ABSTRACT. The project ‘Network for a Forest Information Service’ (NEFIS; contract number QLK5-CT-2002-30638) is an ‘Accompanying Measure’ of the European Commission (EC) 5th Framework Programme. A central component of the project is the establishment of a Web-based KnowledgeBase with substantive structured information content. The KnowledgeBase of NEFIS includes a repository of metadata and controlled vocabulary standards, software design documents, comprehensive frequently asked questions, worked examples and software distributions. Its content is based on essential documentation of activities related to forest information systems. NEFIS originates from the Council Regulation (1989, (EC) No 1615/89 and its extension as of 1998; 1998-2002) aiming to elaborate a European Forest Information and Communication System. A Web-based demonstration tool of such a system was built within a preceding project (European Forest Information System – EFIS; contract number 17186-2000-12 F1ED). NEFIS is taking the development of the tool further by seeking coordination of ongoing efforts to create forest information systems and services at the European level. Further it seeks options to support potential data providers at various spatial (international, national, sub-national) levels to develop harmonized standards and procedures for providing actual data and elaborate metadata. The project has close cooperation with the Global Forest Information Service initiative. This paper will concentrate on giving insight into the establishment of the KnowledgeBase.

Keywords: forest information systems, forest information, knowledge, information, metadata

1 INTRODUCTION

The European Commission (EC) 5th Framework Programme ‘Accompanying Measure’ project ‘Network for a Forest Information Service’, or short NEFIS (contract number QLK5-CT-2002-30638) originates from the Council Regulation 1989, (EC) No 1615/89 and its extension as of 1998 (1998-2002) aiming to elaborate a European Forest Information and Communication System (EEC, 1989). A Web-based and fully operational demonstration tool of such a system was built within a preceding EC activity (European Forest Information System – EFIS; contract number 17186-2000-12 F1ED) (see Kennedy, 2003, Schuck et al., 2004). The functionalities of the developed EFIS demonstration tool include the compilation, processing, analysis and dissemination of available forestry information from various data sources and of various data formats for different spatial levels (Schuck et al., 2005). In order to operationalize EFIS development at a broader scale the system needed to become more flexible in addressing (1) diverse user needs, (2) data access policies and data rights, and (3) adequate and appropriate technological possibilities for the creation and presentation of value-added products (JRC, 2002a).

The NEFIS project has taken the development of the EFIS demonstration tool further towards those goals by seeking coordination of ongoing efforts to create forest information systems and services at the European level. NEFIS aims at elaborating a framework for supporting potential data providers at various spatial scales (international, national, sub-national) to develop harmonized standards and procedures for providing data and metadata. In order to achieve this, the NEFIS project has continued...
in close cooperation with the Global Forest Information Service (GFIS) initiative. The GFIS coordinator is based at the International Union of Forest Research Organizations (IUFRO) in Vienna. IUFRO is also one of the NEFIS consortium members. Further contacts have been established to the Canadian initiative of establishing a National Forest Information System initiative (NFIS) (CCFM, 2004).

One of the NEFIS project’s specific targets is the establishment of a ‘KnowledgeBase’ (KB). This KB allows hierarchical access to metadata and documentation related to forest information systems. The information included in the KB ranges from general descriptions to implementation details. In particular the KB aims to provide a repository for:

- outputs from NEFIS activities;
- freely available documentation of other forest information systems/services development initiatives (e.g. Global Forest Information Service – GFIS, European Forest Information Service – EFIS, National Forest Information System – NFIS) and further relevant projects which were of interest to the NEFIS project activities;
- other relevant software resources, reports and documents.

This paper will describe the development of the KB within the NEFIS project. The content and purpose of the NEFIS KB (information about information services and systems) should not be confused with the content and purpose of EFIS and GFIS (information/data about forests and forestry). However, there may be some resources for which it would be appropriate to use the NEFIS KB and EFIS or GFIS, e.g. the final report of the EFIS project.

1.1 What are data, information and knowledge? As a first step a set of terms used in this paper is presented: data, information, information system, knowledge, Knowledge Base and know-how (Figure 1).

1. **Data** are facts represented in a readable language (such as numbers, characters, images, or other methods of recording on a durable medium). Data on its own carries no meaning (ICHNET, 2005).

2. **Information** can be defined in a number of different ways. According to the Free On-line Dictionary of Computing, it can be a message, in the form of a document or an audible or visible communication, meant to change the way a receiver perceives something and to influence judgement or behaviour (ICHNET, 2005). It can also be defined as data that makes a difference (Davenport & Prusak, 2000) or it can represent patterns in data (O’Dell & Grayson, 1998). A further formulation presented on the Lucent Technologies website bases on Claude Shannon’s work of the 1940s on the subject of information theory defines information as “that which reduces uncertainty” (Lucent Technologies, 2005).

3. **An information system** means an interconnected set of information resources under the same direct management control that shares common functionality. A system normally includes hardware, software, information, data, applications, communications, and people (SEHISC, 2005).

4. **Knowledge** is defined in the Free On-line Dictionary of Computing as “what is known by perceptual experience and reasoning” (ICHNET, 2005). Knowledge can either be explicit through, for example, the use of documents, databases and ‘Knowledge Bases’. It can, however, also be implicit, meaning that it may only be known to individuals. Such knowledge is regarded as experiential and therefore difficult to document (O’Dell & Grayson, 1998).

5. **A Knowledge Base** can be described as a store of knowledge about a domain represented in machine-processable form, which may be rules, facts, or other representations. It may also be referred to as a repository (ICHNET, 2005).

A brief survey of how the term ‘Knowledge Base’ is used shows that there seem to be no harmonized approaches. There are a multitude of different types of on-line services which declare themselves to be a KB. On many websites KBs are Frequently Asked Questions (FAQs). Once FAQs and their answers are categorized, keywords added and all entered into a database, such a system develops in the direction of a ‘Knowledge Base’. Often KBs incorporate more extensive content, including also actual documents.

6. **Know-how** is a particular type of information or knowledge which enables the possessor to achieve a specific goal with an accuracy or precision that would not otherwise be possible (UT-SWMC, 2005).
For example, there are about 20.34 million ha of forest in Finland. We could think of 20.34 million as data. The statement that “Finland’s forest land area has increased by 1.6 million hectares since the 1960s to 20.34 million hectares” can be regarded as information; “The increase in forest land area since the 1960’s is a result of afforestation of agricultural lands and peatlands as well as intensive forest improvement efforts” is knowledge. When now combining information and knowledge from different domains (e.g. economical and technological aspects, environment, etc.) forest managers may come to the conclusion to further increase, decrease or keep the forest area stable. In this way combined knowledge becomes know-how and leads to a specific action.

1.2 The increasing importance of meta information. Embedded in the chain of turning data and information into knowledge and know-how is the organization, transparency and accessibility to the data and information sources (Päivinen & Schuck, 2003). The use of the Web as a tool for identifying data and information has become increasingly important. “Armed with the Internet the customer (or user) is seizing power” (The Economist, 2005). As users have the opportunity to inform themselves, compare and read or share experiences with other users, the competition between providers of services (such as information provision) is intensifying, and standards are being raised. This applies not only to commercial businesses, but also to research and the dissemination of research results. For example, the minutes of the Joint FAO/UNECE Working Party on Forest Economics and Statistics (2005) state that: “the FAO/UNECE website was now the primary method of communication and welcomed the secretariats intention to make it more structured and easy to navigate. As regards to databases, priority should be given to both data quality and availability of metadata”.

There are numerous approaches and standards in organizing data and information resources using metadata. All these initiatives follow common principles of providing a set of standards which allow for discovery of information resources across domains based on a common metadata framework tailoring to particular needs and/or data and information types.

Examples of such initiatives are the ISO 19115 (ISO 19115) which defines the schema required for describing geographic information and services. It provides information about the identification, the extent, the quality, the spatial and temporal schema, spatial reference, and distribution of digital geographic data. In 2004 the European Commission adopted a “proposal for a Directive of the European Parliament and of the Council establishing an infrastructure for spatial information in the Community, (INSPIRE)” (COM(2004) 516 final). The proposed Directive lays down general rules for the establishment of an infrastructure for spatial information in Europe, for the purposes of
environmental policies and policies or activities which may have a direct or indirect impact on the environment (CEC, 2004). The United States Federal Geographic Data Committee (FGDC) uses the Content Standard for Digital Geospatial Metadata CSDGM which was designed to “provide a common set of terminology and definitions for the documentation of digital geospatial data” (FGDC, 1998). The Dublin Core Metadata Initiative (DCMI) is an organization dedicated to promoting the widespread adoption of interoperable metadata standards and developing specialized metadata vocabularies for describing resources that enable more intelligent information discovery systems (DCMI, 2005).

2 THE KNOWLEDGE BASE

One central component of NEFIS has been the establishment of a Web-based KnowledgeBase (KB) with substantive structured information content. The KB of NEFIS includes a repository of metadata and controlled vocabulary standards, software design documents, FAQs, worked examples and software distributions. Its content is based on essential documentation of activities related to forest information systems and services. The KB also gives the options to set up fora for discussions on selected topics and includes a help function introducing the various KB functionalities.

The NEFIS KB metadata structure follows the Dublin Core Metadata Element Set of 15 elements (DCMI, 2004). The set is designed to cater for sharing across disciplines or within any type of organization needing to organize and classify information. For the NEFIS KB all 15 elements were made available for describing contents (Figure 2). Only five elements were labelled as mandatory: Title, Creator, Subject, Description and Identifier. These five elements allow the KB user to get a reasonable overview of the main information content of a resource, and also to be able to obtain (download, access, or order) the resource if desired. In particular the element ‘Identifier’ allows linking to an actual information source via a URL or posting a reference number to a publication (e.g. ISBN, ISSN). The KB further provides the option to attach a document to the metadata record which can then be downloaded by a user.

![Figure 2. Metadata schema of the KnowledgeBase. Note: the marked elements are mandatory.](image)

In order to facilitate a more structured organization of the metadata entries the element ‘Subject’ incorporated a set of controlled vocabulary terms. The terms allow the allocation of information content to a matching or related topic under one or more main headings. The terms themselves were elaborated within the project in view of the intended content of the KB. The actual KB tree structure consists of eight main headings which are then further split up into a number of subheadings (Figure 3).

When entering a record to the KB, the information provider has the option to choose from these main headings and subheadings. The information provider may also choose to enter their own keywords as free text to further specify the content of the resource.
2.1 Technical specifications. UML (Unified Modelling Language) is a standard object-oriented design language. It was used as a tool for describing the structural relationships of the NEFIS KB. Figure 4 shows UML use cases for the different functionalities of the KB. The UML class diagrams were then mapped to Extensible Markup Language or XML Schema. In a next step the Hypertext Preprocessor (PHP) was used to implement the NEFIS KB allowing hierarchical access to metadata and documentation related to forest information systems. PHP is an embedded, server-side scripting language. The metadatabase itself is based on MySQL. Currently the uploaded files which are attached to metadata records amount to more than 12MB.
3 KNOWLEDGEBASE CONTENTS

As of 17 June 2005, the NEFIS KB has more than 130 entries. The records on the main page are organized in terms of utilized controlled vocabulary. A particular metadata record may appear under more than one heading or subheading (Figure 5).

The KB has been and will continue to be used to document the outputs from the NEFIS project. The project deliverables, other reports and minutes of the project meetings are available through the KB. Documents related to the NEFIS project include: the report on the NEFIS metadata schema and keyword lists; the NEFIS metadata guidelines; suggestion for a Forest Markup Language (FML); the keyword lists (for Silviculture; Inventory; Forest products and trade flows; Field experiments; Maps and geo-referenced data; Forest health; Vegetation (or forest or land) types; Non-wood goods and benefits; Forest institutions; Rural development; Fires; Forest operations); Data preparation guide for NEFIS data providers; use case storylines and use case diagrams for the UML (Unified Modelling Language); and data preparation guidelines for NEFIS data providers.
A beneficial side-effect of the KB has been the addition of documentation which has not been officially published (grey literature) but has been of considerable interest and use to the NEFIS project. The KB allows such documentation to become visible or even downloadable for other users who may find them interesting. Examples documents are: (1) the European Forest Information System - EFIS - Final Report including the published executive summary (JRC, 2002b); (2) Data Management and Database Issues for Integrated Forest Resource Information System of the Forest Inventory and Monitoring Project (Ibrahim, 1999); and (3) the Workshop Report of the World Forest Monitoring Workshop (Schuck et al., 1996).

Figure 5. Interface of the NEFIS KnowledgeBase.

Figure 6a. Screenshot of the retrieved records from a search to the NEFIS KB.
Figure 6a demonstrates a sample query to the NEFIS KB. The information seeker is interested in information related to the Dublin Core Metadata Initiative. By clicking on the subheading ‘Dublin Core’ under the main heading ‘Knowledge representation’ the titles of the metadata records related to DCMI are displayed. The information seeker is given the option to ask for full metadata details. In this case the metadata record ‘DCMI Terms’ was selected (Figure 6b). When following the link under the element ‘Identifier’ the information seeker will be guided to the webpage displaying the Dublin Core Metadata Element Set.

A Web-based KB entry interface has been developed for easy submission and editing of metadata records. In order to be able to enter or edit metadata records, users must login. During the NEFIS project lifetime a small group of individuals was granted access rights to upload information to the KB. This was because during the course of the project mainly documentation which was identified as useful within the project was uploaded. The overall management, maintenance and access rights control of the NEFIS KB was monitored by technical personnel (master user).

4 POTENTIAL USE AND VISION

One task after completion of the project will be to guarantee that the KB is maintained allowing for regular entry of records. This will build on a more open structure than was applied in the NEFIS project. Individuals who would like to provide input related to the development of forest information systems and services will be able to register as a KB user and will be given the rights to enter metadata and edit their own metadata records. The KB host in consultation with the management group established within the NEFIS project will make a decision about whether the information will be made visible through the KB.

An additional use for the KB could be found in relation to the creation of a European Forest Information and Communication Platform (EFICP). The EFICP initiative, which was preceded by the Council regulations for a European Forest Information and Communication System, EFICS (EEC 1989; last amended regulation: 1998/1100/EC which expired in 2002) is dedicated to the development of a fully operational information system able to retrieve and analyse forest information from distributed national forest information databases. The EFICP objective is to help reporting and monitoring of forest resources at the EU level and to provide information on these resources.
interested EU, national, and stakeholder communities. In this context, the NEFIS KB may serve as a useful tool in hosting important documentation when building the EFICP.

A further option for the KB would be to seek options on interoperability with other related metadata services so that information can be accessed via other entry gates. One important example within the forestry domain is the Global Forest Information Service. GFIS aims to enhance access to all types of forest information, ensuring that it is accessible to governments and to all stakeholders, including researchers, forest managers, NGOs, community groups and the public at large. It should contribute to an improved understanding of complex forest-related issues, to better decision-making and more informed public engagement in forest policy and forest management at all levels (GFIS, 2005). The NEFIS KB could therefore serve the GFIS as a potential thematic information provider.

Such potential applications and the avenue of promoting the KB as a good reference point for forest service and system related information through popular channels such as popular articles, papers and newsletters may yield good prospects for the growth of the NEFIS KB towards a comprehensive information resource with regards to forest information systems and services.

REFERENCES


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