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Metadata Model for the European Forest Information and Communication Platform*

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Abstract

This paper describes the metadata model conceived for the future European Forest Information and Communication Platform (EFICP). The core of the platform, currently under implementation in the scope of a two-year project funded by the European Commission, is given by a repository of metadata that describes the available information resources. These are distinguished in terms of resource categories (common / bibliographic resources, news, spatial data information services and statistical data) and are treated in a differentiated way by the EFICP metadata model, applying widely accepted standards such as ISO/OGC, Dublin Core, SDMX and RSS, whereas a key requirement for system interoperability is given by the set of INSPIRE implementation rules as currently available.
This paper provides a description of the structure of the EFICP metadata model and its components. This model extends the metadata guidelines as proposed by the former NEFIS project. In order to support the online access and exchange of forestry specific statistical data, a general information model for the modelling of these resources in the context of a proposed EFICP reference reporting system has been created and is proposed for implementation on the basis of the SDMX standard.

Keywords: metadata, Dublin Core, OGC, search and discovery, geospatial information services, forestry statistics, EFICS, EFICP

1. INTRODUCTION

1.1 Objectives and Scope of EFICP

The goal to establish a European Forestry Information and Communication System (EFICS) goes back to the original Council Regulation (EEC) No 1615/89 (later amended in 1998, (EEC) No 110/98) as response to fulfil the growing need to co-ordinate forest information among the EU Member States with the objective to "collect, co-ordinate, standardize, process and disseminate information concerning the forestry sector and its development".

Several activities and pilot projects have been carried out ever since. In 1996, the Commission launched a study with the aim of producing firstly a comparative analysis of forestry inventory procedures in European countries, and secondly, proposals to improve the reliability of forestry statistics at European level. The study revealed the huge disparity in the quality and utility of forest information in Europe and made a series of proposals to harmonize forestry data produced at national levels. Later, several projects running under the 5th Framework Programme (e.g. EUROLANDSCAPE) or as contract with the European Commission / Joint Research Centre (EFIS, NEFIS) prepared the grounds for the EFICS by investigating technological requirements and solutions for the compilation, processing, analysis and dissemination of available forestry information from the most diverse sources in Europe.

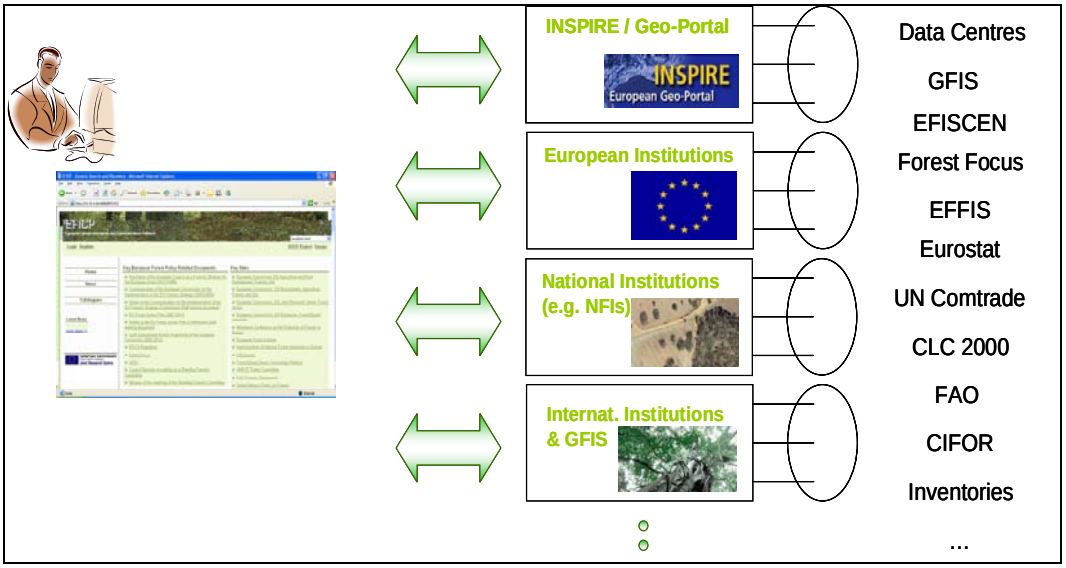
Following up the above mentioned initiatives and building on their results, EFICP is the preparatory action for the implementation of EFICS and is being conceived to become the front door for internet-based information and communication in the European forestry sector. Designed for a wide user community - from policy makers to forest industry and the general public, the new platform will allow for the search, access, analyse, view and download of a wide range of forest related information, such as geographical and statistical data, news, reports, policy papers, links to existing initiatives etc., thus facilitating and enhancing the access to sector specific information.

A major focus in technical design is on interoperability, i.e. to enable EFICP to exchange data with a wide range of external systems and services, adopting INSPIRE guidelines and implementing rules. One of the most innovative features of the EFICP is to allow for on-line access, analysis and visualisation of geographically referenced data and forestry statistics, including comparative analysis through aggregation of these data from different sources.

As communication platform, EFICP is designed in order to connect with other existing services and systems such as the INSPIRE EU GeoPortal, EFFIS, EFISCEN and the Forest Focus Data Platform as well as national forestry

inventories. This approach reflects the EU strategy for a comprehensive and integrated forest monitoring network.

Figure 1: EFICP as front-door to forestry and related information in Europe



2. INTEROPERABILITY AND SYSTEM CONNECTIVITY

2.1 EFICP as Spatial Data Infrastructure

One fundamental operational goal of EFICP is to operate as communication platform that is interoperable with other INSPIRE nodes. In the context of Spatial Data Infrastructures (SDI), these are namely given by external catalogue systems implementing CS-W (OGC harvesting) as well as non-catalogue systems that provide OGC compliant web mapping services (WMS, WFS). In support to the main functional goals for the search and discovery of spatial data resources as well as for access and visualisation, the required technical characteristics that qualify EFICP as SDI infrastructure can be summarised as follows:

Distributed data resources:
As explained, the operational goal of EFICP is to serve as communication platform and access point to a wide range of distributed resources; these include the INSPIRE EU GeoPortal, external catalogues, OGC compliant services and other providers of forestry related information and data.

Harmonisation of data specifications:
Event though EFICP does not provide new harmonised specifications for forestry data, the system has to appropriately ensure the comparability of data (forestry statistics) from heterogeneous sources.

Metadata for forestry information resources:
EFICP has to support the search and discovery of a wide range of information resources as well as the online access to these resources. These do include, but are not limited to geospatial data sets. Particular requirements for the design of the metadata model relate to multilingual support, data quality and other aspects.

Geospatial information services:
Following the so far available definition of INSPIRE Network Services, the operational and functional requirements for EFICP ask for the implementation of a number of services such as for discovery (e.g. based on OGC harvesting), upload (e.g. OGC metadata), (multiple) view and download services.

System architecture:
As INSPIRE compliant information system, EFICP has to adopt the corresponding reference architecture and related technologies and standards.

2.2 Interoperability Requirements

This view of EFICP as a Spatial Data Infrastructure carries a number of fundamental interoperability requirements, summarised according to the three common levels of interoperability:

Technical interoperability:
Following the INSPIRE reference architecture and guidelines, EFICP has to communicate with catalogues and other distributed content repositories and implement respective services (e.g. catalogue, view, download services) following the recommended technical standards. Hence, EFICP has been built as Service-Oriented Architecture (SOA) and adopts corresponding standards as proposed for example by W3C and OASIS. In particular, geographical information exchange is based on web mapping ISO/OGC standards (WMS, WFS) whereas metadata harvesting and publishing for the integration with external catalogues is supported through CS-W, OAI-PMH and also z39.50 as well as RSS for news selection.

Semantic interoperability:
The general concept of semantic interoperability is often understood as ‘metadata interoperability’, i.e. achieving unambiguous interchange between different metadata schemes (models) that share common components with similar or equivalent meaning. As a matter of fact, for EFICP the use of metadata supports

several functional purposes and must also consider the existence of several kinds of information resources, i.e. not only geospatial data. The semantic framework of this system must therefore encompass different levels of metadata:

1. for general search and discovery, based on a scheme with common components (metadata elements, e.g. the field 'Subject') serving a wider user community and application domains, and
2. for detailed search and discovery as well as access and visualisation, allowing for a correct, meaningful and unambiguous interpretation of the content itself, e.g. through a domain-specific ontology.

The second level spans the search and discovery by expert users (e.g. by searching on the basis of scientific terms contained by a controlled vocabulary) as well as the evaluation (e.g. quality related information) and interpretation (in the scope of analysis and visualisation) of the content of resources. Particular requirements can be derived for multi-lingual support (e.g. search for a term in several languages) as well as for the encoding of structural elements of data sets and a harmonised description of data in order to support the comparative analysis of statistical indicators (such as forest inventory data) from heterogeneous sources.

Organisational interoperability:
Apart from organisational requirements for the evolution of EFICP as communication platform at European level and the need to encourage national services and systems to participate, the EFICP must adequately support future exploitation taking into account some fundamental organisational processes and aspects, e.g. those related to the management of metadata, guidelines for data policy management and data provision. Hence, EFICP is expected to provide an adequate organisational framework (including guidelines and recommendations) for the registration of resources and external systems and services, supported by technical means for metadata upload (manual, automatic) and subsequent moderation according to defined procedures for (metadata) data quality management. The metadata model should also be open for further evolution and therefore.

3. THE EFICP METADATA MODEL

3.1 General Overview of the Metadata Model

The analysis of the variety of information resources that can be searched and accessed through EFICP led to the conclusion that these should be grouped into four fundamental types. Whilst all of these can be searched for, the requirements for online access vary depending on the underlying goals for functional use:

Bibliographic / common resources:
This type covers all kinds of file resources as well as top-level description of services (including sites as general access point). Metadata for these are based on Dublin Core.

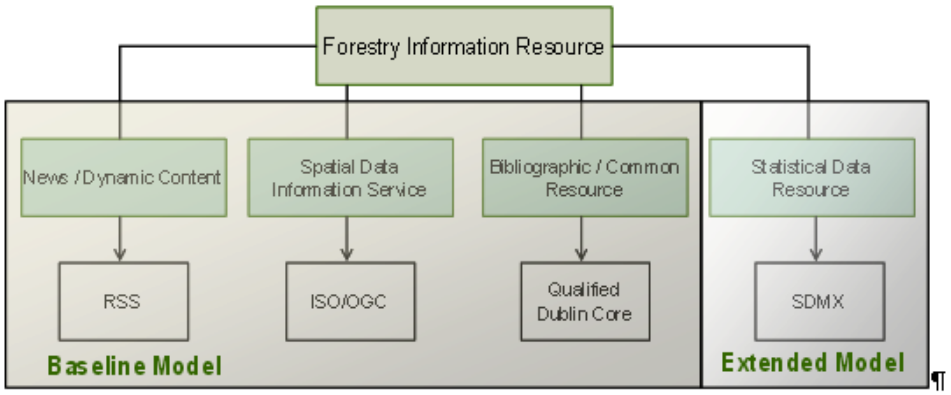
News / dynamic content:
This category encompasses news and other equivalent content dynamically integrated and updated as web content on the basis of the RSS standard.

Spatial data information services:
These resources refer ISO/OGC compliant web mapping services (other spatial data would be treated as common resource). The online access to these services spans the view and download of spatial data sets, i.e. with overlay of spatial data from different sources (using WMS, WFS).

Statistical data resources:
These resources include all statistical data (forestry statistics) services from which data can be accessed and retrieved for visualisation and further analysis. Online access occurs at data set level requiring additional metadata (content, internal structure of a data set, additional metadata). SDMX was found to be the standard that most adequately supports the given functional requirements for online access and visualisation of data sets.

In support to the general goal to enable the Member States to publish and disseminate forestry inventory and related socio-economic data for their countries through EFICP, the particular importance of statistical data resources has given origin to the distinction between a so called Baseline Model and an Extended Model as shown in the following figure:

Figure 2: General structure of the EFICP Metadata Model.



3.2 The Baseline Model

3.2.1 Qualified Dublin Core

The Baseline Metadata Model is based on the use of various standards such as Dublin Core, RSS (news) and ISO/OGC (namely CS-W, WMS, WFS) for geospatial data services. The model builds on the Dublin Core (DC) standard; this was created by the Dublin Core Metadata Initiative (DCMI) which is dedicated to the promotion of the widespread adoption of interoperable metadata standards, developing specialised metadata vocabularies for describing resources that enable more intelligent information discovery systems. The Dublin Core Metadata Element Set, Version 1.1 became the ISO Standard 15836-2003 in February 2003 (Dublin Core Metadata Initiative Documentation, 2007).

The Dublin Core has been chosen as baseline as it is a simple and widely accepted standard facilitating the finding, sharing and management of information over a large number of domains. Of course, it is by itself not adapted to geospatial resources, but can be refined accordingly. One the other hand, as the standard bases on a rather small set of fundamental elements, the mapping between different (i.e. qualified) DC models is still relatively straightforward (through direct mapping between elements) and this simplicity promotes interoperability.

Metadata elements are described at two levels: *Simple* and *Qualified*:
The Simple Dublin Core defines only 15 metadata elements, whereas the Qualified Dublin Core provides additional three elements, whereas most elements also have a limited set of qualifiers or refinements, attributes that may be used to further refine (not extend) the meaning of the element. DCMI has established standard ways for these refinements and encourages the use of encoding and vocabulary schemes:

- *Element Refinement*. These qualifiers make the meaning of an element narrower or more specific. A refined element shares the meaning of the unqualified element, but with a more restricted scope. A client that does not understand a specific element refinement term should be able to ignore the qualifier and treat the metadata value as if it was an unqualified (broader) element.

- *Encoding Scheme*. These qualifiers identify schemes that aid in the interpretation of an element value. These schemes include controlled vocabularies and formal notations or parsing rules. A value expressed using an encoding scheme will thus be a token selected from a controlled vocabulary (e.g., a term from a classification system or set of subject headings) or a string formatted in accordance with a formal notation (e.g.,

> "2000-01-01" as the standard expression of a date). If a client or agent does not understand an encoding scheme, the value may still be useful to a human reader. The definitive description of an encoding scheme for qualifiers must be clearly identified and available for public use.

The EFICP Baseline Metadata model follows the same principles and can be viewed as a Qualified DC model that further extends the model previously proposed by the NEFIS project. Some examples are provided below, to better illustrate these principles. The model implementation is XML based, also following the DCMI rules.

An example of a Qualified DC element is the "Modified" element, which is a refinement of the Simple DC element "Date":

<dcterms:modified>1997-07-27 </dcterms:modified>

Another example is the "DCMIType", but the attribute "xsi:type" now is used:

<dc:type xsi:type="dcterms:DCMIType">text</dc:type>

This kind of XML encoding is used if the refinement is a controlled vocabulary like the "DCMIType" or encoding schemes like the following examples:

< dcterms:spatial xsi:type="Box">northlimit= 70.01;southlimit= 59.60;westlimit= 19.09; eastlimit= 31.58</ dcterms:spatial >

<dc:identifier xsi:type="dcterms:URI">http://www.eficp.eu/sys1</dc:identifier>

The first is the "Box" encoding scheme of the "Spatial" refinement of the Simple DC element "Coverage" which covers both geographical and temporal extension. The second is the "URI" (Universal Resource Identifier) encoding scheme (usually an URL). Both strings are formatted according to a well-established way.

Examples of EFICP refinements (using the namespace "eficp") are the "EFICP Type" and "NUTS". Both are controlled vocabularies, the first defines the EFICP resource classification, whilst the latter is a geocode standard for referencing the administrative division of countries for statistical purposes, called Nomenclature of Territorial Units for Statistics (NUTS).

<dc:type xsi:type= "eficp:EFICPType">Statistical data</dc:type>

<dcterms:spatial xsi:type="eficp:NUTS">GR1</dcterms:spatial>

Regarding element obligation, each Dublin Core element is optional and may be repeated. The Baseline model considers 3 mandatory elements: "Title", "Description" and "Date". We assume that every metadata resource has at least these elements, thus providing the minimum level of metadata interoperability.

For geospatial resources in particular, refinements were made in order to achieve conformance with INSPIRE Discovery Level 1 interface and Article 8. The following elements were included in the Baseline Metadata Model as refinements and encoding schemes of the DC model: "Quality", "Topic Category", "Spatial Resolution", "Service Type" and "Rights Restriction Code". These elements have direct correspondence with the same elements in the ISO standards ISO 19115 and ISO 19119 for geographic information datasets and services.

3.2.2 EFICP Thesaurus

As mentioned in section 2.1, the expert search and discovery requires the use of some kind of expert language that is specific to the application domain. Considering that the use of such domain language must be independent from the general structure of the metadata model, the solution is given by the qualification of the core element "Subject" in the DC model.

In the scope of the project, several alternative approaches for this qualification were studied, considering controlled vocabularies, thesaurus and semantic web approaches. The former NEFIS project had already proposed the use of controlled vocabulary structured into major themes. This approach was considered as not being flexible enough, mainly because the lack of support for relationships between vocabulary elements would not support the search for thematically related terms (i.e. the user would always have to indicate all search terms). This potential limitation can be overcome by using a thesaurus; using the NEFIS controlled vocabulary as baseline, an EFICP specific thesaurus was proposed, arranging the existing vocabulary in a known order and structure such that equivalence, homographic, hierarchical and associative relationships among terms can be identified and indicated to the user. This thesaurus is not a hierarchical structure; apart from the common 'broader' and 'narrower' terms, it uses other relations such as 'Used for', 'Use', 'Plural form', 'Short form' and 'Definition source'.

The thesaurus is seen as a first prototype, open for further development by the scientific community. It should be highlighted that the thesaurus does not only support the search for related terms in a transparent way to the user, as it also satisfies the requirements for multi-lingual support, for example allowing for simultaneous search of terms in several languages.

3.3 The Extended Model

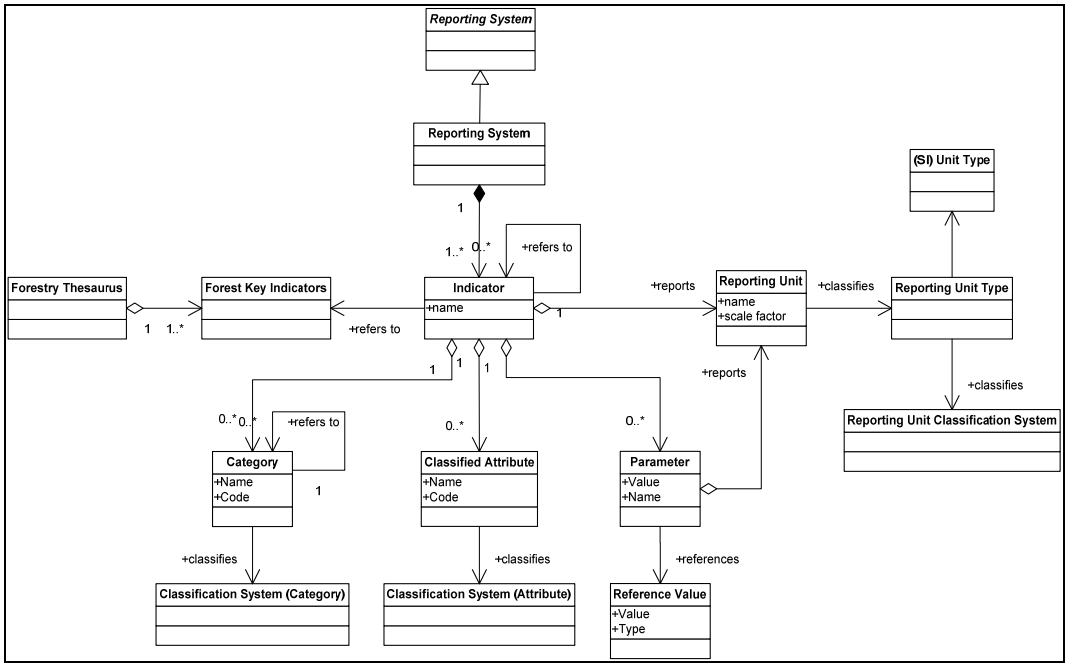
The harmonisation of data specifications in the forestry domain is one of the key requirements for the implementation of the original Council Regulation (EEC) No. 1615/89 concerning the creation of the EFICS - European Forest Information and Communication System (San-Miguel-Ayanz et. al, 2005). The EFICS study carried out until 1997 analysed in detail the statistical resources in Europe (Päivinen, Köhl, 2005), confirming a significant heterogeneity and sometimes even lack of reliability of data sources, not meeting common international requirements as most inventory systems had been developed and optimised towards national objectives. Currently, the ENFIN network and other initiatives work on a harmonised specification of key indicators; however, a general, encompassing harmonisation framework remains a long-term goal.

On the other hand, the reporting of forestry-specific indicators, generally at country level, is managed by organisations such as FAOSTAT and EUROSTAT. The collection of data from countries is based on the use of defined reporting schemes and guidelines, namely FRA (FAO, 2004). For Europe in particular, a more comprehensive view of sustainable forest management than given by traditional NFI (National Forest Inventories) has driven the trend towards a richer reporting covering forest health conditions, the productive functions and socio-economic value as well as biodiversity, forest conservation and other aspects. In this context, the work of the Ministerial Conference on the Protection of Forests in Europe (MCPFE/UNECE/FAO, 2003) has gained particular importance and given rise to the definition of improved, pan-European indicators for sustainable forest management. The regular reporting of these indicators is one of the objectives of the EU Forest Action Plan (European Commission, 2006), thus contributing to the harmonised dissemination of forestry and related information to policy makers and the general public.

The definition of the extended metadata model of EFICP is therefore not only driven by functional requirements for online access to statistical data sets and the underlying mechanisms for querying and corresponding extraction of data as requested by the user. In order to ensure the comparability of data from heterogeneous sources, it is also important to base this metadata model on existing reporting schemes and guidelines such as FRA 2005, MCPFE as well as national systems.

In order to establish a model that satisfies fundamental requirements concerning generic applicability, expressiveness, flexibility and extensibility, work under the EFICP project concentrated first on the elaboration of a general information model for forestry information resources (i.e. for the reporting of indicators).

Figure 3: General model for the definition of indicators in reporting systems.



This model, given as UML class diagram, is of course conceptual in nature and does not yet cover the modelling of structural elements of data sets or particular metadata that may be attached to a dataset. It does however demonstrate that a relatively few elements are sufficient in order to successfully represent the common reporting definition structure for a large variety of indicators as they are currently defined in different reporting systems.

In a second step, the modelling of the structural information of data sets was addressed by looking into existing specifications and standards, considering the various temporal, spatial and data dimensions in data set structures. It was found that SDMX - Statistical Data and Metadata eXchange (Statistical Data and Metadata Initiative, 2005) is currently the most advanced international standardisation effort (being approved already as ISO standard), supporting statistical data and metadata access, exchange between systems and machine-processing (as opposed to simple metadata structures designed for human interpretation such as GDDS/SDDS).

SDMX is actually 'only' a general information model and requires domain and system specific implementations. As needed for EFICP, the standard allows for the definition of complex reporting structures on the basis of generic elements (code lists, hierarchical categories etc.), provides multi-lingual support and

permits the flexible use of metadata attached to single elements or the data set itself. For encoding, querying and transport of data a number of particular messages (SDMX-ML for an XML-based implementation) can be applied.

The solution proposed for reporting under EFICP is hence based on the 'SDMX implementation' of the general domain model as shown in Figure 3. In order to establish an operational baseline for the reporting at pan-European level and the comparability of data sets in the context of aggregated online analyses, EFICP proposes the adoption of particular indicators and their definition according to FRA2005 or MCPFE, leaving the use of alternative definitions (i.e. according to national systems) open. For these indicators, structural definitions are given according to the underlying reporting guidelines (reporting dimensions, measurement units, classified attributes as well as parameters). On the other hand, additional metadata may be attached to a dataset or reporting dimension, i.e. for any reported indicator. These metadata are for example important in case data providers offer data sets from different sources, needing to identify the original source, year/date of provision, access right restrictions and other general measurement specific conditions.

4. INTEGRATION AND INTEROPERABILITY

In order to ensure interoperability with external systems and services, EFICP has to support the mapping between the EFICP metadata model and others. Depending on the general type of resource and underlying standard (as illustrated in Figure 2), this is achieved as follows:

4.1 Bibliographic / common resources

Mapping can be established by directly relating metadata elements of external models and systems to elements of the EFICP metadata model. This is expected to be the most pragmatic and straightforward approach in the case of models that also rely on Dublin Core and even on other models as long as these are built on a smaller number of elements that are conceptually equivalent to Dublin Core.
The relations must be configured through the use of a particular EFICP tool (*under development at the time of the writing of the present paper*) to be used by the providers of external systems in order to harvest or directly import metadata from these into the EFICP catalogue.

Potential drawbacks of the approach taken exist however in the following cases:

- The external model has considerable complexity (e.g. extensions, qualifications and refinements) that make the direct match between the models (EFICP, external) difficult and/or ambiguous. In these cases, the configuration of mappings may imply a loss (neglecting) of some elements.

- In the same way, harvesting requests from external systems to EFICP pose the same problem, i.e. the EFICP baseline model has a considerable number of qualifications and refinements that cannot easily be mapped to simpler (e.g. standard) DC models without loss of some information.

4.2 News / dynamic content

EFICP directly connects to RSS providers. No particular interoperability problem exists, however, it is recommended to filter adequately forestry related news on the provider side. This is for example implemented in the case of the Europe Media Monitor (EMM) provided by the JRC.

4.3 Spatial data information services

For interoperability of EFICP with other spatial data infra-structures and services, several distinct requirements and corresponding mapping mechanisms have to be considered:

OGC Harvesting
EFICP support CS-W 2.0 in order to harvest external OGC-compliant catalogue systems. It is known that the current specification is still not strict enough in order to ensure a 'by-default-interoperability' between systems that are supposedly compliant with the standard. On the other hand, different profile implementations based on ISO and ebRIM also require different approaches to interoperability for CS-W harvesting.
The following examples illustrate how the required mappings were implemented in case of the INSPIRE EU GeoPortal:

OGC Core Metadata – EFICP Baseline Model
When sending an OGC core request (e.g. GetRecords) to the INSPIRE EU GeoPortal, the EFICP obtains a response with core metadata that is mapped to Dublin Core elements of the EFICP Baseline model. This mapping is rather straightforward:

OGC Core (CSW Response) (/GetRecordsResponse/SearchResults/ Record collection)	**EFICP**
-	/BASE_MODEL/eficp:mrid
/Record/title	/BASE_MODEL/dc:title
/Record/abstract	/BASE_MODEL/dc:description
/Record/abstract	/BASE_MODEL/dcterms:abstract
/Record/modified	/BASE_MODEL/dc:date = 'current year' (no OGC Core information on date)
/Record/modified	/BASE_MODEL/dcterms:modified
/Record/subject	/BASE_MODEL/dc:subject
/Record/type	/BASE_MODEL/dc:type
/Record/format	/BASE_MODEL/dc:format
/Record/identifier	/BASE_MODEL/dc:identifier
/Record/language	/BASE_MODEL/dc:language
/Record/relation	/BASE_MODEL/dc:relation
/Record/WGS84BoundingBox /Record/WGS84BoundingBox/UpperCorner (maxy) /Record/WGS84BoundingBox/LowerCorner (miny) /Record/WGS84BoundingBox/LowerCorner (minx) /Record/WGS84BoundingBox/UpperCorner (maxx)	/BASE_MODEL/dcterms:spatial/ @xsi:type="dcterms:Box" = 'northlimit=maxy;southlimit=miny;westlimit=min ;eastlimit=maxx'
/Record/language	xml:lang

The inverse situation (requests from the INSPIRE EU GeoPortal to EFICP) is equivalent.

ISO Metadata – EFICP Baseline Model

In the case of ISO metadata, it must be considered that different schemas exist for the implementation of ISO19115. In the case of the INSPIRE EU GeoPortal, a typical response looks as follows:

```
<?xml version="1.0" encoding="UTF-8" ?>
GetRecords Response xmlns="http://www.opengis.net/cat/csw/">
Request Id>1</Request Id>
SearchStatus status="subset" timestamp="2007-10-25T19:45:37.584+02:00" />
SearchResults elementSet="full" numberOfRecordsMatched="717"
   numberOfRecords Returned="5"
   recordSchema="http://schemas.opengis.net/iso19115full/profileFull.xsd">
ns1:MD_Metadata xmlns:ns1="http://schemas.opengis.net/iso19115full">
ns1:fileIdentifier>
ns2:CharacterString xmlns:ns2="http://metadata.dgiwg.org/smXML">a7c60213-7b27-
   4ccb-83eb-2f28f0034a95</ns2:CharacterString>
  </ns1:fileIdentifier>
ns1:language>
ns3:CharacterString
   xmlns:ns3="http://metadata.dgiwg.org/smXML">en</ns3:CharacterString>
  </ns1:language>
ns1:characterSet>
ns4:MD_CharacterSetCode xmlns:ns4="http://metadata.dgiwg.org/smXML"
   codeList="http://metadata.dgiwg.org/codelistRegistry?MD_CharacterSetCode"
   codeListValue="utf8" />
  </ns1:characterSet>
ns1:hierarchyLevel>
ns5:MD_ScopeCode xmlns:ns5="http://metadata.dgiwg.org/smXML"
   codeList="http://metadata.dgiwg.org/codelistRegistry?MD_ScopeCode"
   codeListValue="application" />
  </ns1:hierarchyLevel>
...
```

The mapping to the EFICP baseline model is given for a subset of ISO metadata elements, considering mandatory elements for Discovery Level 1 as well as other optional elements (see section 3.2). The following table shows only some examples for these mappings; in some case, several ISO elements are mapped to one element of the EFICP baseline model:

ISO (CSW Response) (/GetRecordsResponse/SearchResults/ MD_Metadata collection)	**EFICP**
/MD_Metadata/identificationInfo/MD_DataIdentification/citation/CI_Citation/title /MD_Metadata/identificationInfo/MD_DataIdentification/citation/CI_Citation/alternatTitle	/BASE_MODEL/dc:title
/MD_Metadata/identificationInfo/MD_DataIdentification/descriptiveKeywords/MD_Keywords/keyword (collection)	/BASE_MODEL/dc:subject
/MD_Metadata/identificationInfo/MD_DataIdentification/topicCategory	/BASE_MODEL/dc:subject /@xsi:type=”eficp:ISOTopicCategory”
/MD_Metadata/identificationInfo/MD_DataIdentification/citation/CI_Citation/date	/BASE_MODEL/dcterms:created
/MD_Metadata/identificationInfo/MD_DataIdentification/citation/CI_Citation/presentationForm/CI_PresentationFormCode	/BASE_MODEL/dc:type
/MD_Metadata/identificationInfo/MD_DataIdentification/spatialRepresentationType/MD_SpatialRepresentationTypeCode/ @codeListValue	/BASE_MODEL/dc:type/@ xsi:type=”eficp:SpatialRepresentation”
/MD_Metadata/identificationInfo/CSW_ServiceIdentification/serviceType	/BASE_MODEL/eficp:serviceType
/MD_Metadata/dateStamp	/BASE_MODEL/dc:date
/MD_Metadata/language	/BASE_MODEL/dc:language
/MD_Metadata/identificationInfo/MD_DataIdentification/extent /EX_Extent/geographicElement/EX_GeographicBoundingBox /MD_Metadata/identificationInfo/MD_DataIdentification/extent /EX_Extent/geographicElement/EX_GeographicBoundingBox /northBoundLatitude (maxy) /MD_Metadata/identificationInfo/MD_DataIdentification/extent /EX_Extent/geographicElement/EX_GeographicBoundingBox /southBoundLatitude (miny) /MD_Metadata/identificationInfo/MD_DataIdentification/extent /EX_Extent/geographicElement/EX_GeographicBoundingBox /westBoundLongitude (minx) /MD_Metadata/identificationInfo/MD_DataIdentification/extent /EX_Extent/geographicElement/EX_GeographicBoundingBox /eastBoundLongitude (maxx)	/BASE_MODEL/dcterms:spatial/ @xsi:type="dcterms:Box" = ‘northlimit=maxy;southlimit=miny;westlimit=minx;eastlimit=maxx’
/MD_Metadata/identificationInfo/MD_DataIdentification/descriptiveKeywords/MD_Keywords/keyword	/BASE_MODEL/dcterms:spatial/@ xsi:type="eficp:NUTS
/MD_Metadata/identificationInfo/MD_DataIdentification/resourceConstraints/MD_Constraints	/BASE_MODEL/dc:rights
/MD_Metadata/identificationInfo/MD_DataIdentification/resourceConstraints/MD_LegalConstraints/accessConstraints/MD_RestrictionCode	/BASE_MODEL/dc:rights /@xsi:type="eficp:RestrictionCode"
/MD_Metadata/identificationInfo/MD_DataIdentification/resourceConstraints/MD_LegalConstraints	/BASE_MODEL/dcterms:accessRights

Web Mapping

OGC compliant web mapping services can be registered in the EFICP catalogue in two different ways. The service may be given as one single resource and described on the basis of the EFICP baseline model. With a growing number of service layers (providing different information even though thematically related), this approach is limiting the usability for resources search as the user would find the same service for a larger number of search options, i.e. still not being able to access a specific spatial data set (layer). In order to overcome this problem, EFICP offers the possibility to declare web mapping services on a layer-by-layer basis. As the manual introduction of OGC core metadata would of course not be practicable, EFICP supports the registration process by querying the external service and automatically mapping from the OGC core metadata to the EFICP baseline metadata elements. This approach has for example been taken for the EFFIS and EFDAC hosted by the JRC. When EFICP send a *GetCapabilities* (WMS) request, the response is obtained in *WMT_MS_Capabilities* metadata elements and mapped in the following way:

WMS	**EFICP**
/WMT_MS_Capabilities/Service/Title /WMT_MS_Capabilities/Capability/ Layer/*/Title	/BASE_MODEL/dc:title
/WMT_MS_Capabilities/Service/Abstract /WMT_MS_Capabilities/Capability/ Layer/*/Abstract	/BASE_MODEL/dcterms:abstract /BASE_MODEL/dc:description
/WMT_MS_Capabilities/Service /ContactInformation/ContactPersonPrimary/ ContactPerson	/BASE_MODEL/eficp:publisherContactInformation
/WMT_MS_Capabilities//Service/ ContactInformation/ContactPersonPrimary/ ContactOrganization	/BASE_MODEL/dc:publisher
/WMT_MS_Capabilities/Capability/Layer/ SRS	/BASE_MODEL/eficp:referenceSystem @xsi:type="eficp:EPSG"
/WMT_MS_Capabilities/Capability/Layer/ LatLonBoundingBox/ @minx @miny @maxx @maxy	/BASE_MODEL/dcterms:spatial/ @xsi:type="dcterms:Box" = 'northlimit=maxy;southlimit=miny;westlimit=minx;eastlimit=maxx'
/WMT_MS_Capabilities/Capability/ Layer/*/KeywordList	/BASE_MODEL/dc:subject (one per KeywordList/Keyword)
/WMT_MS_Capabilities/Service/ OnlineResource	/BASE_MODEL/dc:identifier + ?version=
/WMT_MS_Capabilities/Capability/	

WMS	EFICP
Layer/*	/WMT_MS_Capabilities/@version &service=WMS &request=GetMap &layers=/ WMT_MS_Capabilities/Capability/ Layer/*/Layer/Name

4.4 Statistical data resources

Interoperability with other providers of statistical information (datasets) is dependent on the use of the same SDMX-based communication protocol defined by EFICP. As explained in section 3, SDMX corresponds to an information model rather than a ready-to-use standard. The extended EFICP model should therefore be understood as a proposal for a domain-specific SDMX implementation. Relying on the potential power and flexibility of SDMX, this implementation provides thus an operational framework for the sharing of the same kind of information between otherwise heterogeneous sources. This does not take away the need for the external systems to adhere to the proposed technical and semantic framework in order to be able to communicate with EFICP.

5. CONCLUSIONS

The European Forest Information and Communication Platform (EFICP) stands as reference for a thematic (environmental) information portal providing access to a wide range of forestry information resources that include, but are not restricted to, spatial data infrastructures and services. Conformance with the INSPIRE directive and corresponding implementing rules has certainly been one important design goal for the system. However, the diverse nature of information resources and particular objectives concerning the access to and visualisation of these resources (namely for statistical data) called for a more encompassing metadata model and technical framework as explained in the previous sections.

Interoperability has been addressed in a number of ways considering mostly the technical and semantic dimension. As concerns SDI, at the time of the conclusion of the project technical integration focussed mainly on the INSPIRE EU GeoPortal and web mapping services provided by the JRC, such as EFFIS and EFDAC. The interconnection with other national and international systems, including ‘non-geospatial’ catalogue systems that provide thematically relevant information, will be the goal for the first phase of exploitation and further validate the suitability and adequacy of design of the EFICP metadata model and technical framework for open system interconnectivity. From this point of view

and in the light of general community goals for the sharing and reporting of environmental and related information in Europe, as for example for the future SEIS, EFICP is also expected to serve as important reference for future initiatives and systems of similar scope and goals.

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GLOSSARY

CS-W	Catalogue Service for the Web
DC	Dublin Core
DCMI	Dublin Core Metadata Initiative
ebRIM	ebXML Registry Information Model
ebXML	Electronic Business Extensible Markup Language
EEC	European Economic Community
EFDAC	European Forest Data Centre
EFFIS	European Forest Fire Information System
EFICP	European Forest Information and Communication Platform
EFICS	European Forestry Information and Communication System
EFIS	European Forest Information System
EFISCEN	European Forest Information Scenario Model
EMM	European Media Monitor
ENFIN	European National Forest Inventory Network
EU	European Union
FAO	Food and Agriculture Organization
FAOSTAT	FAO Statistical Databases
FRA	Forest Resources Assessment
GDSS	General Data Dissemination System Site
ISO	common short name for the International Organization for Standardization
MCPFE	Ministerial Conference on the Protection of Forests in Europe
NEFIS	Network for a European Forest Information Service
NUTS	Nomenclature des Units Territoriales Statistiques
OAI-MPH	Open Archives Initiative Protocol for Metadata Harvesting
OASIS	Organization for the Advancement of Structured Information Standards
OGC	Opengeospatial Consortium
RSS	Really Simple Syndication
SDDS	Special Data Dissemination Standard
SDMX	Statistical Data and Metadata eXchange
SDMX-ML	SDMX Markup Language
SEIS	Shared Environmental Information System
SOA	Service Oriented Architecture
UML	Unified Modelling Language
UNECE	United Nations Economic Commission for Europe
URI	Universal Resource Identifier
W3C	World Wide Web Consortium
WFS	Web Feature Service
WMS	Web Mapping Service
XML	eXtensible Markup Language