

A Semantic Deliberation Model for e-Participation

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Abstract. There have been very few attempts so far to develop a comprehensive and rigorous conceptualization for deliberations in e-participation. Without a rigorous and formal conceptualization of deliberation, consistent content descriptions creation, deliberation records sharing and seamless exploration is difficult. In addition, no e-participation deliberation ontology exists to support citizen-led e-participation particularly when considering contributions made on the social media platforms. This work bridges this gap by providing a rich conceptualization and corresponding formal and executable ontology for deliberation in the context of e-participation. The semantic model covers the core concepts of technology-mediated political discussion and explicitly supports the integrated citizen- and government-led model of e-Participation enabled by social media. Results from the use of the ontology in describing e-Participation deliberation information at Local Government projects are also presented.

Keywords. e-participation, citizen-led e-participation, e-participation framework

Introduction

e-Participation, implements technology-mediated dialogue between citizens and decision-makers [1] to facilitate, fast-feedback-enabled participation [2] while also introducing new political participation channels [3]. Extant literature on e-participation is replete with reference models. Relatively more cited among these works include: Dimensions of e-Participation Framework [4], Levels of Participation Model [5], Ladder of Online Participation [6], Behavior Chain Model [7], e-Participation Assessment Framework [8], e-Participation Evaluation Framework [9], e-Participation Exploitation Framework [10]. However these models show limited consideration for the implementation of the deliberation channel. This gap is further enlarged when considering spontaneous citizen political discussions on social media. Existing models are very abstract without sufficiently detailed conceptualization to support technical solutions directly. Therefore, existing models do not lend themselves to practical applications in developing technology support for political deliberation on traditional e-participation platforms and social media.

Due to lack of rigorous and scientifically grounded technology-mediated, political deliberation blueprints, e-participation designers intuitively develop dedicated forums imitating popular WEB 2.0 mainstream forum solutions (like HUWY,¹

¹ <http://www.huwy.eu/vi>

U@MARENOSTRUM,² VIDI,³ WAVE,⁴ VOICES,⁵ Puzzled by Policy⁶), drawing from the wisdom and popularity of the consumer, and interest-groups discussion platforms. However, political deliberation is of very special nature and commercial solutions do not necessarily map directly to particular e-participation needs. Against this background and in line with Macintosh et al. in [11], we argue on the need for e-participation to support in particular direct inclusion, monitoring and engagement of citizens with spontaneous political discussions on social media as a fundamental condition for sustainable e-participation. This is reflected in our Integrated Model for e-Participation [12] (IMeP) derived from Giddens's Structuration Theory [13] and complemented by Dynamic Capabilities Theory [14,15] which supports the Duality of e-Participation. Based on the model, we developed a conceptualization for e-participation implemented as a formal Ontology for e-Participation. This core model describes e-participation comprehensively along the core perspectives – platform, project, and process. In this paper we focus on the technical aspect and refine the model to capture the key aspects of the technology-mediated political deliberation. In our approach, we considered state-of-the art models for deliberative argumentation and the Integrated Model for e-Participation to elicit a comprehensive list of technology-mediated, citizen-led political deliberation requirements. Next we align state-of-the art discussion information metadata models, and identify missing concepts. Finally, we present a deliberation ontology for citizen-led e-participation.

The developed semantic model enables detailed, standardised deliberation information descriptions, facilitating seamless knowledge exploration and interoperability between various e-participation platforms, external content linking as well as better understanding of the content among e-participation stakeholders.

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

1. Approach

This section describes how we conceptualize political deliberation in the context of the citizen-led participation. The conceptual framework is provided in Section 1.1 and methodology in Section 1.2.

1.1. Conceptual Framework

Our conceptual framework comprises three core elements: 1) Pepper's World Hypotheses defining generic views for deliberation domain ontological space analysis, 2) Argumentation in Deliberation Theory and 3) our Integrated Model for e-Participation.

While it is common to analyze conceptual space of a domain by answering common journalistic questions (5W1H) [16] as a template for generating domain specific aspects, we intend to use more fine-grained framework derived from Pepper's World Hypotheses [17]. Our choice of is premised on the fact that the Pepper's views are

²<http://www.uatmarenostrum.eu/>

³<http://www.vidi-project.eu/>

⁴<http://www.wave-project.eu/>

⁵<http://www.give-your-voice.eu/>

⁶<http://join.puzzledbypolicy.eu/>

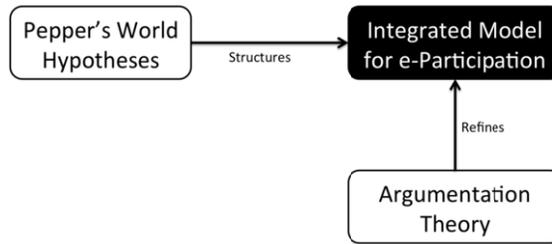


Figure 1. The Theoretical Framework Alignment.

metaphorically richer compared with the journalistic questions [18] as well that it can be mapped to the journalistic questions and Aristotle four causes. Moreover there is evidence of the suitability of applying Pepper's hypotheses for structuring and analyzing socio-technical systems [19]. Pepper identified four different adequate views of the world: Mechanism, Formism, Organicism and Contextualism [19,20] which in the context of e-participation deliberation, enable the specification of: deliberation goals to be realized through some staged models (Organicism); description of different entities involved in realizing a specified deliberation goals (Formism); the different functions, processes and tools required to produce desired e-deliberation outputs or outcomes (Mechanism); indication and evaluation of the experience of actors and observers of deliberation process (Contextualism).

We use the framework to create a theoretical grid (Fig. 1) for competency questions that we derive further from Integrated Model for e-Participation with deliberation part refined by Argumentation Theory. In 2009, Macintosh [11] identified the Duality of e-Participation as one of the key research gaps of the e-participation. The Integrated Model for e-Participation (IMeP) addresses the e-participation duality and is grounded in Structuration Theory and Dynamic Capabilities Theory. IMeP leverages two approaches to e-Participation: classic, Government-led e-Participation and the new, Citizen-led e-Participation. The two channels 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. Citizens given appropriate resources exercise their agency to participate in the social-system re-production. The legitimacy and significance of citizens' contribution to policy making and political deliberation is strengthened directly by government's acknowledgement, consideration and subsequent (partial) adoption. We have identified the following types of essential 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 deliberation monitoring process, deliberation 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.

The OECD [21] put the active participation through deliberation as one of the core e-participation challenges while considering argumentation and engagement as the key aspects of deliberation. Argumentation theory is grounded in informal reasoning and

aims at developing ways of analyzing everyday conversation. According to the theory argument is an attempt to present evidence for a conclusion supported by particular premises (propositions or claims). Argumentative discussion, ideally of low persuasion should not assume particular deliberation results but the conclusions should rather evolve organically from a constructive discussion where participants convince others to their views [22]. According to Schneider [23] the arguments need to be identified, resolved, represented and stored, queried and presented to user. For this Schneider recalls fourteen most prominent reference models as a base for argumentation representation and exploration framework. We list models that we consider most relevant to political discussion requirements:

- **Toulmin** – model for legal, scientific and informal conversation arguments. All the claims supported by evidence or rules (warrants which can have a backing) can be qualified regarding certainty or rebutted.
- **IBIS** – Issue-Based Information Systems centers around issues that may have a form of a question. IBIS distinguishes three separate groups: participants in discussion, experts and decision-makers.
- **Walton’s Critical Questions** – defines a set of critical questions aligned with the particular role addressing the points where the argument scheme may brake down. For example some questions defined can be: How credible is E as an expert source? Is E reliable?
- **Speech Act Theory** – a base for many argumentation conversations. Distinguishes five categories of speech acts: assertives (assumption), directives (order), commissives (vows), expressives (sentiment) and declaratives (enact what is said).

1.2. Methodology

A major goal of this work is to develop a comprehensive e-Participation Deliberation Model and a corresponding formal ontology. Our approach followed the three-staged Thalheim’s construction workflow [24] (relevance stage, modeling stage, realization stage) as a best practice for model design and implementation process. Relevance Stage is represented by Section 2, Modeling Stage corresponds with Section 3 and Realization Stage is widely discussed in Section 3.2, 4 and 5.

In particular the questions for our enquiry include:

- R1. What are the key aspects of political deliberations on e-participation platforms?
- R2. What are the key Competency Questions for political deliberation conceptualization or ontology?
- R3. How to ensure the completeness of the Competency Questions?
- R4. What concepts can be elicited from the e-Participation Competency Questions?
- R5. How can the concepts be consolidated in a comprehensive deliberation model?
- R6. How can the model be leveraged for e-Participation deliberation cases?

Answering these questions based on the following steps:

1. *Knowledge Acquisition*: The Argumentation Theory and the Integrated Model for e-Participation provide a rich source of information on application domain

Table 1. Deliberation Competency Questions

Generic Views	Questions
Formism	CQ.3 Who are the deliberation actors? CQ.6 What are the deliberation claims? CQ.8 What are the topic arguments?
Mechanism	CQ.11 How deliberation is monitored? CQ.12 How deliberation is summarized? CQ.19 How actors are qualified? (credibility)
Organicism	CQ.20 What is the aim of the deliberation? CQ.23 What is the result of deliberation?
Contextualism	CQ.23 What are the deliberation performance measures?

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 four views defined by the Pepper's World Hypotheses.

2. *Deliberation Concepts Elicitation*: Mapping the competency questions to specific political deliberation aspects entails determining which of the four generic views 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.
3. *Concept to Model Alignment*: After eliciting base-concepts and defining the relations we align the concept to the existing deliberation models.
4. *Ontology Creation*: After aligning base-concepts we use available tool (NEOLOGISM [25]) to graphically represent the concepts and relations in a form of a graph with re-using matching concepts by importing (referencing) existing ontologies. 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 [26].

2. Deliberation Conceptualization

This section develops a comprehensive deliberation domain conceptualization which supports the Duality of e-Participation. We elicit a set of relevant political deliberation competency questions from the Argumentation Theory based models and the Integrated Model for e-Participation (Fig. 2) and then align the questions to the four generic views derived from Pepper's World Hypotheses. Due to space limitation, we only present a subset of the competency questions in Table 1.

Having identified the key competency questions we elicit the core deliberation concepts presented in Table 2.

Due to space limitation, we list only few example concepts along with corresponding competency questions and relations between concepts. These conceptualizations are essential for the Thalheim's workflow-based deliberation model design. The concepts and relations presented in a way that can be directly mapped on the classes and properties of existing ontologies.

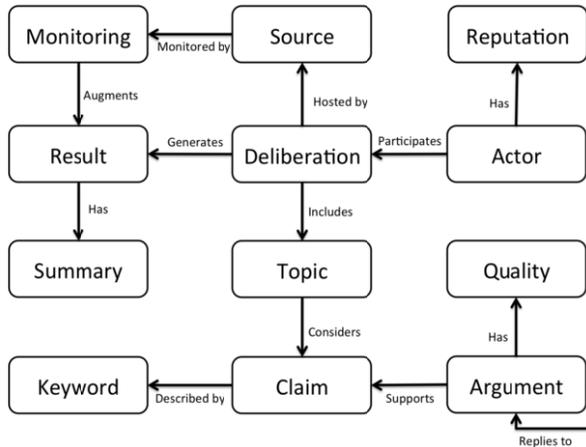


Figure 2. Deliberation Conceptual Model.

Table 2. Competency Questions To Concepts Mapping

Question ID	Concepts	Relations
CQ.5	Topic	Deliberation includes Topic
CQ.6	Claim	Topic has Claim
CQ.7	Keyword	Claim has Keyword
CQ.8	Argument	Claim has Argument
CQ.9	Conclusion	Topic has Conclusion

3. Deliberation Model

In this section we show the design and the implementation of the deliberation model, based on the concepts and relations defined in Section 3. First, we present a conceptual model for deliberation (Fig. 2) highlighting the overall scope and dependencies of the implemented end-model. The generic view is represented with most descriptive concepts only for better understanding of the model. It is clear from the elicited concepts that the central point for discussion on e-participation platforms (or spontaneous political discussions on social media) referred in the model, as a Source is Deliberation. By Deliberation we understand an argumentative discussion where every Post, belonging to particular Topic, is considered a Claim described by particular Keywords and should be supported by relevant evidence in a form of an Argument. Every Argument supplied by an Actor of particular Reputation has particular Quality measure (like relevance) assigned and can be backed or rebutted by other arguments. The Result of the Deliberation should be summarized to address the information overload issue and facilitate discussion exploration experience. The discussion Summary is augmented by extra information coming from Monitoring system mining and linking related information from external sources like other e-participation platforms and social media to ensure deliberation re-production and sustainability.

3.1. Deliberation Model Mission

The main purpose of the model is to provide e-participation platform designers and managers with relevant tool for structured and standardized representation of deliberation data and implicitly to support better e-participation experience for deliberation stakeholders. It is expected that more comprehensive data descriptions will contribute directly to better interoperability, easier data exchange and integration of information from various deliberation sources such us current e-participation platforms as well as social media. Moreover the unified, standardized, machine-readable representation will enable more coherent deliberation evaluation and comparison. The model supports coherent deliberation process design with emphasis on the key aspects essential for sustaining citizen-to-decision-maker dialog. In particular the model covers the Duality of e-Participation through seamless incorporation of spontaneous citizen-contributions on social media therefore significantly supports citizen-engagement as the key factor for e-participation initiative success. To our knowledge, no explicit deliberation ontology exist which comprehensively addresses the Duality of e-Participation. Here we acknowledge the work by Wimmer [27] which provides an ontology for e-participation research structuration and work by Belak [28] whose ontology tackles the deliberation as part of e-participation but focuses on the political aspects of deliberation with emphasis on particular case related to election and political agenda.

3.2. Deliberation Model Architecture and Implementation

Our goal is to implement the deliberation model in a formal ontology language such as RDF⁷ (Resource Description Framework) and OWL⁸ (Web Ontology Language). In line with best practice in ontology development, we attempt to re-use and extend existing and well-established ontologies to support our deliberation model. Thus, we identified key ontologies and align them to the deliberation conceptualization. Among prominent discussion and argumentation ontologies identified by Schneider are: IBIS – RDF (Interoperability in Business Information Systems – Resource Description Framework) [29], SALT (Semantically Annotated LaTeX for Scientific Publications) [30], DILIGENT [31] (DIstributed, Loosely-controlled and evolInG Engineering processes of oNTologies), Change Ontology (ChAO) [32], SIOC-Argumentation (Semantically Interlinked Online Communities) [33] and SWAN-SIOC (Semantic Web Applications in Neuromedicine) [34]. However, only SIOC with Argumentation module (drawing from IBIS and DILIGENT) offers sufficiently generic, domain independent, yet significant coverage for e-participation deliberation needs. The base SIOC⁹ ontology provides core concepts and properties to describe discussion information on the web. The ontology complemented by the Argumentation Module enables comprehensive argumentative discussion coverage for the general discussion case. Therefore in our paper we focus in particular on SIOC with Argumentation ontology as the base ontology and augment it with e-participation domain-specific concepts.

In Table 3 we present the elicited concepts aligned to SIOC and SIOC_ARG (SIOC Argumentation module) where a conceptual match occurs. The remaining concepts make the conceptual space for our deliberation ontology (DELIB). Due to space

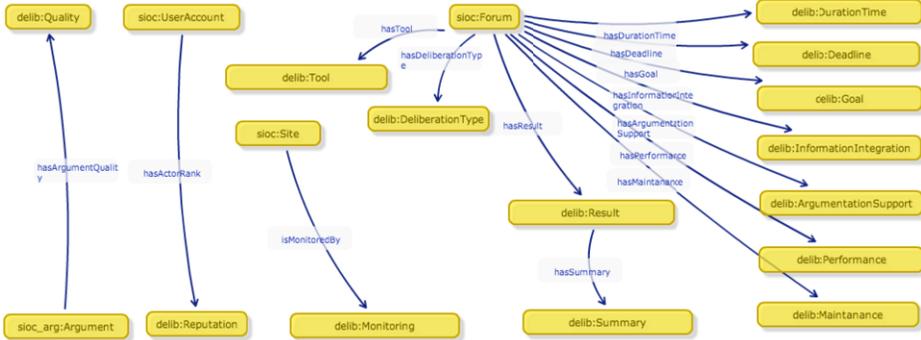
⁷<http://www.w3.org/RDF/>

⁸<http://www.w3.org/2001/sw/wiki/OWL>

⁹<http://rdfs.org/sioc/spec/>

Table 3. Deliberation ontology alignment (selected examples)

Concept	Ontology	Representing Concept
Deliberation	SIOC	Forum
Source	SIOC	Site
Claim	SIOC_ARG	Statement
Argument	SIOC_ARG	Argument
Conclusion	SIOC_ARG	Position

**Figure 3.** DELIB Ontology (without SIOC concepts).

constraints, we do not list all the mappings nor describe in detail the concepts and relations defined by SIOC Argumentation ontology. The final mapping enabled us to construct the e-Participation Deliberation Ontology (DELIB) (Fig. 3) based on web-ontologies best practice. To ensure clarity of presentation we focus only DELIB specific concepts leaving-out the concepts and relations covered by the base ontologies, nevertheless the full ontology representation can be provided if requested.

4. e-Participation Deliberation Model Use-Case

In order to illustrate how to apply the DELIB model; we employed the ontology created to structure and to describe real discussion data from a transportation e-participation initiative in an Irish city. Since the data mined from the dedicated WEB 2.0 forum does not contain the argumentative discussion structure, the descriptions had to be generated semi-automatically with manual categorization of claims and arguments. The ultimate use of the ontology assumes automatic content analysis and structuration accordingly to the DELIB ontology.

5. Validation

In this section we validate the implementation of the e-Participation Deliberation 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 DELIB 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 deliberation information for a case-study of a transportation e-participation initiative.

6. Discussion

The DELIB ontology presented in this paper addresses the need for rigorous conceptual model and formal ontology to describe e-participation deliberation data. 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 deliberation conceptualisation and as a tool for relevant, expressive and interoperable deliberation data representation. The rich conceptualisation with supports the argumentative nature of e-participation deliberation; Duality of e-Participation; seamless integration of external social media content along; and better alignment of discussion reproduction altogether better guarantees sustainable deliberation and increased citizen engagement. In principle the model enables better and more fine-grained deliberation content descriptions, more coherent information linking as well as facilitates the access, re-use and interoperability of the discussion information. DELIB ontology design has been validated and we have shown the utility of the solution. We cannot claim the absolute completeness of the presented semantic model although our ontology has been designed gradually around the Argumentation Theory and Integrated Model for e-Participation starting from the well-established models going towards dedicated implementation; therefore we claim better support of our model for dual e-Participation needs. As indicated in Section 4, we acknowledge the work by Wimmer [27] and Belak [28], nevertheless we argue on significantly different purpose of these ontologies in comparison to DELIB and we are not aware of any significant attempts at addressing the conceptualisation of e-participation deliberation with support for the Duality of e-Participation.

7. Conclusion

Motivated by the need to provide the necessary step towards conceptualising e-participation duality-enabled deliberation, we have presented a Deliberation Ontology for e-Participation. Results from our work show immediate opportunities for consolidating and sharing data from deliberative discourses available on both dedicated e-participation platforms and social media. As next steps, we intend to create an e-participation discussion knowledge base by mining information from e-participation platforms and social media and representing the structured content in a form of a common RDF knowledge graph with our ontology. Further steps include more real-life, case-based evaluations of the ontology, possible extensions.

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