Integrated OCOPOMO toolset for open collaboration in policy modelling

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Abstract—In this paper we present a detailed description of an integrated toolset designed for the open collaboration in policy modelling. Components of the toolset support various tasks required to model a policy domain, create multi-agent simulation models and to analyse simulation results achieving the traceability of each process step to the evidence provided by the involved stakeholders and policy owners.

I. INTRODUCTION
Support of e-Government by information and communication technologies (ICT) is continuously wider. One of important functions of e-Government ICT tools is to foster collaboration between involved parties, governmental bodies, citizens and businesses, during the phases of policy initiation, development, implementation, monitoring and evaluation. Involvement of a wider public in the process of policy creation and evolution is particularly important and can be of beneficial value.

The specific focus of our presented research is given on the design, development and provision of ICT tools and technologies that are capable to support traceability within the process of collaborative policy modelling, where narrative scenarios and agent-based simulations [1] are combined in order to provide foresights on policy effectiveness. According to EU FP7 ICT Programme initiative related to policy modelling, any toolkit should be able to perform simulations integrating all possible variables, parameters, inferences, and scenarios necessary to forecast potential outcomes and impacts of proposed policy measures [2].

The design of a software platform and methodology providing an environment for modelling various policy alternatives and their consequences in a collaborative manner is in the focus of the European R&D project OCOPOMO (Open COllaboration for POlicy MOdelling). OCOPOMO is co-funded by the European Commission under the 7th Framework Programme. The project consortium consists of 10 partners from 5 European countries and is coordinated by the University of Koblenz-Landau, Germany. OCOPOMO is the 3-year project, which has started in January 2010. The project achievements, namely the developed ICT tools for collaborative policy modelling, are tested on pilot applications in Italy, Slovakia, and UK.

The remaining part of the paper is structured as follows: Section 2 describes individual parts of the integrated OCOPOMO platform. Section 3 provides a description of tools in context of the OCOPOMO policy modelling process and section 4 presents technological details of the integrated platform.

II. OCOPOMO TOOLSET
The OCOPOMO toolset for an open collaboration in the policy modelling was designed to fulfil the following main requirements:

- Open e-participation for stakeholders and policy owners in the process of policy modelling;
- Evidence-based scenario centric approach for domain modelling which provides evidence foundation for the simulation model;
- Multi-agent rule-based approach for simulation policy models;
- Strong support for traceability between the model outputs and evidence initially provided by the stakeholders and policy owners.

To fulfil these requirements, a conceptual modelling methodology was designed and instantiated in the policy development process, which is detailed in the following section. Based on the defined process, the main architecture of the toolset was proposed together with a distribution of software components according to the supporting functionalities for each process step (see Figure 1.). On the top level, the architecture can be divided into the following main modules:

- **Scenario Generation Tools** for collaborative editing of evidence-based scenarios;
- **Collaboration Tools** for collaborative commenting of scenarios and evaluation of simulation results;
- **Data Repository** for unified storage of all background materials and artefacts used or generated in policy modelling process;
- **CCD Tools** for conceptual domain modelling in so-called Conceptual Consistent Description (CCD) formalism, which was designed in order to achieve traceability;
- **Simulation Environment** for simulation execution;
- **Simulation Analysis Tool** for navigation in the simulation results and for annotation of results to the simulation-based scenarios;
- **Traceability Tools** designed to support evaluation of simulation results.
Distribution of the particular components in the toolset also reflects the division between four distinct user groups involved in the process, namely:

- **Domain experts** such as policy planners or strategic decision makers, who possess competences for defining initial scenarios and evaluating model-based scenarios provided as the output;
- **Stakeholders** that formulate scenario alternatives, so-called evidence-based scenarios;
- **Modellers** and **Analysts** that are experts in the area of policy analysis and modelling, who are capable to create agent-based policy models corresponding to particular evidence-based scenarios;
- **System maintainers** that control and manage the whole OCOPOMO process from organisational perspective (facilitators) or from technical perspective (administrators).

Tools can be divided according to the deployment to (1) web-based tools primarily used by stakeholders and policy owners, and (2) tools deployed as modules into desktop installations of integrated development environment, which are primarily used by experts in the field of policy analysis and modelling.

### III. OCOPOMO TOOLSET IN THE PROCESS CONTEXT

In this chapter, we will describe details about the functionalities of the OCOPOMO Toolset in the context of the OCOPOMO policy modelling process [3], which consists of six steps described in more details in the subsequent sections. The referenced toolset components are depicted on the architecture scheme in Figure 1. All architecture requirements where described in [4, 5] and the architecture itself was developed according to the well-known architecture design methodology by Rozanski and Woods [6]. The produced toolset architecture follows the structure of three main layers: end-user tools, system core, and data storage.

The underlying OCOPOMO process for collaborative policy development consists of 6 phases labelled as A-F. Usage of particular tools and modules of the OCOPOMO ICT Toolset in these phases, functionality provided by respective end-user tools and involvement of user roles is presented in the following outline.
A. Definition of an initial scenario and collection of background information

The Scenario Generation Tools enable domain experts (i.e., policy planners or decision makers) to collect background documents and create initial scenario in the Alfresco wiki format. The Alfresco Data Repository is used to store any content created on the Alfresco site, including the on-site developed initial policy scenario.

B. Development of evidence-based stakeholder-generated scenarios

Involved stakeholders and domain experts can discuss policy alternatives and exchange opinions by using a set of Collaborative Tools provided by the Alfresco platform and implemented as Discussion Forums, Chat, Polling and rating, and Calendar components. During the focused collaborative discussion, stakeholders may use Scenario Generation Tools to create evidence-based scenarios that represent policy alternatives. The Scenario Generation Tools enable stakeholders to modify existing scenarios, create new scenarios, add or update background documents (of any file-based format), etc. By means of Alfresco collaborative tools, stakeholders may also open a discussion related to a specific topic, chat online, create a poll or share calendar events. All these operations are accessible via OCOPOMO web instance of Alfresco (see Figure 2). The usage of Collaborative Tools and Scenario Generation Tools within the involved community of users is moderated by facilitators, technical maintenance is provided by system administrators.

C. Development of conceptual models

The Content Repository Client makes the content stored in Alfresco Data Repository accessible to experts for further policy analysis. The experts (analysts, modellers) then use the Eclipse platform for developing a conceptual model.

D. Programming of policy models

After finalising the CCD model for the analysed policy, a skeleton of corresponding agent-based policy model can be created from the CCD structure by means of the CCD2DRAMS tool. It generates a stub of the DRAMS source code, which may be then updated by a policy analysis expert in the Java IDE of Eclipse platform. Prepared source code is then deployed to the DRAMS tool, which provides a Repast-based environment for running executable simulations [8].

E. Simulation and generation of model-based scenarios

The simulation executed in the DRAMS tool generates different types of logs in CSV, XML, or TXT formats. These logs are forwarded for further processing to the Simulation Analysis Tool, which enables experts to create a narrative model-based scenario (see Figure 4). The scenario, provided in the Alfresco-compatible wiki format, is linked to the related facts in generated log files such as corresponding CCD model concepts and respective text fragments of input evidence-based scenarios. This connection between simulation logs and generated model-based scenarios is an enabler of the traceability back to evidence-based scenarios or background documents, which is utilized during the next process step in the Traceability Explorer on the Alfresco site.

F. Evaluation of evidence-based vs. model-based scenarios

The evaluation of created model-based scenarios is enabled in Alfresco by a suite of traceability tools, which

![Figure 4. Simulation Analysis Tool, user interface.](image)
include the Traceability Explorer and the Simulation and model based scenario visualisation module. The published wiki page could contain dynamic simulation charts and traceability annotations that help stakeholders and domain experts to navigate from model-based scenarios back to related evidence-based scenarios or background documents (see Figure 5).

In addition, the CCD Model Explorer applet is provided to visualise and browse the whole CCD model and the related DRAMS source code; however, this tool requires advanced skills and at least some experience in the field of conceptual and agent-based modelling.

Since the produced model-based scenario is published on the Alfresco site as a standard wiki page, it can be commented and discussed in a community of involved domain experts and stakeholders, using the Collaborative Tools of Alfresco. Based on this discussion, which may include online chats or polling on possible policy alternatives, etc., a set of new evidence-based scenarios can be created, published on the Alfresco shared space, and forwarded to the Eclipse environment for modelling and simulation in the next iteration cycle of the OCOPOMO process.

In order to illustrate above given steps, a simple use case can be given. The use case is based on Kosice’s pilot - it could make these individual steps clearer. A representative of Kosice self-governing region (as a Domain Expert) creates regional energetic policy strategy (an evidence based scenario) by using Scenario Generation Tools. Then stakeholders (i.e. heating companies, citizens and other involved parties) create alternative evidence based scenarios and subsequently discuss those using Collaboration Tools. Then a facilitator announces modellers and analysts about availability of evidence based scenarios and created supported material. A modeller responsible for creation of CCD model can start to prepare the model by using CCD Tools (Eclipse based desktop application). Created conceptual model of energy policy is transformed into DRAMS stubbed code. Modeller should enhance it into an executable policy model. Running the model produces traceable logs that should be analysed by expert analysts using the Simulation Analysis Tool. The result of the analysis is a traceable model-based scenario published into collaborative space and ready for the evaluation by stakeholders and domain experts. In this case the output scenario could have an impact of changing current energy policy relevant to citizens, heat producers, etc. The whole process could be iterated until an acceptable model is created. Individual preferences and interests can be identified [9] and confronted with collective understanding represented by a set of model-based scenarios. Also, their discussions can be analysed within the collaborative platform in order to identify most attractive topics/users (e.g., using method similar to [10]).

IV. INTEGRATION DETAILS OF OCOPOMO TOOLSET

Previous chapters were mostly focused on a description of basic ideas and overall functionality covered by the OCOPOMO platform [11]. The aim of this chapter is to show integration elements of the platform that are authors’ main contribution in the toolset development.

The ICT toolkit architecture, presented above in Figure 1, shows that there are two repositories of data and content created and maintained within the integrated OCOPOMO system, namely the Alfresco Data Repository and the Eclipse Project Repository. Both Alfresco and Eclipse environments can produce new data artefacts that have to be accessible simultaneously by the tools on Alfresco as well as on the particular Eclipse installations. All the communication between the Alfresco and Eclipse parts of the integrated OCOPOMO platform is initialized from the side of Eclipse. Expert users, i.e., policy analysts and modellers, are able to request the published content from the Alfresco Data Repository by a suite of Eclipse-based tools as well as to publish the content stored in Eclipse Project Repository into Alfresco. All the communication is handled via Alfresco REST-full API or via CMIS protocol [12]. Table 1 shows a list of all artefacts shared between OCOPOMO tools. All the functionality is provided by Content Repository Client, which is provided as installable Eclipse plug-in (which is deployed together with Simulation Analysis Tool and text annotation/analysis tools).

<table>
<thead>
<tr>
<th>Content type</th>
<th>Creating tool</th>
<th>Format</th>
<th>Data exchange protocol</th>
<th>Eclipse direction</th>
</tr>
</thead>
<tbody>
<tr>
<td>evidence-based scenario</td>
<td>Scenario Generation Tools</td>
<td>wiki, HTML</td>
<td>CMS</td>
<td>download</td>
</tr>
<tr>
<td>background document</td>
<td>Scenario Generation Tools</td>
<td>PDF, TXT, HTML, DOC, XML, ...</td>
<td>CMS</td>
<td>download</td>
</tr>
<tr>
<td>local file</td>
<td>CCD Tools</td>
<td>PDF, TXT, HTML, DOC, XML, ...</td>
<td>CMS</td>
<td>upload</td>
</tr>
<tr>
<td>CCD model</td>
<td>CCD Tools</td>
<td>PDF, TXT, HTML, DOC, XML, ...</td>
<td>CMS</td>
<td>upload</td>
</tr>
<tr>
<td>DRAMS code</td>
<td>CCD2DEAMS + Simulation Environment (DRAMS)</td>
<td>DRAMS, Java</td>
<td>CMS</td>
<td>upload</td>
</tr>
<tr>
<td>simulation log</td>
<td>Simulation Environment</td>
<td>XML, CSV, TXT</td>
<td>CMS</td>
<td>upload</td>
</tr>
<tr>
<td>model-based scenario</td>
<td>Simulation Analysis Tool</td>
<td>XML, HTML, wiki HTML</td>
<td>REST</td>
<td>upload + download</td>
</tr>
</tbody>
</table>

Next integration data access point is the Data Source Proxy. It is an extension of the Alfresco REST API,
which allows accessing the content stored in the content server directly via HTTP GET connection, with a transparent authentication. It is used to fetch files of the CCD models for the visualization in the CCD Model Explorer Applet and to fetch XML simulation logs for visualization using the charts (implemented using the Google Visualization API [13]) embedded in model-based scenarios - Alfresco wiki pages. Authentication is encoded directly in the request URL in a form of the authentication token, which is then validated by the Alfresco CMS security module. Using the data source proxy, the client (such as the visualization API or CCD model applet) does not have to provide the authentication credentials directly.

Sharing and transformation of individual data artifacts (evidence based scenario, CCD model, etc.) between OCOPOMO tools should be traceable [14]. For that reason traceability information is included for all artefacts incorporated into OCOPOMO toolkit and that traceability information is propagated through the whole OCOPOMO process. The final product of the process is a model-based scenario which contains full information about its ancestors. The basic traceability annotation mechanism of linking a model-based scenario to the respective input materials, i.e. the evidence-based scenarios and background documents, via simulation log records and CCD model elements is depicted in Figure 6.

V. CONCLUSION

The presented integrated OCOPOMO toolset should help strategic decision makers to make more transparent decisions in the field of local policies. The developed software supports all steps of OCOPOMO policy modelling process including collaborative creation of initial scenarios, iterative construction of formal agent-based policy models, creation of traceable model-based scenarios and their evaluation. It is currently used by pilot applications in Italy (optimal allocation of EU structural funds, Campania), in UK (housing policy, London.), and in Slovakia (policy for exploiting renewable energy resources, Kosice).

For more information about the OCOPOMO project follow this web address - http://www.ocopomo.eu.

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