.

Modul de curăţire ____

Modul de regenerare ____ Categoria de înălţime: 5 Specia: Stejar

Categoria de diametre	Numar de arbori			Volumul in m^3											
				Lemn de lucru				Lemn de foc							
	de lucru	de foc	Total	gros	mijlociu	subtire	Total	din arbori de lucru	din arbori de foc	Total	In total masa lemnoasa	Masa lemnoasa din coroana	Resturi	Total brut	craci
8	5	-	5	-	-	0,07	0,07	0,01	-	0,01	0,07	-	0,04	0,11	0,02
12	12	1	13	-	-	0,48	0,48	0,10	0,06	0,16	0,64	-	0,18	0,82	0,14
16	14	2	16	-	0,56	0,56	1,12	0,28	0,26	0,54	1,66	-	0,42	2,08	0,32
20	-	5	5	-	-	-	-	-	1,15	1,15	1,15	0,05	-	1,20	0,15
24	1	1	2	-	0,23	0,01	0,24	0,05	0,35	0,40	0,64	0,06	0,06	0,76	0,06
Total	**32**	**9**	**41**	-	**0,79**	**1,12**	**1,91**	**0,44**	**1,82**	**2,26**	**4,16**	**0,11**	**0,70**	**4,97**	**0,69**
Total pe suprafata			**41**	-	**1**	**1**	**2**	**0**	**2**	**2**	**4**	**0**	**1**	**5**	**1**

inventariată ____ Parchet 1

capacity tables by the number of trees for each diameter and obtains the total volume and the volume by primary species for each diameter category. The total volume and the volume by primary species for the entire cutting area are obtained by aggregating the volumes of individual diameter classes.

APV has gone through its first field tests. In these tests, it was observed that the likelihood of human errors had been reduced and results were presented in a clear and informative format. Manual calculations from a 300-page book with coefficients of timber have also been replaced with automatic selection of coefficients and calculation of timber volume. The time required to calculate the volume for a single species and a single forest segment (that is, cutting area) using APV is two to three minutes, depending on the number of trees and size of the harvesting area.

PCP Application

Forest management planning relies on georeferenced information and has traditionally used lots of maps. Basically, planning of any forest operation (for example, planting, sowing, and cutting) is mandatorily preceded by the establishment of the exact location where the activity is to be carried out. Technological development in recent years has made various GIS and other map-based applications much easier and affordable. Even consumer-grade Global Positioning System (GPS) devices and GIS software are much more advanced than professional systems were only some years ago.

However, these new systems cannot be applied easily if all the past information is not in electronic format or lacks georeferenced data. In Moldsilva, all geographic information is still stored in paper maps and transferring this "legacy information" to electronic format is difficult and costly. At the same time, electronic mapping systems would be incomplete if this information were excluded. The PCP application aims to help the digitization of map information.

Current Status

The current system of measuring and plotting the area for forest operations is based on manual measurements, first in the field and then preparing a manual drawing of the area on a paper sheet. The field marker points are identified and the distance between them is measured using metallic measuring tapes, and the orientations (angles) are observed by using a compass. These measurements are then tabulated manually.

Once in the office, a sketch of the area is prepared. The sketch is based on the measured boundaries, and it is drawn manually on cross-section paper on a scale of 1:10,000. The area is measured visually from the drawing.

Justification and Results

The process is prone to error and the results are not very reliable. Making manual field measurements, recording the measurements on paper, and transferring the results to cross-section paper for final measurement are likely to produce erroneous results and errors occur during the establishment of angles and distances (polar coordinates), generating errors in closing the polygons. Currently, if the errors are lower than tolerance levels, they are compensated graphically through another drawing. The final polygon for which the area is determined is drawn after the compensation of errors.

In the application, the computer draws—using similar measurements as before—the sketch on an adjustable scale using georeferenced data covering all forest areas in Moldova. The PCP application is fully compatible with the current official procedures for distance and angle measurements.

PCP is a basic map-drawing module in the system. Basically, it is able to calculate the surface area of a given area and visualize its shape and location on a map. It needs to be noted that it is not integrated with larger georeferenced GIS systems. It can do the following:

- Outline design of a polar coordinates plan.
- Calculate and display areas for forest operations.
- Create a print-ready page that can then be attached to the file.

Figure 3.4 shows an example of a print-ready output from PCP.

After the computerization of the sketched drawing, the human factor does not intervene in the drawing phase, preventing errors in area calculation. It also reduces the time needed. In initial tests, the time required to draw and calculate the area for a single forest segment (that is, operating area) is two to three minutes, depending on the number of boundary points.

Figure 3.4 Output from Polar Coordinates Plan

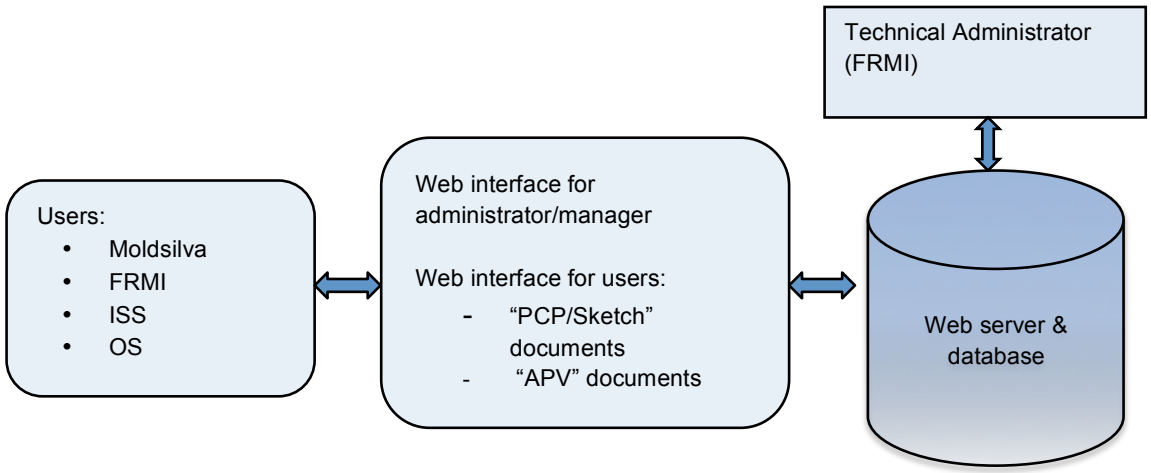
As mentioned above, preparation of the maps is a multistep process and APV is able to computerize one of the steps, but field measurements are still done manually and their accuracy could be improved by using technology for fieldwork and earth observation data for mapping. There are also some other limitations. The PCP application does not perform the complete compensation of errors (that is, internal controls to ensure the consistency of the boundary data entered and that there are no "gaps" in the perimeter measurements). In the future, the application should be improved in such a way that the polygon closes after the last measurement and errors are corrected.

Despite these limitations, compared to previous methods of working with manual drawings and calculations, a reduction in work time of approximately 10 times has been observed, along with a decrease in calculation errors.

System and Applications Design

Both APV and PCP have been designed to work in a modular system as Web clients rather than as stand-alone applications on desktop computers (see Figure 3.5). These applications are expected to be elements in a wider future system where Moldsilva systems are all integrated. In order to run the applications in an efficient way, Moldsilva has developed a platform for these applications that will also be used for future developments (that is, a modular system). The server with database is currently located at ICAS. All users have to be Moldsilva employees, each with a user account issued by the organization. Once Moldsilva has developed a system for exchanging information with outside bodies, the system may be changed in an appropriate way.

Figure 3.5 System Architecture



Since Moldsilva's ICT capacity is still relatively weak (see section 2), it is essential that the technical requirements to run the developed applications are simple. Currently, the systems can be accessed at ICAS's website[6] from any desktop or notebook computer with Internet access and a Web browser. The site comprises four sections (Figure 3.6): home page; plan/sketch (PCP); APV; and an administrative section. The home page aims to be informative and contains general information about forests managed by Moldsilva. The information is public and does not require authorization for viewing.

6. See http://map.icas.com.md/.

Figure 3.6 ICAS Home Page

Training and Dissemination of the Applications

Staff Training

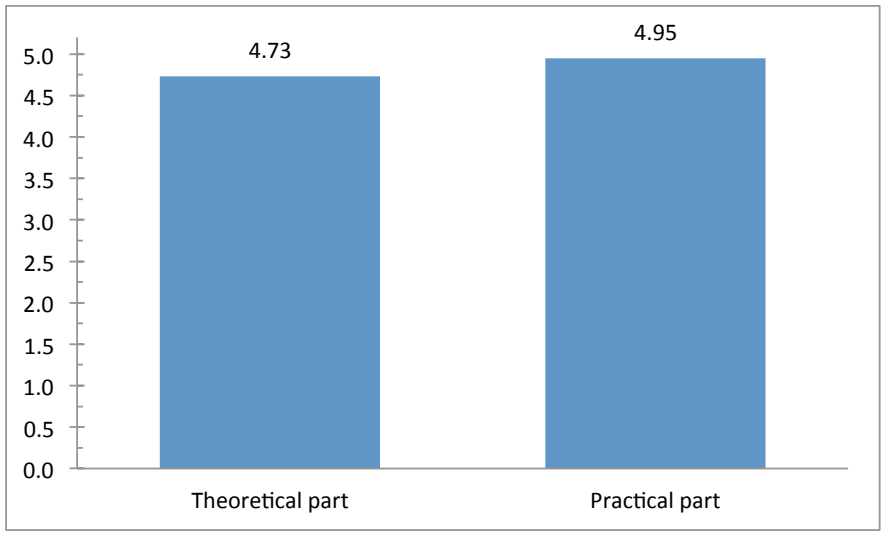
Based on the Moldsilva e-readiness audit (see section 2), it was evident that staff training is required. After developing the two applications, forestry engineer–level staff from all forest enterprises were provided with a two-day training course on the applications and, more broadly, e-development. The training focused on this staff category because it was identified as having the greatest need for advanced ICT knowledge, since they will play an essential role in ensuring the accuracy in data processing and delivery (information, reports, and so on). The training had several purposes:

- Present the legal framework of the applications developed. This included legislation and implementing regulations relevant to information management and ICT in the forestry sector.
- Present the results of the e-readiness audit.
- Present ICT solutions developed by the Forestry Research and Development Institute (FRDI) and Moldsilva, focusing on the central office's potential to develop additional ICT applications and solutions.
- Introduce the potential for using a spreadsheet application, such as Microsoft Excel, in day-to-day management of forest enterprises and explore how it could be used even without predesigned templates.

The participants were also surveyed to obtain information on effective training methods and perceptions on the role of ICT in Moldsilva's operations. Issues covered included (a) the most effective means to implement training activities for forestry staff members; (b) comments and recommendations on the areas that require urgent attention in terms of ICT; (c) which staff categories require the most improvement of ICT knowledge; and (d) feedback on the theoretical and practical training the project provided. Several key results were drawn from the survey:

- All participants commended the training in general, but they rated the practical part higher than the theoretical part (Figure 3.7).
- Participants noted that staff members of forestry enterprises and forestry districts needed to raise their computer literacy level more than the staff from other departments (Figure 3.8).
- Participants stated the most effective form of training was centralized training within Moldsilva on specific topics customized for different staff groups. Training by other, non-Moldsilva organizations did not gain any support (Figure 3.9).

Figure 3.7 Effectiveness of Training



Note: Participants were asked to rate training on a scale from 0 to 5, where 0 = Of no value and 5 = Excellent.

Figure 3.8 Staff Categories That Need to Improve Their Computer Literacy

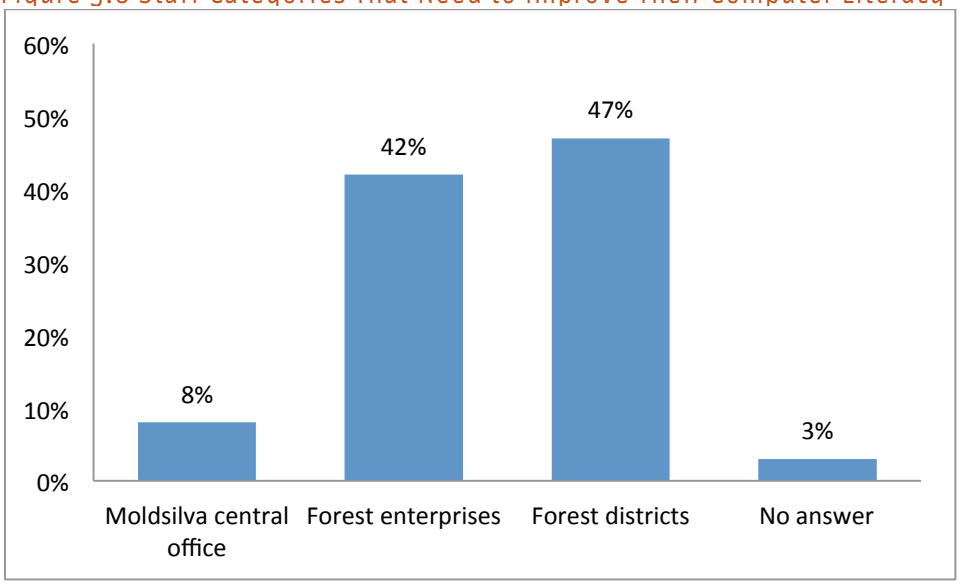
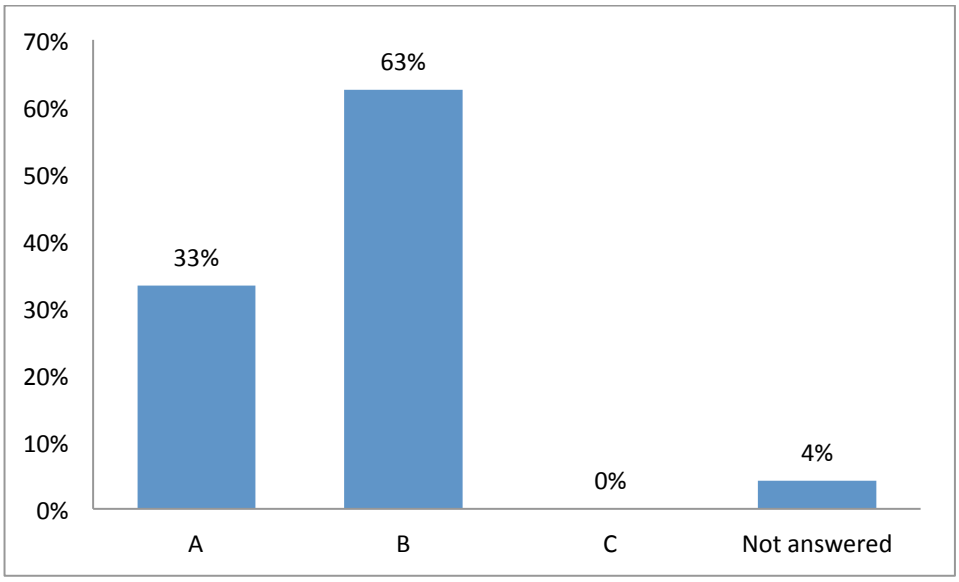


Figure 3.9 Preferable Forms of Training



Note: A = training by forest enterprises and local resources; B = centralized training by Moldsilva; C = centralized training by specialized institutions (universities, vocational schools, and so on).

Field Testing of Applications

The APVPROD and PCP applications were tested by the staff from the Silva Razeni forest enterprise during a field visit organized in February 2013. The field test compared the resource and time use of the current manual systems with the new applications. A manual calculation of standing timber volume was carried out using traditional paper forms, reference book with categories of diameters of trees by species, and a simple calculator; this took almost 20 minutes. Then the volume of standing timber was calculated using the APV application. After creating and activating the personal account on the server and a short explanation of the working process, the chief forestry engineer completed the calculation in two minutes. In addition to time saved, the risk of errors in the calculations was reduced.

For the PCP testing, the usual procedure of the sketch drawing was not separately timed; the process is known to demand a substantial amount of time and attention. The sketch is usually drawn on cross-section paper, and the area of the plot is calculated by millimeters squared. Geographic coordinates from an existing sketch were used to draw a new sketch using the PCP. The chief forestry engineer was able to draw the sketch without assistance after a short explanation and some trial attempts. Although the PCP sketch initially gave a different plot area and outline compared to the hand-drawn sketch, the results of the application were proven to be correct after remeasurement.

Validation and Dissemination of Project Findings by Moldsilva

The project activities and findings were summarized and validated in a workshop organized with Moldsilva and the project team (see Figure 3.10). The validation workshop was attended by more than 25 participants, including staff members from the central office of Moldsilva, a representative from the ENPI-FLEG Program, representatives from forest state enterprises, and project team members.

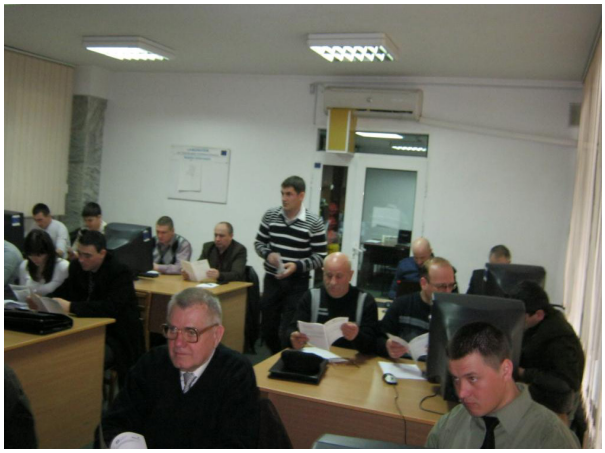
The validation workshop consisted of presentations of the activities of the program as well as demonstrations and additional training in the applications. The workshop had specific objectives:

- Improved awareness of e-development and new applications by Moldsilva staff
- Final delivery of the new applications and related documentation[7]
- Testing of the applications to be completed with staff members from subordinate units and the central office of Moldsilva
- Identification of subsequent e-development objectives and priorities

The applications were well received by the staff, and it was recognized that they have potential for effective use by Moldsilva staff. In the follow-up survey with workshop participants, users noted the utility of the applications and expressed an interest in further development and adaptation of the applications to their particular work conditions. There were also proposals for further development and expansion of the applications for future reference. One particular conclusion reached, given the current possibilities offered by the new information technologies, was that the technical standards should be revised to modernize current working procedures.

Later in 2013, Moldsilva management issued a circular making the applications a part of Moldsilva administrative processes and their use mandatory. Each forest enterprise has been asked to appoint a focal point with knowledge of the applications.

Figure 3.10 Scenes from the Validation Workshop



7. "Guidelines of Personal Computer Use" (for beginners from the forestry sector) and "Guidelines for the Application Use."

Conclusions and Lessons Learned

The participants in the project considered it a success, beyond the actual delivery of the application. The overall process was able to help draw Moldsilva's attention to a number of wider issues related to e-development:

- The need to develop and implement an information system to increase the efficiency of forest management and link this to the wider institutional reform agenda
- Making adequate investments in information management technology at all levels of Moldsilva's organization. This also included investment in software.
- The need for relevant human resource development and training
- The importance of a clearly defined e-development policy in the organization
- The establishment of a legal framework for the creation and implementation of information systems in Moldova, as should have been performed already following the legislation on the establishment of a national GIS and information society
- Establishing working relationships with national institutions in charge of the approval and implementation of information systems in Moldova

Key Success Factors and Risks for Sustainability

There were two key success factors for the project. These same factors are also requirements for other future development activities in e-development in Moldsilva:

- Active involvement of field staff in the project. During the training and the test phase, staff provided feedback on how the applications could be developed. Previously, content from the old books used was never discussed, showing increasing interest in ICT by field staff.
- Recognition of the limitations of the current knowledge of ICT in Moldsilva and the need to link targeted ICT training with the strengthening of basic ICT skills.

ICT development in Moldsilva is still relatively fragile and, while the current project provided some promising signs, there still remain some notable weaknesses that could easily become risks for future development. Some challenges remain:

- **Investments:** In order to optimize the management capabilities in Moldsilva, ICT infrastructure needs to be developed and investments made.
- **Continuation of IT training programs:** More training in all topics (for example, general computer training, specific technical knowledge, designing e-transformation, and so on) and at all organizational levels is crucially needed. This is particularly important for an organization with as low a level of ICT knowledge as Moldsilva.

- **Specific organizational unit or dedicated staff in charge of ICT and knowledge management:** Specific staff are needed for e-development and to provide support to staff members. This includes a specific chief information officer at the senior level.

Recommendations

The current level of ICT knowledge and e-readiness in Moldsilva is still low and development is constrained by insufficient hardware and modest skill levels among staff. However, as smartphones, tablets, and other personal devices with powerful computing features are becoming increasingly ubiquitous in private use, it can be assumed that demand for modernized e-tools will also increase in the professional environment.[8] This increased familiarity with and interest in using computers (including handheld devices), applications, and information systems will rise in the forestry sector, especially for forest areas that require large amounts of mathematical calculations or visual or georeferenced data.

When e-development is based on gradual introduction of technology, first through pilot projects and then through more comprehensive programs, it is essential that systems be based on a modular approach. Gradually introduced ICT systems consist of small applications (that is, modules) that are useful to solve specific problems or parts of the technological process rather than creating one massive information system in a "big bang." Nevertheless, this approach is not without its risks, and modular development requires that the underlying concept of the information system is well developed and guides the gradual introduction of ICT. Without a well-identified master plan, modular systems may become fragmented and are easily developed in an ad hoc manner.

The fragmentation risk is particularly high in environments where development is driven by externally funded projects and experts with relatively weak in-house planning capacity. This is a particularly valid concern in Moldova, where most of the e-development in the sector has happened with external support; it can be assumed that in the past 10 years, little ICT development would have been completed without donor funding. The national budget for forest administration is just enough to maintain Moldsilva's current activities, and its management team agrees that large investments have to be supported by development partners.

In order to benefit from donor funding, the forestry sector should develop a knowledge management strategy. Additionally, linking investments to such a national strategy would help to consolidate donor support and enhance its effectiveness. It would also allow the linking of domestic and external financing to each other, thus avoiding fragmentation of investments. The development of a forest sector e-development strategy requires strong leadership and buy-in from management and needs to be a part of overall national forest sector development strategy. Until now, the management of the forestry sector has not promoted the use of modern ICT tools to any large extent and information management is not seen as a critical success factor. However, recent developments have demonstrated the need for more efficient information management. Potential action to launch the transformation in Moldsilva would be to establish a designated ICT department and a senior level chief information officer position within Moldsilva or ICAS.

The e-government project supported by the World Bank aims at building the government-wide e-services delivery infrastructure to be reused by sectorial ministries and agencies to improve their internal operations, information management, decision making and public service delivery through ICT, in accordance with the Governance e-Transformation Strategic Program, passed by the Government of Moldova in 2011. It is expected that the e-Government Center, which was set up with the

8. This has been demonstrated, for example, in the United States and Western Europe, where changes in consumer technology have changed professional ICT use patterns. Firms and public sector employers are increasingly adopting "bring your own device" policies where professional ICT departments have to adjust to staff preferences rather than vice versa.

World Bank Project's support and which serves as the Government Chief Information Office would also provide guidance to sectorial ministries and state agencies in their efforts to design and implement ICT strategies and projects, like Moldsilva. In the first few years, the project will focus on building internal government digital infrastructure to enable sectorial ministries to deliver public services online. Afterward, each sector will develop its own knowledge management systems and re-using the infrastructure of e-government to make information publicly available and services delivered online. For the forestry sector, in particular, providing information to the public will only be a small part of its duties."

One specific area for the attention of all government agencies would be to strengthen collaboration with private Moldovan ICT-service businesses. Moldsilva will remain a relatively small agency, and carrying out all development work in-house is not feasible or cost-efficient. Collaboration with the private sector and subcontractors would allow the forestry sector to benefit from the latest technologies, competition, and efficiency. ICT, mapping, and ecology are areas where the private sector in Moldova is more developed than state enterprises.