International Congress on Environmental Modelling and Software

5th International Congress on Environmental Modelling and Software - Ottawa, Ontario, Canada - July 2010

Jul 1st, 12:00 AM

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A Pan-European Information System on Environmental Informatics Research Programmes and Projects

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Abstract: In order to overcome the problem of national fragmentation of European research in the field of ICT for environmental sustainability in general and in the field of Environmental Informatics in particular, the ICT-ENSURE project has been launched. The project aims at building a pan-European research area in this field and has been funded by the European Union within its 7th Framework Programme. A main objective within ICT-ENSURE is the provision of information on national research programmes and projects in the European Union in the field of ICT for environmental sustainability. For this, a web-based information system has been developed. The system provides meta information on research programmes to programme managers and scientists in the field and by doing so, it shall help to avoid redundant developments. The system has been developed with free and open source software based on the MVC (Model-View-Controller) architecture. For the characterisation of research programmes and projects, a classification scheme has been developed. European national experts compile the meta information on national research programmes and enter this information into the system by means of an authoring component. The presentation component of the system offers various search and navigation facilities to the end users. The search facilities provide information retrieval capabilities from the database via full text search and attribute search. The navigation facilities allow browsing the database via different access and navigation paths.

Keywords: ICT for environmental sustainability; European Research Area; Information system on research programmes and projects; ICT-ENSURE

1. INTRODUCTION

An important goal of the European Union (EU) is the creation of a united European Research Area (ERA) [ERA 2007]. To meet this goal, various initiatives, programmes, and also support actions have been started and implemented. One of these support actions is the ICT-ENSURE project which aims at building the European Research Area in the field of ICT for environmental sustainability. ICT-ENSURE (*ICT En*vironmental *Su*stainability *Re*search, http://www.ict-ensure.eu) has been funded within the 7th Framework Programme of the European Union from May 2008 to April 2010.

Within the scope of the ICT-ENSURE project, a web-based information system has been developed, which serves as an information source on research programmes and research projects in the EU Member States in the field of ICT for environmental sustainability in general and in the field of Environmental Informatics in particular. This system, the ICT-ENSURE Research Programmes Information System (http://is.ict-ensure.eu), shall help programme managers, scientists, and experts to easily obtain information on national research programmes and projects in the European Union. It shall support the exchange of

expertise and the cooperation in this field and, in this way, it shall contribute to the development of a pan-European research strategy.

This paper will first give a short overview of the objectives of the ICT-ENSURE project. Then, the aim and the structure (data model, architecture) of the ICT-ENSURE Research Programmes Information System will be described and the functionality of the system, including various access paths to the information, shall be explained. Thereafter, challenges in information retrieval for such a pan-European information system will be considered and the procedure chosen for the investigation and acquisition of metadata on national research programmes in the EU Member States will be dealt with. Finally, maintenance of the content will be addressed.

2. THE ICT-ENSURE PROJECT

The ICT-ENSURE project shall essentially contribute to increasing the efficiency and effectiveness of the hitherto fragmented European research in the field of ICT for environmental sustainability [Tochtermann et al. 2008]. For this, the project pursues the following objectives:

1. Establishing a pan-European research community in the field
2. Assessing European research efforts in this field and developing sound recommendations for future research needs
3. Supporting the Single Information Space in Europe for the Environment (SISE) initiative of the European Commission

To establish a pan-European research community, a series of regional workshops and workshops at EnviroInfo conferences with experts and expert organisations addressing different areas of the research field were organised. In addition, two information systems for transnational information exchange on research in the field have been developed: an information system on national research programmes and projects in the field (presented in this paper) as well as a literature information system providing conference papers (see [Schreiber 2010]).

For assessing European research activities in the field and developing recommendations for a European research strategy, profound scientific surveys of selected crucial areas, e.g. ICT for energy efficiency, were performed. From them, future research needs have been derived. In addition, the community building workshops of ICT-ENSURE have compiled and defined requirements of these communities on future research programmes.

For supporting the SISE initiative of the EC (Single Information Space in Europe for the Environment), information sources relevant to an integrated information space have been screened and critical technical and non-technical requirements have been identified [Pillmann and Hřebíček 2009]. On this basis, a concept detailing steps towards an integrated European environmental information space has been derived.

Main target groups of the results of the project are research programme managers, scientists, and other users of research results in the field of ICT for environmental sustainability in Europe.

The ICT-ENSURE project consortium consists of three partners: Graz University of Technology that also is the project coordinator, the International Society for Environmental Protection (ISEP), Vienna, which also is the scientific coordinator, and the Karlsruhe Institute of Technology (KIT, formerly: Karlsruhe Research Centre) that is responsible for the development of the information systems. In addition, several subcontractors are being involved in the project.

3.   GOAL AND SCOPE OF THE ICT-ENSURE RESEARCH PROGRAMMES INFORMATION SYSTEM

Research funding in Europe in the field of ICT for environmental sustainability is highly fragmented. Research programmes and projects of the individual EU Member States and of regions in these Member States predominate. In addition, the European Union is funding research. Apart from public research funding, limited self-financed research activities have been started in the private sector for own purposes (e.g., to meet reporting obligations) or market products. The strong fragmentation of research funding is mainly due to the wide spectrum of the field of environment and ecological sustainability and to the strongly distributed responsibilities and tasks in this field in public administration (over various administrative levels) and in the private sector [Pillmann et al. 2006].

Due to the high fragmentation of European research and research funding, it was very difficult to obtain an overview of research programmes and research projects in Europe. The situation was additionally aggravated by the fact that information on research programmes was often available in the country's native language only and, hence, could hardly be accessed. As a pan-European scientific community in the field of ICT for environmental sustainability existed in a rudimentary manner only, it was hardly possible to obtain information on the European research programmes via this community.

In view of this situation, the ICT-ENSURE Research Programmes Information System was (and is) aimed at facilitating the access of scientists and programme managers to information on the research programmes and projects in Europe. The information system shall promote community building and the coordination of research activities in Europe in this field. At the same time, the efficiency of research funding shall be enhanced and the use of research results shall be increased by avoiding double efforts [Geiger et al. 2009a].

The information system focuses on programmes and projects in the field of ICT for environmental sustainability, i.e. on programmes and projects dealing with both the development or use of ICT and the application in an area relevant to environmental sustainability. However, only a few research programmes are completely devoted to a combination of ICT and environmental sustainability, e.g. research programmes on environmental information systems. More often, the focus of a programme is either on environmental sustainability (with some challenging ICT tools or techniques being used) or on ICT (with environmental sustainability being a field of application). Such programmes are also compiled in the system, if both sides ("ICT" and "environmental sustainability") are represented to an adequate extent and with an adequate sophistication.

The primary objective of the investigations is research *programmes* in the field. In addition, large projects in the field are collected. Such a project can be part of a research programme or it can be a large, independent project not embedded in an explicit research programme.

The information system concentrates on national, transnational, and regional research programmes in Europe, because the research programmes of the European Commission are already well documented by the CORDIS information system and can be searched there [CORDIS 2010]. Some research projects are also included in the UFORDAT information system of the German Federal Environment Agency (http://doku.uba.de/). However, UFORDAT is geographically restricted to Germany, Austria and Switzerland, and its topic is "the environment", whereas the Research Programmes Information System is focused on "ICT for environmental sustainability" and also includes research programmes.

4.   STRUCTURE OF THE INFORMATION SYSTEM

The ICT-ENSURE Research Programmes Information System is a web-based information system that supplies certain metadata on research programmes and projects in the field of ICT for environmental sustainability as well as links to original and further information.

Basically, the information system comprises three components: an authoring component, a presentation component, and an information management component [Geiger et al. 2009b]. The authoring component provides national experts in the European Union with the possibility to enter and maintain the metadata of research programmes and projects in the system via the Internet. For this, the authors are given a system account, via which each author (or author group) can modify own data exclusively. The presentation component provides the user interface for the end users of the system. It offers various search functions and navigation facilities and presents the selected data. The information management component of the system manages the metadata based on the data model of the system.

4.1 Data Model

Central classes of the data model are (research) *Programme*, *Project*, and *ResearchField* (see Figure 1). The *Programme* class contains attributes identifying the programme, like its name or acronym, and attributes describing the subject and organisation of the programme (short description, abstract, start and end date of the programme). Furthermore, this class provides several references to other classes, like *Country* and managing or funding *Organization,* as well as references to subordinate projects or to a superordinate programme. Links to the programmes' homepages, to other websites, or to external documents complement the metadata of a programme. In addition, each programme is assigned to *Research Field*. The *Project* class covers largely the same attributes and references as the *Programme* class.
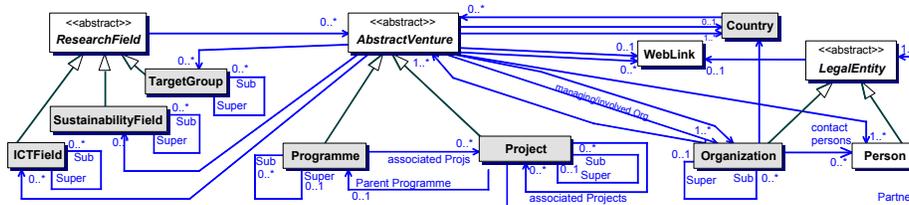

Figure 1. Simplified data model of the information system (UML).

The *ResearchField* class serves for characterising and classifying research programmes and projects with respect to their research field(s) within the area of ICT for environmental sustainability. For this, a systematic classification scheme of this area has been developed. This classification scheme comprises three subclasses: *ICTField*, *SustainabilityField*, and *TargetGroup*. For each of these classifying attributes, there is a pre-defined catalogue of possible values. Multiple values of the catalogues can be assigned to each programme or project.

The subclass *ICTField* characterises research programmes and projects in terms of ICT methods, tools, and techniques used to maintain or improve environmental sustainability. As a basis for the classification of the ICT area in the Research Programmes Information System, the IST ERA taxonomy has been taken [CISTRANA 2008]. This taxonomy has been extended by some ICT fields that are especially important to the research area "ICT for environmental sustainability". Some other categories that are not relevant in this research area were removed. The classification scheme of the Research Programmes Information System as well as of the IST ERA taxonomy comprises two levels.

The subclass *SustainabilityField* serves for the characterisation of the application area of the research programmes and projects. For this, a three-level classification catalogue of environmental sustainability fields has been defined. On the top level, the fields "ecological sector", "economic sector", and "social sector" have been specified according to the three dimensions (pillars) of sustainability.

The subclass *TargetGroup* characterises research programmes and projects according to the target audience of their results. Examples for target groups in the Research Programmes Information System are: politics and justice, public administration, business and economy.

4.2   Software Architecture

The system has been implemented according to the MVC (Model-View-Controller) concept for web applications, which separates business logic (data store and control actions) from presentation logic (user interface) [Lutz et al. 2009]. It is based on various open source or free software tools and libraries. The view level with the presentation component and the authoring component has been implemented using the Apache Velocity template engine (http://velocity.apache.org/). The control level with the application component and the persistence component has been realized with the Java EE servlet technology and the Java Persistence API (http://java.sun.com/javaee/technologies/persistence.jsp). Apache Tomcat has been used as servlet container. For the storage of data, the MySQL database management system has been chosen. The full text search has been realized using Apache Lucene.

5.   FUNCTIONALITY OF THE INFORMATION SYSTEM

Search for information on research programmes and research projects may be determined by different initial situations and objectives. To allow for an efficient search by the user under these different situations, several search and navigation options are offered, which are accessible for the user via the left column of the user interface of the system (cp. Figure 2):

- Fulltext search in all contents of the information system is offered as a general search aid. According to the experience gained from other web-based information systems, this access path is the most frequently used by end users.

- Search by criteria allows specifying search criteria for individual attributes of research programmes, research projects, and organisations. For example, this search option supports searches for programmes/projects, in the title of which a certain term is used. Search by criteria helps the user in case of full-text search supplying too many hits.

- The navigation options in "ICT Fields", "Sustainability Fields", and "Target Groups" of the classification scheme (see also section 4.1) supports the search for programmes and projects in a certain scientific area of ICT for environmental sustainability or for a certain target group.

- The access "Focal Topics" was created in order to rapidly find programmes and projects on topics of special current or strategic importance. These topics are displayed on the homepage already. They may be administrated flexibly by the system operators via the administrator interface and assigned to the *ICT Fields*, *Sustainability Fields*, and *Target Groups* of the classification scheme of the research area.

- Via the access "All Countries", a list of the programmes and projects of a certain country may be obtained. Here, the user can select a Member State of the EU by means of an interactive map of Europe. Then, the user is given an overview of all programmes and projects of this country.

- By the accesses "All Programmes", "All Projects", and "All Organisations" an overview of all programmes, projects, and organisations compiled by the system is offered.

As the result of a query or selection, the user is given a list of the programmes and projects fulfilling the search criterion or corresponding to the selection, see Figure 2. When selecting a programme or project, its metadata is displayed, see Figure 3.

6.   INVESTIGATION OF PROGRAMMES AND PROJECTS, CONTENTS OF THE SYSTEM

The project is aimed at compiling the relevant national research programmes and projects in all 27 EU Member States and entering them in the ICT-ENSURE Research Programmes

Information System. However, the information on national research programmes and projects on the Internet often is available in the national language only. Moreover, this information frequently is insufficient and/or outdated. Initial collection of information for the system may therefore be accomplished with good quality only with the support of national experts speaking the respective country's local language.

Figure 2. Example of the result list (programmes and projects) of a query or selection.

Figure 3. Example of the metadata of a research programme.

To limit the administrative expenditure for initial data collection, the national experts usually analyze a cluster of countries, such as e.g. the Scandinavian States or the Baltic States. To ensure the quality of the data collected by the experts and to protect personal data when listing the names of contact partners, these contact partners of programmes and projects were contacted. The partners were informed about the data collected and asked for a confirmation or correction of the information listed.

Acquisition of the data in the information system generally is accomplished directly by the national experts with the help of the authoring component of the system (see Section 4). For an offline compilation of the data, the experts are alternatively provided with a Microsoft Excel^{TM} sheet, the data of which can then be entered into the system.

End of April 2010, the system contained information of all EU Member States. The database comprised more than 100 programmes and 120 projects. More than 240 programme managers and other contact persons are associated with the research programmes and projects acquired. These contact persons are an important target group not only for the information system itself, but also for community building in the field of ICT for environmental sustainability and for the dissemination of the results of the whole ICT-ENSURE project.

7.   CONCLUDING REMARKS

A basic version of the Research Programmes Information System has been made available in the web since October 2009. The complete version is accessible via the URL http://is.ict-ensure.eu since end of April 2010 (end of ICT-ENSURE project).

The effort in the last phase of the project has been concentrated on the extension of the contents and on quality assurance of the data. In addition, detailed concepts for the dissemination of the system and alternatives for the sustainability of the service have been developed [see Geiger et al. 2010]. The alternatives for the continuous provision of the

information system will be discussed with the European Commission, DG Infso (Directorate General for Information Society and Media).

A main challenge for the sustainability of the service is the continuous updating of the contents (cp. Section 6). However, a substantial advantage after the end of the project is that major actors and contact persons for the research programmes and projects are already known now. These actors and contact persons can be contacted regularly to ensure the quality of the database. They shall not only be asked for the current relevance and correctness of the metadata of their programmes or projects, but they shall also be asked for new programmes and projects in their field of work or their environment.

Interviews with programme managers have shown that they usually are highly interested in the presence of their programme or project in the ICT-ENSURE Research Programmes Information System. It may therefore be expected that the responsible persons and organisations will actively participate in the maintenance and updating of the system contents.

ACKNOWLEDGMENTS

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LIST OF ABBREVIATIONS

DG Infso: EU Directorate General for Information Society and Media
ERA: European Research Area
EU: European Union
ICT: Information and Communication Technology
ICT-ENSURE: ICT for Environmental Sustainability Research
ISEP: International Society for Environmental Protection
IST: Information Society Technologies
KIT: Karlsruhe Institute of Technology
MVC: Model-View-Controller
SISE: Single Information Space in Europe for the Environment