EU COMMUNITY

ICT-2013.5.4 ICT for Governance and Policy Modelling

EU COMMUNITY MERGES ICT AND SOCIAL MEDIA NETWORKING WITH ESTABLISHED ONLINE MEDIAAND STAKEHOLDER GROUPS TO CULTIVATE TRANSPARENCY, ENHANCE EFFICIENCY AND STIMULATE

Deliverable D4.1

Policy Modelling and impact assessment elements analysis

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Abstract:	The document reviews the current state of the art in the areas of Policy Modelling and Impact Assessment. It analyses existing solutions, current practices and techniques against the specific objectives of the project in order to extract insights for the design and implementation of the EU Community Policy Component.
Keyword List:	state-of-art, policy modelling, impact assessment, system dynamics, ontology

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Definitions, Acronyms and Abbreviations

Table 1: Definitions, Acronyms and Abbreviations

Acronym	Title
PM	Policy Modelling
IA	Impact Assessment
LCA	Life Cycle Assessment
CBA	Cost Benefit Analysis
SD	System Dynamics
EC	European Commission
RIA	Regulatory Impact Assessment

1 Executive Summary

EU Community goes beyond the current generation of policy-making tools. It helps decision-makers identify relevant stakeholders and key documents. EU Community merges ICT and social technologies with established online media and stakeholder groups, to maintain transparency and enhance efficiency of EU policy-making. In order to achieve this, it brings to the Policy Debate Process advanced tools and techniques coming from different fields such as Policy Modelling and Impact Assessment. These fields already have applications in the policymaking area, however EU Community poses specific challenges to be addressed through the project research.

In the current deliverable, an overview of the present state of play in the domains of Policy Modelling and Impact Assessment is provided. The main methods and tools of these fields have been examined, in order to identify the ones suitable for the EU Community project. Based on the EU Community needs, it has been concluded that ontology building tools should be offered to the users to represent the underlying domains of policy topics, while for providing simulation capabilities with regard to the policy debate, the System Dynamics methodology should be used. Furthermore, other existing tools have been reviewed as well in order to guide the design and implementation of the modules of the Policy Component, namely the Policy Modeller and the Simulation subsystem.

2 Introduction

2.1 Objectives and Purpose

The objective of the current deliverable is to set the relevant background of WP4, which concerns the development of the Policy Modelling & Impact Assessment Component of the EU-Community platform. For this purpose, it both collects and builds upon the requirements set in earlier deliverables and engages in an analysis of the relevant state of the art in the two related fields, examining the current methodologies and techniques, and their suitability to be utilised for the project. In particular, the report aims to describe the classification of the existing policy analysis, modelling and evaluation methods and tools, according to various parameters.

Ultimately, the deliverable aims to map the most useful and viable possible directions for further developments in WP4 and provide actionable recommendations for the project and any related future endeavours in the domain of ICT for Governance and Policy Modelling.

2.2 Relation to other Work Packages/Deliverables

Deliverable D4.1 will provide the guidelines to drive to the implementation of the EU Community Policy Component. It is the first deliverable of WP4, resulting from task T4.1 and will be used as input for the subsequent tasks of WP4, mainly T4.2 which refers to the design and development of the Policy Component. It will contribute to the production of deliverables D4.2 (Policy Component Specification) and the two versions of D4.3 (Policy Component prototype). In addition, D2.1 (Baseline definition report) acts as a starting point for D4.1 feeding it with the insights concluded there for the Policy Modelling and Impact Assessment baseline. Along with D2.4 (Community requirements and specifications), they give to WP4 the necessary input in terms of requirements, which have to be taken into consideration.

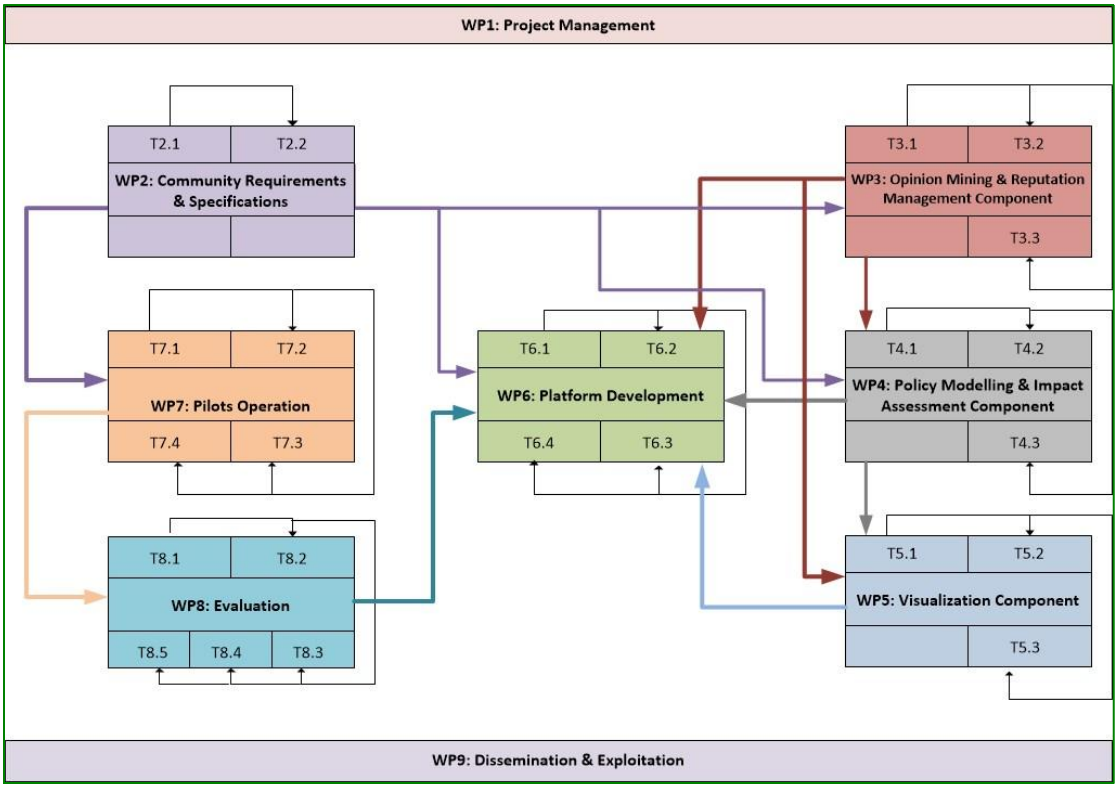


Figure 1: WPs interdependencies and relations

Finally, WP4 is strongly related with WP6, WP3 and WP5, since the policy modelling and impact assessment component to be delivered will exchange data with the opinion-mining component and produce outcome to be visualised through the visualisation component, and finally will be integrated in the EU Community system. Therefore, the guidelines, which will derive from this document and will lead to the design specifications in task T4.2, should be formulated in parallel with the other components design.

2.3 Structure of the Document

The deliverable is structured as follows; initially, the next section introduces the specific challenges to be addressed within the EU Community project context, with regard to policy modelling and impact assessment needs of the project and the EU policymaking process in general. Sections 4 and 5 provide the analysis in the two fields respectively. Finally, in the last section, the conclusions drawn from the analysis are presented through a classification of the existing examined tools, and the future steps for the project are defined. The methodology followed during the production of the document and in the same time completion of task T4.1, is depicted in Figure 2: Methodology for deliverable D4.1

- Initially the state of the art (SOA) was reviewed concerning policy modelling methods and tools,

- then the state of the art (SOA) was reviewed concerning policy impact assessment methods, modelling approaches and tools,
- finally, based on them (in combination with the baseline and the requirements developed in the above mentioned work packages) the policy domain modeller and the simulation component have been specified.

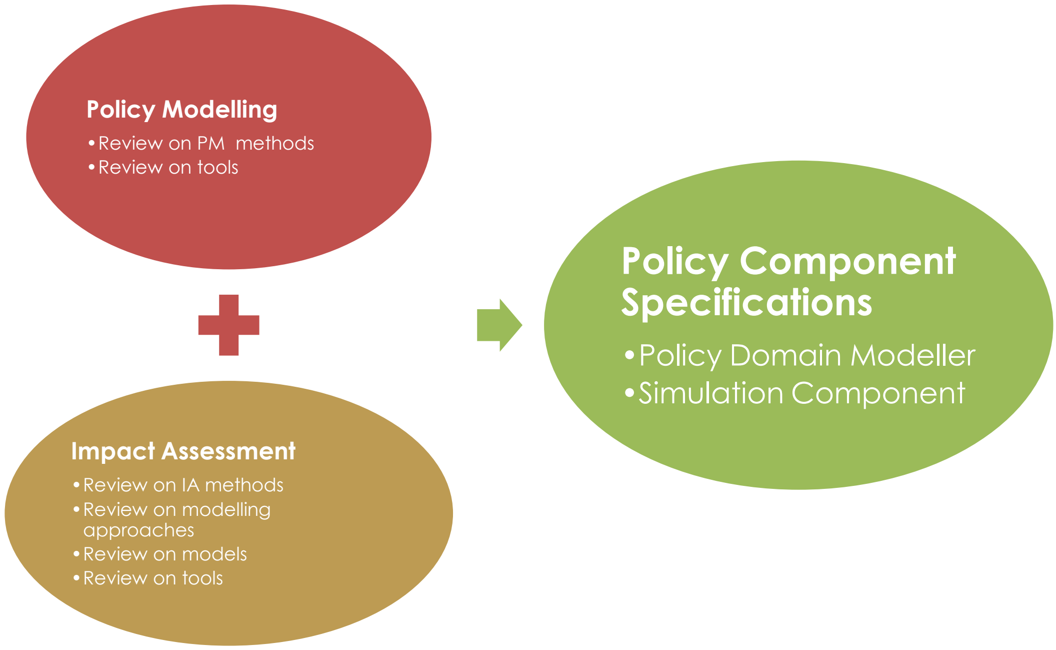


Figure 2: Methodology for deliverable D4.1

3 EU community challenges and needs to be addressed

EU Community is a somewhat unusual project not only because it targets a small group of potential users for whom involvement with EU policy matters is a critical part of their job description (rather than the general public), but also because it promises maximum yield for minimum user input. Practically, all the primary data that the various software components will process and users will see appearing in EurActory and PolicyLine, are sourced from the Web. The entirety of the automated processing involved is based on a small amount of specialised human expert knowledge. WP4 in turn has a special place in the project because it is to deliver:

- the **Policy Domain Ontology Modeller**, which will be the prime tool for topic experts to provide such specialised human knowledge and
- the **Simulation Subsystem** which will be the one software tool that does not merely depict the current status quo but rather attempts to predict, on the basis of extant data and user assumptions, the course of events in the future.

More specifically, the **Policy Domain Ontology Modeller**, will be used by topic experts to provide a conceptual map for each policy topic in terms of a coherent ontology (to be then used by the platform's artificial intelligence) as well as declare its various sub-topics. The more detailed the domain ontologies, the better the project's AI will be able to perform the various automated tasks assigned to it. In order for the system to keep abreast with new developments (and new terminology) in each domain, there is a need for the policy domain ontologies to be updated periodically. As there is a small fixed number of domains/topics, neither this need, nor the need for comprehensive initial ontologies make EU Community a high-maintenance project.

The **Simulation Subsystem**, will be a component, which given the existing data and user's input will be able to make predictions on the status and evolvement of the operations of the policy process and provide estimations on various aspects that affect policy choices (e.g. awareness, engagement, reaction of citizens). It will be based on a mechanism responsible for assessing the impact of interactions among various stakeholders.

Summarising the findings of D2.1 and complementing them with the community requirements, the following challenges should be addressed within the development of the above components:

- *The Policy Modeller will require the creation / insertion of a model or the selection among the existing in the policy models repository. Therefore, Policy Modelling should be simple enough to be used by users who are experts in their respective domains but not (necessarily) in ontologies and policy modelling (such as policy experts or the pilot users in the case of EU Community). Therefore, the project should provide a user-friendly tool for representing a policy topic, without requiring much detail (and therefore effort) per model item.*

- *The Policy Domain Modeller should be able to export or otherwise publically expose EU Community ontologies in an appropriate interoperable format.*
- *Given the wealth of existing ontologies from other projects (e.g. the Energy model from NOMAD), the Policy Domain Modeller will be designed to be capable of importing/re-using extant ontologies.*
- *The simulation provided should be timeline-based; more specifically all input data to the model as well as its outputs will be anchored to specific dates.*
- *The simulation subsystem should allow users to insert user-defined simulation parameters as input in the models. Therefore, it should provide a playful user interface in order for the users to experiment with the models and customize inputs to test alternative scenarios. Previous experiences from other projects showed that users not familiar with simulation techniques need a user-friendly interface to experiment with the simulation models and explore their results. The EU-Community simulation tool should be accessible from a graphical web interface. In addition, simulation results will be conveyed into intuitive and meaningful visualisations for decision makers.*
- *The input data for a predictive simulation will consist of system gathered data and any, if any, user assumptions the user wants to explore.*
- *The simulation subsystem should be purpose-agnostic at its core, allowing potentially different uses in the future than the ones originally envisaged. However, such generality should not lead to an option-heavy and unfriendly user interface.*
- *The possible uses of the simulation subsystem will be determined by the types of time-anchored system gathered data that will be available to it. Indicatively, one possible input dataset would be the daily number of mentions of a particular policy proposal document or of documents in a particular area. In such a case, the output of the predictive simulation could be used to determine when to best schedule relevant events or actions. Different kinds of input data would lead to different kinds of predictions, which could be utilised in different ways.*

4 Policy Domain Modelling Tools and Technologies

4.1 Introduction

A *domain* is an area of interest, for example energy, education, healthcare, etc. In EU Community domains coincide with policy topics.

A *domain model* is a high-level logical view of reality specific and restricted to the domain; it contains the concepts of importance to the domain in question and their relationships.

Domain models are highly-abstract and conceptual; they should not be confused with database models or schemas, which will be at a much greater level of detail. Moreover, they should not be confused with the representation (e.g. XML) used to store or transmit them.

Domain modelling and ontology building are not new ideas, but a lot of progress has been made in the field during the past few years due to an interest in the envisaged (and partially realised) next step in the evolution of the Web, the so-called Semantic Web. Section 4.2 provides an overview of the relevant technologies, which can be used in the project, whereas Section 4.3 reviews relevant projects and Section 4.4 relevant tools. In Section 4.5, conclusions are drawn and directions for the Policy Modeller component design are given.

4.2 Policy Domain Modelling and Semantic Web Technologies

The Semantic Web initiative offers a set of standards (RDF, RDFS and OWL) for the representation and exchange of information. The primary strengths of RDF/OWL as:

- support for information integration and reuse of shared vocabularies
- handling of semi-structured data
- separation of syntax from data modelling
- web embedding
- extensibility and resilience to change
- support for inference and classification, based on a formal semantics
- representation flexibility, especially ability to model graph structures
- ability to represent instance and class information in the same
- formalism and hence combine them

At present, the Semantic Web standards comprise two primary layers (Figure 3).

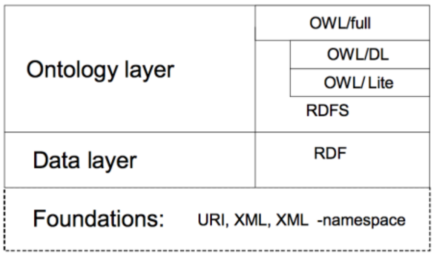
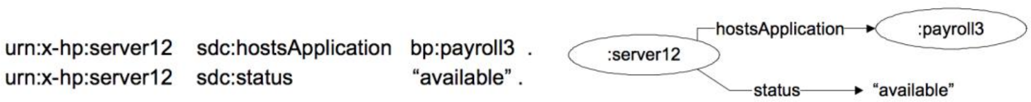


Figure 3: Core semantic web standards

The first layer, the data layer, comprises the RDF (Resource Description Framework [30]), a language that provides a common data representation that can be used for exchange and integration of machine-readable information. The second layer, the ontology layer, supports the specification of the vocabularies to be used in RDF data. This ontology layer comprises the simple RDF Schema language (RDFS) and a richer Web Ontology Language OWL. The full OWL language is a superset of RDFS so we will typically refer to the entire standards set from RDF up to OWL/full as RDF/OWL. In fact there are several restricted language profiles of OWL (OWL/Lite, OWL/DL) that provide different expressivity/performance trade-offs.

RDF represents information by means of atomic, logical statements. These statements take the form of triples: subject predicate object. For example:



The subject (thing or resource being talked about) and the predicate (the property or relation being described) are identified by URIs. The object (the value of the predicate) may be either another resource or a literal value (a string or a typed value such as a number or date). The use of URIs is a key feature of the design. It provides a means for global naming (avoiding accidental clashes), it connects the statements to web resources (for example the thing described might be a web page or service with an identifying URL) and it provides a mechanism for publication and discovery (the description of the predicate is often published at the URI used to identify it). The approach of representing information as sets of separate atomic statements is quite different from other modelling approaches such as XML or object oriented designs where values are grouped into packages (documents, or objects) with local structure (hierarchical tags, field names). It stems from the aims of the Semantic Web to support distributed sharing and integration of information. Two sets of RDF statements can be integrated by simply forming the union of the sets. The RDF specifications include a standard XML serialisation format. However, RDF is the data model rather than the serialisation, so other serialisations are also possible and the data can be merged and processed independently of the serialisation format chosen.

RDF provides a standardised means for exchanging data in a way that supports distribution and integration of information from multiple sources. However, that data is only useful for machine processing if the applications share or can exchange some common model of the domain. In concrete terms this means we need some way to specify the vocabulary elements that can be used and how they relate to each other. This is the job of the ontology layer.

The term ontology, in this context, just means a description of the concepts and relationships that make up a model of a domain. Using the term ontology implies that this description is formal, with well-defined semantics.

OWL/full is a substantial extension of RDFS that enriches the set of axioms that can be stated about the classes and properties in our domain model. Amongst the important groups of additional capabilities are tools for declaring:

- features of properties (such as that one property is the inverse of another, or a property is transitive or symmetric, or that a property is functional or inverse functional);
- restrictions on classes - cardinality restrictions (such as all members of C have at least one value for property P), local range restrictions and value restrictions;
- class relationships, such as class C is the union of classes A and B;
- equality relationships – that two resources, classes or properties are the same, that two resources are different or that two classes are disjoint (have no members in common).

OWL allows to express the relationships between things by standardising on a flexible, triple-based format and then providing a vocabulary ("keywords" such as rdf:type or rdfs:subClassOf) which can be used to say things.

OWL can include detailed information about the data model, showing how to work efficiently with database queries and automatic reasoners, and it provides useful annotations for bringing data models into the real world.

We conclude that RDF/OWL is particularly suited to modelling applications, which involve distributed information problems, such as integration of data from multiple sources, publication of shared vocabularies to enable interoperability and development of resilient networks of systems, which can cope with changes to the data models. For the above reasons the comparison of the proposed techniques for data modelling, and in our case, policy modelling, leads to the adoption of the Semantic Web, RDFS and OWL standards.

4.3 Approaches from relevant projects

Name	**IMPACT[1] - Integrated Method for Policy Making Using Argument Modelling and Computer Assisted Text Analysis**
Objectives	IMPACT is conducting original research to develop and integrate formal, computational models of policy and arguments about policy, to facilitate deliberations about policy at a conceptual, language-independent level. These models will be used to develop and evaluate a prototype of an innovative argumentation toolbox for supporting open, inclusive and transparent deliberations about public policy.
Lessons Learnt	A policy analyst to construct a model of the alternative policies, together with the arguments pro and con each policy can use the IMPACT policy-modelling tool. The policy-modelling tool includes an inference engine, which enables the public, in an interactive and visual way, to analyse the legal effects of each policy on the facts of particular cases. The models could be published on a web site, allowing the public to evaluate the effects of each policy on the cases, which interest them. The organisation could publish benchmark cases they think require special consideration. The project has conducted research on tools enabling stakeholders to simulate the legal effects of policy proposals in real and hypothetical cases is being conducted, using the Web Ontology Language (OWL) and the Legal Knowledge Interchange Format (LKIF) to model policies.

Name	**OCOPOMO[2] – Open Collaboration for Policy Modelling**
Objectives	The main expected outcome of OCOPOMO is the implementation and proof of concept of a configurable modular ICT toolbox to support complex socio-economic policy making. The core objective of OCOPOMO is to demonstrate that, with appropriate ICT, the integration of formal policy modelling, scenario generation and open and widespread collaboration is not only possible but essential at all levels of policy formation whether local, regional, national or global.

[1] http://www.policy-impact.eu

[2] http://www.ocopomo.eu

Lessons Learnt	OCOPOMO addresses on the one hand the part of policy development and policy modelling, supported with narrative scenario generation. On the other hand, the technological part cares about ICT design and implementation to support policy modelling and open collaboration. In OCOPOMO, simulation model refers to agent-based computer programs using the rule engine DRAMS (Declarative Rule-based Agent Modelling Software) consisting of a number Java classes and declarative code, created on base of conceptual models (CCD) for several policy cases.

Name	**NOMAD[3] – Policy Formulation and Validation through non-moderated crowdsourcing**
Objectives	Nomad's vision is to provide decision-makers with fully automated solutions for content search, acquisition, categorisation and visualisation that work in a collaborative form in the policy-making arena.
Lessons Learnt	NOMAD research on Policy Modelling focuses on using advanced semantic representation technologies, to capture topics and arguments relevant to the policy and their inter-relations. The NOMAD visual tool for semantic authoring and policy argumentation modelling, a user-friendly environment for experts with limiting expertise in knowledge representation technologies facilitates this.

4.4 Review of existing tools

Protege	http://protege.stanford.edu/
	Protege is one of the most popular tools of the ontology visualisation. The "Protégé" tools are being applied for further development in various disciplines for better understanding of knowledge. These tools commonly use four methods of ontology visualisation, namely, indented list, node-link and tree, zoomable, and focus and context. It is a free, open source ontology editor and a knowledge acquisition system. Protege provides a graphic user interface to define ontologies. It also includes deductive classifiers to validate that models are consistent and to infer new information based on the analysis of an ontology. Protege is a framework for which various other projects suggest plugins. This application is written in Java and heavily uses Swing to create

[3] http://www.nomad-project.eu

	the rather complex user interface. Protege recently has over 200,000 registered users making it the leading ontological engineering tool. Protege is being developed at Stanford University in collaboration with the University of Manchester.
Mind42	http://mind42.com/about
	Mind42 is an online mind mapping application that allows users to visualize their thinking using the proven mind mapping method. Mind Mapping is a useful technique that helps people learn more effectively, improve the way that they record information, and supports and enhances creative problem solving. The name refers to the collaborative features of the product, and is intended to be pronounced like "mind for two". It has been recommended by Freelance Weekly as one of their favourite time-management and organisation tools. This application has one main weakness, which is that it is necessary to create an account before one can save any mindmaps or even create any mindmaps. This is a problem (compared to other software) because some users may hesitate to proceed to a signup process; they may prefer a ready-to-use solution. Unfortunately, the loading time of Mind42 is also quite long, which is another disadvantage of it. The main reason for this cause is because there are too many functions, like bubbl.us.
NOMAD Authoring Tool	http://www.nomad-project.eu/
	NOMAD Model Authoring Tool is a tool for policy makers to create domain and policy models. It is a complete set of tools for searching, analysing and visualising arguments, opinions and sentiments regarding a policy domain. It supports analysing the content, concerns, sentiments and other information hidden within the text of the citizens conversations working on tailoring this analysis to the specific policy-makers' objectives creating a semantically rich, accurate stream of data that can be leveraged in the next phases. Each web page found by the NOMAD Crawler goes through a series of automated analysis processes: ▪ Language detection: With the use of a Natural Language Processing algorithm which will recognize the language used in the page ▪ Opinion and Argument Extraction: With the use of the appropriate semantic similarity measures and the inference mechanism that allow NOMAD to identify analysed content that is pertinent to the arguments that make up a policy. ▪ Sentiment Analysis: Smart sentiment classifiers analyse the mentions and recognize their 'tone'

	(positive, neutral, negative) towards each query ▪ Argument Summarisation: With the use of the appropriate algorithms for generating qualitative information about opposing arguments, in the form of anonymity-preserving and automatically-generated summaries.
Mindmaps	Mindmaps represents a category of tools, such as WInMup, WiseMapping etc.
	A mind map is a diagram used to visually organise information. They are widely recognised as an effective method to improve understanding and memory through the visual representation of information. A mind map is often created around a single concept, drawn as an image in the centre of a blank landscape page, to which associated representations of ideas such as images, words and parts of words are added. Major ideas are connected directly to the central concept, and other ideas branch out from those. Mind maps can be drawn by hand, either as "rough notes" during a lecture, meeting or planning session, for example, or as higher quality pictures when more time is available. They show the overall structure of a subject and the relative importance of individual parts of it. They help us to associate ideas, think creatively, and make connections that we might not otherwise make. Mind Maps are useful for summarising information, for consolidating large chunks of information, for making connections, and for creative problem solving. They are well suited for: ▪ Making connections between different areas ▪ Creating a broad overview of a subject/study topic ▪ Planning projects or subject topics ▪ Delving in-depth into an area Each Mind Map node can delve deeper into one area and someone can easily make connections between different areas, which we may not have seen before. Being able to have an in-depth and broad overview of a study topic simultaneously is what makes mind makes such a good study tool. There is a lot of free or commercial mind mapping software available.
IMPACT	http://www.policy-impact.eu/
	The Policy Modelling Tool (PMT) is a tool that enables stakeholders of the public to analyse the legal effects

	alternative policies put forward in policy debates would have in particular cases, real or hypothetical. The PMT helps stakeholders to form well-founded opinions about the legal effects of policies on cases and to make case-based arguments about the pros and cons of alternative policies, which can be contributed to policy debates. The PMT tries to close a gap between abstract policies and their concrete effects on stakeholders. Policy debates require discussion about the comparative effects of policy alternatives, including the status quo policy, on the cases of organisations, individuals and other stakeholders. Understanding these differential effects is a prerequisite for stakeholders to have an informed opinion about which policies promote their interests. The PMT aims to help stakeholders to reveal what the legal effects of policies on cases are and to understand how policies produce these effects in a way sufficient to enable them to contribute constructive criticism and arguments to the policy deliberation process. The policy model for a debate is constructed by a policy analyst who has been trained in the use of LKIF. Existing third-party tools for OWL and XML will be used to construct and edit ontologies and LKIF rule bases. (LKIF is an XML schema.) In addition, the analyst defines forms and questions to be presented to public users in order to ascertain the relevant facts of cases, during the simulation of policies, in a goal-directed way, as needed. For each question, help texts and example answers are provided, to assist users in answering the questions. The PMT provides a user interface for the policy analyst which enables him/her to publish all the relevant data in the Content Management System (CMS) of the IMPACT toolbox in such as way as to enable members of the public to find, open and use the models with the simulation component of the PMT.
ELEON	http://users.iit.demokritos.gr/~eleon/
	ELEON is a tool for the creation and editing of dataset descriptions. These descriptions comprise metadata regarding the structure, semantics, and volume of RDF data repositories. Such metadata is used by distributed querying engines in order to optimize query execution. In ELEON, the structure of data repositories (and of collections comprising multiple data repositories) is perceived as a hierarchy of datasets and their subsets: a dataset contains all of the RDF triples contained in all of its subsets; these subsets are a dataset in their own right, and can be broken down into smaller subsets that have semantics and volume properties of their own. Each dataset is represented as a node in a tree – like hierarchy. Each node is associated with values for the annotation properties that are foreseen by the annotation schema in use. The distinction should be noted between: ▪ The schemas used in the datasets themselves - Here,

<table>
<tr><td></td><td>we will call these data schemas; and

▪ The schemas used in order to describe datasets - Here, we will call these annotation schemas

With respect to annotation schemas, ELEON supports the Vocabulary of Interlinked Datasets (VoID) and Sevod, the extension of VoID developed in the SemaGrow project.

ELEON Ontology Enrichment Environment is a metadata authoring environment developed by NCSR Demokritos. ELEON focuses on allowing non – technical domain experts to annotate ontologies with application – specific meta – information. ELEON was assumed as the foundation for the development of the SemaGrow Synergetic Semantic Annotation Environment.

ELEON is published as open source software under the GPLv2 license. ELEON was originally developed on CVS and then on an internal git installation at NCSR Demokritos. ELEON uses the Apache Jena Framework to handle ontology creation and annotation. Jena is an open source Semantic Web framework for Java. It provides an API to extract data from and write to RDF graphs. The graphs are represented as an abstract model. A model can be sourced with data from files, databases, URLs or a combination of these. A model can also be queried through SPARQL and updated through SPARQL. Jena supports serialisation of RDF graphs to a relational database, RDF/XML, Turtle, and Notation 3.</td></tr>
<tr><td rowspan="2">Oracle Policy Automation</td><td>http://www.oracle.com/technetwork/apps-tech/policy-automation/downloads/index.html</td></tr>
<tr><td>Oracle Policy Automation (abbreviated OPA) is a suite of software products for modelling and deploying business rules within enterprise applications. Oracle Corporation acquired OPA in December 2008, when it purchased Australian software company RuleBurst Holdings, then trading as Haley. Oracle Policy Automation was designed by RuleBurst to transform legislation and policy documents into executable business rules, particularly for the calculation of benefit entitlements and payment amounts. Although OPA was originally developed for and sold to the public sector, it can be used in other industries as well.

Oracle Policy Automation continues to be available as a standalone offering and an integrated rules solution for SAP and Siebel.

Oracle Policy Automation is designed as a specialised rules platform. While it provides the benefits of a traditional technical rules platform, it is optimised to implement complex policy logic that drives substantive determinations. Oracle Policy Automation also includes specific functionality and pre-built application functionality targeted at Public Sector policy</td></tr>
</table>

	applications. From a general perspective, Oracle Policy Automation is well-suited to: ▪ Complex determinations, decisions, recommendations and calculations, especially if the source material includes legislation, regulations or policy. ▪ Online advice and guidance tools, where an organisation wants to deploy advice-giving questionnaires very rapidly, and where different users should see different questions based on their circumstances. Users create their rules in their natural language using: ▪ Microsoft Word ▪ Microsoft Excel ▪ Microsoft Visio The rules are kept separate from any application code: ▪ Easier to test and maintain ▪ The rules look like the source documents

4.5 Conclusion on the Policy Modelling elements

Policy modelling tools and techniques help users model and visualize policy related information from the real world into computers, serving various different purposes (e.g. description of policy's main elements, simulation, support of policy's application, etc.). In this section we reviewed several of them, with main emphasis on the ones more appropriate for the needs of the EU-Community project (i.e. for building models of a policy which include the main topics, sub-topics and terms of it, in order to be used for collecting relevant content authored by experts in various electronic spaces). We placed strong emphasis on policy modelling tools developed in previous relevant European projects. Policy Modelling Tools make use of a variety of languages and standard APIs each one with specific advantages and drawbacks that can be customised for every different scenario.

Finally, it has been concluded that the use of the Semantic Web based on ontologies (making use of OWL) is the appropriate policy modelling technique to be used in this project. The main reason for this is the ability OWL provides for the data representation, information integration and reuse of vocabularies. Furthermore, the support it offers inference and classification, based on a formal semantics, which is a must-have for this proposal it offers for inference and classification, based on a formal semantics, is also a desirable feature.

5 Impact Assessment Tools, Methods and Approaches

5.1 Impact Assessment in the policy making process

According to the European Commission, Impact Assessment (IA) is a "set of logical steps to be followed when preparing a policy". It is a process that prepares evidence for decision makers on the advantages and disadvantages of possible policy options by assessing their potential impacts [11]. OECD perceives this approach as a mean not only to assess the impacts of proposed policies, but has established the so called Regulatory Impact Analysis (RIA) methodology also as an approach to evaluate already existing regulations. Within a broader view [21], Impact Assessment is defined as a formalised, knowledge and evidence-based procedure aiming to identify the anticipated or actual impacts of a policy intervention, on the social, economic and environmental factors, which the intervention is designed to affect, or may inadvertently affect. In the context of policy making, Impact Assessments focus on assessing the intended and unintended, positive and negative impacts of policy proposals, in order to inform policy development [1], and be taken into account in the decision making process.

Policy Assessment may take place before the implementation of a policy intervention (*ex ante*), after its implementation (*ex post*), or at any stage in between. *Ex ante* assessment, forecasts potential impacts as part of the planning, design and approval of an intervention. *Ex post* assessment, identifies actual impacts during and after implementation, to enable corrective action to be taken if necessary, and to provide information for improving the design of future interventions.

Impact assessment can be either internal or external. In the case of internal, it usually includes monitoring and evaluation through various impact indicators, performed inside the organisation for purposes of learning and improvement. Management Information systems often keep activities and expenses records that allow the calculation these indicators. On the other hand, external impact assessment comprises the involvement of external actors, such as independent investigators or consultants who produce reports for specific interventions. Separate ex post assessments may be undertaken or commissioned to external expertise groups for any particular policy intervention or set of interventions in order to get a comprehensive view of the potential impact.

During the last two decades, the concept of policy impact assessment has been spread, as public institutions and governments have been increasingly adopting Policy Impact Assessment systems for many national or local level policies. Nowadays, assessments have been introduced in all OECD countries [22] and other industrialised countries, while the European Commission's Impact Assessment system was launched in 2003 [10][13]. This wide spread has emerged from the societal need for better government policies and regulations, and can offer various advantages, such as:

- inform better the decision-makers

- allow the predictions of possible ramifications of a regulation on the economy, society or environment
- enable evidence based, participatory decisions
- increase transparency of the processes and legitimacy of policies and regulations
- clarify how policy proposals contribute to the various priorities, goals, and indicators of policy, thereby supporting achievement of goals.
- contribute to a continuous learning process in policy development

In particular the guidelines of the EC for IA prescribe six key analytical steps when carrying out an IA [11]:

1. Identification of the problem, its causes, its extent and affected population.
2. Definition of the objectives (specific or operational) to respond to the problem and its causes.
3. Development of the main policy options distinguishing regulatory or non-regulatory approaches.
4. Analysis of the direct and indirect impacts (economic, social and environmental).
5. Comparison of the options and identification of the preferred ones.
6. Outline policy monitoring and evaluation through indicators for the key objectives.

As stated above, impact assessment initiatives can be launched in multiple stages of the policy making cycle: agenda setting, policy analysis, policy formulation, policy implementation, and policy monitoring and evaluation. In some cases, ex ante assessment is a prerequisite part of the decision cycle for the approval of certain policy actions. In the scope of the project, impact assessment is needed to be applied before the policy intervention, in the early phases of the policy making cycle, where consultations about the various options are taking place. Therefore we speak on ex ante' assessment, rather than 'ex post' evaluation of policies. Furthermore, as Adellle et al. in [1] highlight the role of policy assessment is not restricted in identifying the overall "best policy option, but to inform the debate and critical reflection in the messy reality of policy-making". This fits well with the EU Community project's objectives, as it intends to support the whole spectrum of the EU policy process.

5.2 Impact Assessment Methods

There are various methods for conducting Impact Assessment, which can be used either individually or in combination. A generic classification emerged from the LAISE Network of Excellence [19] distinguishes them in the following categories, proposing indicative tools for each type:

- **Scoping** (e.g. checklists, result chain analysis): performed in the phase of planning the IA to determine its scope.
- **Qualitative methods** (e.g. focus groups, case studies, participatory scenario development, repertory grid technique, Technical Innovation System): aims to observe human behaviour and other complex phenomena along with their causes and social impacts.
- **Quantitative methods** (e.g. statistical analysis, baseline studies, modelling, surveys, collection and analysis of economic data, Life Cycle Assessment (LCA)): based on numerical data to measure outcomes and evaluate them against predefined objectives, using statistics, mathematical or computational methods.
- **Methods for aggregation and comparison of options** (e.g. Cost Benefit Analysis (CBA), Cost-Effectiveness Analysis, Multi-Criteria Analysis): used to combine and summarize the evidence and knowledge obtained from the IA process. Cost-benefit Analysis is applied to public policy making to assess the costs and benefits of policy options, focusing solely on the economic impact, while Cost-effectiveness analysis takes into account other less tangible impact as well.
- **Methods to assess the policies coherence** (Gender IA, Cross – Impact Analysis): measure correlations among of mutually reinforcing policies.
- **Participatory approaches** (e.g. consensus conference, internet consultation): implies the stakeholders' participation and involvement in the impact assessment to express their perceptions of actual and potential impacts.
- **Methods for Monitoring and evaluation** (e.g. indicators, peer reviews): refers to the last step in the policy design, when the policy option to be adopted has been decided, to evaluate if the policy objectives are met.
- **Data presentation and involvement** (e.g. GIS, data visualisation): includes presentation of data to allow communication with external persons, consultations and coordination of decision – makers.

5.3 Modelling and Simulation approaches in the context of IA

Approaches to policy analysis in general are based on either qualitative research or quantitative one, which usually includes statistical (including econometric) and mathematical modelling. Most qualitative research is not formal, while statistical and mathematical models are more formal. However, the major difficulty in the policy process lies to the fact that the complexity of the social problems inherent in policy actions is quite difficult to address. Rittel and Weber theorise that social problems are usually 'wicked', because they lack clear and widely agreed definition and objectives, since they have many stakeholders with different and heterogeneous problem views, concerns and expectations and various social interactions among them [24].

Long before complexity science came to be recognised as an umbrella for related objects of scientific investigation, social scientists developing simulation approaches recognised the importance of explaining macro-level phenomena that emerged from social processes, whereby individual behaviour and social interaction together produced phenomena that could not be explained by the individual behaviour alone. Nigel Gilbert [15] argued that the only way to capture the behaviour and interactions was by means of simulation modelling. The definitions of both processual and structural complexity require that any model of the phenomena to be able to represent social interactions amongst individuals. In conditions where precision but not accurate prediction can be expected of model-based analyses, the value of the models can be no more than to generate clear scenarios. In order to explore the policy space flexibly and broadly, the models need to be open. That is, it must be possible for model operators to explore a wide range of specifications of behaviour and social interaction. This is not just a matter of setting parameter values, but of specifying the ways in which individuals' reason about their circumstances, how they filter their perceptions, how they choose their friends and other elements of a model that are structural rather than parametric.

Modelling belongs to the quantitative methods for impact analysis targeted especially to complex issues. In the context of Policy IA, it can be defined as a technique for analysing and predicting the potential impacts of policy initiatives. Modelling outweighs from the other quantitative methods in the fact that modelling techniques are capable of addressing the difficulties for inference of cause and effect in order to evaluate the success of the intervention and the magnitude of any adverse effects. It uses simulation implemented through computer software to help in reducing uncertainty to the possible future policy impact by forecasting the outcome of possible solutions. Modelling can offer a more holistic view on the impacts to be evaluated, since it provides simplified representations of a part of the real world, which includes only some of its elements on which a particular study is focusing [18]. Focusing especially on a policy model, it is defined as an artificial world giving the modeller (e.g. an advisor or assistant to a policy maker) the unprecedented opportunity to test interventions and improvements on policies, aiming to strengthen their outcome, in a manner safe from the risks of their real implementation in the society. Apart from the application of the approach for purposes of forecasting, planning and decision-making support in policy issues of great complexity, it is also valuable for education, if the access to the real system is costly or impossible.

Modelling promises to bring scientific-evidence as an asset to decision makers and lead to more 'rational' policy-making, achievable only by the application of analytical tools, as envisaged by the definition of policy assessment. Simulation is considered as suitable for investigating policy issues and exploring policy implications because it can take into consideration exogenous variables (e.g. instability in the policy environment) and integrate cross-cutting issues. Indeed, the employment of modelling and simulation approaches for impact assessment and assessing the potential impact of future policies under different perspectives (social, environmental, economic) is adopted by the EC Impact Assessment official assignments ([9][13][17]).

Typically, each model is designed for a specific purpose or area of analysis (e.g. environmental policies, agricultural policies (e.g. under the Common Agricultural Policy)) and is based on a set of assumptions that is suitable for this purpose. These assumptions need to be made transparent for users in every modelling exercise, since they have relevant effects on modelling results and are also relevant for interpretation of these results. If social simulation models are to be used for policy analysis, it is of course important that they should describe with some accuracy the social context, the characteristics of the behaviours of individuals in different circumstances and the relationships amongst those individuals. At the same time, prediction cannot be relied upon in conditions of complexity. Whilst in these conditions, models cannot be relied upon to yield accurate predictions; they are still formal systems and, as such, capture relationships and outcomes that are precise and unambiguous. Precision is useful in ensuring that analysts have to state their assumptions clearly and that they do not rely on emotive phrasing to justify actions that have no basis in understanding or experience. They require data sets tailored to the particular problem area. In addition, it may be necessary to combine this quantitative method with some degree of qualitative interpretation, in order to evaluate the causes of impacts, which have been observed through modelling.

The existing modelling and simulation approaches have been reviewed from the perspective of participatory policy making [8]. According to this, there are four main modelling paradigms: Discrete Event, System Dynamics, Dynamic Systems and Agent Based Modelling. These can be classified based on two dimensions: a) the level of modelling detail/abstraction (high abstraction/less detail, medium abstraction/detail or low abstraction/more detail) and b) the way time is modelled (as continuous or discrete time) (see also [6]). Agent-Based and Discrete Event simulation are discrete time approaches, while in System Dynamics and Dynamic Systems simulation time is continuous. These four approaches differ also in the level of abstraction: while aggregative System Dynamics present the highest abstraction, on the contrary Dynamic Systems present the lowest one, Discrete Event is used at low or middle abstraction and Agent-Based modelling range across all levels of abstractions accordingly the nature of the problem. A third dimension has also been used to categorize the different methods that these approaches encompass, on whether they are based on stochastic processes (include stochastic differential equations, random numbers generators for simulating uncertainty) or deterministic (they unfold exactly as specified by some pre-specified logic, e.g. equation-based).

The following table summarises the results of this classification, presenting the most prevalent modelling and simulation approaches and their main characteristics mentioned above.

Table 2: Overview of simulation modelling paradigms[8].

Methodology	Time	Simulation	Process	Level
Queuing models	Discrete	Dynamic	Stochastic	Micro-Meso
Monte Carlo	Discrete	Dynamic	Stochastic	Micro
System Dynamics	Continuous	Dynamic	Deterministic	Macro
Dynamic Systems	Continuous	Dynamic	Deterministic	Micro
Cellular Automata	Discrete	Dynamic	Deterministic	Meso-Macro
Agent-based	Discrete	Dynamic	Deterministic	Meso-Macro

Taking into account the project needs for a tool to be capable of screening the numerous views of stakeholders on the policy options under debate, estimating their interactions, and projecting in the future the interest in and acceptance on these options, from the above paradigms of simulation modelling **Systems Dynamics seems to be more appropriate**. This is because the purpose of our case is to include the social actors and provide simulation for assessing the impacts of their interactions, which are evolving in continuous time and affect one another (cause and effect). In particular, the model to be used should be of low detail and high abstraction focusing on aggregate values (number of documents, number of supporters of policy choices) and relations among them. In addition, with respect to the modelling time EU Community simulation should consider the real time in which a discussion advances, for each time step the new state of the system will be calculated.

The System Dynamics (SD) methodology is an equation-based modelling approach, which examines how causal and feedback relationships among the elements of a system (i.e. system structure) can influence the behaviour of it. The representation of real-world systems through SD is based on stocks (of individuals of resources) and flows between these stocks (which increase or decrease these stocks) and information that determines the values of these flows. It is suitable for systems having numerous interdependent variables, whose rates of change interact with one another. Therefore, the systems to be modelled will include various individual processes with 'stocks' (e.g. stakeholder groups etc.) and 'flows' among them, which are influenced by internal and external factors. Another advantage is that Systems Dynamics has been successfully used in other projects so it has reached maturity and experience has been gathered from its use in the policy impact assessment [19].

5.4 Relevant Approaches

To investigate the current state of the art (in terms of practice and research) in the domain of simulation modelling in the context of IA, a study about the social simulation models particularly in matters relating to public administration was conducted. This section aims to provide an overview of indicative good practices that have already been implemented in the area.

The biggest library of resources (models, methods, impact areas, good practices, experts) collected from different sources of knowledge can be found in the LAISE KIT [9], which consists of a hub in the domain of Policy Impact Assessment addressed to policy makers and researchers. LIAISE has also conducted a comprehensive analysis of nine years of FP6 and FP7 programmes, to identify projects targeted at the design of IA tools [21]. According to this, despite the fact that there are a number of projects designing IA tools increased during this period, there still is a relatively low number of analytical tools directly targeted for application in IA. In addition, the focus is mainly on policy areas related to agriculture, environment and transport. It seems that gaps exist in the availability of IA tools for other policy areas and for supporting the policy making process itself regardless the policy area. CROSSOVER project on Policy Making 2.0 also has formulated an extensive list of cases of Policy Assessment modelling cases. Focusing on System Dynamics models constructed for this scope, we can mention some examples on immigration policies (GAIM), on transportation policies (ESCOT), on pharmaceutical planning, on health policies assessment. Another set of SD practices in public policy making can be found in [19], where cases refer to taxation policies, waste management, technology improvements and e-government policies. The identified examples reinforce the conclusion emerged from the aforementioned LIAISE analysis and highlight the absence of a generic SD model to be integrated in the policy making process.

Several projects also involve the development of agent based social simulation models for purposes of social policy analysis. First among them chronologically is companion modelling ([4][5][7]), an approach that involves iterations between stakeholder engagement and, in particular, role-playing games for purposes of knowledge elicitation and model evaluation. A similar approach was undertaken in the EU projects FIRMA (Freshwater Integrated Resource Management with Agents, funded under the fourth Framework Programme) and CAVES (Complexity Agents Volatility Evidence and Scale, funded under the sixth Framework Programme).

Finally, a list the indicative projects with more relevant approaches to EU Community is provided below:

Name	**MOSIPS[4] - Modelling and Simulation of the Impact of Public Policies on SMEs**
Objectives	The aim of the MOSIPS Project is to develop a user-friendly policy simulation system allowing forecasting and visualisation of the socio-economic potential impact of public policies. The simulation system will allow policy makers to make experiments with different socio-economic designs, with the participation of citizens and potentially impacted stakeholders, before the settlement of a public policy.
Lessons Learnt	MOSIP allows the combination of suitable data, models, artificial intelligence and interactive tools to deliver a policy wind tunnel. MOSIPS will deliver a multi-agent based simulator for policy impact assessment and validation with features dedicated to public policies evaluation, flexibly adaptable to particular needs of given policy domains.

Name	**GSD[5] - Global System Dynamics & Policies**
Objectives	The project's purpose is to review how complex systems analysis can be applied to policy decisions, with a particular focus on climate change, sustainable cities, risk, energy and social problems. The programme aims to connect the building of different methodologies of multi-physics modelling, engineering systems, dynamics, economics and organisations modelling.

[4] http://www.mosips.eu

[5] http://www.globalsystemdynamics.eu

Lessons Learnt	The project has produced models for economic sustainability and web-based modelling tool incorporating policy scenarios surrounding energy usage issues – for example the effect that greater taxation could make on emissions.

Name	**PADGETS[6] - Policy Gadgets Mashing Underlying Group Knowledge in Web 2.0 Media**
Objectives	PADGETS aims at bringing together two well-established domains, the mash up architectural approach of web 2.0 for creating web applications (gadgets) and the methodology of system dynamics in analysing complex system behaviour. The objective is to design, develop and deploy a prototype toolset that will allow policy makers to graphically create web applications that will be deployed in the environment of underlying knowledge in Web 2.0 media.
Lessons Learnt	PADGETS has developed a Decision Support Engine, which runs simulations based on data both coming from social media and a data-mining engine. The simulations are performed through a generic model developed on the System Dynamics methodology, which can be reused in every policy domain and provides data sets for awareness, interest and acceptance of citizens against a prospective policy. A Decision Support Component was developed based on a generic System Dynamics model, taking as input Social Media interactions and Opinion Mining results to forecast the awareness, acceptance and interest towards any policy.

Name	**FUPOL[7] – Future Policy Modelling**
Objectives	FUPOL proposes a new governance model to support the policy design and implementation lifecycle, through changing the way politicians communicate with citizens and enterprises and take decisions. The FUPOL system will be able to automatically collect, analyse and interpret opinions expressed on a large scale from the Internet and provide capabilities to simulate the effects of policies and laws and to assist governments in the whole policy design process.
Lessons Learnt	In the FUPOL policy process, the aspect of simulation plays an important role, in identifying the predicted impacts on policy indicators or other influencing factors. FUPOL implements only

[6] http://www.padgets.eu/

[7] https://www.fupol.de

	some simulations based on agent based simulation and system dynamics to show how simulation can be used in the policy lifecycle. The scope of the models, which can be reused, is limited to the major domains in urban policies including: Land use and urban planning, Sustainable development and environment, Urban segregation and migration, Education, Demography. According to FUPOL It is important to understand that there is no single "one fits all" simulation software package and methodological approach to policy simulation. In each policy domain there are several ways how to model a given policy.

Name	**ePolicy[8] – Engineering the Policy making Life Cycle**
Objectives	The project aims at providing decision support systems for policy makers in their decision process across a multi-disciplinary effort aimed at the engineering of a policy making life-cycle that integrates, in a unique way, global and individual perspectives on the decision process. The implementation required a simulator to understand complex agent interactions in order to evaluate the economic, social and environmental impacts during policy making (at both the global and individual levels).
Lessons Learnt	The project combines the Agent –Based approach (individual policy modelling) with a game theoretical approach for the interaction between the global and the individual levels. The general methodology and tools provided are specifically targeted on regional energy planning. It has emerged that Social simulation aids the policy maker to understand the individual perspective, but the project proposed a technique to integrate optimisation and simulation.

5.5 Review of simulation software tools

As illustrated above, the impact assessment module of the EU Community will be based on the System Dynamics modelling methodology. Hence, functionalities to perform simulations based on the constructed model should be available for the user. A simulation engine supporting SD has to be developed either from scratch or by using an existing software package or library. Therefore, a number of existing solutions that can be used to construct and simulate models has been examined. In the following table, an overview of the characteristics of the most widely use simulation software, is presented. The basic information for each tool is provided and the category in which System Dynamics Society classifies them [28].

[8] http://www.epolicy-project.eu

Table 3: List of simulation software

Package name	License type	Implementation language	Web site	Description	Category
Analytica	Commercial	C++	http://www.lumina.com	Supports system dynamics, Monte Carlo simulation, array abstraction, linear and non-linear optimisation	Extensive[9]
AnyLogic	Commercial	Java; UML-RT (UML for real time)	http://www.anylogic.com	Supports system dynamics, agent based and discrete event modelling	Core Software
Consideo	Commercial		http://www.consideo-modeler.de/	Combines different methods, concept maps, system dynamics	Extensive
Dynaplan	Commercial	C++	http://www.dynaplan.com/	Combines elements of simulation modelling, spreadsheet modelling and presentation development in an integrated platform	Extensive
Forio Simulations	Commercial		http://www.forio.com	Web based interfaces for already developed models, a library of interactive environments to explore	Web Based
GoldSim	Commercial		http://www.goldsim.com/	Focus on Monte Carlo simulation but can support stock and flow style modelling	Extensive
Insight Maker	Free (Insight Maker Public License)	Javascript	http://www.InsightMaker.com	Web based (runs completely in the browser), multi-user, supports Causal Loop Diagrams, Rich Pictures, Dialogue Mapping, Mind Mapping, as well as Stock & Flow simulation models.	Web Based
iMODELER	Free for educational purposes		http://www.consideo.de	Runs also on smartphones and tablets.	Web Based

[9]Extensive software refers to software extending system dynamics elements with other modelling approaches and diagrammatic representations

NetLOGO	Free for use by the public	Java, Scala	http://ccl.northwestern.edu/netlogo	Multi-agent programmable modelling environment	Pedagogical
OptiSim	Free for educational use	Java	http://www.optisim.org	Web-based system dynamics software for educational use	Pedagogical
Powersim	Commercial	C++	http://www.powersim.com	Supports system dynamics and discrete event modelling	Core Software
Simantics System Dynamics	EPL	Java, Modelica	http://sysdyn.simantics.org	Open source system dynamics modelling software with stock and flow modelling, hierarchical models and array variables.	Extensive
Simile	Commercial	C++, Prolog, Tcl	http://ww.simulistics.com/	System Dynamics software with object-based concepts	Extensive
Stella, iThink	Commercial /Educational licenses		http://www.iseesystems.com	Intuitive icon-based graphical interface (different configurations available) Stella Modeler for iPad	Core Software
Sysdea	Commercial		https://sysdea.com	On-line, browser based, easy model sharing options, includes sample models	Pedagogical
Vensim	Commercial		http://www.vensim.com	Vensim applications (can be developed with the Venapp builder, or in a programming language such as Visual Basic, C, C++, Visual C++, Delphi, Excel, and multimedia authoring too	Core Software
System Dynamic Frameworks / Libraries					
Aivika	BSD3	F#	http://hackage.haskell.org/package/aivika	An extensible multi-paradigm simulation library	
JDynSim	GPL	Java	http://code.google.com/p/dynsim/	System dynamics framework for java.	

JMCAD	GPL v2	Java	http://jmcad.sourceforge.net/	Block diagram language for creating complex nonlinear dynamic systems	
Mapsim	GNU Library or Lesser General Public License (LGPL)	Microsoft .NET	http://mapsim.sourceforge.net	Open Source simulation engine for System Dynamics	
Pyndamics	Free (MIT License)	Python	https://code.google.com/p/pyndamics/	Free and open source numerical dynamics software written in Python, supporting a simple syntax for writing differential equations.	
Sphinx SD Tools	Free (Apache License, Version 2.0.)	Java	http://sourceforge.net/projects/sphinxes/	Environment for system dynamics simulation	
Simantics	EPL	Java	https://www.simantics.org/	Binary package ready-to-use system dynamics modelling and simulation software application	
System Dynamics	GPL	Java	http://sourceforge.net/projects/system-dynamics/	Graphical Java application for modelling, visualisation and execution of System Dynamics models.	
SD		Javascript	https://github.com/bpowers/sd.js	in-browser system dynamics model simulation and display	

The main criteria for the selection among the above tools are: to support sufficiently SD modelling, to be free for research proposes, and to be implemented in one of programming languages that fits to the EU Community Architecture, and to be easily embedded in a web-based environment. Therefore, the mainstream options consist of Insight Maker, Vensim and ithink. In case integration issues arise, a new implementation will take place based on one of the existing open source libraries.

5.6 Conclusion on the impact assessment elements

In this section we reviewed the existing approaches of modelling that can be used for the impact assessment purposes of the EU Community project, and concluded that the use of System Dynamics modelling is the most appropriate one, as it offers a series of advantages (mentioned at the end of 5.3), and also software tools supporting its application.

It has been concluded that modelling and simulation on aspects of a policy debate can provide a more clear view on the aspects of the discussion and the factors that can influence its final outcome. In this respect, the EU Community impact assessment component will play a supportive role in the whole decision process. It will allow estimations on the different reactions of the involved parts on the policy issues (awareness, interest) and create possible scenarios on how interactions between the parts of the debate will vary and how the whole debate will evolve over time.

The focus of EU-Community Impact Assessment module will also be to help stakeholders predicting end evaluating the impact of the discussion on the various policy options. Therefore it will be based on a generic model, that could applied for every policy topic and could also act as a standalone tool, for forecasting any policy consultation within the policy making process. Taking into account there is gap between Impact assessment systems and their implementation, EU Community aspires to reduce the barriers for its adoption (by making it simple enough) and provide practical knowledge for the implementation of these kinds of systems by pubic decision bodies.

6 Conclusions

The value proposition of EU Community lies across the entire policy making process, with particular focus on the first stages of policy analysis and the later policy consultation. Its main difference from other research projects in this area is that it does not focus on the general public, but - adopting a more selective approach - on a smaller group of topical experts (on the particular topic we are interested in). This approach necessitates on the one hand experts' reputation management/credibility rating and documents' relevance rating, and on the other hand extraction of information relevant to the specific public policy we are interested in based on a model of this policy, which includes its main topics, subtopics and terms. Furthermore, we are concerned with the present awareness, interest and discussion on this policy, but also with its future evolution as well, by using impact assessment modelling. These two fields analysed in the current document, i.e. the Policy Modelling and the Impact Assessment mainly with respect to the above stages of the policy lifecycle. A review on existing methodologies, approaches and tools on the above areas have lead to particular findings against the project needs and guidance for the future development steps in these areas.

In particular, with respect to the Policy Modelling, various approaches for the representation of a prospective policy and its main options have been examined, indicating that OWL covers the EU Communities needs for policy representation and information exchange between the other components (crawlers, opinion mining). An ontology editor (policy modelling) component to model the policy domain will be developed "from scratch", in order to fully interconnect with the common database and implement the EU-Community specific metadata schema for policy description. The ontologies fits to the semantic concept that the project embraces, extracting information of multiple sources on the web, while in the same time will allow to users to easily create and as also reuse policy models.

On the other hand, Impact Assessment has been recognised as a key step in the public policy making with many valuable applications in various domains. The methodologies for carrying out impact assessments vary and should be selected according to the particularities of each case. In the context of EU Community, the SD modelling approach seems to be more suitable, since it can simulate complex systems with different stakeholders/ social actors and provide future indications on aggregated indicators. To make this feasible a valid simulation model has to be constructed and as well an interface that will allow users to run different scenarios. For this development, three candidate simulation engines meeting the EU Community simulation requirements have been selected among the ones that have been examined.

The scope of this deliverable is to give the initial directions for the implementation. Further specifications for the above components will follow in the subsequent deliverable D4.2 of WP4, providing the decisions on which of the above solutions can be better integrated with the EU Community platform and meet its users' needs.

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