A Semantic Model for e-Participation - Detailed Conceptualization and Ontology

Lukasz Porwol
Insight Centre for Data Analytics
National University of Ireland, Galway
lukasz.porwol@insight-centre.org

Adegboyega Ojo
Insight Centre for Data Analytics
National University of Ireland, Galway
adegboyega.ojo@insight-centre.org

John Breslin
Insight Centre for Data Analytics
National University of Ireland, Galway
john.breslin@insight-centre.org

ABSTRACT

There have been limited efforts so far to provide a detailed conceptualization and formal ontology for e-Participation. Current e-Participation literature is replete with fragmented models, which only partially describe aspects of e-Participation. Consequently consistent descriptions and comparison of e-Participation initiatives is difficult. In addition, no e-Participation ontology exists, which supports citizen-led e-participation on the Social Media platforms. This work bridges this gap by providing a detailed conceptualization and corresponding formal and executable ontology for e-Participation. These semantic models cover the core perspectives of e-Participation; democratic process, initiative and sociotechnical system. The developed models also explicitly support the integrated citizen- and government-led model of e-Participation. Results from the use of the ontology in describing two e-Participation initiatives at Local Government or County and European levels are also presented.

Categories and Subject Descriptors

D.4.7[**Organization and Design**]:*Interactive Systems*

General Terms

Design, Human Factors

Keywords

e-Participation, Duality of e-Participation, Participatory Democracy, Online Political Deliberation, Social Media Mining

1. INTRODUCTION

e-Participation leverages technology-mediated dialogue between citizens and the politics sphere and citizens and administration [25] to ensure improved, fast-feedback-enabled, public participation [4] while also introducing new, innovative channels for political participation [7]. The domain of e-Participation, after over a decade from its conception, generated many reference models as a base for e-Participation projects' architectures. Some of the most widely recalled include: Dimensions of e-Participation Framework [15], Levels of Participation Model [6], Ladder of Online Participation [13], Behavior Chain Model [8], e-Participation Assessment Framework [27], e-Participation Evaluation Framework [17], e-Participation Exploitation Framework [21] and few others [1, 12, 24, 26].

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Nevertheless as shown in our previous work [23], although these models address one or more aspects of e-Participation, the degree of complementarity of these models and the extent to which they collectively cover the e-Participation concept-space is insufficient. Therefore the utility of the models as a practical tool for describing aspects of e-Participation is limited. Moreover in line with the observation by Macintosh et al. in [16], we argue that e-Participation must support inclusion, monitoring and engagement of citizens with spontaneous political discussions on Social Media for sustainable e-Participation.

In our Integrated Model for e-Participation [22] we draw from Gidden's Structuration Theory [9] together with the complementary Dynamic Capabilities Theory [28] [31] to develop a conceptualisation of the Duality of e-Participation and link it to the classical models for e-Participation. The presented model structures the citizen-to-decision-maker communication and identifies the key e-Participation process capabilities required to implement both Government-led and Citizen-led e-Participation. From this model we have elicited a comprehensive matrix of e-Participation requirements and made a recommendation for state-of-the art tools that could satisfy e-Participation needs.

Building on the Integrated Model, this paper provides a comprehensive conceptualization and ontology for e-Participation. The model enables a detailed e-Participation process specification facilitating collaboration and interoperability between various e-Participation initiatives as well as better understanding among e-participation stakeholders. Specifically, our approach entailed: 1) deriving the set of competency questions (or requirements) from all core facets of the integrated model, 2) eliciting core concepts and relations from the competency questions, 3) developing a conceptual model by consolidating the concepts and relations, 4) refining the conceptual model into a formal ontology in Resource Description Framework (RDF), and finally 5) employing the developed ontology to describe two e-Participation initiatives in the transportation domain (at the County level) and immigration policy at the European Union level.

Our major contribution is not limited to providing for the first time a comprehensive conceptualizing and ontology for e-participation, but also in supporting both government- and citizen-led e-participation.

2. APPROACH

This section presents the approach we employed for the design of the e-Participation semantic model. The conceptual underpinning is presented in Section 2.1 followed by a description of the methodology in Section 2.2.

2.1 Conceptual Framework

We leverage the conceptual framework created in our previous works which defines the e-Participation Ontological Space (Figure 1) and the Integrative Framework for e-Participation. The framework distinguishes three different perspectives on the nature of e-Participation. Each of these perspectives is then organized into four Generic Views. After partitioning the conceptual space, we define the Competency Questions for the e-Participation conceptual model and ontology. The questions from comprehensive Integrated Model for e-Participation (grounded in Structuration Theory and Dynamic Capabilities Theory) establish the scope of our e-Participation semantic models.

2.1.1 e-Participation Ontological Space

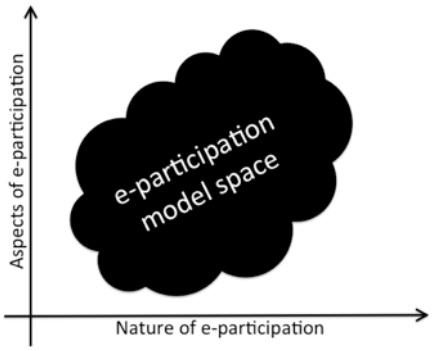

Figure 1: e-Participation Ontological Space

The Integrative Framework for e-Participation structures the e-Participation Ontological Space along three basic Views of e-Participation (Democratic Perspective, Project Perspective and Platform Perspective) accordingly to the popular journalistic questions of What, When Who, Why, Where and How [33] as a template for generating domain specific aspects. In particular the framework leverages Pepper's World Hypotheses or Views [20] as a generic set of aspects for a phenomenon such as e-Participation. Our choice of the Pepper's World Hypotheses is premised on the following: 1) the Pepper's views are metaphorically richer compared with the traditional journalistic questions and Aristotle four causes [14]; 2) the possibility of mapping Pepper's views to the journalistic questions and Aristotle four causes; and 3) evidence of the suitability of applying Pepper's hypotheses for structuring and analyzing socio-technical systems [18]. Pepper identified four different adequate views of the world: Mechanism, Formism, Organicism and Contextualism [11] [18]. In the context of e-Participation, Pepper's four views enable the specification of: e-Participation goals to be realized through some staged models (Organicism); description of different entities involved in realizing a specified e-Participation goal (Formism); the different functions, processes and systems required to produce desired e-Participation outputs or outcomes (Mechanism); indication and evaluation of the experience of actors and observers of e-Participation system (Contextualism).

2.1.2 Integrated Model for e-Participation

The Integrated Model for e-Participation (IMeP) presented in Figure 2 is grounded in the integration of Structuration Theory with the complementary, Dynamic Capabilities Theory in a single e-Participation social system model [22] IMeP employs two approaches to e-Participation: classic, Government-led e-Participation and the new, Citizen-led e-Participation. The two modalities are exploited simultaneously to support the dynamic distribution of allocative and authoritative resources between citizens and decision makers in the context of decision or policy-making. Given appropriate resources, citizens exercise their agency to participate in the social-system re-production. The legitimacy and significance of citizens' contribution to policy making is strengthened directly by government's acknowledgement, consideration and subsequent (partial) adoption. We have identified the following types of core capabilities for realizing such integrated e-Participation framework: 1) adaptive capabilities including dynamic resources (re-) distribution and acquisition, rules re-production and reformation process; 2) absorptive capabilities including continuous monitoring process, participation shaping process, citizen information services; and 3) innovative capabilities including flexible monitoring process and ubiquitous e-Participation. These capabilities ensure continuous reflexive dialogue and dialectics among citizens and between citizens and decision makers respectively characterizing the dual-nature e-Participation process.

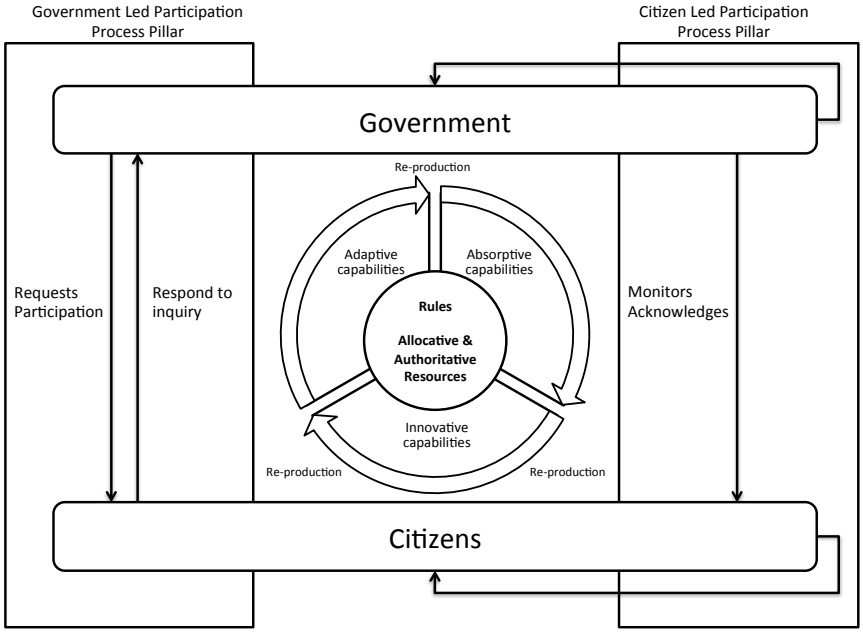

Figure 2: Integrated model for e-Participation

2.2 Methodology

A major goal of this work is to define key e-Participation concepts combined in a comprehensive e-Participation Conceptual Model implemented in a form of ontology. In our methodology we follow three-staged Thalheim's construction workflow[29] (relevance stage, modeling stage, realization stage) as a best practice for model design and implementation process. Relevance Stage is represented by Section 2.1 and Section 3, Modeling Stage and Realization Stage are widely discussed in Section 4. In particular the questions for our enquiry include:

R1. What are the key dimensions of e-Participation?
R2. What are the key Competency Questions for e-Participation conceptualization or final ontology?
R3. How can the Competency Questions be aligned with the four e-participation dimensions described in 2.1.1 in the e-Participation Integrative Framework?
R4. Which key concepts can be elicited from the aligned e-Participation Competency Questions?
R5. How can the concepts be combined in a comprehensive e-Participation model?
R6. How can the model be leveraged for e-Participation case description?

Answering these questions is contingent on adoption of the Integrated Model for e-Participation as the application domain knowledge source then deriving the Competency Questions and organizing them into twelve grid-themes delivered by Integrating Framework for e-Participation. We briefly describe below how competency questions were generated and aligned. We also show how the key concepts have been elicited and combined in a model.

- *Knowledge Acquisition:* Integrated Model for e-Participation has been based on rich state-of-the art review and extends the up-to-date e-Participation research models with specific modes of citizen-acknowledgment and e-Participation reproduction aspects. Therefore the Model represents rich source of information on application domain essential for the relevance stage of the construction workflow. We followed the key model-properties and we aligned them in competency questions accordingly to the e-Participation dimensions defined by the Integrative Framework for e-Participation.
- *e-Participation Concepts Elicitation:* Mapping the competency questions to specific e-Participation aspects entails determining which of the three perspectives of e-Participation and which of the four generic aspects of e-participation are addressed by the questions. The unique subjects and objects were selected as base-concepts. Relations between concepts were defined based on the common knowledge.
- *Model creation* – After eliciting base-concepts and defining the relations we use available tool (NEOLOGISM) to graphically represent the concepts and relations in a form of a graph. Finally we discuss the utility of the model on case study of existing e-Participation initiative.

We argue for the reliability of our mapping based on the results of "*inter-observer"* and *"test-retest"* reliability tests [2].

3. e-Participation Conceptualization

This section is intended to deliver a comprehensive e-Participation domain conceptualization with particular acknowledgement of Duality of e-Participation. We elicit a set of relevant e-Participation Competency Questions from the Integrated Model for e-Participation and then align the questions to the twelve distinct themes of the Integrative Framework for e-Participation. We present the aligned question-space in Table 2. For better clarity, every competency question has been given a unique identifier indicating the particular e-Participation view axis assignment. Here CQPL prefix refers to competency questions on sociotechnical platform view; CQPR refers to the project view and CQDP indicates questions related to the e-Participation democratic view. Accordingly to the generic view axis the questions referring to e-Participation entities are represented by the Formism row. The Mechanism row defines the questions on the e-Participation key functions and operations. Organicism refers to e-Participation goals and properties while Contextualism considers matters of adoption, usability and evaluation.

Table 1: e-Participation Project Conceptualization

Question ID	Concepts	Relation
CQPR.1	Stakeholder	**e-Participation has Project** Project has Stakeholder Stakeholder is a subclass of Person Stakeholder is a subclass of Organisation
CQPR.2	e-Participation Channels	Project has e-ParticipationChannel
CQPR.3	Domain	Project has Domain
CQPR.4	Funding	Project has Funding
CQPR.5	Dissemination	Project has Dissemination
CQPR.6	Stakeholder Motivation Strategy	Project has StakeholderMotivationStrategy
CQPR.7	Management	Project has Management
CQPR.8	Cost	Project has Cost
CQPR.9	Start Time	Project has StartTime
CQPR.10	End Time	Project has EndTime
CQPR.11	Goal	Project has Goal
CQPR.12	Result	Project has Result
CQPR.13	Evaluation Measure	Project has EvaluationMeasure
CQPR.14	Performance	Project has PerformanceValue

After we defined the questions we elicit the key e-Participation concepts. The concepts are divided by the e-Participation view and grouped in three separate tables where the first position represents the unique identifier of the question, next the corresponding concept name followed by the relations between the elicited concepts. Consequentially Table 3 lists the concepts derived from the questions with CQPL prefix, Table 1 from CQPR and finally Table 4 lists concepts elicited from CQDP type of questions. These conceptualizations are essential for the Modeling stage of the Thalheim's workflow-based e-Participation model design. The concepts and relations are presented in the way they can be directly mapped on the classes and properties of the end-model. The concepts presented are possibly generic to ensure clean and universal e-Participation model design**.**

Table 2: e-Participation Competency Questions

Generic Views	e-Participation Perspectives		
	Sociotechnical system view	Project view	Democratic view
Formism	CQPL.1 Who are the e-Participation actors? CQPL.2 What are the e-Participation tools? CQPL.3 What are the deliberation topics? CQPL.4 What level of user-engagement is supported? CQPL.5 What type of communication is supported?	CQPR.1 Who are the e-Participation project stakeholders? CQPR.2 What are the e-Participation channels leveraged? CQPR.3 What is the e-Participation project area? CQPR.4 What is the e-Participation project funding?	CQDP.1 Who are the e-Participation democratic process stakeholders? CQDP.2 What are the e-Participation democratic process instruments? CQDP.3 What is the e-Participation problem domain? CQDP.4 What level of stakeholder engagement is supported?
Mechanism	CQPL.6 How is the e-Participation platform maintained? CQPL.7 How discussions are monitored? CQPL.8 How discussions are summarized? CQPL.9 How is user-feedback supported? CQPL.10 How user-engagement is supported?	CQPR.5 How the e-Participation project is disseminated? CQPR.6 How the e-Participation project stakeholders are motivated? CQPR.7 How the e-Participation project is managed?	CQDP.5 How is the e-Participation democratic process started? CQDP.6 How is the e-Participation democratic process executed? CQDP.7 How is the e-Participation democratic process incorporated with policy-making process?
Organism	CQPL.11 What is the aim of the deliberation? CQPL.12 What is start time of the deliberation? CQPL.13 What is end time of the deliberation? CQPL.14 What is the result of deliberation?	CQPR.8 How much the e-Participation project costs? CQPR.9 When the e-Participation project starts? CQPR.10 When the e-Participation project ends? CQPR.11 What is the aim of the e-Participation project? CQPR.12 What are the e-Participation project results?	CQDP.8 Why the e-Participation democratic process is performed? CQDP.9 When the e-Participation democratic process starts? CQDP.10 When the e-Participation democratic process finishes? CQDP.11 What is the e-Participation democratic process result?
Contextualism	CQPL.15 How the e-Participation platform technical performance is evaluated? CQPL.16 What is the technical performance of the e-Participation platform? CQPL.17 What is the level of Adoption of e-Participation platform? CQPL.18 What is the user-ranking of the e-Participation platform	CQPR.13 How the e-Participation project is evaluated? CQPR.14 What is the performance of the e-Participation project?	CQDP.12 How the e-Participation democratic process is evaluated? CQDP.13 What is the performance of the e-Participation democratic process?

Table 3: e-Participation Platform Conceptualization

Question ID	Concepts	Relation
CQPL1	Actor	**e-Participation has Platform** Platform has Actor Actor is a sublclass of Person Actor has subclass Citizen Actor has sublcass DecisionMaker Actor has sublcass Facilitator
CQPL2	Tool	Platform has Tool
CQPL3	Topic	Platform has Topic Topic has Discussion
CQPL4	User-Engagement Level	Platform implements UserEngagementLevel
CQPL5	Communication Type	Platform implements CommunicationType
CQPL6	Platform Maintenance	Platform has Maintanance
CQPL7	Discussion Monitoring	Platform has DiscussionMonitoring
CQPL8	Discussion Summary	Platform has DiscussionSummary
CQPL9	User-Feedback	Platform has UserFeedback UserFeedback has UserFeedback Direction
CQPL10	User-Engagement	Tool supports UserEgnagementLevel
CQPL11	Deliberation Aim	Discussion has Goal
CQPL12	Deliberation Start Time	Discussion has StartTime
CQPL13	Deliberation End Time	Discussion has EndTime
CQPL14	Deliberation Result	Discussion has Result
CQPL15	Technical Performance Measure	Platform has TechnicalPefromanceMeasure
CQPL16	Technical Performance	TechnicalPefromanceMeasure has TechnicalPerformanceValue
CQPL17	Adoption	Platform has AdoptionValue
CQPL18	Ranking	Platform has UserRanking

4. E-PARTICIPATION MODEL

In this section we show the design and the implementation of the e-Participation model based on the concepts and relations defined in Section 3. First, we present a generic conceptual model for e-Participation (Figure 3) showing the overall scope and dependencies of the intended end-model. The three major e-Participation views are represented with most descriptive concepts. It is clear from the elicited concepts that the e-Participation Platform is dependent on Project and the Project is linked closely to Democratic Process. The overlapping concepts include Stakeholder, Result, Domain and more importantly Constraints like Time, Performance or Goal. To highlight the strong implicit dependencies it is important to mention for example that the process domain influences the project focus area and that generates particular demand on the platform main topic. On the other hand the platform's results and performance influence the project outcomes, which finally shape the democratic process overall performance. The relations between

Table 4: e-Participation Democratic Process Conceptualization

Question ID	Concepts	Relation
CQDP.1	Stakeholder	**e-Participation has Democratic Process** Process has Stakeholder Stakeholder is a subclass of Person Stakeholder is a subclass of Organisation
CQDP.2	Instrument	Process has Instrument
CQDP.3	Domain	Process has Domain
CQDP.4	User (Citizen) Engagement Level	Process enables UserEngagementLevel
CQDP.5	Trigger	Process has Trigger
CQDP.6	Execution Procedure	Process has ExecutionProcedure
CQDP.7	Policy Making Handle	Platform has PolicyMakingHandle
CQDP.8	Goal	Process has Goal
CQDP.9	Start Time	Process has Start Time
CQDP.10	End Time	Process has End Time
CQDP.11	Result	Process has Result
CQDP.12	Evaluation Measure	Process has EvaluationMeasure
CQDP.13	Performance	Process has PerformanceValue

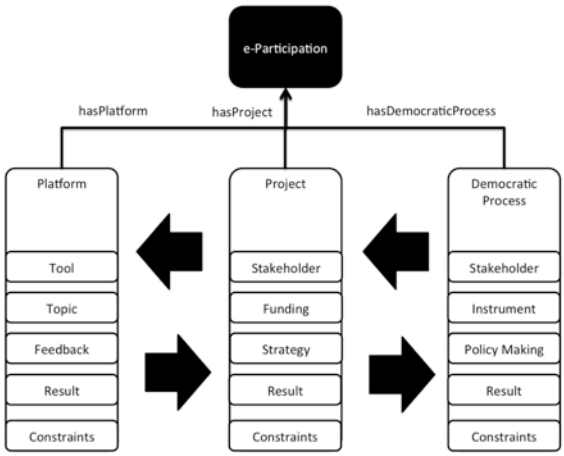

Figure 3: e-Participation Generic Conceptual Model

the three different views of e-Participation are explained in detail further. Following the construction workflow on Figure 4 we present the intended full e-Participation model.

4.1 e-Participation Model Mission

The main purpose of the model is to provide e-Participation creators, managers and champions with relevant tool for structured representation of key e-Participation aspects. This will help the e-Participation initiatives to be described in a more comprehensive way therefore will contribute directly to better e-Participation information representation, exchange and integration. Moreover the unified, standardized, machine-readable representation will enable more coherent e-Participation initiatives' evaluation and comparison, facilitating the transparency through rich, Open-Data-enabled format. The model supports coherent e-Participation design with emphasis on the key aspects essential for the citizen-to-decision-maker dialog sustainability and iterative re-production. In particular the model explicitly addresses the Duality of e-Participation through the acknowledgement of spontaneous citizen-contributions via Social Media therefore significantly supports citizen-engagement as the key factor for e-Participation initiative success. Here it is important to emphasize that the model has been intentionally designed as a core model in order to ensure possibly universal applicability with details left to be specified on case-to-case bases.

To our knowledge, the state-of-the-art-literature does not provide an explicit e-Participation Ontology that would cover comprehensively e-Participation as an initiative contingent on three main e-Participation aspects. Here we acknowledge the work by Wimmer [32] who provides an ontology for e-Participation research structuration and work by Belak [30] who's ontology tackles the deliberation aspects of e-Participation.

4.2 e-Participation Model Architecture and Implementation

In order to achieve maximum clarity of expression and sufficiently explicit model representation, enabling more comprehensive visualization, we incorporated the conceptual model and implementation of the modeling stage and realization stage of the construction workflow in one single step. We represented the model using RDF[1] – Resource Description Framework and OWL[2] – Web Ontology Language. For the particular model implementation we leveraged the NEOLOGISM[3] and PROTÉGÉ[4] tools for the ontology design, description and visualization. Moreover the NEOLOGISM enabled direct ontology publishing therefore the full ontology representation can be provided if requested. RDF technology has been designed and developed in order to supply interoperability for information on the Web[5]. The connected, structured data on the Web is called Linked Data [3]. The RDF information can be stored in a form of an interconnected knowledge graph in an RDF store (such as JENA TDB[5] or SESAME[6]), which provides a standardized way of querying the graph – SPARQL endpoint utilizing the SPARQL[7] query language. The RDF semantic interoperability layer leverages ontologies as a means of describing the information. An ontology can be understood as an explicit specification of a conceptualization therefore can be defined as a specification of a representational vocabulary for a domain[10]. In particular the conceptualization can be understood as classes and their relations in the domain of a discourse, which can be represented with a predicate calculus [19]. The purpose of an ontology is sharing and reuse of knowledge therefore this representation aligns perfectly with the identified mission of the e-Participation Model. The concepts defined follow the best practice for ontology creation and explicitly express the key aspects of e-Participation domain.

4.3 e-Participation Model dependencies and deployment constraints

In this section we discuss how the relations between the three distinct views of e-Participation: Platform, Project and Process are reflected in the model design. We use the capitalized concepts names to link the considered content with the model presented on Figure 4. First, ideally the Democratic Process drives the whole e-Participation initiative. It is up to this process to define the mission (Policy Making Handle), key actors responsible (Stakeholder who can be a person as well as an organisation), execution (Execution Procedure), basic Instruments of execution, the scope (Domain), the expected outcomes (Result) and the initiation of e-Participation (Trigger). The basic process definition and formal declaration is used to spawn a relevant e-Participation project within particular constraints of Cost/Funding and timeframe (Start Time, End Time) executed by particular consortium of Stakeholders, with an expectation of comprehensive outcome (Result). The project demands sufficient marketing and Dissemination efforts within defined constraints in order to maximize the project impact. Here the expected impact has to be defined as an Evaluation Measure and aligned to the defined Goal and will be finally expressed through Performance Value. The project uses the resources assigned to realize e-Participation facilitated by the project Management team. The common realization of the e-Participation Channel is a particular e-Participation platform where the Maintenance is entrusted to the project team who design the platform but can be also delegated to external service providers. The platform is built with available Tools enabling fast and easy citizens-to-citizens and citizens-to-decision-makers (dependable on User Feedback Direction) communication (User Feedback) in a form of structured Discussion on particular Topic within the initiative Domain. Here the Communication Type provided can be synchronous (for instance a live-chat) or asynchronous (forum, blog etc.). Moreover the discussion on the platform is extended with deliberation on Social Media through relevant citizen-spontaneous-discussion Monitoring services. The platform performance is evaluated accordingly to Technical Performance Measures defined and expressed by particular Technical Performance Value. Finally in order to deal with information overload and facilitate information exploration the Discussion is summarized (Discussion Summary) either in an automatic or manual manner and published in a form of platform discussion Result along with citizen-satisfaction expressed in User Ranking. The Result, together with User Ranking and the Technical Performance Value are important elements of the e-Participation project outcomes reporting and finally decide about the overall e-Participation Democratic Process performance as a part of e-Participation re-production effort.

[1] http://www.w3.org/RDF/

[2] http://www.w3.org/2001/sw/wiki/OWL

[3] http://neologism.deri.ie/

[4] http://protege.stanford.edu/

[5] http://jena.apache.org/documentation/tdb/

[6] http://www.openrdf.org/

[7] http://www.w3.org/TR/rdf-sparql-query/

4.4 e-Participation Model Use-Case

In this section we are discussing example use of the presented ontology for two different real-world e-Participation initiative cases. The first case study involves a transportation e-Participation initiative (Forum) established in 2011 as a volunteer initiative in Galway, Republic of Ireland, to identify a range of implementable, short-term traffic measures that will help alleviate some of the current city-transport difficulties. The core idea behind the solution has been to address the participation barriers, especially in context of social inclusion and impact on policy-making. The project involved most major local transportation stakeholder groups, ranging from government officials to ordinary citizens. The diverse group of stakeholders includes: the mayor, chamber of commerce, local development authorities, representatives of the enterprise sector, academia (especially civil engineering, social science and computer science), along with independent volunteers and finally the citizens.

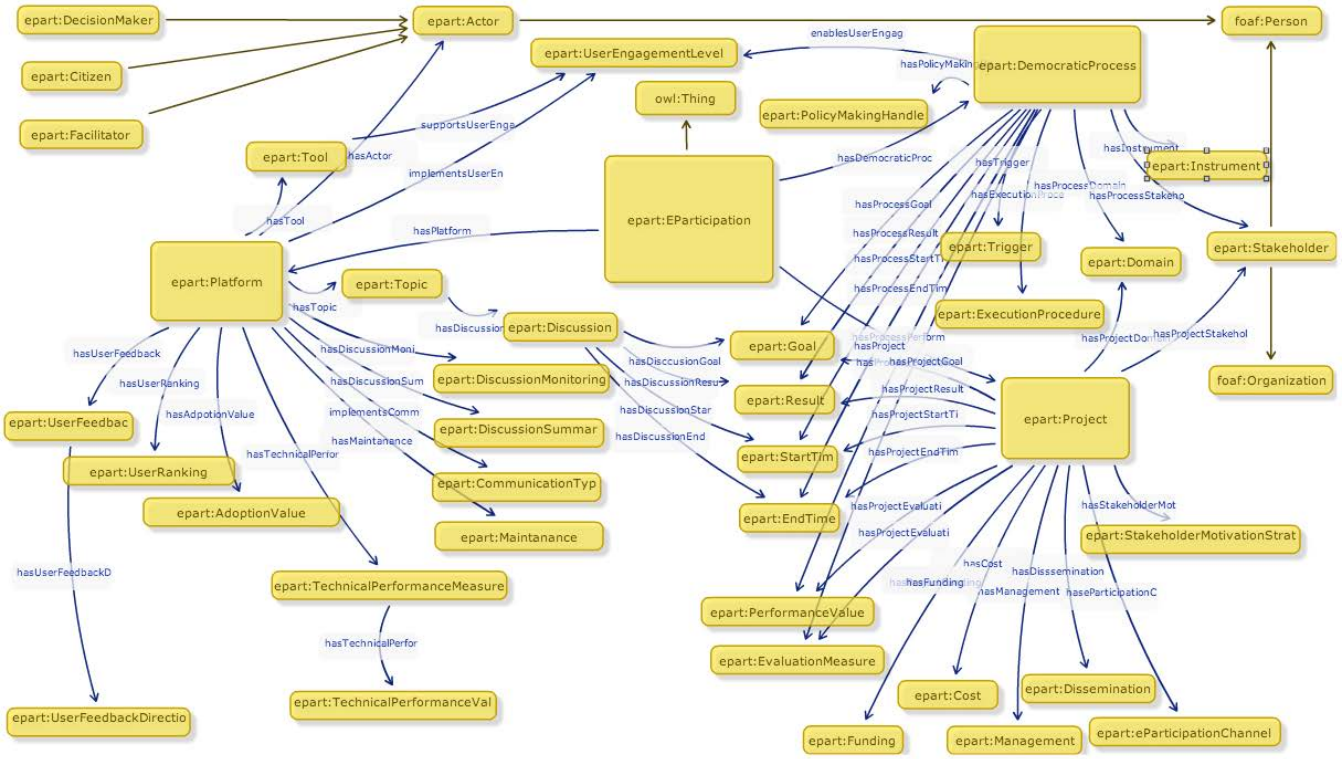

Figure 4: e-Participation Ontology

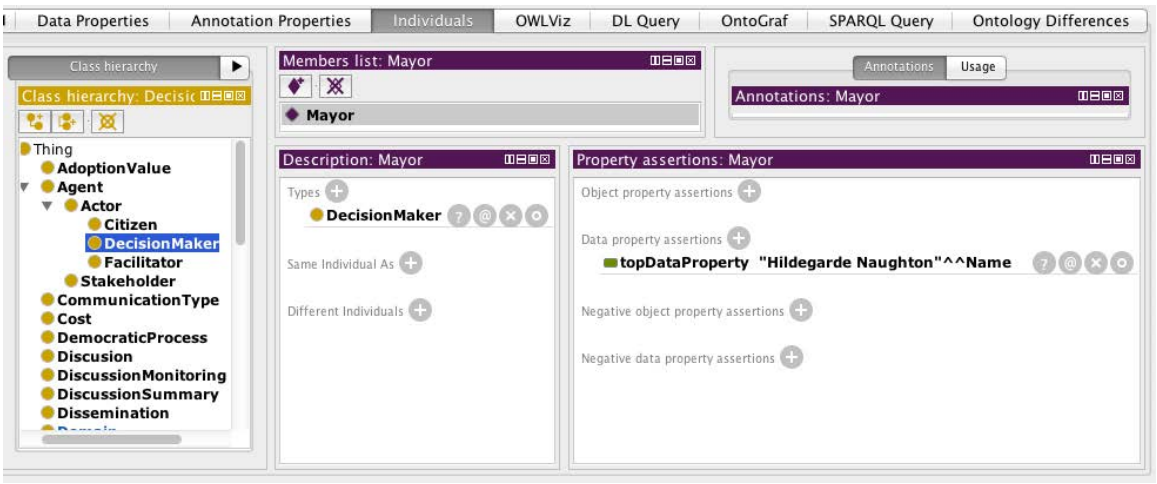

Figure 5: Platform Actor Example

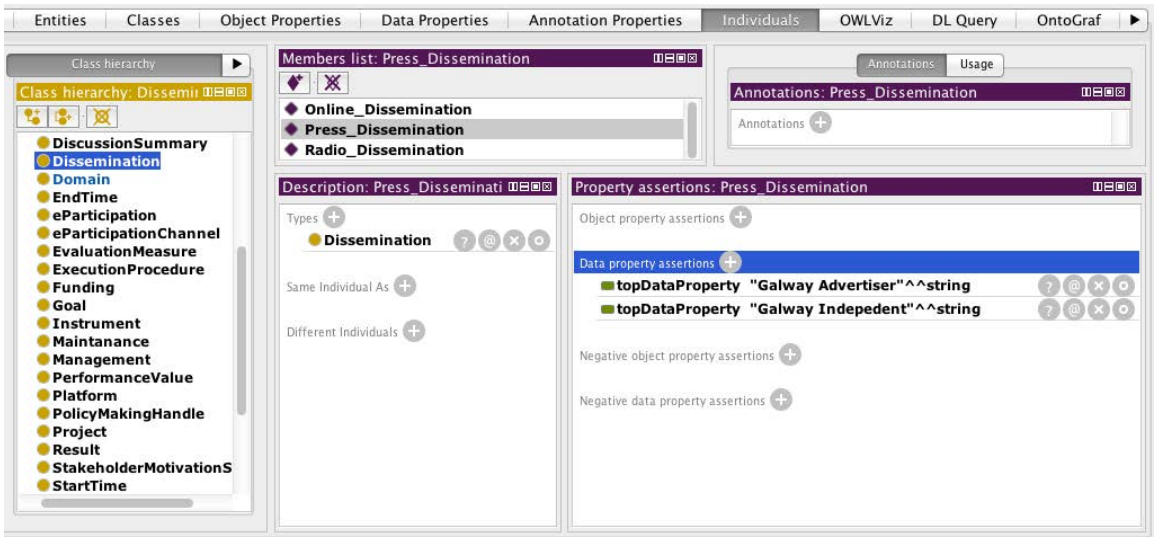

Figure 6: Project Dissemination Example

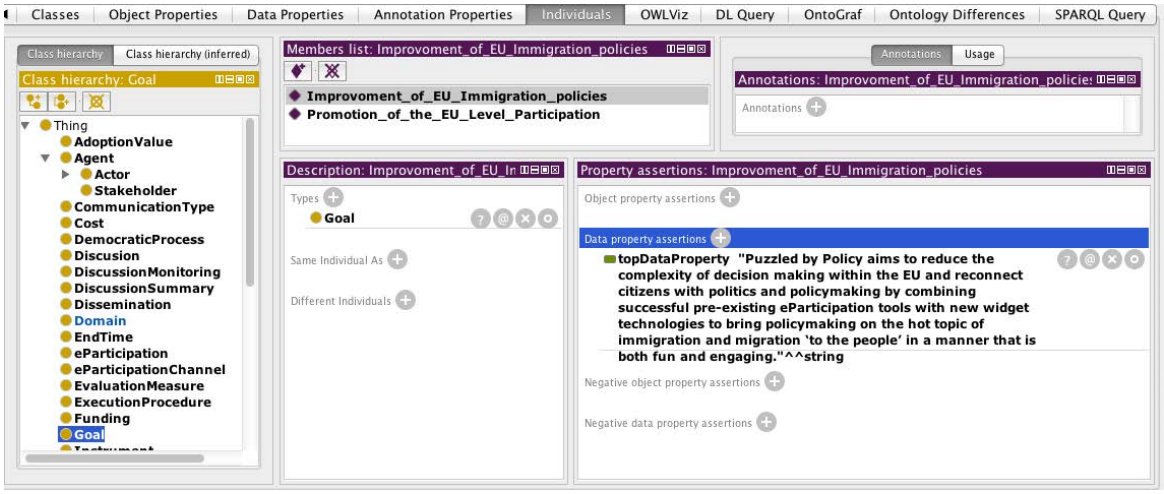

Figure 7: Project Goal Example

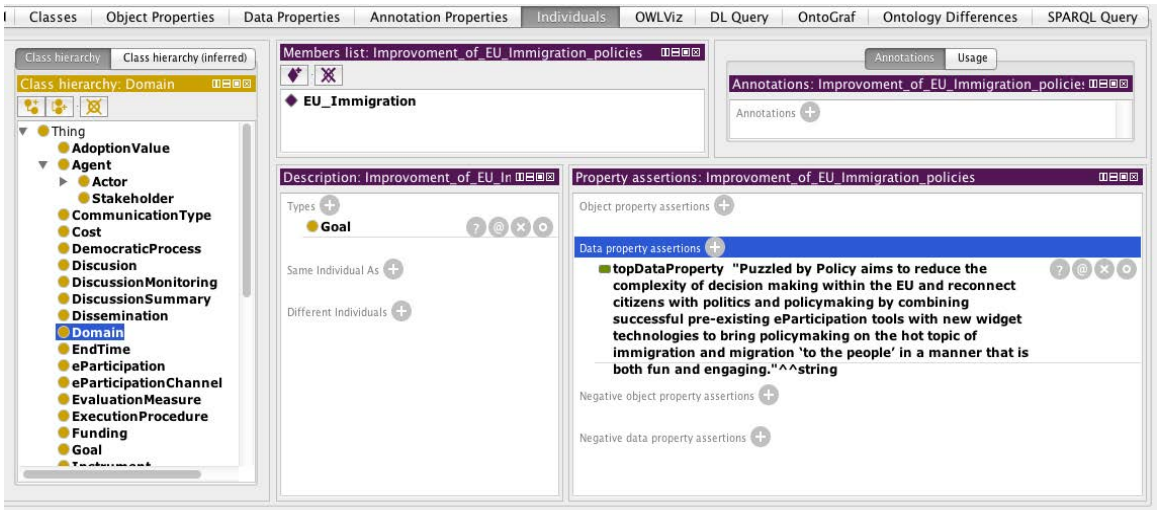

Figure 8: Project Domain Example

Now we use our e-Participation Ontology to represent the information about the Transportation e-Participation initiative. In order to generate the dataset presented we uploaded our ontology into PROTÉGÉ tool and leveraged the provided interface to generate relevant individuals. Because of limited space of this document we restrict ourselves to show just few representative examples. It is possible to request a full RDF description of the initiatives presented.

Figure 5 presents PROTÉGÉ interface with the ontology tree expanded on the left hand side along with the particular individual – here the platform Actor expanded. The particular Actor is of type Decision Maker and is the Mayor of the city where the transportation deliberation is taking place. On the right hand side we can see the name of the mayor specified. This enables us to conclude that the platform has active user, here decision-maker, the mayor of the city, whose participation is of great value considering the citizen-engagement on the platform.

Figure 6 presents a view on Dissemination individuals set which includes Online, Press and Radio dissemination. As it can be learnt from the figure the Press Dissemination efforts for the transportation e-Participation initiative involved local newspapers such as Galway Advertiser and Galway Independent. This is an important fact considering that these two positions are the most popular press in Galway City area and are an important communication channels reaching most of the local population.

The examples presented highlight the base structure of the use of the e-Participation Ontology for the transportation initiative in Galway. What can be observed immediately is that the data recorded has very rigid, typed format therefore can be machine processed directly and this facilitates easy data exploration and management. For instance the individual's data on Press Dissemination on Figure 6 is represented as topDataProperty of string type. This indicates explicitly the way the particular content can be extracted and processed. Similarly to the examples presented we have described the whole transportation e-Participation initiative accordingly to the defined ontology. The result has a form of a publishable RDF file that can be uploaded to any website or can be stored as query-able knowledge base and exposed on the web via SPARQL endpoint for full information transparency accordingly to the Open-Data principle.

The second case study refers to the European e-Participation project funded under FP7 framework – PuzzledByPolicy. The project aims to reconnect citizens with politics and policymaking in the context of immigration in Europe. The multinational project gathering partners from Ireland, Greece, Slovenia, Italy, UK, Portugal, Netherlands, Spain and Hungary contributes to the increase of public awareness on many aspects of immigration and to deliver relevant, objective information in presence of many confusing and politically biased opinions. The platform provided by the project in a form of a digital discussion forum, leverages special profiler tool to help citizens to identify their political standing. Again we use our ontology to represent information about the e-Participation initiative. On Figure 8 we can observe how the Domain for the project has been defined as EU Immigration and the data property provides detailed description of the domain discussed before. On Figure 7 we show how the Goals of the initiative are specified, in particular the goal to improve EU immigration policies has been highlighted with details recorded as data property. On request we can provide an RDF file with a complete initiative description.

5. VALIDATION

In this section we validate the implementation of the e-Participation ontology. Our first argument for the validity of our ontological model with respect to the competency questions follows from the ontology construction process. Given that the ontology was generated from competency questions (through Thalheim's construction workflow), the question of whether the ontology answers the competency questions is trivially satisfied, i.e. the ontology is "correct by design". Second, regarding the internal consistency of the e-Participation ontology (expressed in RDF/OWL), we verified using the PROTÉGÉ Pellet Reasoner tool that the ontology is coherent or without contradiction. Third, the utility and practical relevance of the ontology was established through its use in encoding the two case-studies of Transportation and EU immigration e-Participation initiatives.

6. DISCUSSION

The e-Participation Ontology presented in this paper addresses the need to have a comprehensive ontology for the e-Participation domain. The ontology covers three distinct views of e-Participation: Platform, Project and Democratic Process. The semantic model construction process is rigorous and grounded in solid theoretical framework ensuring high validity of the presented model as a solution for coherent e-Participation conceptualisation and as a tool for relevant, expressive and interoperable e-Participation initiative description. The rich e-Participation conceptualisation with particular acknowledgement of the state-of-the-art e-Participation extended with support for Duality of e-Participation, incorporating Social Media channels along with better alignment of citizen-contribution and e-Participation re-production ensure better sustainability and potentially increased citizen engagement. In principle the model enables better and more rigid e-Participation initiatives descriptions therefore supports more coherent comparisons and evaluations as well as facilitates the access, re-use and interoperability of the information about the initiatives.
The e-Participation ontology design has been validated and we have shown the utility of the solution.

Like any domain theory, we cannot claim the completeness of the presented semantic model although our ontology has been designed gradually around the Integrated Model for e-Participation with particular acknowledgement of the issue of Duality of e-Participation starting from the scientifically supported model going towards dedicated implementation, therefore we claim better alignment of our model to dual e-Participation needs.

As indicated in Section 4 we acknowledge the work by Wimmer [32] which defined an ontology for e-Participation, but focuses on e-Participation as a research project and is intended to serve as e-Participation research domain map. The referenced work by Belak [30] is even more focused and tackles explicitly the political discourse with emphasis on political issues and solution generation. Nevertheless we are not aware of any significant attempts at addressing the conceptualisation of e-Participation contingent on three views (Platform, Project, Democratic Process) with support for the Duality of e-Participation.

7. CONCLUSIONS

Motivated by the need to provide the necessary step towards conceptualising three major aspects of e-Participation in a single model, we have presented a universal, core e-Participation Ontology. Results from our work show immediate opportunities for consolidating and sharing knowledge about e-Participation initiatives. We have demonstrated theoretically the usefulness of the model. As next steps, we intend to establish an e-Participation knowledge base gathering information about e-Participation initiatives structured with our ontology. Furthers steps include design of a fine-grained ontology extending the core ontology with support for deliberative political discourse management with particular support for the Duality of e-Participation followed by the design of a solution for a deployment for selected e-Participation initiatives.

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