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Social Software Infrastructure for e-Participation

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ABSTRACT

Despite the ubiquity of e-Participation initiatives, efforts in mainstreaming social media-based and citizen-led political deliberations are still limited. Consequently, there is little opportunity to leverage, study and understand the expected mutual re-shaping of deliberations on traditional e-Participation and spontaneous citizen discussions on social media platforms. This mutual re-shaping phenomenon also referred to as "duality of e-Participation"; requires inter alia a Social Software Infrastructure (SSI) to enable decision makers in government access relevant information about ongoing citizen discussions on social media platforms. This article describes the design of such SSI. The design is based on a comprehensive set of requirements specifying relevant technical capabilities required to support a number of core facets of an integrated e-Participation model. In addition, the paper describes the software components for realizing the design and how an implementation of the SSI was employed as part of an e-Participation initiative in Europe. We conclude with some of the socio-technical challenges associated with implementing of some of the components of the Social Software Infrastructure.

1. Introduction

e-Participation employs technology-mediated dialog between citizens and the politics sphere and between citizens and administration (Sabo, Rose, & Skiftenesflak, 2008) to enable effective, concurrent public participation and feedback (Chadwick, 2003) while also introducing new ways of political participation (Dijk, 2000). In line with the definition provided by Macintosh et al. (Macintosh, 2004a, 2004b), we consider e-Participation as a distinct area from e-Voting, which is classified as a support tool for e-Enabled election.

The domain of e-Participation has over the years generated a plethora of reference models. Widely referenced conceptualisations of e-Participation include: Dimensions of e-Participation Framework (Macintosh, 2004a, 2004b), Levels of Participation Model (DESA, 2005), Ladder of Online Participation (Li & Bernoff, 2007), Behavior Chain Model (Fogg & Eckles, 2007), e-Participation Assessment Framework (Tambouris, Liotas, & Tarabanis, 2007), e-Participation Evaluation Framework (Ann Macintosh, 2008), e-Participation Exploitation Framework (Phang & Kankanhalli, 2008) and a few others (Aichholzer & Westholm, 2009; Islam, 2008; Preece & Shneiderman, 2009; Sæbø, Flak, & Sein, 2011). These models capture the key aspects and success factors for e-Participation. They also provide the foundation for e-Participation projects and architectures discussed further in Section 2. However, as we showed in our previous research work (*reference removed for the review*), despite the fact that these models address one or more aspects of e-Participation; they do not sufficiently cover the core facets of e-Participation. In our opinion, the inadequacy of existing models to simultaneously address technical and democratic facets of e-Participation initiatives may be partly responsible for the largely poor e-Participation outcomes to date; in particular abysmal level of citizen engagement (Macintosh, Coleman, & Schneeberger, 2009). Extant literature provides multiple reasons why people participate in e-Participation initiatives (Batson, Ahmad, & Tsang, 2002; Clary & Snyder, 1999; Klandermans, 2003; McEwin, 1992; Rochester, 2006). For example, motivational factors for participation include: 1) self-development or 2) career advancement and 3) better group status. Unfortunately, these facts are not exploited in the state-of-the-art e-Participation models and rarely in the design of e-Participation platforms. In this context, Macintosh et al. (Macintosh et al., 2009) observed that citizens' owned informal communication channels, create new forms of e-Participation that if harnessed could potentially shape deliberations on traditional e-Participation platforms, resulting in some duality of e-Participation with potentially stronger and more positive participation outcomes. Macintosh et al. (2009) frame duality of e-Participation as a complementarity of the two distinct e-Participation channels; citizen- and government-led e-Participation channels. In particular, Macintosh and her co-authors argue for the importance of synergy of the old and emerging channel given that similar issues are discussed on both types of platforms.

The article describes the design of the technology subsystem (a Social Software Infrastructure) of an e-Participation system — the Social Software Infrastructure (SSI). The SSI enables e-Participation stakeholders harness the synergy and potential re-shaping effect of

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citizen-led and government-led e-Participation (i.e. the duality of e-Participation). The design model is grounded in a theoretical framework drawing from Gidden's Structuration Theory (Giddens, 1984) and complemented by Dynamic Capabilities Theory (Teece, Pisano, Shuen, & Shuen, 1997). The underpinning theoretical framework (*reference removed for the review*) describes an Integrated Model for e-Participation that identifies the key e-Participation capabilities required to support the integration of both government-led and citizen-led e-Participation. Central to the Social Software Infrastructure are Information Extraction and Knowledge Discovery components that automatically process textual contents from major social media platforms to generate useful information about citizen comments, opinions and sentiments on public services and policies of interest.

The rest of the article is organized as follows: Section 2 discusses related work, while Section 3 presents the methodology. Section 4 elaborates on requirements specification, architecture, implementation and validation model for Social Software Infrastructure. Section 5 presents a case study describing the use of SSI, while Section 6 discusses the contribution of the work towards improved e-Participation and also discusses challenges in the implementation of the SSI. Final conclusions and future work are described in the conclusion.

2. Related work

The last decade showed many examples of the use of social software as an infrastructure for realizing particular aspects of e-Participation. Social software is usually referred to as Web 2.0 software or Web 2.0 platforms, and it enables social networking. Specifically these platforms provide capabilities for people to contact and interact with each other (Reuter & Marx, 2011). The main principles of Web 2.0 include the collective intelligence (wisdom of the crowd) and collaborative content creation and linking by users (or citizens in this case) contributing towards common knowledge (O'Reilly, 2007). Many e-Participation projects such as eMPOWER[1] EUROPETITION,[2] HUWY,[3] U@MARENOSTRUM,[4] VIDI,[5] WAVE,[6] VOICES,[7] WEGOV,[8] Puzzled by Policy,[9] IMPACT,[10] COCPIT,[11] OCOPOMO,[12] PADGETS,[13] SPACES,[14] NOMAD[15] and EPOLICY[16] are built on Web 2.0 tools such as digital forums, blogs, wikis and live-chat to provide dedicated e-Participation environment where citizens can express and discuss their needs and concerns. These highly structured platforms, though well designed to specific e-Participation needs; in principle suffer from a lack of engagement from citizens. Whereas, social software tools like social media platforms, are widely and routinely used by citizens for spontaneous political discussions, though without direct link to the formal e-Participation process (Macintosh et al., 2009). Bouman et al. (2008) argue that the success of particular social software design is determined not by the functionality, but the sociality support the social software system provides to its users. Sociality here connotes enjoyment of companionship and social activities (Bouman et al., 2008). Therefore, the design of social software focuses the on means of increasing the sociality value. Bouman et al. (2008) also argue that a designer of social software has to address all issues of enabling practice, mimicking reality, building an identity and actualizing self.

Typical examples of popular and successful social software platforms include Facebook and Twitter. These well-established platforms attract far more engagement than any traditional e-Participation solution. In fact, their use has been incorporated into everyday activities (Lane & Coleman, 2012). The significant advantage of popular social media over other means of electronic communication (from e-Government perspective) is in the ease of use, rich interaction dynamics and accessibility to information of interest. Thus, there are greater social capital potentials with social media that tends to increase citizen trust and government transparency (Bonsón, Torres, Royo, & Flores, 2012; Magro, 2012). In particular, as it has been shown that successful social media campaign can affect political popularity going by election results, many governments have employed social media as an important communication channel with citizens (Effing, Hillegersberg, & Huibers, 2011; Moreira & Ladner, 2009). Enriched government interaction with citizens on the social media has made co-production of public information and service with citizen a viable model of public service delivery (Linders, 2012). Other social-media use for e-Participation includes improved social-media-supported disaster and crisis management and policy development (Ashley, Corbett, Jones, Garside, & Rambaldi, 2009; Kuzma, 2010). Furthermore, social media have been playing an increasing role as crowdsourcing and rapid response tools, especially in crisis events; including political crisis (Makinen & Wangu Kuira, 2008) and natural disasters (Gao, Barbier, & Goolsby, 2011).

The social-media applications for e-Participation in the cases mentioned above focus on the use of popular social media platforms directly as a Government-to-Citizen communication tool targeted at a specific problem in a domain (e.g. gaining more electoral votes). Most of the past attempts to harness social media as e-Participation platform addressed only very specific aspects of e-Participation. Therefore a solution that would attempt to comprehensively consolidate traditional e-Participation channels and complement them with data generated from social media exploration for a window into citizen perspectives is yet to be developed. The design of such an e-Participation is considered in this article.

3. Approach

A major goal of this work is to elicit the requirements and develop a design model for the technical infrastructure needed to support the integration of social media based discussion and traditional e-Participation to enable the investigation about the duality of e-Participation. In particular, the technical infrastructure — a Social Software Infrastructure, will capture, process and analyze citizen-led political deliberations on social media and integrate results with those produced from traditional government-led e-Participation platforms and processes.

3.1. Methodology

This section describes the methodology used for designing the e-Participation Social Software Infrastructure. Our approach follows the Design Science Research Framework — DSRF (March & Smith, 1995) as the core approach. We adopt the DSRF to the specific needs of e-Participation Infrastructure design.

The design of the Social Software Infrastructure consists of the following steps:

S1) *Identifying the infrastructure requirements* — based on our Integrated Model for e-Participation described further in Section 3.2, we elicit the requirements for Social Software Infrastructure. This is achieved in two sub-steps. The first sub-step involves determining the required socio-technical and organizational capabilities (Table 1) for provisioning such

[1] EMPOWER http://www.ep-empower.eu/10.07.13
[2] EUROPETITION http://www.europetition.eu/10.07.13
[3] HUWY http://www.huwy.eu/vi10.07.13
[4] UMARENOSTRUM http://www.uatmarenostrum.eu/10.07.13
[5] VIDI http://www.vidi-project.eu/10.07.13
[6] WAVE http://www.wave-project.eu/10.07.13
[7] VOICES http://www.give-your-voice.eu/10.07.13
[8] WEGOV http://www.wegov-project.eu/10.07.13
[9] PUZZLED BY POLICY http://join.puzzledbypolicy.eu/10.07.13
[10] IMPACT http://join.puzzledbypolicy.eu/10.07.13
[11] COCPIT http://www.cockpit-project.eu/10.07.13
[12] OCOPOMO http://www.ocopomo.eu/10.07.13
[13] PADGETS http://www.padgets.eu/10.07.13
[14] SPACES http://www.positivespaces.eu/10.07.13
[15] NOMAD http://www.nomad-project.eu/10.07.13
[16] EPOLICY http://www.epolicy-project.eu/node/10.07.13

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Table 1
Social Software Infrastructure requirements.

Aspects of e-Participation		Dynamic capabilities		
		Adaptive	Absorptive	Innovative
	Empower	R.22 Government needs to provide tools that would enable citizens to influence directly policy making	R.23 Government needs to build an approach where citizens' suggestions are reflected directly in the policy-making agenda	R.24 Government should constantly seek for new ways of involving citizens into policy-making processes
CLeP	Process	R.19 Government needs tools that would facilitate the processing of the vast social media participation data	R.20 Government should analyze the spontaneous citizen discussions and recognize valuable contributions	R.21 Government should harness new technologies for better and faster processing of citizen input
	Shaping	R.16 Government needs tools to interact effectively with citizens and shape discussions on deliberation platforms	R.17 Governments should analyze citizens' discussions and provide frequent feedback to guide the discussions (expert opinion)	R.18 Government should harness new technologies enabling faster and more relevant interaction with citizens
	Listening	R.13 Government needs tools to monitor social media for spontaneous citizen deliberations	R.14 Government needs to recognize and acknowledge the citizen opinions provided on social media	R.15 Government needs to provision technology-agnostic (desktop, mobile), ubiquitous e-Participation platform through multiple social media channels
GLeP	Process	R.10 Government needs tool that would facilitate the processing of the participation data	R.11 Government should analyze citizens' discussions, for instance, to determine sentiments, complaints or their opinions on topics considered important by the citizens	R.12 Government should harness new technologies for better and faster process of citizen input
	Acknowledge	R.7 Government needs tools to provide feedback in response to citizen's contributions	R.8 Government needs to be responsive to citizens' ideas (recognize valuable contributions and provide constructive feedback)	R.9 Government should seek new ways of rewarding citizens for their contributions
	Stimulate	R.4 Government needs tools for dissemination and reaching wide audience to stimulate and sustain e-Participation	R.5 Government should give recognition to citizens contributing significantly to the discussions	R.6 Government should explore new ways for citizen engagement
	Request Participation	R.1 Government needs a platform to invite people to participate and discuss issues	R.2 Government should request participation on topics drawn from citizens expectations	R.3 Government should explore new ways for e-Participation dissemination

infrastructure, while second consists of refining these capabilities into concrete system requirements (Table 3).

S2) *Gap analysis based on mapping of related social media technologies* — we investigate existing practices and technologies that could support the implementation of the requirements defined in Step 1. Following the mapping, we elaborate on particular gaps identified with respect to the realization of the Social Software Infrastructure.

S3) *Creating the Social Software Infrastructure design* — based on the requirements and gaps identified in Steps 1 and 2, we develop the key design elements for the SSI. The resulting model addresses the integration of government- and citizen-led e-Participation as a synergistic process.

S4) *Validating the SSI Design* — the final step involves the validation of the constructed design. To demonstrate the use of the developed infrastructure design, we discuss application of the design implementation in a European Commission e-Participation project aiming to enrich discussions on traditional government-led participation platform with elements of citizen discussions on social-media platforms.

3.2. Theoretical framework

In this section, we elaborate on the key theoretical paradigms underpinning our Social Software Infrastructure design. In particular, we consider Structuration Theory and Technology in addition to Capabilities Theory.

The base requirement for a social system can be defined as a dialog of at least two personal systems or people in their roles (Parsons, 1991). Therefore, in line with the definition, the interaction between citizens and decision-makers together with other related entities constitute a social system. In order to leverage social system theories for analyzing e-Participation, it is necessary to develop a comprehensive conceptualization for e-Participation. To re-conceptualize the extended e-Participation processes (that which considers discussion on external social media platforms), we have in our previous work (*reference removed for the blind review*) developed an Integrated Model for e-Participation presented on Fig. 1.

As indicated earlier, the model was built upon Structuration Theory complemented by Dynamic Capabilities Theory. The Structuration Theory (ST) proposed by Giddens (Giddens, 1984) and refined by Orlikowski (Orlikowski, 2005), deals with the creation and reproduction of social systems. We adopt the Structuration Theory as a comprehensive framework for the analysis of the citizen participation from the agency (understood as freedom to perform an action) and structure perspective. Based on this framework, we assume that citizens as participants in political deliberation possess a reasonable level of awareness and knowledge of the political conditions of their environment (Miller & Krosnick, 2000). This assertion directly draws from the axiom that agents are knowledgeable in the context of Structuration theory. While Structuration Theory explains the shaping and reproduction of the social system supported by knowledgeable agents, it does not supply fine-grained view on the nature of the capabilities required to support and sustain the social processes (here citizen-to-government collaboration). Moreover, ST does not illustrate how the internal and external competences should align to the organizational rules and routines. To bridge this gap, we complement ST with the Dynamic Capabilities Theory (DCT) (Wang, 2007). DCT enables more detailed analysis of capabilities and resources required for social and organizational changes. The DCT, in particular, extends the RBV (Resource Based View) theoretical framework (Wernerfelt, 1984) to cover dynamic environments (Teece et al., 1997). The dynamic capabilities are intended to constantly integrate, re-create and re-configure the resources as well as the basic capabilities. The constant refinement enables effective adaptation to the fast changing environment (Cepeda & Vera, 2007). The DCT distinguishes three core types of the dynamic capabilities with regards to the change of the operational routines: 1) adaptive capability, 2) absorptive capability and

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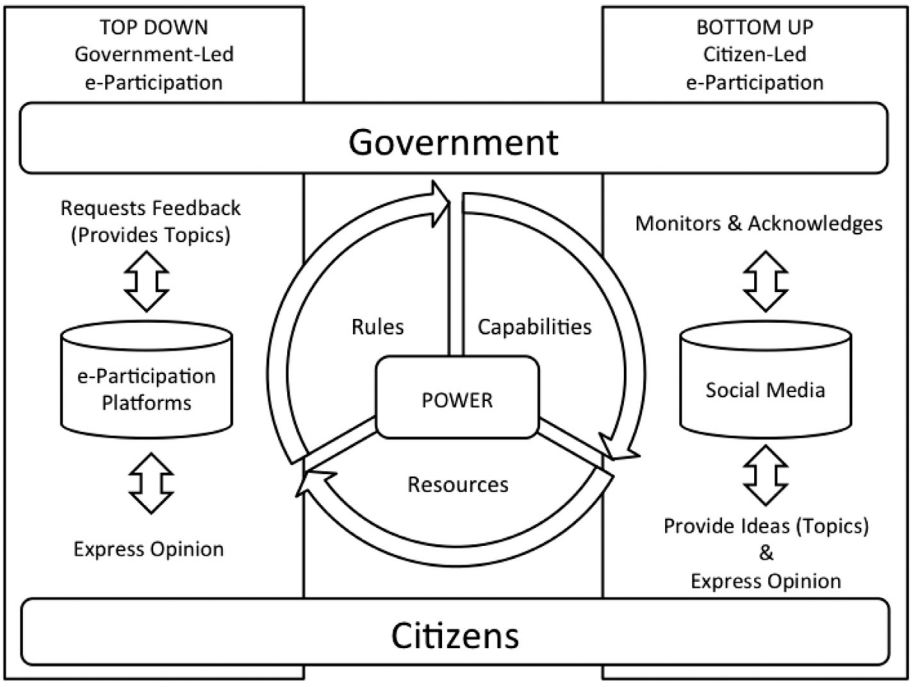

Fig. 1. Integrated model for e-Participation.

3) innovative capability. Next, we describe how we generated a comprehensive set of e-Participation requirements from our Integrated Model for e-Participation.

4. Infrastructure design

4.1. Requirements

We elicit the requirements for the Social Software Infrastructure based on the analysis of the Integrated Model for e-Participation described in Section 3. The model comprises two major pillars: one representing the government-led e-Participation (GLeP) and the second representing the citizen-led e-Participation (CLeP). The GLeP infrastructure, as we show later, is widely available in a form of dedicated e-Participation platforms, where the decision-makers request feedback from citizens on some particular topics of interest. In this channel, citizens are provided allocative resources (providing means - tools, for citizens to exercise their agency) in a form of specialized e-Participation tools that can be employed by citizens to express their opinion. Here, the goal is to ensure ubiquitous, accessible e-Participation (hardware and software independent participation) platform. Although there are past attempts to process citizens' feedback from other sources than dedicated e-Participation platforms, comprehensive CLeP infrastructure, as conceived in our Integrated e-Participation Model is yet to be realized. Currently available forms of CLeP are characterized by spontaneous, loosely structured, political discussions on widely accessible social media platforms. This kind of wisdom of the crowd is difficult to comprehend due to information overload and varying quality of the contributions. Thus, there is a need for e-Participation platform designers to harness the potential of effective discussion monitoring. This will enable governments observe citizens' debates and acknowledge constructive suggestions, and at the same time publicly recognize citizens for their contributions by including deliberation outcomes in their agendas. This is in contrast to current e-Participation solutions in which even when governments consider contributions by citizens, these contributions are rarely acknowledged and with no or at best ad hoc process for explicitly including such contributions in policy or decision-making. In order to ensure that citizens' contributions are recognized by the government and then processed and leveraged in a constructive way, relevant absorptive capabilities including continuous monitoring and participation-shaping processes as well as personalized citizen information services need to be developed. This demands additional capabilities to deal with information quality and information overload issues commonly associated with social media contents. In addition, the infrastructure must support the adaptive capabilities where citizens are explicitly included in the policy making a loop at the agenda formation stage. This can be provided by giving citizens adequate allocative resources in a form of a platform but more importantly; salient authoritative resources (legislative rights or privileges) to support them with their democratic rights. For instance, citizens have to be provided with explicit feedback channel that explicitly informs them that their contributions are being considered or studied by the government. Citizens also need to be given a possibility to discuss the current political decisions as well in addition to discussing and shaping the e-Participation process itself. This demands core capabilities such as the rules' reproduction and formation process. Finally, the infrastructure has to support innovation by monitoring multiple, also new, emerging, deliberation platforms and by this enable citizens to participate by using hardware and software of their choice rather than enforcing the use of one particular platform. To summarize, we structure the SSI requirements in Table 1 below.

The two axes of the table represent the key aspects of e-Participation (divided by GLeP and CLeP means of e-Participation) and the corresponding dynamic capabilities essential to be implemented by the government. Consequentially, requirement IDs (R.XX) are ordered progressively from most basic government-led e-Participation requirements, through citizen-driven e-Participation to citizen empowerment as the highest level of e-Participation.

4.2. State of the art coverage

In this section, we present the state of the art coverage for the Social Software Infrastructure requirements. We use the requirements scoped in Table 1 align the relevant e-Participation processes and technology. The mapping of the state-of-the-art onto our requirement grid

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presented in Table 1 is the outcome of an extensive review of e-Participation literature including in particular (Charalabidis, Gionis, Ferro, & Loukis, 2010; Gowda & Gupta, 2010; Ann Macintosh et al., 2009; Ann Macintosh, 2007; Panopoulou, Tambouris, & Tarabanis, 2010; Sabo et al., 2008; Sæbø et al., 2011; Sæbø, Rose, & Nyvang, 2009; Sanford & Rose, 2007; Scherer, Neuroth, Schefbeck, & Wimmer, 2009; Scherer & Wimmer, 2010; Smith & Commission, 2008; Susha & Grönlund, 2012; Taylor-smith & Lindner, 2009). In Table 2, we show the extent to which the requirements identified in Table 1 is covered in the state-of-the-art. We adopt a color coding scheme for to indicate the gap between expected requirement and currently available solutions in the state-of-the-art: White color denotes that an area is well covered. We distinguish two shades of Gray color to visually indicate the degree of coverage. Light gray is used for partial coverage while dark gray represents little or no coverage of an area. From the resulting grid in Table 2, we observe areas with no little or no solution in the e-Participation space includes "Listening and Shaping" together with the "Empower" aspect of citizen-led e-Participation approach. On the other hand, it can be noticed that although the government-led participation requirements are largely covered, areas such as Participation Request and Acknowledgement, deliberation content Processing and citizen engagement and Stimulation still require significant attention.

The dominant e-Participation approach is directed on top-down, in which decision-makers directly, or indirectly create new discussion topics, post them on dedicated e-Participation platforms and invite citizens to comment on particular issues (Chang, 2008; Ann Macintosh et al., 2009). This approach does not guarantee the engagement of decision-makers in ensuing discussions with citizens. In fact, experience shows that decision-makers are usually reluctant to engage in e-Participation process (Ann Macintosh et al., 2009; Scherer & Wimmer, 2010).

The e-Participation platforms associated with this approach are mostly implemented in the form of standalone Web 2.0 digital forums (all the e-Participation projects reviewed), some of them with support for popular social media (Facebook or Twitter) publishing and post feed integration (Chang, 2008; Panopoulou et al., 2010; Phang & Kankanhalli, 2008; Rose & Sæbø, 2010). More advanced solutions such those presented in the PADGETS project (Charalabidis & Loukis, 2011) involves integration of special widgets into social media. Again, these solutions do not address the issue of content volume nor address issues associated with the quality of contributions (Agichtein, Castillo, Donato, Gionis, & Mishne, 2008). There are emerging attempts to leverage the potential of spontaneous discussions on social media, such as the innovative approach presented in WEGOV project (Claes, Sizov, Angeletou, Taylor, & Wandhoefer, 2010). While these are early efforts to harness social media contents, they do not exploit the synergy between current government-led solutions and citizen-led participation on social media. Also, the approach focuses narrowly on technical challenges of e-Participation without consideration of the more holistic sociotechnical requirements like the need for dynamic capabilities or re-production

Table 2
e-Participation state of the art coverage.

Aspects of e-Participation		Dynamic capabilities		
		Adaptive	Absorptive	Innovative
	Empower	Lack of tools to enable citizens to influence policy making directly (Greg Power & Karl Wilding, 2007; Kamal, 2009)	Lack of an approach where citizens' suggestions would be reflected directly in the policy-making agenda (Bonsón et al., 2012; Kamal, 2009)	Governments are reluctant to seek for new ways of involving citizens into policy making process. Slow e-Participation policy progress (Bonsón et al., 2012)
CLeP	Process	Lack of effective, dedicated tools available to facilitate the processing of the vast social media political deliberation data, mostly manual processing or simple topic detection/trending — many general-purpose business solutions available (Ann Macintosh et al., 2009)	Lack of relevant processes to analyze the spontaneous citizens discussions and recognize valuable contributions. Limited recognition of citizen-suggestions on social media. (Ann Macintosh et al., 2009)	Governments are reluctant to harness new technologies for better and faster processing of citizen input (Bonsón et al., 2012)
	Shaping	Lack of validated, available, dedicated tools to interact effectively with citizens and shape discussion on social media platforms (information overload) — only general purpose business solutions available (Ann Macintosh et al., 2009; Ann Macintosh, 2007)	Governments do not analyze citizens' political deliberations on social media nor provide frequent feedback to guide the discussions (Chen, 2006)	Governments are slow to harness new technologies enabling faster and more relevant interaction with citizens (Bonsón et al., 2012)
	Listening	Lack of validated, dedicated, available tools to monitor and analyze citizens' political deliberation on social media (information overload, low quality contributions) — only general purpose business solutions available (Chen, 2006; Ann Macintosh et al., 2009)	No official recognition or acknowledgement of citizen opinions provided on social media (Chen, 2006)	Little support for technology-agnostic (desktop, mobile) or ubiquitous e-Participation platform through multiple social media channels (Bonsón et al., 2012; Charalabidis et al., 2010)
GLeP	Process	Mostly manual processing and reporting on deliberation data, lack of highly specialized tools (Chen, 2006; Panopoulou et al., 2010)	Insufficient interest from decision makers to analyze citizens' discussions (Ann Macintosh et al., 2009; Scherer & Wimmer, 2010)	Governments are slow to apply new technologies for information processing and decision support. Manual processing is considered satisfactory.(Rose & Sæbø, 2010)
	Acknowledge	Feedback through Web 2.0 Web portals, discussion forums, digital surveys, online chat and consultation forms (Chang, 2008; Panopoulou et al., 2010; Phang & Kankanhalli, 2008; Rose & Sæbø, 2010)	Rare government participation and feedback on dedicated platforms (Ann Macintosh et al., 2009; Scherer & Wimmer, 2010)	Government are reluctant to seek new ways of rewarding citizens for their contributions (Greg Power & Karl Wilding, 2007; Rifkin & Kangere, 2001)
	Stimulate	Lack of highly customized, dedicated dissemination tools. Mostly manual advertising or widget technologies (Puzzled by Policy, WEGOV, PAGETS) on social media (Taylor-smith & Lindner, 2009; (Charalabidis et al., 2010)	Government does not give recognition to Citizens (Ann Macintosh et al., 2009; Scherer & Wimmer, 2010)	Governments are reluctant to explore new ways for citizen engagement. Limited encouragement initiatives on social media (since the government have limited control over this channels) (Greg Power & Karl Wilding, 2007; Ashley et al., 2009).
	Request Participation	Dedicated e-Participation Platforms or manual social media advertising (Panopoulou et al., 2010; Phang & Kankanhalli, 2008; Gowda & Gupta, 2010).	Governments usually rely on their expertise and agenda in forming the e-Participation discussion topics with exception for loud general public topics (Coleman, Gøtze, & Coleman, 2001)	Limited, advertising on social media. Lack of significant innovative dissemination beyond the e-Participation platforms and governmental portals or mainstream media. (Taylor-smith & Lindner, 2009)

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and re-shaping processes. Finally we have identified a number of relevant, generic social media analytics tools available (discussed in the implementation part of the paper) which have not been exploited to our knowledge these by the governments for e-Participation purpose.

4.3. Design

In this section, we identify the essential SSI design components that are required to implement the SSI requirements and issues described in Tables 1 and 2. We align the defined building blocks to the determined SSI requirements matrix (Table 3).

Governments need technological tools to realize the essential absorptive requirements and innovate the e-Participation process. The components elicited in the table have been mapped to the Social Software Infrastructure design presented in Fig. 2**: SSI — Design**.

The presented design has been constructed by a detailed analysis of the SSI requirements table. The names of the building components have been shortened for better clarity of the model. We divided the design space into two parts: Information Processing space and Information Mining and Publishing Space. This enables us to separate clearly the knowledge retrieval functions from those of knowledge exploitation. The Black and White components represent the tool containers while arrows represent the interfaces. The Citizen Interface is given a distinguished representation as it represents a set of both mobile- and web-mediated access to social media and dedicated e-Participation platforms. We have grouped the Policy-making Agenda Creation Tool under Mission Control Tool since the function of the components is complementary to the Promotion of active citizen engagement reinforced by the acknowledgement and recognition of citizens' contributions. Similarly, the Discussion Exploration and Analytics tools have been grouped as part of the Discussion Control (DC); as the tools deliver a subset of the key functions of the DC. A central component of the design is the Data Analytics Component that we refer to, as the Knowledge Extraction & Management (KEM). This component is primarily responsible for all e-Participation related data and metadata processing within SSI. The input data can be fetched from social media and dedicated e-Participation platforms via available APIs to produce structured information. Dependable on the source, and input data structure, additional metadata can be retrieved for the analysis such as Ratings and Recommendation Links. The same APIs are used by the KEM to publish data on citizen-led and government-led platforms. Therefore, KEM provides the output gate for information gathered, processed and published. In principle, the KEM component analyses the data, i.e., posts, user profiles, discussion topics, threads and performs continuous data quality improvement by filtering and linking related concepts as well as data from external sources such as other e-Participation systems, governmental portals or any other places holding valuable e-Participation information. The secondary function of the component is to create and maintain logs and service feedback for all the other infrastructure components and perform analysis on the log contents. This way, the Knowledge Extraction & Management component enables a better understanding of the processes and future system re-shaping and reproduction through the application of relevant improvements. We present the information flow in the design in Fig. 3. As before, this model is partitioned into the e-Participation approach: GLeP and CLeP subsystems. The flow of information starts from citizens generating spontaneous deliberation contents on multiple social media platforms as well as on the dedicated e-Participation platform. Unlike in the social media platforms, the dedicated e-Participation platforms hold more structured data in a form of hierarchical forum data or argumentation tree data. The information is mined and processed by the Information Processing Component (IPC) encapsulating all the tools responsible for Discussion and Mission Control as well as KEM — the Information Processing part of SSI design.

Governments explore the content through the IPC and stimulate the participation by frequent feedback to active contributors and by shaping deliberations through contributions in selected discussions. Finally, the decision makers incorporate constructive solutions from citizen contributions into the official collaborative policy-making process with explicit acknowledgement to citizens' contributions. Both dedicated e-Participation platforms and social media channel work in synergy, by exchanging the deliberation data and combining the results.

An important obligation that goes with any design is the provision of evidence or arguments of its correctness and validity. In our case, we have to show that the design is valid with respect to the requirements in Tables 1 and 2. Given that the design components were directly identified from requirements, we could argue that design will satisfy the requirement. To support the line of argument, we show in Fig. 4 how each

Table 3
SSI technology requirements.

Aspects of e-Participation		Dynamic capabilities		
		Adaptive	Absorptive	Innovative
	Empower	Collaborative **Policy-making Agenda Creation Tool**	Collaborative **Policy-making Agenda Tool** (explicit, citizen direct input inclusion support)	Collaborative **Policy-making Agenda Tool** (Monitoring Log, Feedback and Improvement support)
CLeP	Process	**Multi-source Knowledge Extraction and Management Tool** (Filtering, Clustering, Linking, Content Recommendation)	**Multi-source Knowledge Extraction and Management Tool** (political discussion detection and analysis support)	**Multi-source Knowledge Extraction and Management Tool** (Monitoring Log, Feedback and Improvement support)
	Shaping	**Discussion Control Tool** (topic tracking, user tracking, trends detection/prediction)	**Discussion Control Tool** (political discussion analysis and direct engagement support)	**Discussion Control Tool** (Monitoring Log, Feedback and Improvement support.)
	Listening	**Discussion Exploration and Analytics Tool** (leverages **Multi-source Knowledge Extraction and Management Tool**)	**Discussion Exploration and Analytics Tool** (citizen opinion mining and tracking support)	**Discussion Exploration and Analytics Tool** (Monitoring Log, Feedback and Improvement support with assurance of new platforms discovery)
GLeP	Process	**Knowledge Extraction and Management Tool** — (can be realized as a subcomponent of CLEP Process)	**Knowledge Extraction and Management Tool** — (discussion analysis support)	**Knowledge Extraction and Management Tool** (Monitoring Log, Feedback and Improvement support)
	Acknowledge	**Mission Control Tool** (e-Participation promotion and feedback dissemination, targeted dissemination)	**Mission Control Tool** — (support for recognition of valuable contributions and constructive feedback delivery)	**Mission Control Tool** — (Monitoring Log, Feedback and Improvement support)
	Stimulate	**Discussion Control Tool** (topic tracking, user tracking, trends detection/prediction)	**Discussion Control Tool** (political discussion analysis and direct engagement support)	**Discussion Control Tool** (Monitoring Log, Feedback and Improvement support)
	Request Participation	**Mission Control Tool** (e-Participation promotion and feedback dissemination, targeted dissemination)	**Mission Control Tool** — (support for participation topics based on citizens' input)	**Mission Control Tool** — (Monitoring Log, Feedback and Improvement support)

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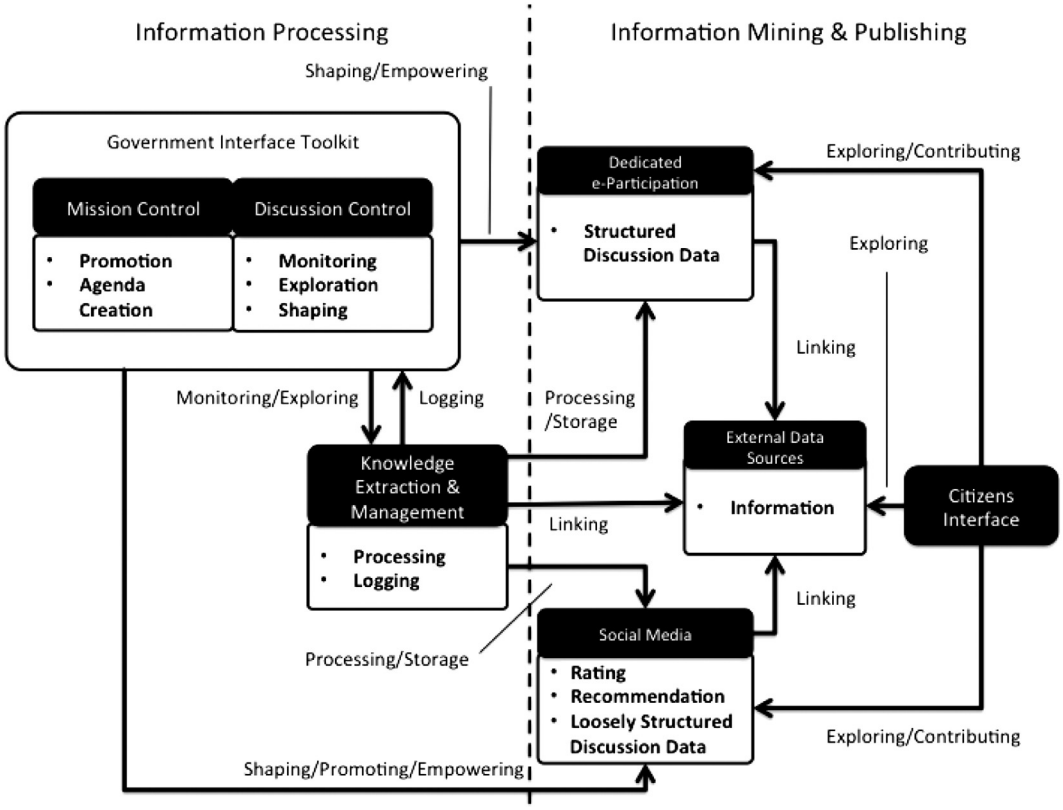

Fig. 2. SSI — design.

specific requirements is supported by specific components in the design model.

In next section, we present implementation scenarios to realize the presented integrated e-Participation design model.

4.4. Implementation

In this section, we discuss an example implementation for the Social Software Infrastructure design. We describe how to realize the SSI design components by existing technologies to address the existing gaps in integrated citizen- and government-led e-Participation system.

The Mission Control and Discussion Control components are currently implemented through manually maintained, Web 2.0 forums and consultation tools (Rose & Sæbø, 2010). Governments request and stimulate participation through dedicated e-Participation platforms, government portals or governmental social media pages. This area could be significantly improved first by applying targeted participation advertising (such as Facebook Targeted Ads[17] mechanism or Promoted Tweets[18] on Twitter). Next, the RDF[19]-based Linked Data[20] technologies could be used for more descriptive metadata and effective information inference with detailed information about the origin and authorship of the contributions. This way, decision makers can reach easily the valuable contributions and reward the particularly active citizens through personal acknowledgement. This can be ensured by referral to their specific account name (like social media pseudonym or avatar) or by referring to their real name if provided. The information processing aspect could also be significantly improved by employing automatic or semi-automatic content summarization tools such as Open Text Summarizer (OTS),[21] MEAD[22] or natural language processing tools such as NLTK[23] or Stanford Core NLP.[24] Citizen-led e-Participation requires analytical tools (Discussion Control and KEM) for social media. Currently, there are some technological solutions for effective, simultaneous processing of multiple social media channels such us SocialMention,[25] HootSuite[26] or BuzzEquity.[27] However, in the context of e-Participation, it is far more important to go beyond simply 'scanning' the social media towards direct engagement with citizens. This is important to shape ongoing online discussions (Mission Control). For this purpose a number of tools is available such as Bottlenose,[28] SproutSocial,[29] UberVU,[30] Visible,[31] NetBase[32] or NUVI.[33] Linked Data technologies could be employed to structure the online discussions on multiple platforms and integrate them in a single knowledge base, to enable decision makers engage directly with users and authors of the valuable contributions. The knowledge base could be hosted and made accessible to the public for exploration. This could be implemented through one of the RDF Store, data

[17] FACEBOOK TARGETED ADS https://www.facebook.com/about/ads/10.07.13
[18] PROMOTED TWEETS https://business.twitter.com/products/promoted-tweets-self-service10.07.13
[19] RDF http://www.w3.org/RDF/10.07.13
[20] LINKED DATA http://www.w3.org/standards/semanticweb/data10.07.13
[21] OTS http://libots.sourceforge.net/10.07.13
[22] MEAD http://www.summarization.com/mead/10.07.13
[23] NLTK http://nltk.org/10.07.13
[24] NLP http://nlp.stanford.edu/software/corenlp.shtml10.07.13
[25] SOCIAL MENTION http://socialmention.com/10.07.13
[26] HOOT SUITE https://hootsuite.com/10.07.13
[27] BUZZ EQUITY http://buzzequity.com/10.07.13
[28] BOTTLE NOSE http://bottlenose.com/10.07.13
[29] SPROUT SOCIAL http://sproutsocial.com/10.07.13
[30] UBERVU http://www.ubervu.com/10.07.13
[31] VISIBLE http://www.visibletechnologies.com/10.07.13
[32] NETBASE http://www.netbase.com/10.07.13
[33] NUVI http://www.nuviapp.com/10.07.13

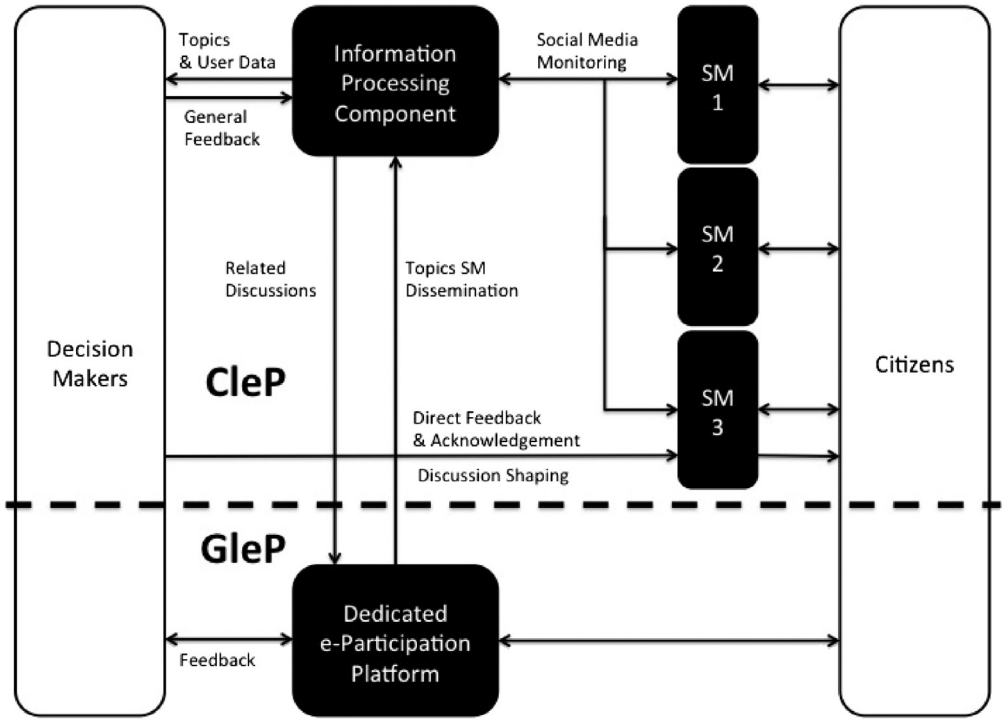

Fig. 3. SSID Information Flow.

graph based, solutions such as Virtuoso,[34] SESAME[35] or popular Apache Jena TDB[36] (KEM). In this case, the SPARQL[37] endpoint technology would facilitate easy knowledge graph querying to ensure easy, standardized access to the data.

In our opinion, full Monitoring Capability implementation demands more than common topic detection, trend prediction or direct messaging to contributors capabilities. In particular, it implies the need for deep understanding of spontaneous citizens' political discussions and incorporation of the constructive suggestions into policy-making agenda. This should be again supported by dedicated ontologies such as SIOC Ontology[38] enriched with Argumentation extension combined with content summarization tools like OTS as an input. In particular, Linked Data technologies will ensure interoperability of the infrastructure, acting both as structuring tool as well as the information exchange and storage medium (Heath & Bizer, 2011).

5. Case study

5.1. EU Immigration e-Participation initiative (assessment of practical application)

The case study considered in this section refers to the European e-Participation project funded under FP7 Framework — PuzzledByPolicy.[39] The project aims to re-connect citizens with politics and policymaking in the context of immigration in Europe. The multinational project includes partners from Ireland, Greece, Slovenia, Italy, UK, Portugal, Netherlands, Spain and Hungary. The goal of the project includes increasing public awareness on many aspects of immigration and to deliver relevant, objective information in the presence of many confusing and politically biased opinions. The initiative leverages a Web 2.0 platform with digital discussion forum and special policy profiler tool helping citizens to identify their political stand. Communication with citizens is carried out mainly through the platform and is supported by a dissemination strategy involving sharing of special Web Widget (embeddable on any website). It also includes sharing information on the project on popular social networking platforms (in particular on Twitter). Part of the evaluation report of the project included stakeholder-reported issues regarding the e-Participation experience. The issues referred mainly to information overload, difficulty in navigating through the contents and lack of interoperability with other similar immigration forums and platforms.

The SSI design covers most of the issues identified. The large quantities of forum posts and threads can be effectively summarized by leveraging KEM component with a text summarizer like OTS. To improve navigation and data interoperability, Semantic Web technologies can be leveraged for data representation stored in an RDF store. Finally, relevant social media monitoring could be exploited to extend the content available with spontaneous contributions on social media.

In this use-case, as the coordinating stakeholder, we received a special permission from the project consortium to proceed with a basic showcase prototype implementation. This enabled us to assess practically the efficacy of SSI for enabling the provision an integrated e-Participation system. The prototype implementation was developed as a lightweight extension of the PuzzledByPolicy portal, with the core execution components written mainly in JavaScript.[40] The implementation employed some technologies including JENA, TDB and RDF store as a backend for the discussion data stored in RDF graph. The RDF data is processed via a KEM pipeline including text summarizer — OTS and topic detection supported by OpenCalsis[41] as well as relevant visualization tool — D3[42] to present data in the user-friendly form and for easy navigation. Finally, the implemented SSI-based extension applied social

[34] VIRTUOSO http://virtuoso.openlinksw.com/rdf-quad-store/10.07.13
[35] SESAME http://www.aduna-software.com/technology/sesame10.07.13
[36] JENA TDB http://jena.apache.org/documentation/tdb/10.07.13
[37] SPARQL http://www.w3.org/TR/rdf-sparql-query/10.07.13
[38] SIOC http://www.w3.org/Submission/sioc-spec/10.07.13
[39] PUZZLED BY POLICY http://www.puzzledbypolicy.eu10.07.13
[40] JAVASCRIPT http://www.ecma-international.org/publications/standards/Ecma-262.htm10.07.13
[41] OPEN CALAIS http://www.opencalais.com/10.07.13
[42] D3 http://d3js.org/10.07.13

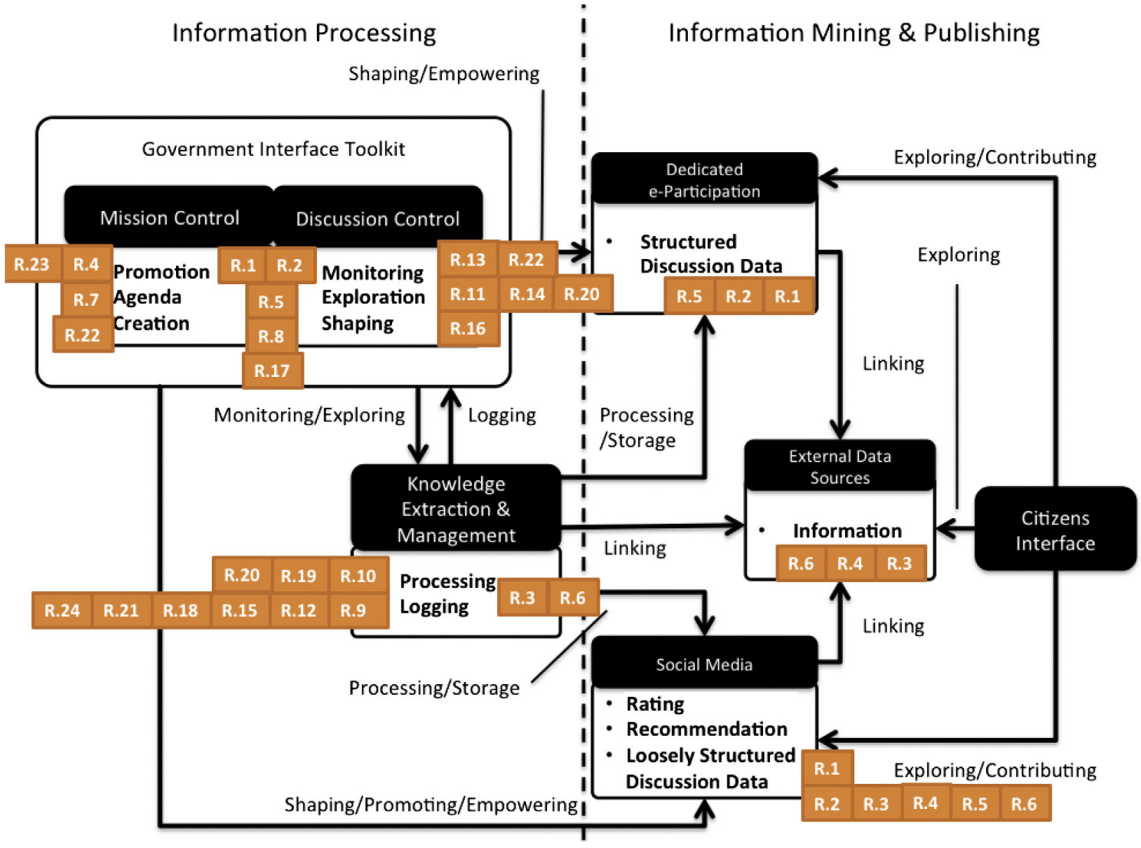

Fig. 4. SSI Requirement Alignment.

media integration through extraction and inclusion of posts from social media into the PuzzledByPolicy platform. The data obtained from social media is integrated with discussion RDF knowledge graph using the KEM pipeline.

Feedback from the presentation of the prototype of to the stakeholders showed that there was clear interest in the additional richer information provided from the social media plugin to the PuzzledbyPolizy platform. They specifically pointed out benefits of easier information exploration and richer information derived from relevant data integration (social media). In our small evaluation (20 participants representing project stakeholders), users confirmed that the clustered synopsis of the large amounts of information within particular discussion threads reflects well the overall message and intention of the contributors, while the new navigation capabilities enabled fast exploration of many threads. Therefore in the case of the PuzzledByPolicy extension, the prototype SSI implementation generated significant interest and increased awareness of possible future improvements that could be applied to the currently running platform.

6. Discussion

Following our methodology that comprises four basic steps, we: S1) have investigated the requirements for an integrated e-Participation infrastructure to support both government-led and citizen-led e-Participation initiatives; S2) determined the state-of-the-art in e-Participation infrastructure and the availability of citizen-led e-Participation infrastructure; S3) carried out a gap analysis of availability of technology solutions to meet the identified requirements for the integrated constructed Social Software Infrastructure Design and S4) validated the SSI design against the initial requirements and stakeholder feedbacks from its prototype implementation in the PuzzledbyPolicy project.

In particular, with respect to the first and the second objective, our analysis showed that e-Participation is still in its infancy, lacking relevant methods and tools in many areas. Gaps were widest in aspects like citizen discussion monitoring, citizen contribution acknowledgement, government expert feedback (discussion shaping) as well as integrating contributions explicitly into the policy-making process. With our third objectives, we have attempted to bridge some of these gaps. We have identified and described core components required to implement these features as part of the overall Social Software Infrastructure. We have shown the centrality of Semantic Web, Natural Language Processing and social media analytics tools in realizing a dedicated SSI.

In our opinion, the SSI design model and its implementation enables the study and better understanding of the degree of the duality of e-Participation. Specifically, it enables decision makers to monitor and capture aspects of spontaneous citizen deliberations as direct input into decision making. Simultaneously, decision makers can also post feedbacks, acknowledgements or information to shape ongoing discussions by citizens.

The presented infrastructure has been designed to cover the requirements for e-Participation based on the analysis of contemporary, traditional e-Participation platforms and most popular citizen-controlled e-Participation spaces – Facebook and Twitter. Therefore, we can only claim some level of compatibility of the proposed solution with future or new participation tools. Although there have been other attempts to incorporate social media into e-Participation process, the existing solutions are limited mainly to embedded micro-blogging feeds and embedded posts from social media without significant effort put on actual understanding of how to undertake the spontaneous political discussions (regardless the tool that hosts the discussion) and make them valuable to decision-makers and then incorporate it into policy-making process. Moreover, most of the solutions seem to adopt common off-the-shelf Social Software Infrastructure without careful consideration of e-Participation principles or any particular support

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for e-Participation specific processes, being rather a single mode and single purpose public consultation tool. The SSI design in this sense is more general than state-of-the-art e-Participation solutions. In fact, we designed our infrastructure in a way that social media is just a single class of many possible communication tools to be leveraged as information input and the core model is flexible enough to potentially support information exchange between other, digital channels that may gain significant popularity in near future. Considering the implementation discussed, to ensure the compatibility with the diverse set of platforms (and future ones), all the information inputs are translated and structured (with the state-of-the-art W3C standard — RDF) into an open format–knowledge graph. The RDF represented data is ready to be published as Linked Data, therefore, the SSI enables support for ubiquitous, Internet-of-Things based platforms (like highly distributed mobile platforms and citizen-sensing-based tools).

Regarding the fourth objective, the presented SSI design, has been verified against identified infrastructure requirements. The solution covers both GLeP and CLeP aspects of e-Participation including all the essential components related to e-Participation content creation and dissemination, debate information mining, processing, exploring, promotion and dissemination, discussion stimulation, shaping and incorporation into policy-making. Moreover, the design supports constant e-Participation re-shaping and re-production capabilities. The design-science-based approach applied and the solid theoretical underpinning of infrastructure guarantees high-level of the efficacy of a solution to study government-led — and citizen-led e-Participation mutual re-shaping processes. We have determined the practicality and usefulness of the infrastructure through the prototype implementation and initial deployment of SSI in PuzzledByPolicy project. However, we cannot claim the absolute validity of the solution only until fully-fledged implementation is deployed, followed by a large-scale evaluation. Consequently, we cannot also claim the absolute completeness of the presented infrastructure, nevertheless as our solution has been designed bottom-up gradually around the goal to study the duality of e-Participation starting from the scientifically supported thesis going towards dedicated architecture, we claim better alignment of our infrastructure to e-Participation process needs. We are not aware of any significant attempts at analyzing the duality of e-Participation by employing a combination of social media analytics, Semantic Web and NLP. Moreover, we have not found any other approach that has applied similar theoretically grounded infrastructure design process.

Due to the limited scope of this document we do not elaborate on ethical and moral considerations, beyond citizens' motivations to participate. Future work demands a deeper investigation into ethical aspects of e-Participation, whether it refers to the political campaigns and intentional political propaganda or citizen privacy issues and seed users influence on social media.

7. Conclusion

Motivated by the need to improve the e-Participation process, we have presented a Social Software Infrastructure design to study the phenomena of Duality of e-Participation. The infrastructure bridges the hitherto dichotomy of government-led and citizen-led e-Participation discussions. In particular, the results from our work contribute towards better understanding of e-Participation socio-technical aspects. The developed SSI design relies on consolidating the knowledge exploration (RDF — Semantic Web), social media and text analytics tools. We have developed a prototype of the SSI for validation and step towards studying the duality of e-Participation. The prototype implementation has been deployed in an e-Participation initiative. Nevertheless, we are nearing the completion of the second version of the SSI to as part of the more elaborate implementation of the SSI design presented in this article. The next steps for the research include the implementation and deployment of full CLeP solution as part of an Integrated e-Participation system, followed by an evaluation of the degree of duality enabled by the use of the system through interviews with relevant e-Participation stakeholders.

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Research leader of the Unit for Social Software at Insight (formerly DERI) [2006–]
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