
ENHANCING DELIBERATION FOR THE FORMULATION AND APPLICATION OF PUBLIC POLICY ON THE ENVIRONMENT AND ENERGY USING FEDERATED CONTENT, ONTOLOGIES AND MAPS

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Abstract. The problems of formulation and application of various kinds of public policy concerning energy and environment are wicked' and highly complex ones, with multiple and conflicting objectives and many stakeholders with different views, values and concerns. For this reason a deliberation among stakeholders and argumentation approach using advanced information and communication technologies (ICT) is the best way for addressing such problems. The use of e-participation technologies and methods can be very useful for this purpose. This paper describes an advanced ICT platform that has been developed for supporting and facilitating such deliberation and argumentation approaches, as part of the FEED (Federated e-Participation Systems for Cross-Societal Deliberation on Environmental and Energy Issues) project. This platform aims to support and enhance deliberation among all stakeholders and argumentation for the formulation and application of public policy concerning environment and energy, by providing i) federated content from various sources, ii) efficient mechanisms for accessing it based on ontologies and maps, and ii) stakeholders' interaction capabilities through forum and petition functionalities. Also, a usage scenario of this platform is described.

1. Introduction

The problems of formulation and application of various kinds of public policy concerning energy and environment belong definitely to the class of problems termed as 'wicked' by H. Rittel [1], since i) they have many stakeholders, who are affecting and/or affected by the problem and the solution, each of them having a different view (representation) of the problem (i.e. perceiving different issues and dimensions of the problem), and also different values and concerns, ii) they do not have mathematically 'optimal' solutions, and pre-defined algorithm for calculating them, but only 'better' and 'worse' solutions, the former having more advantages and positive arguments in favour of them than the latter, iii) there are no clear rules for stopping the search for solution. Such 'wicked problems' cannot be solved by formal methodologies (based on pre-defined algorithms), which are termed by H. Rittel as 'first generation design methodologies', and require 'second generation' ones, which are

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based on deliberation and argumentation approaches [1], [2]. These approaches include several circles of deliberation, in which the stakeholders interact, each of them raising issues concerning the problem under discussion, proposing solutions and arguing about advantages and disadvantages of them. Such a deliberation and argumentation approach is the best way for addressing the highly complex problems of formulation and application of public policy concerning energy and environment. However, in order this approach to be effective and successful it demands a number of critical preconditions: a) all stakeholders should be provided extensive supportive information on the public policy problem under discussion, which usually comes from many different sources, is diverse in format, unstructured and difficult to retrieve, ranging from legal documents, policy declarations, articles, opinions of stakeholders, to maps and multimedia information (such as images, or videos from discussions in parliaments or local councils), and then b) all stakeholders should be offered the capability to participate in and contribute to the deliberation, exchanging information, expressing their own views and opinions, and interacting.

The use of e-participation information and communication technologies (ICT) and methods can be very useful for this purpose. The high potential of modern ICT for supporting citizens' engagement in the public policy and decision making and in the democratic processes in general is increasingly recognized by academics and practitioners [3] – [6]. The Organisation for Economic Co-operation and Development (OECD) emphasizes that 'all OECD member countries recognise new ICTs to be powerful tools for enhancing citizen engagement in public policy-making' since 'the unprecedented degree of interactivity offered by new ICTs has the potential to expand the scope, breadth and depth of government consultation with citizens and other key stakeholders during policy-making' [4]. However, we are still in the beginning, and further research and development is required in order to find innovative ways of exploiting to a larger extent the great potential of ICT in this directions.

This paper describes an advanced ICT platform that has been developed for supporting and enhancing the above deliberation and argumentation approach for the formulation and application of public policies concerning environment and energy, as part of the FEED (Federated e-Participation Systems for Cross-Societal Deliberation on Environmental and Energy Issues) project (www.feed-project.eu), which is co-funded by the European Commission under the FP7 e-Participation Initiative. The proposed platform offers: i) federated content (both 'internal' to it, and 'external', residing in other web-sites) from various sources (managed, validated and non-validated),

ii) efficient mechanisms for accessing it based on ontologies [7], [8] and maps,

iii) stakeholders' interaction capabilities through forum and petition functionalities.

The paper is structured in seven sections. In section 2 the technical architecture of the FEED platform is presented, while in section 3 the functionality it offers are described. Then section 4 analyses the types of federated content it can offer to the users, followed by section 5 outlining the use of ontologies for supporting efficient access to it. In section 6 a usage scenario of this platform is described. Finally section 7 summarizes the conclusions and the next steps we are going to take concerning the use and evaluation of this platform.

2. Platform Technical Architecture

One of the main objectives of the FEED platform, as mentioned in the introduction, is to integrate content from a variety of sources, ranging from internally stored content to external



Figure 2: FEED Launch Web Page

As we can see in Figure 2, the platform consists of eight interconnected modules, including map-oriented applications, text based search engines, multimedia streaming services as well as forum and petition applications. One of its most innovative features is the wide use of map technologies in order to present information and initiate public deliberation. It should be emphasized that the map environment is completely interactive, in the sense that it is used not only to provide to the users already stored data (both 'internal' and 'external'), but also to enable them upload on the platform their own content on the topic under discussion (e.g. textual or multimedia files), opinions and plans, and associate them instantly with a specific location (point or area) on the map. The FEED platform includes three map-oriented modules: **Map, History and Vision**.

The **Map** module allows the user to focus on a particular geographical area of interest and interrogate the system to provide all information available through the FEED platform (both 'internal' and 'external' to it) about this area. Registered users can also upload content (e.g. textual, image or video files) and attach it to a particular location (point or area) on the map; this user-uploaded content, after being subject to moderation that verifies the quality of it, becomes publicly available, so that all the other users of the platform (both registered and non-registered) can view it. This capability creates a strong mechanism of interaction among the users. All map pages of this module are split into four sections, as shown in Figure 3:

- the '*map section*' shows the map of the area of interest selected by the user, with all relevant data available marked thereon;
- the '*layers section*' allows the user to select various thematic layers of information to appear on the map, based on various environmental, recreation, etc. categories;
- the '*tabbed documents section*' lists documents available for the area of interest, categorized under various tabs;
- and the '*search section*' allows the user to enter plain text or a taxonomical phrase in order to filter the information appearing in the documents tab.

The **History** module presents a map of an area selected by the user and provides controls that

allow the user to see how this area has changed over time. The user has zoom control over the map area, while a slider over a timeline offers the capability to select different past times; as the slider is moved, the map changes reflecting the level of development of this area at the corresponding time. The last, and most ambitious, map-related module is called **Vision** and allows users to run “what if” scenarios for regional planning. This module allows any interested party (individual, organization, or public administration) to mark a map area and declare their vision concerning the development of this area in terms of industry, transport, energy, environment, etc. The map will automatically display information about the current status as well as about the national and European laws and conditions applying to the specific area. The system can also present possible implications of such a vision, e.g. conflicting laws and disagreeing parties, allowing the user to refine and improve their visions and plans prior to formal submission.



Figure 3: FEED Maps Page (Quick Map)

In addition to the above map-related modules, the platform provides additional modules offering valuable interaction and information retrieval capabilities. The **Meetings** module lists webcasts associated with the topic of the deliberation, while clicking on a particular webcast provides further information, shows location information associated with the webcast on an interactive map and allows users to watch the webcast. The **Topic** module is a text-based search page where the user can choose to search based on structured search terms contained in a taxonomy or by entering “free text”. Resulting content is returned to the page and the user can click on any of these results in order to see the corresponding document or webcast, and

also, if applicable, its location on the map. The **Forum** and **Petition** modules provide the means to support public deliberations. In particular, the **Forum** module provides discussion - deliberation spaces in the form of online bulletin boards, where users can read existing messages on the topic under discussion in a 'threads structure', respond to any of these messages in a particular thread by entering a new message connected to the former, or create a new thread of discussion. The **Petition** module offers the capability to start online petitions about different types of issues (e.g. concerning environment, city planning, etc.) in order to increase the influence of public opinion in the public policy and decision making process. Finally, it should be noted that throughout the pages of the platform users are offered the capability to rate any content item they select, be it a document, webcast or discussion message. Based on these user ratings the popularity of content items is determined, and the most popular of them are shown in the **What's Hot** page, which provides a single place where the user can go and discover what are the most interesting and popular items in the platform; as with the **Topic** page, the user can then click on any of these items and get further information and map location, where available.

4. Federated Content Provision

As mentioned in the previous sections, the provision to the user of federated content from various 'internal' and 'external' sources on environmental and energy issues is a central feature of the FEED platform, which can gather any kind of content and references to content, from any source, using the Internet, and make it available to the end users through appropriate search capabilities. The FEED content can be grouped into the following three categories according to its source:

I) Managed Content: It includes material that has been selected by the authorized system managers, assessed as suitable for the purposes of the particular e-deliberation project, and stored, maintained and updated within the FEED platform (internal content). It consists of a) textual content, such as laws relevant to environmental and energy issues, legislative process documents, relevant articles, etc., b) multimedia content, such as images, or audio and video material from discussions in parliaments or local councils, enriched with vital contextual information (e.g. textual information concerning speaker's profile or the particular agenda item that the particular audio/video concerns) making these webcasts more meaningful and useful, and c) spatial data, such as maps of the area that the particular environmental and energy deliberation concerns, providing also the capability to connect the above textual and multimedia content to particular geographic locations of these maps (geographic referencing).

II) Validated Content: It includes material from similar sources as the managed content (e.g. relevant laws, legal documents, etc), but also news items/newsfeeds, which have been selected as appropriate and have been validated by the system managers, but reside in external organized storage facilities (e.g. in various web databases, such as EUR-LEX); they are accessible to the FEED users through a searching capability, that either accesses directly the content's storage facility, or uses its search API (if it exists). Integration of this category of content is made in the case that the necessary APIs/Web Services are available on behalf of the corresponding content providers (e.g. the EUR-LEX database).

III) Non-validated Content: It includes material stored outside the FEED platform that has not been validated by the system managers, so no guarantee can be given about its reliability, but might be of interest for the participants in the particular e-deliberation project. Main sources of such information are links to other web sites and/or content stored in external systems, as well as all the widely used search engines that exist on the Internet; this type of content will

be accessible by the users through their references stored in the platform. Also we can have non-validated content provided by the platform end users, either as posted references in the forums, or as attached textual or multimedia documents (possibly connected to a particular location (point or area)), which will be stored within the FEED platform.

5. Use of Ontologies

The platform has been built in close cooperation with regional authorities that face regional “wicked” problems, related to land use, planning and environmental constraints, in combination with a ‘Not in My BackYard’ (NIMBY) attitude of many citizens. From this cooperation have been identified three major challenges for the designers of the FEED platform concerning the use of ontologies:

i) One of the goals of this platform, as an eParticipation platform, is to provide to the citizens true transparency: the user should be afforded to form a complete picture of the issues involved around the problem at stake and the balancing between all interests. However, regional authorities responsible for planning and environment protection work with a ‘professional jargon’ of terms for decision making processes, habitats to be protected, influential research reports, environmental effects measurements, etc. The formal set of terms is already maintained in some regional decision making processes, and they will be fixed in Europe due to the implementation of the INSPIRE [9] and SEIS [10] Directives. They concern terms like “Decision process phase”, “authority involved”, “legal base”, “area under scrutiny”, “type of land use allowed”, “type of ecology protected”, “appeal time allowed for”, etc. However, the user of the platform should be provided with an interface that allows for using ‘everyday language’ in query articulations, but generate the relevant answers from databases and maps using the above ‘professional’ language. Therefore this user-friendly front-office should be connected to a professional back-office. In order to fulfil this requirement the design of the platform was based on a maintainable relationship network between search terms in ‘everyday language’ and formal controlled vocabularies concerning land use and planning administration.

ii) The second challenge that had to be met was the relationship with the relevant laws. The legal framework of land use and planning is the most reliable source of vocabulary to be used in the platform, since most activities of the responsible public authorities are related to the application of these laws. For this reason it was decided to use in the platform as reference terms the ones of the spatial planning laws, which constitute a very stable framework. Such a framework enables a search match between a term like “Natura2000” and places or areas where the term was applicable. For crossing the natural language barrier it was decided to build a connection to the “GEneral Multilingual Environmental Thesaurus” (GEMET) [11]. This offers the capability to enter a Czech term in a Czech interface and obtain a relevant area on a Dutch map. This GEMET thesaurus presents 5.298 descriptors, including 109 Top Terms, and 1.264 synonyms in English. The 5.524 terms belonging to the parental thesauri and not included in GEMET, constitute an accessory alphabetical list of free terms. GEMET is increasingly relevant because of INSPIRE related democratic decision making processes all over Europe. The GEMET thesaurus operates as an online translation service for controlled vocabularies dealing with environmental and other relevant issues. However, its semantic capability design has some limitations. The SCOS hierarchical terms structure does not meet the requirements of proper OWL-based reasoning that is necessary for juridical interpretation. One cannot retrieve a comparison between two relevant map layers in this way, like building area versus recreational or Natura2000 area. For this reason we have adjusted the SCOS hierarchy for our purposes.

III) The third challenge from a semantic perspective for the platform was to enable very fast calculations for opportunity finding and interest balancing. In real life situations a decision concerning a ‘wicked’ problem is made in many stages with a large number of stakeholders involved. The process involves many negotiations about a range of different interests. This creates a need for an instrument that depicted not only the end-bid spatial representation of a planning proposal; it is also required a digital representation that allowed for negotiating by “dragging” the designated areas of roads, building areas and recreational territories further or nearer towards environmentally protected habitats or areas that might become such. The design challenge is to make the annotation engine calculate legal opportunities on the fly by a web service during “dragging” a mouse over a map. There are limits to the amount of concurrent calculations that can be serviced this way. This technology will be much easier when more GIS tools are enabled with web map feature service potential, rather than web map service capabilities. The feature service can afford calculation and comparison while being called upon as a web query.

Taking into account the above challenges, the semantic system or “annotation engine” for the platform has been designed in Topbraid Composer, which is a professional version of Protégé [12]; the controlled vocabularies and the frequent search terms have been connected to the map using openGML techniques from the openGIS community [13].

6. A FEED Platform Usage Scenario

As usage scenario for testing the FEED eParticipation platform was selected the Dutch case of the Flevoland region. This is an area that was reclaimed from the sea and was destined to become land. Later it was decided to keep the water area intact, but this caused severe scarcity of land resources in the Amsterdam urban expansion area. There were a number of reasons for selecting the Flevoland area. A first reason is that the Flevoland public authority has to coordinate the revision of the entire regional development plan with six cities in a concurrent manner. All changes are made available to all interested actors through a web-service. Flevoland launched the “Geopolis” initiative to create the right spirit of collaboration among actors involved in informing the public and businesses about the redevelopment plans. A second reason is that Flevoland had the vision to write the explanatory paragraphs on the 200 pages regional development plan in XML and in object oriented slices. This means that businesses and citizens or non-government organizations (NGOs) can find relevant and precise location-based interpretations of the usually very diplomatic language of such plans without having to rely on professionals, who are paid to read through political documents. The third reason is that the area to be re-developed is under high pressure from many actors, who want to launch economic and recreational activities in a densely populated area, where one European directive demands that people stay away in order to save protected birds species, while another European directive demands large scale redesign operations to maintain water quality in the inner lake.

The interface of the FEED platform instance developed for this Flevoland pilot, which is shown in Figure 4, is linked to the Oracle database of the regional authority of Flevoland. All map layers available can be projected on this Google map screen. In this way the conflict resolution system will maintain dynamic input from legal constraints and map layer updates. The documents we can see in this particular screen example are the relevant research reports retrieved upon entering the keyword `algemeen_rec` in the search field concerning the blue square area on the map.



Figure 4: Interface of the FEED platform instance for the Flevoland pilot

In this Flevoland pilot the FEED platform will be used for cases of environmental trade-offs and 'NIMBY', such as the allocation of a water ski resorts near parts of the ecological protected surroundings, hotel and other recreation facilities and the construction of new islands for housing. The legal reasoning becomes relevant when the law offers limited possibilities of intrusion of "green" areas by compensation of other "green" elsewhere. For the purpose of European transferability it is intended to apply Google maps technology rather than GIS technology in order to support "contour editing" by visitors of the website. The visitor will be able to indicate a specific area he/she is interested in by drawing a rectangle on the map, in order to discuss and support his case with documents, research reports, legislation and plans that can be uploaded, stored and downloaded for this drawn area.

7. Conclusions

In the previous sections has been described an advanced ICT platform, which has been developed for supporting and facilitating deliberation and argumentation approaches for addressing the 'wicked' problems of formulation and application of public policies concerning environment and energy, as part of the FEED (Federated e-Participation Systems for Cross-Societal Deliberation on Environmental and Energy Issues) project. The proposed platform offers: i) federated content (both 'internal' to it, and 'external', residing in other web-sites) from various sources (managed, validated and non-validated), ii) efficient mechanisms for accessing it based on ontologies and maps, and iii) stakeholders' interaction capabilities through forum and petition functionalities. Also a usage scenario of this platform has been described for the Dutch case of the Flevoland region, which has to address complex problems of balancing conflicting objectives concerning development of economic and

recreational activities on one hand, and environment protection (e.g. maintain water quality in inner lakes, protection of several birds species, etc.) on the other. The FEED platform will be tested not only in this Flevoland pilot, but also in three more pilots to be conducted in Greece, Great Britain and Czech Republic; after the end of these pilots a comprehensive evaluation of them will take place, based on the e-Participation evaluation methodology developed by the first of the authors [14-15], and its conclusions will be used for improving the platform and the practice of its usage.

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