Combining Technocrats' Expertise with Public Opinion through an Innovative e-Participation Platform

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Abstract— Previous political sciences research has revealed that democracy (democratic institutions, consultations with citizens) and technocracy (specialized knowledge of experts) are the main foundations for the development of effective and socially acceptable public policies, and that there should be balance as well as interaction and exchange of knowledge between them. However, there is a lack of e-participation platforms supporting this required 'duality': the collection of policy related information, knowledge and opinions from both citizens and experts, as well as the communication and interaction between them. This paper contributes to filling this critical research gap. It describes the development of an innovative e-participation platform, which supports on one hand structured consultation and argumentation between experts/technocrats concerning important social problems and public policies for addressing them, and on the other hand the collection and interrelation of relevant citizens-generated textual content from numerous external social media. This platform enables the meaningful combination of technocrats' expertise with public opinion, allowing the technocrats participating in policy related structured consultations to retrieve, understand and get insights from citizens' perceptions. Evaluation results show that users appreciate the potential of exploiting the synergy of machine and human reasoning enabled by the proposed platform through a combination of data mining and structured consultation/argumentation - collaborative decision-making services.

Index Terms — government, public policy, decision support, knowledge management

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1 INTRODUCTION

THE term e-participation, coined during early 2000's, has been defined as "the use of information and communication technologies to broaden and deepen political participation by enabling citizens to connect with one another and with their elected representatives" [1]. Since then, several ICT-based platforms have been specifically developed to facilitate citizens and other stakeholders' involvement in diverse governmental decision and policy making processes. In the first generation of e-participation, such platforms were designed to support different forms of participation in democratic process, including information provision by government, consultations with citizens and deliberation, petitioning, polling and community building according to the institutional framework of their operation. They enabled citizens to get informed by government, to provide feedback on different policy issues, and to get actively involved in government decision making [2], [3].

Since the advent of the e-Participation paradigm, major advancements in the ICT field have resulted in new technologies and toolkits supporting the involvement of diverse type of stakeholders in the policy making processes. In particular, the last two decades have witnessed major advances in the following directions:

1. The rise of Social Media during late 2000s and the proliferation of the user generated content within them, led to the emergence of new e-Participation platforms, incorporating Web 2.0 functionalities and architectures, and social networking tools, far away from the strict and official centrally managed e-Participation systems. Web 2.0 empowers citizens by providing new types of discussion forums, and enhance mass and diverse participation by exploiting popular social media where citizens increasingly choose to discuss and generate content [4].

2. The significant evolution of the Computer-Supported Cooperative Work (CSCW) field, by adopting a knowledge-based decision-making approach, while also enabling the meaningful accommodation of the results of the social knowledge and related mining processes. Related ICT environments support structured consultation and collaboration, as well as knowledge exchange and co-creation, through argumentative discourse of stakeholders, who discuss their perspectives on a social problem or relevant public policy, in order to promote mutual understanding and synthesis [5].

3. The longstanding movement towards the Open Data

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and Open Government paradigms [6], and, as a consequence, the emergence of data-driven innovation [7] and Big Data based policy making [8]. Big data seems to have positive consequences on policy making, filling in areas where previously information was scarce or difficult to obtain. If we add to this the increasing availability of computational capacity needed for gathering and processing quicker larger volumes of multimodal information, we can understand the current trend towards the so-called "datification of governance" [6].

4. The growing adoption of private sector crowdsourcing and open innovation paradigms [9] in the public sector in order to tackle the increasing complexity of problems and policy challenges faced by contemporary societies. Applications of these paradigms have introduced new opportunities to exploit for the design of better public policy ideas and knowledge on one hand of general public (citizen-sourcing) [10], [11], and on the other hand of experts (expert-sourcing) [12], [13], incorporating them into the work of the governments.

The above advancements have brought in a wide variety of tools and technologies enhancing e-Participation, such as Social Media Monitoring, Argumentation and Decision Making Support services (see review of e-participation tools in section 3). However, these tools are divided into two main categories based on the two different purposes they serve. On the one hand, some of them focus on the general public, and aim to incorporate public perceptions, concerns, needs and values into governmental policy and decision making, regarding this as the fundamental principle of e-Participation [10], [11], [14]. On the other hand, some other tools aim at the collection of experts' policy relevant knowledge flow, either by enabling sophisticated interactions among them [15], [16], or by collecting and analyzing content generated by experts [12], [13]. However, there is a lack of a combined approach and corresponding e-participation tools supporting the collection of policy related information, knowledge and opinions from both citizens (general public) and experts, as well as the meaningful communication and interaction between them. Previous political sciences research on 'democracy versus technocracy' (see Section 2.2) has concluded that both 'democracy' (democratic institutions, consultations with citizens) and 'technocracy' (specialized knowledge of experts) are highly important for the design of public policies, and that there should be a balance, as well as interaction between them. It is quite important that this required 'duality' is supported by advanced ICT tools, enabling the combined e-participation of both citizens and technocrats in public policies' formulation, as well as a meaningful interaction among them.

This paper contributes to filling this gap by proposing an innovative e-participation platform, which supports on one hand structured consultation and argumentation between experts/technocrats concerning important social problems and public policies for addressing them, and on the other hand the collection and processing of relevant citizens-generated textual content from numerous external

social media (e.g. various political blogs, fora, Facebook accounts, etc.) and their proper interrelation with the experts' knowledge.

This paper is structured in 6 sections. Section 2 provides the theoretical background for the development of the proposed solution, by discussing previous research on 'democracy and technocracy', the 'wicked problems' treatment, and the 'citizen-sourcing' practices. Taking this literature review into account, Section 3 presents a critical review of existing tools and technologies that are employed within e-Participation. Then, Section 4 describes in detail the proposed an 'dual' e-participation platform, and its application through a relastic scenario. Section 5 reports on evaluation issues, while Section 6 outlines concluding remarks and future work directions.

2 BACKGROUND

2.1 Action Research and Design Science Research

Our overall approach adopts the Action Research paradigm, which "aims to contribute both to the practical concerns of people in an immediate problematic situation and to the goals of social science by joint collaboration within a mutually acceptable ethical framework" [17]. As such, it concerns the improvement of practices and strategies in the particular cognitively-complex collaborative environment under consideration (i.e. public policy making), as well as the acquisition of additional knowledge to improve the way stakeholders address issues and solve problems [18]. As proposed in the dual cycle model of McKay and Marshall [19], in which the cycle of research interest and the cycle of problem solving interest proceed in parallel while closely interacting with each other, our work contributes to practice and research at the same time.

At the same time, the development of the proposed e-participation platform follows the Design Science paradigm, which "seeks to create innovations that define the ideas, practices, technical capabilities, and products through which the analysis, design, implementation, and use of Information Systems can be effectively and efficiently accomplished" [20]. This paradigm has been extensively adopted in the development of Information Systems in order to address what are considered to be wicked problems [21], i.e. problems characterized by unstable requirements and constraints based on ill-defined contexts, complex interactions among issues of the problem, inherent flexibility to change design processes and artifacts, a critical dependence upon human cognitive abilities to produce effective solutions, and a critical dependence upon human social abilities (e.g. teamwork) to produce effective solutions (see section 2.3).

The combination and complementarity of the above-mentioned two research paradigms, together with the associated practicalities and difficulties, has been extensively discussed in [22]. As noted, the basic research interest of the latter is to construct innovative ways to solve a class of problems, thus creating new reality, while the former mainly concerns the understanding of existing reality, such as the complex workings of organizational situations and

human behavior. In our approach, there is significant overlap between them, in that we aim to solve a socio-technical problem by developing a new solution technology and evaluating it in an organizational context.

2.2 Technocracy and Democracy

Previous political sciences research has revealed that democracy (democratic institutions, consultations with citizens) and technocracy (specialized knowledge of experts) are the main foundations for the development of effective and socially acceptable public policies [29], [30]. The development of the 'participative democracy' ideas have resulted in a growing involvement of the citizens in the development of public policies [23], [24], [25]. The participatory democracy does not aim to replace the existing 'representative democracy' (and its democratic institutions, such as the Parliaments and other representative institutions), but on the contrary to support and complement them. However, throughout the public participation literature it is emphasized that in order to be successful the participating citizens should be sufficiently informed about the complex social problems under discussion, which public policies aim to address. This becomes increasingly important, due to the growing complexity of the problems of modern societies, as well as the alternative interventions for addressing them, which has increased the importance of knowledge and expertise for the design and implementation of public policies. For this reason experts, and especially various forms of expert bodies (ranging from committees to separate organizations, such as economic institutes), have become today highly important for and influential on the formulation of public policies, which is termed 'technocracy' [26], [27], [28].

However, the above relevant research has highlighted the need of balance as well as communication, interaction and exchange of knowledge between 'democracy' and 'technocracy', as they are complementary, since each of them needs inputs from the other, while both make significant but different contributions to the design of public policies [29], [30]. In particular, the participants in the democratic processes (citizens and their representatives, stakeholder groups) need extensive knowledge and expertise on the social problems they are dealing with, while the lack of them can have quite negative impacts on the effectiveness of the formulated public policies. At the same time experts dealing with important social problems tend to ignore or neglect some important aspects of public policies, such as their impact on employment, social inequalities, quality of life, etc., and to 'de-politicize' them . In order to reduce these negative tendencies, experts need inputs from the democratic political processes, concerning diverse values and concerns of different stakeholder groups, as well as their diverse perspectives, approaches and ideologies. As Gilley [30] argues, 'democratic sovereignty and technocratic expertise must coexist', concluding that 'a healthy democracy requires a healthy technocracy and vice versa'.

For the above reasons, it is quite beneficial to have e-participation platforms supporting this required 'duality': the collection and meaningful interrelation of policy re-lated information, knowledge and opinions from both citizens (general public) and experts, as well as the proper communication and timely interaction between them. As revealed in Section 3, there is a lack of such integrated solutions; our paper contributes to filling this gap.

2.3 Wicked Problems

Another stream of political sciences research has revealed that the problems of modern societies have become complex and 'wicked', and this has made the design of appropriate public policies for addressing them much more difficult than in the past [21], [31], [32], [33]. In particular, previously most social problems had clear and widely accepted definitions and objectives, which were widely accepted in the society, so they could be solved through 'first generation' mathematical optimization methods, which determine the optimal solution of the problem that achieves some predefined objectives with the lowest possible resources. However, in the last decades societies became more heterogeneous in terms of values, concerns and lifestyles and, as a result of this, most social problems tend to lack clear and widely acceptable definition and objectives, having many stakeholders with different and heterogeneous problem views, concerns and objectives; this kind of problems are called 'wicked'. According to Rittel and Webber [32], wicked policy problems necessitate the use of 'second generation' methods for addressing them, which include: (i) a first stage of consultation among problem stakeholders, aiming to formulate a shared understanding and definition of the problem, and the particular objectives to be achieved, and then (ii) a second stage of mathematical optimization analysis of the well-defined at this stage problem in order to identify the best solution.

Subsequent research on this 'second generation' approach for addressing wicked social problems, by designing appropriate public policies for them, has revealed that its first stage can be greatly supported by the use of appropriate information systems, termed as 'issue-based information systems' (IBIS), which allow stakeholders to exchange information about their perceptions concerning the main elements of the particular social problem under discussion, which are: (i) 'topics' (meant as broad discussion areas); (ii) 'questions/issues' (particular problems to be addressed within a discussion topic); (iii) 'ideas' (possible alternative answers-solutions to these questions/issues); and (iv) 'arguments' (positive or negative - evidence or viewpoints that support or object to these ideas/alternatives) [31], [34], [35], [36]. In this direction, previous empirical research has concluded that 'structured' e-consultation tools based on the abovementioned IBIS framework (allowing users to enter and exchange semantically annotated information concerning the main elements of the social problem under discussion: main issues, alternative solutions/interventions for addressing each of them, and also pro-arguments and contra-arguments about them, as well as comments) enable much more focused, effective and productive electronic policy related discussions and exchanges of information and views, than the usual 'unstructured' fora; however, they are more difficult to use by the less sophisticated users (in terms of education and

knowledge about the social problem under discussion), and more appropriate for the more sophisticated ones and the experts [15], [35].

For the above reasons, our approach – as far as the experts' consultation and argumentation component of the proposed solution is concerned – builds on and extends the well-tried IBIS framework.

2.4 Citizen-sourcing

The success stories of 'open innovation' and 'crowd-sourcing' in the private sector ([9], [37], [38]) have motivated government agencies to move in this direction as well, and this gave rise to the development of 'citizen-sourcing' practices in government, and also of considerable research activity in this area [10], [11], [39], [40], [41], [42]. Governments are increasingly using ICT, mainly social media, in order to collect information, knowledge, ideas and opinions from the citizens about important social problems, as well as existing or under formulation public policies for addressing them. According to a recent review of the research literature in this area [41] most of this research focuses on the analysis of the specific activities government agencies conduct for this purpose, the impact of the external context on them, as well as the demographics and the behavior of the participating citizens; on the contrary, limited research has been conducted for the development of advanced and more effective ICT platforms for citizen-sourcing.

Most of this ICT platforms related research focuses on 'active citizen-sourcing', which is based on the use of government agencies' social media accounts in order to pose a specific social problem or public policy (existing or under development), and solicit relevant information, knowledge, ideas and opinions from the general public [4], [39], [42]. Recently, a novel approach to government citizen-sourcing has started being developed, which is based on 'passive citizen-sourcing [10], [40]. In this approach government agencies have a more passive role: they exploit policy-related content that has already been generated by citizens freely, without any active stimulation or direction by government, in various external social media (such as political fora and blogs, Facebook, Twitter, etc. accounts, etc.) not belonging to government agencies. This 'passive citizen-sourcing' approach offers significant advantages over the 'active citizen-sourcing' one: (i) it enables government agencies to access, retrieve and exploit much larger quantities of more diverse policy relevant content from a wide variety of social media sources of different political orientations; and (ii) this content already exists, so government agencies do not have to find ways to attract large numbers of citizens to participate in citizen-sourcing and generate new content. For the above reasons, we build on the concept of 'passive citizen-sourcing' as a foundation for the design of the citizens' related components of the proposed e-participation platform.

3 E-PARTICIPATION TOOLS REVIEW

Typical examples of e-participation platforms operating to-day are the European Citizens' Initiative (http://ec.europa.eu/citizens-initiative/), enabling the direct involvement of citizens in the formulation of EU policies, the Citizen Space (http://www.citizenspace.com), a system enabling national governments and local authorities to organize online consultations), the Agora Voting (http://agoravoting.org/), an open-source e-voting platform, the participation portal of the Frankfurt city (Frankfurt Fragt Mich, https://www.ffm.de/), etc. The ParticipateDB (http://www.participatedb.com) lists over 350 ICT tools and services that have been used for civic engagement, as well as 300 projects exemplifying the practical applications of these tools.

Yet, e-participation can involve a considerable variety of underpinning technologies and tools. Our aim here is to identify the main families of e-participation tools, rather than providing an exhaustive list of tools used in the field. Our approach draws on the original classifications of e-participation, which include efforts to develop frameworks in order to model and conceptualize the e-participation domain [43], [44], to identify areas of public participation [45], to evaluate e-Participation related tools [46] and projects [47], and to compare e-Participation initiatives [1]. After conducting a thorough study of the above approaches, in the subsequent paragraphs we briefly present the main families of tools that contribute to the enhancement of e-Participation efforts.

Open Data Platforms. In the effort to structure, manage and represent government and policy related information (as information provision is a critical foundation of public participation), open government data portals have proliferated over the last years [48]. Governments have created portals mashing up national, regional and cross-national datasets, such as the EU Open Data Portal (https://www.europeandataportal.eu), CKAN (https://ckan.org), the World Bank (http://www.worldbank.org), etc. The value of public sector information is recognized with respect to enhancing transparency, empowering citizens to participate and hence leading to informed policy decisions. Open Data platforms play a major role in increasing the accessibility of public sector data to diverse societal actors, thus fostering their communication and interactions with political actors and enabling stronger and more meaningful and substantial civic engagement [71], [72].

Engagement and Collaboration Support. The emergence of the Web 2.0 era lead to the introduction of a plethora of collaboration tools, which enable citizens' engagement at a massive scale and feature novel paradigms [4], [39], [42]. At the same time, it is broadly admitted that the collaboration aspect of e-participation initiatives in the public sector is relatively unexplored [49]. These tools cover a broad spectrum of needs ranging from knowledge exchanging, sharing and tagging, to social networking, group authoring, mind mapping and discussing. For instance, Facebook (http://www.facebook.com) and LinkedIn (http://www.linkedin.com) are representative examples of social networking tools that facilitate the formation of online communities among people with similar

interests; tools such as MindMeister (http://www.mindmeister.com) and Mindomo (http://www.mindomo.com) aim to collectively organize, visualize and structure concepts via maps to aid brainstorming and problem solving; Debatepedia (http://wiki.idebate.org) and Cohere (http://cohere.open.ac.uk) are typical tools aiming to support online discussions over the Web; phpBB (http://www.phpbb.com) and bbPress (http://www.bbpress.org) are Web 2.0 applications enabling the exchange of opinions, focusing especially on the provision of an environment in which citizens can express their thoughts without paying much attention to the structure of the discussion. At the same time there are tools enabling a more structured, and therefore more focused and effective consultation [15], [16], [35], [36].

The above e-participation tools' categories enable the massive and unconstraint collaboration of users; however, this very feature is the source of a problem that these tools introduce: the problem of information overload. The amount of information produced and exchanged and the number of events generated within these tools exceeds by far the mental abilities of users to: (i) keep pace with the evolution of the discussion/collaboration in which they engage, and (ii) keep track of the outcome of past sessions. Current Web 2.0 collaboration tools exhibit two important shortcomings making them prone to the problems of information overload and cognitive complexity. First, Web 2.0 collaboration tools lack reasoning services, with which they could actively and meaningfully support a more productive collaboration. Second, these tools are "information islands", thus providing only limited support for interoperation, integration and synergy with third party tools. While some provide specialized APIs with which integration can be achieved, these are primarily aimed at developers and not end users.

Social Media Monitoring. Social Media Monitoring and Analytics is an evolving marketing research field that refers to the tracking or crawling of various social media content as a way to determine the volume and sentiment of online conversation about a brand or topic [40]. Their added value lies on the fact that such investigations can be performed at real time and in a highly scalable way [50]. Well-known platforms of this category include Hootsuite (https://hootsuite.com), Trackur (http://www.trackur.com), and Sysomos (https://sysomos.com).

Limited research has been conducted concerning the use of such tools by government agencies as well as the extent these are useful for performing citizen-sourcing aiming at understanding and addressing the complex and 'wicked' problems of modern societies [10], [40], [51]. In this direction, a platform has been developed in the context of the NOMAD European project, which provides a set of tools for searching and analyzing public policy related content that has been generated by citizens in numerous 'external' social media (i.e. not belonging to government, such as various political blogs, fora, Facebook and Twitter accounts, etc.); furthermore, this platform provides advanced tools for analyzing this content in order to identify specific issues, ideas, concerns and other information hidden within the text of citizens' posting on the web, enabling in

this way a 'passive citizen-sourcing' [10], [51]. What differentiates NOMAD from typical Social Media Monitoring tools is that analysis is tailored against specific policy makers' goals, by properly visualizing arguments, opinions and sentiments regarding a policy domain, and creating a semantically rich, accurate stream of data that can be leveraged in any workflow. Such tools can support the required "attention mediation" suggested by Klein and Convertino [52], by providing a structured way to represent the "big picture". Disclosing the analytics and reports implies the provision of feedback to the involved population on how their input has been taken into account.

Opinion Mining. Opinion mining tools employ natural language processing, machine learning, text analysis and computational linguistics to extract relevant information from the vast amounts of human textual communication over the Internet or from offline sources. In fact, the propagation of opinionated textual data has caused the development of Web Opinion Mining [53] as a new concept in Web Intelligence, which deals with the issue of extracting, analyzing and aggregating opinions from large quantities of textual data. The analysis of the sentiment of citizens' opinions, known as Sentiment Analysis, is significant for both the private and the public sectir, because it allows determining how people feel about a product or service, or about a public policy or service. We can distinguish between two types of tools in this category; those that provide a framework for data mining algorithms, e.g. Rapidminer (https://rapidminer.com), WEKA (http://www.cs.waikato.ac.nz/ml/weka/), and KNIME (https://www.knime.org/) [54], and online platforms that can visualize (in real time) Opinion Mining Analytics on predefined Web 2.0 Sources, e.g. sentiment viz (political https://www.csc2.ncsu.edu/faculty/healey/tweet_viz/tweet_app/) and Socialmention (http://www.socialmention.com).

In the last decade there is extensive and continuously growing creation of political textual content in the Internet, and especially in social media. Opinion Mining methods and tools make it possible for public administration to collect and analyse it in order to identify citizens' opinions about policies and other topics of interest [55]. For this reason opinion miming methods can be used in combination with the abovementioned engagement and collaboration tools as well as social media monitoring tools. However, there are certain factors that make Web 2.0 data more complicated and difficult to be parsed using Opinion Mining Methods. An interesting study about the identification of such factors was made by Maynard et al. [56], in which they exposed important features that pose certain difficulties to traditional approaches when dealing with social media streams, such as the short length of messages, the existence of noisy content and the disambiguation in the subject of reference.

Reputation Management. Reputation Management refers to the need to seek references for an individual or organization participating in social networks and communities regarding their intellection or influence [57]. This need is partially addressed by existing online reputation management services, which monitor one's influence based on

his/her activities in the social web, such as Klout (http://www.klout.com) and Naymz (http://www.naymz.com); or in the research domain measure one's scientific performance based on citation analysis, such as Google Scholar (http://scholar.google.com) and Research Gate (http://www.researchgate.net). Another stream of reputation management systems is using customer feedback to gain insight on suppliers and brands, or get early warning signals to reputation problems (e.g. eBay RMS).

Likewise, e-Partcipation initiatives may attract and make use of information from a plethora of different sources, and may be affected by the public relations between multiple stakeholders, which should be treated according to their credibility. Current reputation assessment algorithms can partially address this challenge by assigning a generic reputation score to individuals and enabling the identification of experts. Nevertheless, a valid application of author-based contribution filtering [52] for identifying promising ideas and proposals from large corpuses demands contributors to be assessed against their expertise on specific topics related to the public problem under investigation. Such an approach has been developed in the European project EU-Community [12], [13], based on the use of reputation management techniques. In particular, by collecting data concerning the knowledge, credibility and expertise of individuals, reputation scores are calculated for each individual with respect to different policy related thematic areas using a synthetic algorithm; based on these reputation scores, content generated by the most knowledgeable experts over the web can be shown first in users' searches, and this enables the identification of and the focus on the highest quality policy related content that has been already generated in various electronic sources by experts ('passive expert-sourcing').

Argumentation Support. As far as argumentation is concerned, various tools focusing on the sharing and exchange of arguments, diverse knowledge representation issues and visualization of argumentation have been developed. Tools such as Araucaria[58], Reason!Able [59] and Compendium (http://compendium.open.ac.uk) allow users to create issues, take positions on these issues, and make pro and contra arguments. They can capture the key issues and ideas and create shared understanding in a knowledge team; in some cases, they can be used to gather a semantic group memory. Some research has been conducted concerning the application of such approaches in the public sector, for the developemet of tools for structured consultation and argumentation (based mainly on the abovementioned IBIS framework – see section 2.3) with citizens (mainly sophisticated ones or experts) about social problems and public policies for addressing them, with encouraging results [15], [35], [36]. However, these argumentation support tools have the same problems with the aforementioned Web 2.0 engagement and collaboration tools. They too are standalone applications, lacking support for interoperability and integration with other tools (e.g. with data mining services foraging the Web to discover interesting patterns or trends). They also cope poorly with voluminous and complex data as they provide only primitive reasoning services. This makes these tools prone

to the problem of information overload. Argumentation support services recently developed in the context of the Dicode project [16] address most of these issues through innovative virtual workspaces offering alternative visualization schemas that help stakeholders control the impact of voluminous and complex data, while also accommodating the outcomes of external web services, thus augmenting individual and collective sense-making.

In any case, argumentation support tools reveal additional shortcomings that prevent them from reaching a wider audience. In particular, their emphasis on providing fixed and prescribed ways of interaction within collaboration spaces make them difficult to use as they constrain the expressiveness of users, which in turn results in making these systems being used only in niche communities. Adopting the terminology used in the most common theoretical framework of situational awareness shaped by Endsley [60], this category of tools only partially cover the needs of the three stages of situational awareness, namely perception (i.e. perceive the status, attributes, and dynamics of relevant elements in the setting under consideration), comprehension (i.e. perform a synthesis of disjointed elements of the previous stage through the processes of pattern recognition, interpretation, and evaluation), and projection (i.e. extrapolate information from previous stages to find out how it will affect future instances of the operational setting).

Policy Modelling. The increasing complexity of social problems has triggered the evolvement of Policy Modelling, a research field that incorporates the use of information technologies and computational modelling to inform policy analysis, management and decision-making. Estrada [61] define it as "an academic or empirical research work that is supported by the use of different theories as well as quantitative or qualitative models and techniques, to analytically evaluate the past (causes) and future (effects) of any policy on society, anywhere and anytime". Policy Modelling tools are mainly based on Ontological Engineering and Semantic Web tools including ontology editors (e.g. Protégé - http://protege.stanford.edu and ELEON - http://users.iit.demokritos.gr/~eleon/). The majority of them serve purposes of building and running models of a policy or a social problem to be solved, structuring the main elements, topics, sub-topics and terms of it, in order to be used for collecting relevant content authored by citizens and experts in various electronic spaces. For instance, in the abovemetnioned NOMAD project an Authoring Tool has been developed, which provides a web-based interface to create domain and policy models that capture topics and arguments relevant to a policy and their inter-relations. These models set the basis for the retrieval and analysis of policy relevant text segments that have been published on the web [51].

Dynamic Simulation. Dynamic simulation methodologies (such as Agent-based, Discrete Event and System Dynamics simulation) are applied to model and simulate complex problems in various domains. During the policy formulation process, they can help visualize policy related information from the real world. Simulation allows testing alternative solutions, as well as predicting and assessing

the impact of prospective policy choices, reducing the associated uncertainty. Well known examples of simulation platforms are Vensim - http://www.vensim.com and Anylogic - http://www.anylogic.com). Although simulation approaches are mainly addressed to experts and policy makers to help them to understand the complexity of phenomena and policy impacts, e-Participation platforms combining simulation and gamification have been also developed as a means to promote participation of the general public (e.g. participatory budgeting simulation) [62].

Decision making support. Data warehouses, on-line analytical processing, and data mining have been broadly recognized as technologies playing a prominent role in the development of current and future Decision Support Systems [63], in that they may aid users make better, faster and informed decisions. However, one critical point that is still missing is a holistic perspective on the issue of decision making. This originates out of the growing need to develop applications by following a more human-centric (and not problem-centric) view, in order to appropriately address the requirements of public sector stakeholders. Such requirements stem from the fact that decision making has also to be considered as a social process that principally involves human interaction [64]. The structuring and management of this interaction requires the appropriate technological support and has to be explicitly embedded in the solutions offered for this purpose. The above requirements, together with the ones imposed by the way public sector stakeholders work and collaborate today, delineate a set of challenges for further decision support technology development. Such challenges can be addressed by adopting a knowledge-based decision-making view, while also enabling the meaningful accommodation of the results of social knowledge mining processes (revealing the needs, perceptions, opinions of the general public). Knowledge management activities, such as policy related knowledge elicitation, representation and distribution influence the creation of the decision models to be adopted, thus enhancing the decision making process [65], while evaluation of contributions in the decision making process act as a reputation mechanism and provide incentives for engagement.

From the above review of the main categories of e-participation tools, it can be concluded that they can be distinguished, based on their main purpose, into two types: (i) those oriented towards the collection, integration and analysis of citizens (general public) information, knowledge, opinions and values, and (ii) those targeted to the collection, analysis and consolidation of experts' knowledge through technology-mediated structured dialogue among them (such as Structured Collaboration, Argumentation and Decision making support tools, possibly in combination with Reputation Management); each of these two types of e-participation tools can provide either limited or substantial analysis/processing capabilities, which constitutes another important categorization of them. In any case, there is a lack of approaches combining the collection of policy related information, knowledge and opinions from both citizens (general public) and experts, and facilitating the interactions between representatives of the technocracy and democracy. However, this combination and

interaction is necessary, since – as mentioned in Section 2.2 - previous political sciences research has revealed that both democracy and technocracy are fundamental foundations for the development of public policies, and that there should be balance as well as interaction and exchange of knowledge between them. Our work aims to address this very gap through an innovative and user-friendly 'dual' platform.

4 AN INNOVATIVE DUAL E-PARTICIPATION PLATFORM

4.1 Description

The proposed 'dual' platform consists of two main components: the first of them supports structured consultation and argumentation among experts, based on the IBIS framework (see Section 2.3), concerning social problems and public policies for addressing them; the second component supports the collection and processing of relevant citizens-generated textual content from numerous external social media (e.g. various political blogs, fora, Facebook accounts, etc.). Content related to the first component is directly uploaded by the experts (expressing alternative solutions and arguments in favor or against them for the issue under consideration), while content related to the second component is semi-automatically extracted from external applications (used to justify or oppose one's claim, or even 'feed' an ongoing consultation with additional information). As explained in Section 2.1, our overall approach for the development of this platform adopts the Action Research and Design Science Research paradigms. In particular, our work has been based on close collaboration with selected experts aiming to fully understand the wicked problems associated with the cognitively-complex and data-intensive public policy making context, the development of an innovative solution to solve practical problems within the above context, as well as the evaluation of the proposed solution in diverse organizational settings.

Generally speaking, in complex contexts such as that of public policy making, which are characterized by diverse types of stakeholders (both experts and generic public) and activities, diverse e-participation tools need to be integrated and meaningfully orchestrated (enabling, on one hand, structured consultations/argumentations and, on the other hand, collection and analysis of various types of relevant data). In most cases, this is a complex and challenging issue, which depends on many factors, such as the type of the resources to be integrated, performance requirements, data heterogeneity and semantics, user interfaces, and middleware [66]. At the same time, policy makers and experts are confronted with the rapidly growing problem of information overload. An enormous amount of policy related content already exists in the "digital universe", i.e. information that is created, captured, or replicated in digital form, which is characterized by high rates of new information that demands attention. When working together, experts have to cope with this diverse and exploding digital universe; they need to efficiently and effectively collaborate and make decisions by appropriately assembling and
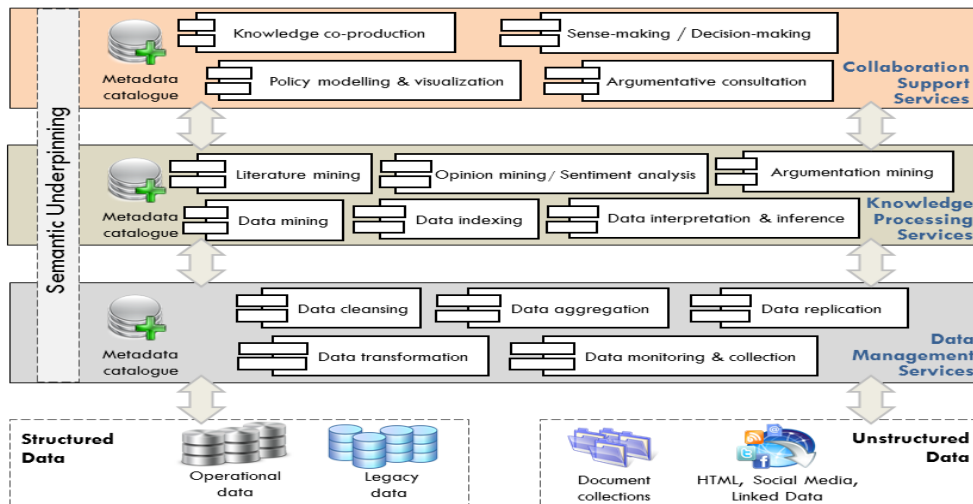
Fig. 1. The architecture of the proposed e-Participation platform.

analyzing enormous volumes of complex multi-faceted data residing in different sources and incorporating valuable policy related knowledge, perceptions and ideas of the citizens. Admittedly, when things get complex, we need to aggregate big volumes of data, and then mine it for insights that would never emerge from manual inspection or analysis of any single data source.

We argue that the above requirements can be fully addressed by an innovative web-based platform that ensures the seamless interoperability and integration of diverse components and services, as those reported in Section 3. This platform, whose three-layer architecture is illustrated in Fig. 1, enables a synergy of human and machine reasoning, through a meaningful integration of a series of services that facilitate and augment the participation of diverse types of experts in structured consultations/argumentations. The proposed solution is able to loosely combine web services to provide an all-inclusive infrastructure ('single-access-point') for the effective and efficient support of public and private sector experts, possibly expressing views of different stakeholders, participating in policy making procedures. This solution does not only provide a working environment for hosting and indexing of services, seamless retrieval and analysis of large-scale data sets; it also leverages Web technologies and social networking solutions to provide stakeholders with a simple and scalable solution for targeted collaboration, resource discovery and exploitation, in a way that facilitates and boosts open innovation activities. This platform exploits rich semantics at machine level to enable the meaningful incorporation and orchestration of interoperable web services in customized workflow settings, aiming to reduce the data-intensiveness and smooth the associated workloads to a manageable level.

The proposed integration can be based on established technologies and standards of a service-oriented architecture. Application Programming Interfaces (APIs) allow different applications to connect and interact with each other, while web services provide a standardized way of integrating web-based applications using open standards such as XML, SOAP, WSDL and UDDI. Such an architecture and overall integration approach has been fully developed in the context of the Dicode EU project (http://dicode-project.cti.gr/), where a widget-based solution was conceived to deliver diverse web services to end-users and alternative service integration modes were proposed and thoroughly tested in the project's use cases. It has been shown that this approach, namely the Dicode Workbench [67], ensures a flexible, adaptable and scalable information and computation infrastructure, and exploits the competences of the experts to properly confront information management issues, such as information characterization, classification and interpretation, thus giving added value to the underlying citizens' collective intelligence. Moreover, it facilitates knowledge sharing and knowledge co-creation, and assures better-informed collaboration.

In particular, the proposed platform includes a series of consultation, collaboration and decision making support services (see top layer of the architecture shown in Fig. 1) developed in the context of the Dicode project [16]. Specifically, these services (i) provide advanced knowledge exchange and collaboration support functionalities through innovative virtual workspaces, (ii) are geared towards achieving consensus and gaining of deeper insights, (iii) support incremental formalization of argumentative collaboration (i.e. a stepwise and controlled evolution from a mere collection of individual ideas and resources to the production of highly contextualized and interrelated knowledge artefacts), which augments sense-making through reviewing, commenting on and extending the shared content, and (iv) aid experts rank alternative solutions and determine the best one (i.e. reach a decision) based on predefined criteria, offering a working environment that supports interpretation of diverse knowledge items and their interrelationships.

The above services (supporting experts' e-participation activities) can be combined with another set of services for sophisticated collection and analysis on textual content published by citizens in external social media (see bottom and middle layers of the architecture shown in Fig. 1),
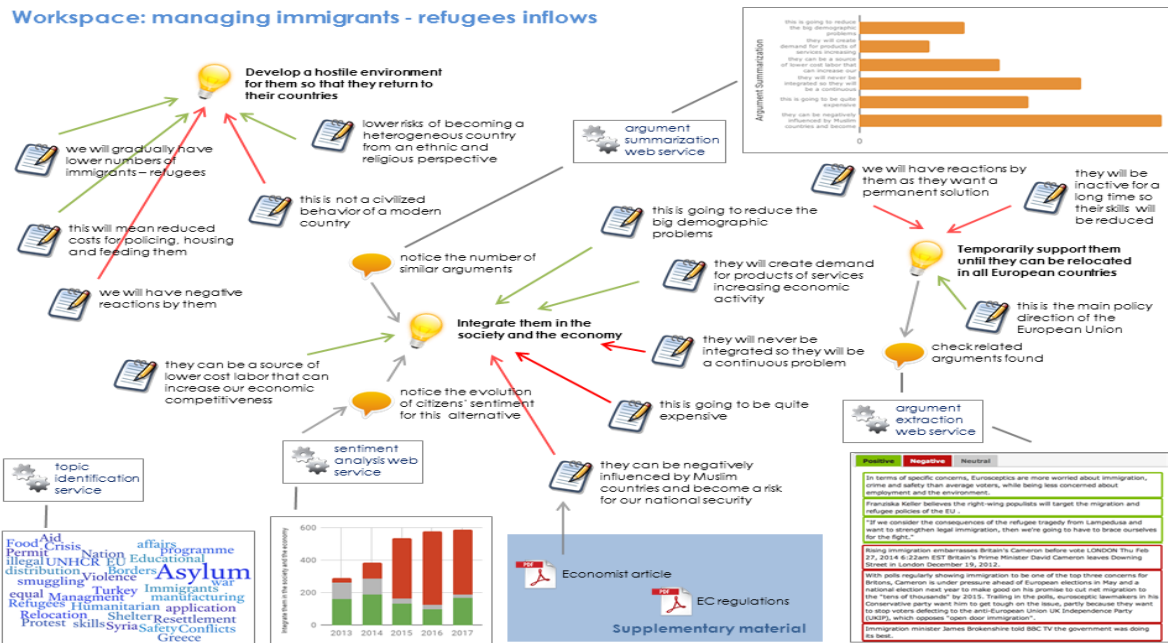
Fig. 2. Workspace of the application scenario (an instance).

which has been developed in the context of the NOMAD (http://nomad-project.eu) [10], [51]. This is highly valuable, as it enables experts' collaboration and argumentation taking place as part of e-participation initiatives to take into account and benefit from 'fresh' relevant content contributed by citizens in numerous social media, incorporating useful ideas, knowledge as well as perceptions of the general public. Integrating components from many of the tool categories presented in Section 3, the NOMAD tool-set provides APIs for services that: (i) create and maintain policy models (incorporating the main elements of the public policies, for which we want to collect relevant content from the above social media), (ii) using such policy models, mine relevant citizen-generated content from a variety of online text sources (e.g. political blogs, social media, websites), which are pre-defined by the user (iii) perform linguistic analysis of this collected content in order to transform this free text into a set of structured data, (iv) discover and extract main issues discussed as well as arguments from this free text, (v) perform sentiment analysis of it to classify text segments according to their 'tone' (positive, neutral, negative), (vi) cluster arguments, based on calculated similarities, and present automatically-generated summaries, and (vii) visualize a structured view of citizens' opinions on a policy related topic (visualized through word-clouds and other kinds of charts), providing insights on what about, how much and when citizens are discussing concerning this topic. These services allow defining a set of high quality on-line sources of citizen-generated textual content concerning a public policy (e.g. economic, social, educational, technological, etc.) we are interested in, which can include a large number of relevant political blogs, as well as social media accounts and web-sites of important stakeholders, analysts, journalists, organizations, etc., and continuously monitor relevant content produced in them. The integration of the above NOMAD services

with those developed in the context of the Dicode project is straightforward due to the API-based communication approach adopted in the proposed solution (APIs are customizable interfaces that enable software components to effectively communicate by overcoming the inherent incompatibilities caused by different software platforms).

Such a combination between human argumentative collaboration support on one hand, and data collection and analysis tools on the other, builds on the synergy between human and machine intelligence to enhance individual and collective work during the entire e-participation process. In addition, it addresses the diversity of requirements related to the data intensiveness and cognitive complexity of settings concerning e-participation in the public sector. The proposed solution adopts a knowledge-based collaboration and decision-making approach to experts' e-participation and, at the same time, enables the meaningful accommodation of the results of a social knowledge mining process. According to this apprach, which builds on bottom-up innovation models, decisions concerning the best alternative solution/intervention for addressing a social problem are considered as pieces of descriptive or procedural knowledge referring to an action commitment. In such a way, the decision-making process is able to produce new knowledge, such as evidence justifying or challenging an alternative or practices to be followed or avoided, thus providing a refined understanding of the particular social problem.

4.2 An Application Scenario
The proposed solution is illustrated through a realistic example concerning the development of public policy for the management of the immigrants-refugees' inflows problem in Greece. Assuming that the related e-participation process is initiated by the Greek Ministry of Interior, policy makers and advisors from the Ministry in cooperation with

other experts (NGO representatives, academics, migration experts, etc.) use the Dicode Collaboration Support services (see Fig. 2) to elaborate the issue. They gradually develop three alternative solutions (appearing next to the 'light bulb' icons in the Dicode workspace of Fig. 2). Different technocrats' perspectives are associated with these solutions as arguments in favour or against them (shown with green and red arrows, respectively). Experts may also contribute to a better understanding of the problem and its policy context by uploading supplementary material of any format (e.g. documents referring to EU legislation, multimedia material pointing to a particular dimension of the problem, informative graphs and tables etc.) and comments (shown with yellow ellipses).

At the same time, experts and technocrats may easily invoke external web services (through the 'double gear' icons shown in the Dicode workspace) to look for the public opinion related to the model of a public policy under consideration (these services search in a predefined list consisting of news sites, RSS feeds, Facebook pages and Twitter accounts, and collect from then relevant textual content generated by citizens). Through appropriate APIs, external services may upload their outcomes (=results from advanced analyses of the above collected content, such as main topics discussed, and corresponding citizens' sentiments, arguments, in visualized form) into the Dicode collaboration workspace, thus making them part of the undergoing collaboration. For instance, a Topic Identification service may reveal - through the word cloud shown in Fig. 2- the most popular topics discussed by citizens in relevant web sources (blogs, news sites, social media communities, etc.) concerning the immigrants-refugees' inflows problem as well as the above three proposed alternative solutions, thus triggering the consideration of additional perspectives (e.g. those related to provision of asylum). In the instance shown in Fig. 2, a set of NOMAD services have been already executed to aid the required sophisticated analysis of the associated big textual data promoting 'citizen-sourcing'. In particular, a set of on-line sources with relevant citizens-generated content (according to our previous experience) have been defined, and then the following NOMAD services have been executed: (i) the Word Cloud Sentiment service, which provides the main topics discussed by the citizens in the bove sources about the immigrants-refugees' inflows problem as well as the above three proposed alternative solutions; ii) the Analysis service, which enables experts to view the extent (and evolution over time) of the support or opposition of the citizens on an alternative solution, (iii) the Argument Extraction service that reveals new arguments discussed online in favor or against the already proposed solutions, which can then be exploited by stakeholders, (iv) the Argument Summarization service that returns the volume of extracted arguments' clusters to provide users with estimations about their popularity.

The argumentative collaboration environment proposed allows experts to upload and refine alternative ideas and proposals, argue on them (positively or negatively), and take into account and evaluate existing citizens-generated content, consolidating the knowledge brought forward by both humans and the machine. Machine-retrieved content can be leveraged by the experts, in that it enables them to advance an ongoing deliberation and gain new insights, based on 'fresh' content from the society reflecting knowledge, perceptions and feelings of the general public. In addition, it motivates brainstorming and ideation in the policy formulation process. Furthermore, decision making support services also offered by the Dicode approach may be used in order to aid the evaluation of alternative solutions, by incorporating various multi-criteria decision algorithms and predefined criteria.

Additional services may further enhance the e-participation process illustrated in Fig. 2. For instance, a Reputation Management service may provide ranking of ideas based on the expertise of the contributor; a Policy Simulation service may run scenarios to predict the outcome of the most prevalent policy choices. In parallel, real time social data can be aggregated with statistical information coming from public administration (e.g. Ministries, Greek Asylum Service, Eurostat) or related open data platforms.

5 EVALUATION

The Dicode solution (diverse services and their integrated platform) has been thoroughly evaluated through the project's real use cases, which concerned public policy implications of clinico-genomic research, medical decision making, through argumentative collaboration of experts, using Web 2.0 data. A full description of the evaluation process, which took place in two rounds, can be found in [68], [69].

During the first evaluation round, the Dicode Workbench and structured consultation, collaboration and decision-making support services were evaluated in terms of usability, accessibility and acceptability by 61 volunteers from the four participant countries of the project (Greece, Spain, Germany, and United Kingdom). Questionnaires distributed to evaluators aimed at gathering mainly both quantitative and qualitative feedback. Evaluators were asked to carefully read the related instructions, have a 'hands-on' session, and finally proceed to the evaluation. Based on the feedback received from the first evaluation phase, the Dicode Workbench was reported to be a promising tool for collaborative sense making of clinico-genomic research and its public policy implications. The vast majority of the evaluators appreciated the potential of exploiting the synergy of machine and human reasoning through the proposed combination of data mining, structured consultation/argumentation and collaborative decision-making services. In addition, they agreed on the usefulness of the provided services. Nevertheless, additional work towards the improvement of Dicode services in terms of user interface and performance seemed to be essential.

For the second evaluation round, where an enhanced version of the Dicode solution was assessed, rather than evaluating the usability of each service, we were interested in evaluating how those tools facilitate collaborative processing of the tasks at hand, paying particular attention to issues related to data analysis, as well as understanding and assessing its findings in a multi-disciplinary collaborative environment. This second round was conducted by recruiting 24 senior members of the affected communities,

to whom a scenario very similar to the one presented in Section 4.2 was distributed in order to assess the proposed solution. Based on related literature suggestions [70], we combined two evaluation methodologies, namely scenario-formed video-casts and questionnaires, in order to capture experts' judgements about the usage of Dicode services and their overall ratings in an effortless way.

Overall, the Dicode Workbench was reported to be intuitive with well integrated services. Evaluators were skeptical about adopting new practices, but less skeptical for the ability of the proposed services and integrated platform to deal with cognitively complex issues, to enhance structured consultation/argumentation and collaboration between their peers, and in that respect assist exchanging of information and knowledge. The Dicode structured consultation collaboration and decision-making support services were highly marked; special mentions included the data management and analysis mechanism, and the different manners of sharing or discussing data and results. It has been admitted that these services provide functionalities that help alleviate the impact of data-intensiveness during collaboration sessions. The alternative ways offered for discourse structuring, as well as for aggregation and filtering of knowledge items expressed were highly valued, since these enable users to control the complexity of collaboration workspaces, while at the same time making the discourse understandable. Furthermore, evaluators reported that the Dicode platform offers ease of communication and knowledge exchange, as well as strong data/information archiving features. Evaluators deemed that the Dicode Workbench brings potential benefit to their work and provides sufficient services to support their work. Finally, the overall evaluation process revealed that there is great potential for adaptation and application of the Dicode platform in a wide range of different organizations.

With regard to the citizen-sourcing component of our e-participation platform, enabling the collection of citizen generated content, this has been evaluated as part of the European project NOMAD, using a multi-perspective evaluation framework [10]. For this purpose, two pilot applications have been conducted. They were carried out by government organizations, the Greek and the Austrian Parliament, aiming to collect public opinions, attitudes/sentiments, proposals and ideas in order to inform the preparation of legislation on national energy planning and open government policies, respectively.

For each pilot, a focus group discussion was organized, which was attended by personnel of the organization involved, as well as external experts invited to express their point of view (22 for the Greek pilot and 10 for the Austrian). We conducted qualitative discussions focused on the questions of the three perspectives of our evaluation framework [10] (political, crowdsourcing and innovation diffusion perspective) in order to gain a deeper and richer understanding of the value generated by this component along each of these perspectives.

The evaluation has concluded that this citizen-sourcing component can significantly promote and enhance the participation of citizens, as it can provide extensive policy related information, knowledge, ideas and opinions, which

can be highly important for public policy making. In particular, it allows extracting from social media various kinds of useful external 'high level' knowledge concerning the level of interest/discussion in the society for a particular domain of government activity, or an existing or under development policy, and the attitudes/sentiments of the society. Furthermore, it allows extracting more detailed external knowledge about relevant issues posed by citizens, and - to a lower degree - proposals of them for solving relevant problems or improving policies and relevant arguments (positive or negative), which can significantly facilitate, promote and support open innovation in public policy making. Another interesting finding is that this method is useful for 'sensing' changes in the external environment of government agencies, which can be very useful for the development of policies for addressing these changes.

However, some risks have been identified, associated with the degree of representativeness of the citizens' groups who produce the content collected from the monitored social media, and also its reliability (i.e. whether it is non-biased, non-manipulated and of good quality). Such risks can be avoided by carefully selecting the social media sources to be monitored. Therefore, in order to have representative and reliable policy related content, it is necessary to monitor a big number of high quality and politically diverse sources (i.e. having different political orientations). Despite these drawbacks, evaluation results concerning this citizen-sourcing component seem to be highly useful for the development or improvement of public policies, for both government agencies and experts. An overview of the abovementioned evaluation results is given in Table 1.

TABLE 1
OVERVIEW OF EVALUATION RESULTS

Service Evaluated	Number of Evaluators	Evaluation Method	Remarks
DICODE Workbench	61 (1st round) / 24 (2nd round)	Qualitative (scenario-formed video-casts) and Quantitative (questionnaires)	Highly rated: integration adaptation and application Ease of communication and Knowledge exchange
DICODE Collaboration and Decision-Making Support	61 (1st round) / 24 (2nd round)	Qualitative (scenario-formed video-casts) and Quantitative (questionnaires)	Usefulness of services for data management and data analysis Additional work: User interface and Performance
NOMAD Social Media Monitoring	32	Qualitative (focus groups discussions) and Quantitative (questionnaires)	High quality information from citizen-sourcing Usefulness in public policy formulation Risks of representativeness and reliability

6 CONCLUSION

Taking into account the diversity of requirements concerning the collection and meaningful combination of information, knowledge and opinions from both experts and citizens (general public), who are according to previous political sciences research on 'democracy and technocracy'

the main complementary pillars of public policy design (see Section 2.2), this paper presents an innovative 'dual' e-participation platform for this purpose.

The proposed solution integrates on one hand experts' structured consultation, collaboration and decision support services, and on the other hand services for the collection and analysis of policy-relevant citizen-generated textual content from external social media (e.g. various political blogs, fora, Facebook, Twitter, etc.). In our approach, all these are not working as standalone, but coexist and make use of other services' outcomes to improve their performance. This solution builds on the synergy of machine and human reasoning, through a proper combination of external social media data collection, analysis and mining with experts' structured argumentation and collaborative decision-making services. This approach enables experts dealing with cognitively complex issues to exchange relevant information and knowledge, and conduct enhanced collaboration towards the creation of new solutions, interventions and public policies for complex social problems. At the same time, the proposed platform can provide experts with extensive policy related relevant external information, knowledge, ideas, and opinions of citizens, enabling effective communication and interaction of 'technocracy' (experts working on important public policies) with 'democracy' (citizens' perceptions, feelings, opinions).

Future work directions include the use of the proposed platform for socially informed structured consultations/argumentations among experts on a wide range of social problems and relevant public policies. Also, it will be very interesting to evaluate in more depth to what extent such a platform enables a transfer of knowledge, perceptions and feelings from the society towards the experts/technocrats, contributing to overcoming the negative aspects of the 'technocracy' (e.g. limited understanding of diverse needs, values and concerns of different stakeholder groups on particular social problems the experts analyze) [12], [13], [30]. Finally, it would be interesting to develop mechanisms and ICT tools for the transfer of knowledge in the opposite direction: from the 'technocracy' (technocrats' expertise) to the 'democracy' (citizens or representatives of them, elected officials) concerning complex social problems and relevant public policies.

REFERENCES

[1] A. Macintosh, "Characterizing e-participation in policy-making," in *Proceedings of the 37th Annual Hawaii International Conference on System Sciences*, 2004, no. 1, pp. 1–10.

[2] E. Loukis, A. Macintosh, and Y. Charalabidis, *E-Participation in Southern Europe and the Balkans*. Routledge, 2013.

[3] M. Gramberger, *Citizens as Partners OECD Handbook on Information, Consultation and Public Participation in Policy-Making*. Public Policy Centre, Romania, 2001.

[4] Y. Charalabidis and E. Loukis, "Transforming Government Agencies' Approach to e-Participation through Efficient Exploitation of Social Media," in *European Conference on Information Systems (ECIS)*, 2011.

[5] A. Weinberger and F. Fischer, "A framework to analyze argumentative knowledge construction in computer-supported collaborative learning," *Computers and Education*, vol. 46, no. 1,

pp. 71–95, 2006.

[6] M. Janssen, Y. Charalabidis, and H. Krcmar, "Introduction to Open Data, Information Processing, and Datification in Government Minitrack," in *Proceedings of the 50th Hawaii International Conference on System Sciences*, 2017.

[7] M. Poel *et al.*, "Data for Policy: A study of big data and other innovative data-driven approaches for evidence-informed policymaking," *Report about the State-of-the-Art. Amsterdam: technopolis, Oxford Internet Institute, Center for European Policy Studies*, 2015.

[8] M. Severo, A. Feredj, and A. Romele, "Soft Data and Public Policy: Can Social Media Offer Alternatives to Official Statistics in Urban Policymaking?," *Policy & Internet*, vol. 8, no. 3, pp. 354–372, Sep. 2016.

[9] H. Chesbrough and M. Bogers, "Explicating Open Innovation: Clarifying an Emerging Paradigm for Understanding Innovation Keywords," *New Frontiers in Open Innovation*, pp. 1–37, 2014.

[10] E. Loukis, Y. Charalabidis, and A. Androutsopoulou, "Promoting open innovation in the public sector through social media monitoring," *Government Information Quarterly*, vol. 34, no. 1, pp. 99–109, 2017.

[11] T. Nam, "Suggesting frameworks of citizen-sourcing via Government 2.0," *Government Information Quarterly*, vol. 29, no. 1, pp. 12–20, 2012.

[12] A. Androutsopoulou, F. Mureddu, E. Loukis, and Y. Charalabidis, "Passive Expert-Sourcing for Policy Making in the European Union," in *Electronic Participation. ePart 2016. Lecture Notes in Computer Science, vol 9821*, 2016, vol. 9821, pp. 162–175.

[13] A. Androutsopoulou, Y. Charalabidis, and E. Loukis, *Technocracy to democracy knowledge transfer using social media and reputation management*, vol. 10429 LNCS. 2017.

[14] J. L. Creighton, *The public participation handbook: Making better decisions through citizen involvement*. John Wiley & Sons, 2005.

[15] E. Loukis and M. Wimmer, "A Multi-Method Evaluation of Different Models of Structured Electronic Consultation on Government Policies," *Information Systems Management*, vol. 29, no. 4, pp. 284–294, 2012.

[16] N. Karacapilidis, *Mastering Data-Intensive Collaboration and Decision Making: Research and practical applications in the Dicode project*, vol. 5. Springer Science & Business Media, 2014.

[17] R. N. Rapoport, "Three Dilemmas in Action Research," *Human Relations*, vol. 23, no. 6, pp. 499–513, 1970.

[18] P. Checkland and S. Holwell, "Action research: Its nature and validity," *Systemic Practice and Action Research*, vol. 11, no. 1, pp. 9–21, 1998.

[19] J. McKay and P. Marshall, "The dual imperatives of action research," *Information Technology & People*, vol. 14, no. 1, pp. 46–59, 2001.

[20] A. R. Hevner, S. T. March, J. Park, and S. Ram, "Design Science in Information Systems Research," *MIS Quarterly*, vol. 28, no. 1, pp. 75–105, 2004.

[21] H. J. W. Rittel and M. Webber, "Planning problems are wicked problems," in *Developments in Design Methodology*, N. Cross, Ed. New York: John Wiley, 1984, pp. 135–144.

[22] J. Iivari and J. Venable, "Action Research and Design Science Research - Seemingly Similar but Decisively Dissimilar," in *17th European Conference on Information Systems*, 2009, pp. 1642–1653.

[23] B. Barber, *Strong Democracy*. Berkeley: Cambridge University Press, 1984.

[24] G. Rowe and L. J. Frewer, "Evaluating Public Participation

Exercises: A Research Agenda," *Science, Technology & Human Values*, vol. 29, pp. 512–557, 2004.

[25] OECD, "Focus on Citizens: Public Engagement for Better Policy and Services," Paris, 2008.

[26] F. Fischer, *Technocracy and the Politics of Expertise*. SAGE Publications, 1990.

[27] C. M. Radaelli, "The role of knowledge in the policy process," *Journal of European Public Policy*, vol. 2, no. 2, pp. 159–183, 1995.

[28] A. Esmark, "The informational logics of liberal democracy. Making sense of the nudging agenda," *Information Polity*, vol. 21, no. 2, pp. 123–137, 2016.

[29] M. B. Brown, *Science in democracy: Expertise, institutions, and representation*. MIT Press, 2009.

[30] B. Gilley, "Technocracy and democracy as spheres of justice in public policy," *Policy Sciences*, vol. 50, no. 1, pp. 9–22, 2017.

[31] W. Kunz and H. W. J. Rittel, *Issues as elements of information systems*, vol. 131. Institute of Urban and Regional Development, University of California Berkeley, California, 1970.

[32] H. W. J. Rittel and M. M. Webber, "Dilemmas in a general theory of planning," *Policy Sciences*, vol. 4, no. 2, pp. 155–169, 1973.

[33] B. W. Head, "Wicked Problems in Public Policy," *Public Policy*, vol. 3, no. 2, pp. 101–118, 2008.

[34] J. Conklin, "Dialog Mapping: Reflections on an Industrial Strength Case Study," in *Visualizing Argumentation: Software Tools for Collaborative and Educational Sense-Making*, P. A. Kirschner, S. J. Buckingham Shum, and C. S. Carr, Eds. London: Springer London, 2003, pp. 117–136.

[35] N. Karacapilidis, E. Loukis, and S. Dimopoulos, "Computer-supported G2G collaboration for public policy and decision-making," *Journal of Enterprise Information Management*, vol. 18, no. 5, pp. 602–624, 2005.

[36] N. Karacapilidis and D. Papadias, "Computer supported argumentation and collaborative decision making: The HERMES system," *Information Systems*, vol. 26, no. 4, pp. 259–277, 2001.

[37] J. Howe, *Crowdsourcing: Why the Power of the Crowd Is Driving the Future of Business*, 1st ed. New York, NY, USA: Crown Publishing Group, 2008.

[38] M. Hossain and I. Kauranen, "Crowdsourcing: a comprehensive literature review," *Strategic Outsourcing: An International Journal*, vol. 8, no. 1, pp. 2–22, 2015.

[39] I. Mergel and K. Desouza, "Implementing Open Innovation in the Public Sector: The Case of Challenge. gov," Public Administration Review, vol. 73, no. 6, pp. 882–890, 2013.

[40] V. Bekkers, A. Edwards, and D. de Kool, "Social media monitoring: Responsive governance in the shadow of surveillance?," *Government Information Quarterly*, vol. 30, no. 4, pp. 335–342, 2013.

[41] R. Medaglia and L. Zheng, "Mapping government social media research and moving it forward: A framework and a research agenda," *Government Information Quarterly*, 2017.

[42] E. Ferro, E. N. Loukis, Y. Charalabidis, and M. Osella, "Policy making 2.0: From theory to practice," *Government Information Quarterly*, vol. 30, no. 4, pp. 359–368, 2013.

[43] E. Kalampokis, E. Tambouris, and K. Tarabanis, "A domain model for eParticipation," in *Internet and Web Applications and Services, 2008. ICIW'08. Third International Conference on*, 2008, pp. 25–30.

[44] L. Porwol, A. Ojo, and J. Breslin, "A Semantic Model for e-Participation - Detailed Conceptualization and Ontology," in *Proceedings of the 15th Annual International Conference on Digital Government Research*, 2014, pp. 263–272.

[45] C. Fraser *et al.*, "DEMO - net: Deliverable 5.1 Report on current ICTs to enable Participation."

[46] D. Zissis, D. Lekkas, and A. E. Papadopoulou, "Competent electronic participation channels in electronic democracy," *Electronic Journal of e-Government*, vol. 7, no. 2, pp. 195–208, 2009.

[47] S. Koussouris, Y. Charalabidis, and D. Askounis, "A review of the European Union eParticipation action pilot projects," *Transforming Government: People, Process and Policy*, vol. 5, no. 1, pp. 8–19, 2011.

[48] C. Alexopoulos, E. Loukis, S. Mouzakitis, M. Petychakis, and Y. Charalabidis, "Analysing the Characteristics of Open Government Data Sources in Greece," *Journal of the Knowledge Economy*, (to apperar) 2017.

[49] I. Mergel, "Opening Government: Designing Open Innovation Processes to Collaborate With External Problem Solvers," Social Science Computer Review, vol. 33, no. 5, pp. 599–612, 2015.

[50] I. Stavrakantonakis, A.-E. Gagiu, H. Kasper, I. Toma, and A. Thalhammer, "An approach for evaluation of social media monitoring tools," in *1st International Workshop on Common Value Management*, 2012, vol. 2012, pp. 52–64.

[51] Y. Charalabidis, E. Loukis, A. Androutsopoulou, V. Karkaletsis, and A. Triantafillou, "Passive crowdsourcing in government using social media," *Transforming Government: People, Process and Policy*, vol. 8, no. 2, pp. 283–308, 2014.

[52] M. Klein and G. Convertino, "A Roadmap for Open Innovation System," *Journal of Social Media for Organizations*, vol. 2, no. 1, p. 1, 2015.

[53] E. M. Taylor, C. Rodríguez O., J. D. Velásquez, G. Ghosh, and S. Banerjee, "Web Opinion Mining and Sentimental Analysis," in *Advanced Techniques in Web Intelligence-2: Web User Browsing Behaviour and Preference Analysis*, 2013, pp. 105–126.

[54] A. Dhokrat, S. Khillare, and C. N. Mahender, "Review on Techniques and Tools used for Opinion Mining," *International Journal of Computer Applications Technology and Research*, vol. 4, no. 6, pp. 419–424, 2015.

[55] M. Maragoudakis, E. Loukis, and Y. Charalabidis, "A Review of Opinion Mining Methods for Analyzing Citizens' Contributions in Public Policy Debate," in *Electronic Participation Proceedings of the 3rd IFIP WG 8.5 International Conference, ePart 2011*, 2011, vol. 6847, pp. 298–313.

[56] D. Maynard, K. Bontcheva, and D. Rout, "Challenges in developing opinion mining tools for social media," in *LREC 2012*, 2012, pp. 15–22.

[57] D. He, Z. Peng, L. Hong, and Y. Zhang, "A social reputation management for web communities," *Lecture Notes in Computer Science*, vol. 7142, pp. 167–174, 2012.

[58] C. Reed and G. Rowe, "Araucaria: Software for puzzles in argument diagramming and XML," *Department of Applied Computing, University of Dundee Technical Report*, pp. 1–21, 2001.

[59] T. van Gelder, "Argument Mapping with Reason!Able," *The American Philosophical Association Newsletter on Philosophy and Computers*, vol. 2, pp. 85–90, 2002.

[60] M. R. Endsley, "Toward a theory of situation awareness in dynamic systems: Situation awareness," *Human Factors*, vol. 37, no. 1, pp. 32–64, 1995.

[61] M. A. Ruiz Estrada, "Policy modeling: Definition, classification and evaluation," *Journal of Policy Modeling*, vol. 33, no. 4, pp. 523–536, 2011.

[62] S.-K. Thiel, M. Reisinger, K. Röderer, and P. Fröhlich, "Playing

(with) Democracy: A Review of Gamified Participation Approaches," *JeDEM - eJournal of eDemocracy and Open Government*, vol. 8, no. 3, pp. 32–60, 2016

[63] J. P. Shim, M. Warkentin, J. F. Courtney, D. J. Power, R. Sharda, and C. Carlsson, "Past, present, and future of decision support technology," *Decision Support Systems*, vol. 33, no. 2, pp. 111–126, 2002.

[64] S. W. Smoliar, "Interaction management: The next (and necessary) step beyond knowledge management," *Business Process Management Journal*, vol. 9, no. 3, pp. 337–353, 2003.

[65] N. I. Karacapilidis and T. F. Gordon, "Dialectical Planning," in *Proceedings of 14th International Joint Conference on Artificial Intelligence (IJCAI-95); Workshop on Intelligent Manufacturing Systems*, 1995, pp. 239–250.

[66] P. Ziegler and K. R. Dittrich, "Three Decades of Data Integration — All Problems Solved?," in *18th IFIP World Computer Congress (WCC 2004)*, 2004, vol. 12, pp. 3–12.

[67] G. de la Calle, E. Alonso-Martinez, M. Tzagarakis, and N. Karacapilidis, "The Dicode Workbench: A Flexible Framework for the Integration of Information and Web Services," in *Proceedings of the 14th International Conference on Information Integration and Web-based Applications and Services*, 2012, pp. 16–25.

[68] R. Löffler, "Opinion Mining from Unstructured Web 2.0 Data: A Dicode Use Case," in *Mastering Data-Intensive Collaboration and Decision Making: Research and practical applications in the Dicode project*, N. Karacapilidis, Ed. Cham: Springer International Publishing, 2014, pp. 181–200.

[69] G. Tsiliki and S. Kossida, "Clinico-Genomic Research Assimilator: A Dicode Use Case," in *Mastering Data-Intensive Collaboration and Decision Making: Research and practical applications in the Dicode project*, N. Karacapilidis, Ed. Cham: Springer International Publishing, 2014, pp. 165–180.

[70] J. Cugini *et al.*, "Methodology for evaluation of collaboration systems," *The evaluation working group of the DARPA intelligent collaboration and visualization program, Revision 3.0.*, 1997.

[71] U. Sivarajah, V. Weerakkody, P. Waller, H. Lee, Z. Irani, Y. Choi, R. Morgan, and Y. Glikman, The role of e-participation and open data in evidence-based policy decision making in local government, *Journal of Organizational Computing and Electronic Commerce*, vol. 26, pp. 64–79, 2016.

[72] Kassen, M. (2013). A promising phenomenon of open data: A case study of the Chicago open data project. *Government Information Quarterly,* vol 30, pp. 508–513.

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