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INTEGRATION OF MODELS, DATA AND EXPERT KNOWLEDGE BY MEANS OF INDICATORS: THE SEAMLESS PROJECT EXPERIENCE

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Introduction

The European Commission has introduced impact assessment as an essential step in the policy development. In the SEAMLESS integrated project (http://seamless-ip.org), researchers work to develop a computerised Integrated Framework, aiming to provide (among others) with a set of economic, social and environmental indicators allowing the assessment of ex-ante, alternative agricultural and environmental policy options. Stakeholders' involvement is of crucial importance in impact assessment (European Commission, 2005). Key requirement for SEAMLESS-IF is consequently to be generic and transparent for different types of user groups. Indicators in SEAMLESS are built upon model outputs. However for social indicators model support is weak so the number of social indicators is low. These indicators will instead based on simple causal relations, expected trends and expert or stakeholder assessment. Moreover, threshold and target levels are essential to contextualise indicators. Stakeholders define threshold and target levels and their quantification. The challenge for SEAMLESS-IF is therefore to deploy a software implementation that enables the integration of the results from mechanistic models with the information provided by different types of stakeholder groups.

Methodology

Due to the broad scope of the project, communication between researchers from different research groups coming from various disciplines and backgrounds, as well as between scientists and stakeholders is a great challenge. To overcome these difficulties the SEAMLESS project has decided to employ ontologies as a medium for systematise communication. Formal domain ontologies are knowledge engineering artefacts that describe an agreed interpretation of domain knowledge, making explicit the terms that represent pertinent concepts and their intended meaning (Uschold and Gruninger, 1996). This approach is in line with the work of Brilhante et al (2006) that presents a sustainability analysis framework, which enables the connection of a software implementation with the analysis of systems sustainability, and the work of Pennington et al (2007), that describe collaborative efforts between a knowledge representation team, a community of scientists, and scientific information managers in developing knowledge models for ecological and environmental sciences. In our case, numerous iterations between researchers in the project and stakeholders in four steps: 1) literature study on indicator frameworks (indicator developers) 2) identification of indicators that can be derived from existing models or require some post-model processing (indicator developers and modellers) 3) knowledge systematization and ontology development (by indicator developers and knowledge engineers) 4) implementation of indicator library and calculator (software engineers). To facilitate the communication, workshops and user forum meetings have been organised frequently.

Results

The SEAMLESS project has developed a goal-oriented framework (GOF), which aims to facilitate the users' assessment of ex-ante impacts of specific policy options (Bockstaller et al., 2007). The indicator framework is based on a sub division of sustainable development into goals which are linked to the environmental, economic or social dimensions of sustainable development. For each dimension of sustainability, three generic themes are specified and structured in sub-themes. Each sub-theme can host an unlimited list of indicators. Based on interactions with stakeholders form different categories and scales (EU, national and regional) it became evident that these lists of indicators should be closely related to indicators that are already in use in the EU. Each indicator is specified in detail using an indicator fact sheet and calculation sheet hosting information on e.g. the place of the indicator in the indicator framework (GOF), the model output that the indicator is based on and the detailed calculation of the indicator. These documents have served as an input to the developed indicator ontology aiming to facilitate the handling of the information that is needed to implement the indicator in the tool as well as to facilitate the users selection of indicators for and impact assessment. This structured approach to information harnessing creates the basis for the generic structure of the tool and re-use of indicators between different impact assessment projects using it. A first, indicator ontology has been drafted upon the indicator fact sheets pertaining their content. A screenshot of that ontology is shown in Fig.1. On top of the developed ontology, that defines the attributes of an indicator, its classification according to themes and some textual comments, we developed a facility that enables end-users to access and modify this information through a web-based prototype. Note that the population of the indicator library is done by non-modellers and non-specialists, since the interface is build with user-oriented concepts. The indicator calculator is a framelet integrated into the SEAMLESS-IF tool. It was build to enable for the calculation of indicators that are transformed model outputs. Through the indicator manager the stakeholders are given the opportunity to define target levels or thresholds that are relevant for the specific impact assessment assignment.

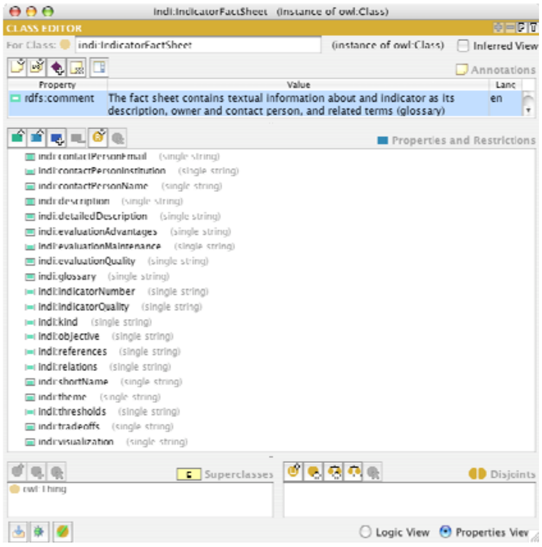

Fig. 1 The indicator fact sheet structure

Conclusions

This paper provides an example how researchers that are distant to software engineering and modelling can contribute to the development of a system for indicator implementation and management within a larger context of a complex computerized tool. The system is designed in such a way that it can be customized to various methodologies of indicator calculation (directly from data, linked to model outputs, transformed model outputs) to fit the scientific reality of economic environmental and social indicators. Since model inputs and outputs and model output transformation are described in the ontology it is facilitates the tracing of the model chain needed for indicator calculation. The ontology of the indicator calculator enables the integration of qualitative and quantitative indicators, something that facilitates the inclusion of social indicators. The developed indicator ontologies allow tracing the implementation of an indicator based on a big set of data and visualising the result by means of declarative modelling and various software tools. Through the developed graphical user interface built upon the designed ontology the users will also be able to define their case specific thresholds and target values. The ontology facilitates both the exchange of knowledge between the researches in the project as well as improves the communication between the expert tool and stakeholders.

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