Practical Experiences with Enhancing Semantic Interoperability in eGovernment using WSMO

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Motivation: Interoperability in eGovernment

• Status quo:
  • eGovernment services are difficult to find;
  • Individual e-services are disconnected, not interoperable;
  • Users (citizens/businesses) have to find several services, going then from one to another.

• Interoperability (technical, organisational, semantic) - a prerequisite for the delivery of eGovernment services across boundaries.

• EU initiatives towards the interoperability:
  • eEurope 2005 action plan
  • 12010 EU strategy (2005), ec.europa.eu/12010
  • Interoperability for Pan-European eGovernment Services (2006), europa.eu.int/idabc/servlets/Doc?id=24117

Semantic interoperability:

• To ensure that the meaning of the information exchanged is not lost in the process, that it is retained and understood by the participants involved.

• Solution: employment of semantic technologies

• Research goals and challenges:
  • Improve accessibility and connectivity of government services for users (ease to find the relevant services only)
  • Simplify the usage of services for users:
    • Creating an integrated hybrid scenario by combining relevant atomic services
    • Providing guidance to users while implementing the scenario
  • Provide platform, tools, and methodology that enables to transform existing services to be semantically interoperable
Related research

- Terregov project, [www.terregov.eupm.net](http://www.terregov.eupm.net)
  - A platform for enhancing existing government web services with a semantic description
- SemanticGov project, [www.semantic-gov.org](http://www.semantic-gov.org)
  - Infrastructure for semantic interoperability in eGovernment; focus is on discovery, composition, mediation, and execution of web services.
- OntoGov project, [www.ontogov.com](http://www.ontogov.com)
  - Semantics-based platform for the consistent composition, reconfiguration, and evolution of eGovernment services.
- eGovernment interoperability frameworks such as e-GIF in the UK, SAGA in Germany, European IDABC, etc.

Access-eGov project: Basic facts

Full title: Access to e-Government Services Employing Semantic Technologies

- Starting date: January 1st, 2006
- Duration: 36 months
- EC Funding: 1,983,000 €
- Total Budget: 2,279,243 €
- Contract No.: FP6-2004-27020
- Consortium: 11 partners, 5 countries (SK, PL, D, GR, Egypt)
- Coordinated by the Technical University of Kosice, Slovakia

Main goal: To develop and validate a platform for composition of gov. services into complex process definitions (life events) enabling semantic interoperability of particular eGov services.

More on: [www.accessegov.org](http://www.accessegov.org)

Access-eGov project: Pilot applications

- **Slovakia**: Land-use planning and processing a request for a building permit.
- **Poland**: Establishing an enterprise - the process of company registration.
- **Germany**: An upgrade and field test based on the existing good practice "Zuständigkeitsfinder" ("Responsibility Finder"), by introducing a semantic layer (securing semantic interoperability between national and local governments). Use-case: Getting married.
- **Egypt (German University of Cairo)**: Usability testing from outside EU.

Access-eGov system: Architecture

Three major component groups:

- The Access-eGov infrastructure
- User clients - Personal Assistant Tool and other end-user interfaces
- Administration and management tools (Annotation Tool)
Implementation platform:

- **WSMO** (Web Service Modelling Ontology, [www.wsmo.org](http://www.wsmo.org)) - conceptual model for the description of ontologies, Semantic Web services, goals, and mediators.
- **WSMX execution environment** - discovery, selection, mediation, and invocation of Semantic Web services.
- **WSML language** - formal description of the WSMO elements.
- **Java** programming language; WSMO4j data model.
- **Java web technologies**: JSF, JSP, Apache Tomcat, Lucene, ...
- **Peer-to-peer engine**: JXTA connectivity framework
- **Web services**: JAX-WS

Methodology (1)

Three resources to design the semantic description:

- Adaptation of WSMO conceptual model
- Reusing of existing ontology resources
- Requirement-driven approach, 7-step procedure

1. Adaptation of WSMO conceptual model

Methodology (2)

2. Reusing of existing ontology resources

   - Analysed about 25 different ontology resources and standards
   - Reused: Dublin Core, SKOS, vCard, XHTML, SemanticGov, TerreGov, OntoGov, WSMO, Protege
   - Example:

     ```
     namespace { _"http://www.accessegov.org/ontologies/core/", 
       dc _"http://purl.org/dc/elements/1.1/", 
       v _"http://www.w3.org/2006/vcard/ns#" }
     concept
     Organization
     v#relation ofType Link
     v#organizationName ofType _string
     v#organizationUnit ofType _string
     v#addr ofType (1 1) v#Address
     ```

3. Requirement-driven approach, 7-step procedure

   - Designed and developed by GUC:

Methodology - Requirement-driven approach

Requirement-driven approach, steps 1-7:

<table>
<thead>
<tr>
<th>No.</th>
<th>Step / Task</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Identify informational needs</td>
<td>User scenarios [D2.2]</td>
</tr>
<tr>
<td>2</td>
<td>Identify required information quality</td>
<td>Trial descriptions [D8.2]</td>
</tr>
<tr>
<td>3</td>
<td>Create glossary of topics &amp; terms</td>
<td>Glossary</td>
</tr>
<tr>
<td>4</td>
<td>Create controlled vocabulary</td>
<td>Controlled vocabulary, hierarchy of terms</td>
</tr>
<tr>
<td>5</td>
<td>Group &amp; relate terms</td>
<td>Ontology-like structure with the relations and dependencies specified</td>
</tr>
<tr>
<td>6</td>
<td>Design an ontology</td>
<td>Formally expressed ontology (in Access-eGov, the ontology is represented in the WSML notation)</td>
</tr>
<tr>
<td>7</td>
<td>Implement the semantics</td>
<td>Formal representation of ontology, enhanced by workflow structures.</td>
</tr>
<tr>
<td>8</td>
<td>Verify the ontology on real data</td>
<td>Ontology with instances (possibly the structure of ontology updated)</td>
</tr>
</tbody>
</table>

Additional step, which was added for practical reasons during the process of ontology creation:
**Requirement-driven approach - Outputs**

Ontology structure, result of step 5:

![Ontology Diagram]

Formal ontology in WSML, implementation of semantics:

```
<om:namespace prefix="shg:" uri="http://www.accessegov.org/ontologies/shg/"
    prefix="aeg:" uri="http://www.accessegov.org/ontologies/core/
"/>  
<nsnfp:goal title="Marriage"/>

<interface:MarriageLifeEventInterface/>
```

**Resulting ontologies**

- **AeG Core Ontology** - definitions of basic elements (concepts, attributes, relations) shared among the pilots and used for annotation of the atomic services.
  - For SHG-DE pilot, the Core ontology was modified (due to complex structure of spatial responsibilities)

- **Life-events Ontology** - conceptual descriptions of life events, complex goals (also referenced as generic scenarios), and elementary goals for the pilots. Separate L-E ontologies were produced for SHG-DE, GLI-PL, and KSR-SK pilots.

- **Domain ontologies** - domain-specific information for the pilots; includes the concepts describing forms, documents, certificates, location constraints, fees, questions, notification messages, etc., that are necessary to model the inputs and outputs of the provided governmental services. Separate domain ontologies were produced for each of pilots.

**Annotation Tool - Principles**

- **Dedicated for public administration employees**, no special knowledge on semantic technologies required.
- **Web application**, JSF technology (Browser capable of javascript required).
- **Features, functionality provided**:
  - **Service templates**: Predefined set of the functional properties and workflow,
  - **Annotation**: Specification of concrete values for non functional properties of services,
  - **Web grabbing**: possibility to include and annotate a content from existing web pages.
Personal Assistant Client - Principles

- **Dedicated for users** - citizens, businesses.
- **Provides browsing, discovery, and execution of services** according to a specified life event or goal.
- **Web application**, JSF technology.
  - Interface is dynamically created from the WSML descriptions and is customized by the user's answers during the processing.
- **Features, functionality provided:**
  - **Navigation** in the structure of life events, goals, and services, based on the customization data entered by the users. Automatic resolving of sub-goals, according to the user's answers.
  - **Integration** of traditional, electronic, and web services into a single platform.
  - **Direct invocation of web services** (via standardized WS interface).
  - **Description:** The client provides a textual description of the services that can not be directly invoked (i.e. traditional services).

Personal Assistant Client - Interface

Pilot applications - First trial (1)

- **Carried out:** October 2007 - January 2008
- **Lab test in Egypt** (GUC)
  - Testing the user perspective, Personal Assistant Client
  - 14 testers (students) performed 3 different tasks
  - Results were evaluated and the tool was enhanced accordingly

- **German field test** - "Getting married" life event
  - Carried out by Ministry of Finance, Schleswig-Holstein
  - 11 municipalities participated
  - **Aim:** test the integration of distributed information resources
  - **1st phase:** Semantic annotation of the resources (by administration officers), 7-step procedure of Req.-driven approach
  - **2nd phase:** Personal Assistant Client tested by public, providing the support for the "marriage" life event.
  - **link:** [http://esprit.ekf.tuke.sk/acg-client](http://esprit.ekf.tuke.sk/acg-client)

Pilot applications - First trial (2)

- **Slovak pilot** - "Obtaining a building permission" life event
  - Carried out by the Kosice self-governing region and the municipality of Michalovce
  - **Objective:** To provide the necessary information from heterogeneous sources in a comprehensive and user-friendly way
  - **1st phase:** Four scenarios for the life event were specified:
    - land-use proceedings,
    - building proceedings,
    - merged procedure of land-use and building proceedings,
    - final approval proceedings
  - The scenarios were semantically described, using the 7-step procedure and the Annotation Tool.
  - **2nd phase:** Personal Assistant Client tested by municipality employees for the specified scenarios.
  - **link:** [http://webocrat.fei.tuke.sk/acg-client](http://webocrat.fei.tuke.sk/acg-client)
Pilot applications - First trial (3)

Polish pilot - "Establishing an enterprise" life event
- Carried out by the Gliwice City Hall
- Objective: to provide a single entry point where users can obtain relevant information and are properly navigated in the whole complex process
- 1st phase: Four complex goals for the life event were specified:
  - registration in local government,
  - registration in statistical office,
  - registration in tax office
  - registration in social insurance agency
- The scenarios and goals were semantically described, using the 7-step procedure and the Annotation Tool.
- 2nd phase: Personal Assistant Client tested by three groups of users: civil servants, IT experts, general public
  - link: http://147.232.5.49:8080/acg-client

Evaluation of the first trial (1)

Annotation Tool
- Instruments used for collecting the feedback
  - Internal testing by developers
  - Testing by user partners
  - Feedback from annotators during the training sessions
  - Think-aloud session (GUC)
  - Accessibility and usability evaluation (e-Isotis)
- Results in summary
  - Use of AT was effective
  - Using the component without training is possible
  - Usability, efficiency and performance need to be improved
- Specifications for revision of AT regarding
  - Usability
  - Performance and efficiency
  - Annotation of existing web contents

Evaluation of the first trial (2)

Personal Assistant Client
- Instruments used for collecting the feedback
  - Internal tests of developers and user partners using TRAC (iterative tests)
  - Think-aloud sessions (SHG)
  - Workshop with PA's and IT experts (SHG)
  - Public testing with test scripts and feedback through email and interviews
  - Online and/or internal questionnaires
  - Accessibility and usability evaluation (e-Isotis)
- Results in summary
  - Use of PAC was (mostly) effective
  - Usability, navigation structure, and information quality need to be improved
- Specifications for revision of PAC regarding
  - Information quality
  - Navigation and structure of the services (step-by-step guide preferred)
  - Usability, leading user through the process, labels of buttons, links, and contextual help.

Evaluation of the first trial (3)

Personal Assistant Client - Results from questionnaires

Polish pilot: questions on information quality
Lessons learned, future work

Lessons learned:

- Access-eGov system - a feasible solution for integration of existing electronic and traditional services on a semantic basis.
- Navigation and user interface is of high importance (and needs significant improvements in the second trial).
- Methodology is an essential part, when applying the system for semantic interoperability; it increases understanding of the technology and involves the PA employees into the development process.

Future work:

- Second prototype of the Access-eGov system: Implementation of the updates resulted from the 1st trial evaluation, namely integration of external web services and updates in PAC interface. (10/2008)
- Pilot applications, second trial: Separate installations and customization of the system for particular pilot applications. (12/2008)
- Testing, evaluation of the second trial (2/2009)

Thank you for your attention!

www.accessegov.org

Questions?