Semantics-powered Virtual Communities and Open Innovation for a Structured Deliberation Process

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Abstract. In the last few years the importance of connectedness, social networking ties and the ways that networks influence individuals have started to gain widespread attention and recognition, exacerbated by the advent of the Social Media paradigm. Our goal in this paper is to examine how Social Media empower Virtual Communities, how Semantics empower Social Media as a knowledge elicitation platform and how we can leverage these phenomena via Open Innovation to build a structured deliberation process.

1 Virtual communities and Government2.0

In the last few years the importance of connectedness, social networking ties and the ways that networks influence individuals have started to gain widespread attention and recognition [3]. This tendency has both catalyzed and been catalyzed by the advent of a new paradigm in computing, the so-called Social Media (SM). Our goal in this paper is to examine how SM empower Virtual Communities, how Semantics empower SM as knowledge elicitation platforms leading to Enterprise2.0 and Government2.0 and how we can leverage these phenomena via Open Innovation to build a structured deliberation process to lead us beyond open, towards inclusive policy making [16].

1.1 Virtual communities as emergent socio-technological phenomena

People increasingly connect with one another via ICT, a paradigm known as Social Media (SM) [1]. These SM fostered connections can be leveraged in order

to build, sustain and utilize communities of interest on various domains, which can then in turn be leveraged in order to collectively perform tasks, an approach known as Crowdsourcing problem solving [10]. This can be attributed to two important indicators of social development we see on the rise -information literacy and leisure- and represents a radical step in the evolution of the way communities form and operate, giving birth to the concept of virtual communities.

There is a fundamental debate as to whether virtual communities can reflect meaningful forms of social interaction and participation. For the traditionalist, communities are closely linked and discussed in regards to notions of space, locality and neighbourhood, where physical co-presence of community members is seen as a defining factor. In this view, communities affected by technological change (most notably, SM which have popularised virtual communities) are frequently associated with disintegrated, fragmented, socially weak or isolated forms of social organisation. Nevertheless, ethnographic studies [8] have captured the persistence of communities and have pointed towards an understanding of communities in relation to social networking, rather than space. Under the postmodernist tradition that considers innovations in transport and technology to eliminate space through time, these studies suggest that social networking can reflect equally meaningful and significant forms of social interaction and participation even when members are spread throughout the world [28].

Therefore virtual communities and social networks can play a significant part in shaping society and the economy, since they can reflect means of meaningful engagement, companionship and belonging. Lave and Wenger [13] talked about legitimate peripheral participation of agents in social communities, i.e. the process through which agents become members in social communities. They argued that, via learning, the meaning of the social world is constantly (re)negotiated among agents in communities of practice and, in turn, agents develop identities that are finely tuned with the constantly evolving meaning of the social world and progressively move from peripheral to central participation.In doing so, they continuously influence the existing system of relations within a community, while their identities are similarly influenced and eventually legitimate the participation of the agent in the community. Thereafter, shared understandings among legitimate members are again informed through interaction and new experiences of the world, community and the self. A community 'develops a shared understanding of what it does, of how to do it, and how it relates to other communities and their practices - in all, a 'world view'. It is this common, shared understanding of the world, or of a political, religious and/or social issue that enables the flow of knowledge between community members and helps them 'fill in' information and cultural references missing via SM user-generated content.

Even more importantly however, virtual communities and networks do not exist in isolation from the wider online environment and other communities within it. Incidents such as the Arab uprisings and the role that SM played in their organisation and expression highlight the potential of online media in reaching and connecting considerable parts of the world population. Such phenomena suggest that the processes of socialization, social change and reform, and

the development of broader social dynamism via the extensive dissemination of knowledge in a format that is readily accessible to many, become shorter, immediate and significantly more inclusive. Communities create streams of political influence sustained via SM, counterbalancing the power of traditional media and shaping the political views and understanding of citizens across the world [4].

1.2 The role of Social Media and the Semantic Web in eliciting knowledge and supporting open governance: Government2.0

In today's globalised context a community need not be strictly defined by the legal, political and ideological framework of those elected to represent it [9]. SM and the enabling powers of the Semantic Web (SW) transfer the constitutional powers of knowledge and information to the public in unprecedented proportions. This leads to improved civic equality - the idea that more voices are heard - and potentially enhanced civic action, the idea that the public or a specific community within it has more ways to act on matters of common concern.

Recent research in multinational, knowledge intensive organisations has shown that the development of a critical approach will supersede issues of common concern. The ability to critically reflect, analyse and synthesize that is constitutive of a social self will be similarly applied at the level of online social interaction and engagement and manifest in political/civic choice and action [12]. That is, online content users and generators will use their critical thinking abilities more broadly in online and face-to-face interactions, public and private life and in relation to social, political and economic issues that attract their attention.

Post-WWII industrialist societies are typically characterized by rising GDP per capita, rising educational attainment, rising life expectancy as well as widespread adoption of reduced working times. For the first time, society forced onto an enormous number of its citizens the requirement to manage something they had never had to manage before: free time. This vast amount of free time, known as Cognitive Surplus, has up to now mostly been spent in consumerist activities and traditional one-way media, however with the advent of SM we see an increasing amount of this surplus being 'invested' therein, with Wikipedia being the prominent, but not sole, example of a development that has tremendous implications from a knowledge elicitation perspective [22].

Even though tacit knowledge, or what the knower knows, is the most valuable distributed database in any organization, it is not easily accessible or explicit to those around us [11]. Traditionally tacit knowledge is exchanged by means of social interaction, but SM has enabled people to exchange tacit knowledge via ICT as "that's what social networking enables and that's what the exchange of tacit knowledge means" [11]. By doing so, socialization is essentially transformed to externalization and large scale knowledge-based communities may be supported. The advent of Web2.0 and its interlinking with the SW marks significant progress in this direction, giving birth to concepts such as Interlinked Online Information Societies [18], with applications in private and public organizations. The notion of Enterprise2.0, "the use of emergent social software platforms within companies, or between companies and their partners/customers" [14], has promptly

been expanded to Government2.0: "the use of IT to socialize and commoditize government services, processes and data"

Government2.0 is a domain in its infancy, thus although it has received high calibre attention (e.g. [16]) many of the issues pertaining therein have been merely identified, not effectively dealt with. As stated in [27], "online engagement vastly increases the range, type and mix of expertise on which complex and challenging decision processes can draw. This is particularly useful where issues are complex, contentious or involve conflicting values and assumptions. Government2.0 allows access to more open, diverse knowledge base from which to draw to improve the chances of seizing an opportunity or solving a problem".

If "everybody is ignorant, just on different subjects", SM show the reverse also applies: everyone is knowledgeable, just on different subjects and SM provide unique ways to tap into that knowledge.

2 Open Innovation for Government2.0

Open Innovation [2], based on the notion of innovation economics, emerged as a new paradigm for Enterprises to develop novel technologies by seeking intelligent solutions and ideas beyond Enterprise borders. Soon, a number of websites started to emerge to facilitate the process of Open Innovation on the Web, serving as mediators for Enterprise R&D tasks. In this respect, we can consider the approach as part of the Enterprise2.0 paradigm, therefore we claim that a similar approach may also be applied to Government2.0, harvesting intelligent solutions and ideas beyond Government borders to develop novel policies.

2.1 Innovation Economics

Innovation economics got prominent with the seminal works of J.A. Schumpeter,who addressed the relationship of entrepreneurship, innovation and business cycle fluctuations. In his work [21] the role of the entrepreneur as the driving force for innovation and conclusively economic growth is emphasised: the entrepreneur is conceived as an energetic and active agent who attracts attention along deviant behaviour. This sort of behaviour does not rely on rational expectations - as per the homo oeconomicus doctrine - but originates from risk-taking under uncertainty. Successful innovation is seen as the enforcement of new combinations of existent things, like products or even production methods. This notion leads us to a concept of novelty under the aspect of emergence [31]. Novelty originates through the introduction of new knowledge into the economy by setting a new standard in the form of a socioeconomic institution [5], or generally in the form of a new information structure/ontology. New economic rules are created through the diffusion of this novelty on the basis of recombination, imitation and adaptation. Innovation is an emergent property of the diffusion of an invention, by that we understand emergence as the unintended establishment of a new quality on a higher level/layer as their original parts. The economic aspects of innovation can then be summarized in the following categories, encoding the fundamental potential of innovation:

1. The creation and enforcement of new products or new qualities of products
2. The introduction of new methods of production
3. The creation of new industrial organizations
4. The disclosure of new sales markets
5. The disclosure of new sources of supply

Obviously technology plays a central role in innovation economics and technological progress within organizational research and development represents a major address of the rather young discipline of evolutionary economics. Evolutionary change reflects a combination of gradual continuous systemic development, but features also discontinuous breaks in this development, which introduce something novel in the complex process of speciation. Technological progress can be considered in a similar way, where major innovations lead to the upcoming of really new socio-economic as well as cultural structures. The most influencing technological inventions go hand in hand with the rise of new economic epoques or a cultural Zeitgeist as shown in Figure 1.

Period	Date	Innovation	Saturation point
First Industrial Revolution	Circa 1800–1850	Cotton based technology; spinning weaving, etc.	1810 –end of Napoleonic Wars
Second Industrial Revolution	Circa 1850–1900	Age of steam; railways, shipping, heavy industry, iron and steel, etc.	1870s
Third Industrial revolution	1908–1947	Petrochemicals, internal combustion engine, electrification.	Inter-war slump 1920s and 30s
Post-war Boom	1947–1991	Consumer goods, electronics, etc.	1973
Contemporary Era	1991 – present	Internet, wireless technology, biotechnology, etc.	2010s

Fig. 1. Economic periods according to major inventions

Currently culture is tremendously affected by widespread broadband internet adoption as a new medium of communication and social exchange which accelerates the rise of innovations and leads to new modes of innovation. Tight computational networking enables researchers and developers to reduce transaction costs and bridges agglomeration bottlenecks. The new literature on innovation systems originated from work on organizational routines within firms [15]. Organizational routines represent the key to successful innovation today; innovation got professionalised along design and establishment of innovation systems [6].

2.2 Problem formulation and expertise location in Open Innovation

Problem formulation is essential to achieving openness and diversity in the innovation process. The ability to speak to different communities of practice and reach people using different terminologies, common to their own field of expertise is identified as a major technological challenge for open innovation tools on the Web [24]. The appearance of problem solving marketplaces have marked a significant paradigm shift from the old "Define and try" to the new "Describe and

search" approach [23]. The motivation behind the latter is the fact that ideas, and sometimes solutions and technologies to innovation problems might already exist, in form of online content, or in the minds of the Web users - experts in their fields. In order to leverage their potential for the purposes of industrial innovation, the first step is to identify and formulate a problem.

A major limitation is however the fact that no text can be equally appealing and understandable to all communities of practice, while texts that would be general enough, would at the same time probably be less useful. This limitation of human communication is hardly surmountable by writing a better problem text, however the use of metadata can help broadcast the problem to the right place and audience. The textual formulation of a problem is the most evident aspect of its communicative side, but other characteristics of the problem also play an important role in the problem dissemination and in the harvesting of solutions [23]. Principally we refer to the keywords, deadlines proposed for solving, challenge type, as well as the reward that is offered to the best solutions.

In order to create an ontology for representing problems, we analyzed the nature of information relevant for problems and innovation challenges. The main rationale is to enable actors to consume, and automatically treat the problem descriptions in a rich and meaningful way that would enable them to match the problems to the competencies of their users, or to the content that they may possess and that potentially contains solutions. An additional motivation was to make explicit the nature of innovation challenge and the nature of rewards and IP transfer that is supposed to follow the acceptance of solutions. As a result we have produced an ontology of problem challenges - Problem Challenge Ontology (PCO), available at http://ontologies.hypios.com/tag , that responds to the needs of representing problem challenges for their meaningful exchange between innovation-related systems. A detailed description is beyond the scope of this paper, but let us note the main aspects of our ontology: Challenge Workflow and Status, Rewards, Transfer Type, Challenge Type, and Problem Composition.

In order to enable matching of problems to other content such as user profiles and user generated content, the ontology reuses existing ontologies such as FOAF, Tag Ontology and DublinCore. The topics of the problem are expressed using the existing property from the Dublin Core ontology dcterms:subject that is commonly used on the Web of Data. Furthermore, each problem may be assigned tags through the property tag:tag of the Tag Ontology which links problems to individuals of the class tag:Tagging. Topics and tags play a crucial role in matching the problems to potential solvers and solutions on the (Semantic) Web. We have evaluated the potential of the Linked Data cloud to serve the needs of expert finding in open innovation scenarios in [25]. Although a range of imperfections in the currently available data imposes the need for intermediary data cleaning and binding tools and heuristics, the current Linked Data cloud can serve those purposes rather well, while bringing more flexibility to the expert finding process compared to legacy expert search approaches. We have also built a flexible expert finding system based on Linked Data for the purposes of Open

Innovation scenarios and raising problem awareness by targeting the expert in the problem domain and the fields related to the problem domain [26].

2.3 Idea Management in Open Innovation

Idea Management Systems evolved from mind maps & suggestion boxes, adding options to store, display and organize submitted ideas due to technological development. SM have further contributed to their evolution, extending submission boxes to idea capture methods, as richer and better organized user input data brought new opportunities for data presentation and selection [29].

On a practical level, exchanging and analysing ideas across different software tools and repositories is needed to implement the concepts of open innovation and holistic innovation management across different virtual communities. As a plethora of virtual communities keeps emerging, it is foreseen that despite the fragmentation there will be overlap in terms of domain of interest and ideas generated. In this light, a common framework for defining and exchanging Idea Management community output would greatly benefit Open Innovation.

There is in fact work in this direction: ontological frameworks proposed to provide a common language to foster interoperability between tools and to support the idea life cycle include the Idea Ontology [19] and the GI2MO Ontology [30]. Through the use of an ontology additional benefits like semantic reasoning and automatic analysis become available. By adopting an ontological framework to express content generated by virtual communities, we enable expressing a variety of aspects about ideas in a structured way, thus enabling discovery.

We choose to adopt concepts, relationships and attributes that are particularly appropriate for describing such idea-related knowledge from the GI2MO schema, as it covers a broader scope and fits better to our purpose, especially in the way it facilitates categorization and tagging of ideas. The ontology captures a core idea concept that covers the 'heart of the idea' and further concepts to support collaborative idea development, including rating, discussing, tagging, and grouping ideas, as well as the idea lifecycle, which is of particular relevance when integrating idea management in the deliberation process.

GI2MO provides the property hasTagging which relates an idea with individuals from the class tag:Tagging of the Tag Ontology and the property gi2mo:hasCategory which does the same for individuals with individuals from the class gi2mo:IdeaCategory. The latter class has also the property gi2mo:hasSubCategory which is particularly useful for relating categories to each other and thus taking advantage of reasoners in order to infer multiple categories for an idea. Furthermore, there is also the property sioc:topic which relates resources such as forums, blog posts or news articles with ideas and thus compatible with the ontological representation in our community platform [7].

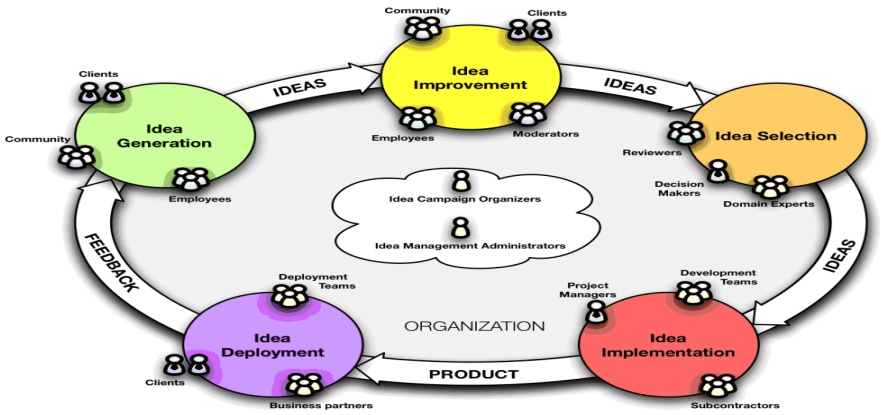

Fig. 2. Idea Management Lifecycle

3 Towards a new deliberation paradigm: problems and ideas as part of a structured dialogue process

Having given background on virtual communities and the SM leverage on knowledge elicitation to support an open innovation process for Government2.0, we now turn our attention to defining and supporting a new deliberation process.

3.1 The need for a new deliberation process

Citizen abstention from political processes and growing indifference to public affairs and politics, even to the point of renouncing the cornerstone of democratic rights -voting in elections- is considered the greatest threat to democracy today. The EU Council Green Paper forecasts that abstention rates in Western Europe can reach 65% by 2020 [20]. Indifference and lack of trust in institutions reveal a "democratic deficit" which should be managed by political governance.

A promising approach to this direction is the use of ICT to broaden and deepen political participation by enabling citizens to connect with one another and with their elected representatives. This approach, founded on eParticipation and eDemocracy but expanding their philosophy, is termed Citizen Engagement [**?**]. Citizen Engagement (CE) builds on both ICT and political science and bears the promise of reconnecting citizens and all other stakeholders to decision making and governance, by means of policy formulation and evaluation. All technical and legislative issues aside however, what remains the greatest challenge in today's CE landscape is actually achieving substantial CE levels [17]. Therefore, an approach that takes into account today's socio-technological context is needed.

At its foundation, SM is a set of technologies and channels aimed at forming and enabling a potentially massive community of participants to productively collaborate. The Six core principles that underlie the value of SM solutions,

and in combination serve as the defining characteristics that set SM apart from other forms of communication and collaboration are Participation, Collectivity, Transparency, Independence, Persistence and Emergence [1]. SM are becoming increasingly successful and widely used and at the same time more focused, a fact that can be seen as an oxymoron if we compare with the aforementioned CE bottleneck and consider how many these two domains seem to have in common. A way forward for CE could then be to learn from and adopt the SM paradigm.

3.2 Open Innovation as part of the deliberation process

In our existing work [7], we have taken a two-dimensional approach to facilitating CE via an eDeliberation process:

- a methodology has been developed, based on extensive study of related literature and deployed projects worldwide.
- an integrated SM platform has been implemented, using appropriate tools to support the methodology in every aspect.

eDeliberation is a tight 'serial process' within a specific time-frame, with 7 concrete steps embedded in each deliberative cycle. Initially we have the agenda setting step, in which citizens may choose among a list of proposed issues for deliberation. After choice has been made, we move on to the discussion step, succeeded by a report publishing step, in which moderators summarize the discussion in a report. Then there is the voting step, in which citizens have to fill in questionnaires to quantify opinions and finally, after another report has been published to summarize the outcome of this step, an interactive online real-time council takes place. The process concludes with the publishing of an overall report. We will now extend this approach in order to incorporate the aspects of Problem Formulation and Idea Management in the eDeliberation process.

Fig. 3. Methodology steps for eDeliberation

First, we introduce problem formulation in the process. After having chosen a general topic for the deliberation in the agenda setting phase, we break down this topic in specific problems to address. Problems can either be formulated using an online wizard-like tool that supports problem formulation in compliance with the problem ontology, or they can be harvested from the SW. This is in essence a matching task, so using the textual topic description that is the result of step

1 we can query semantic indices for matching problems. A number of problems will be the result of this process, therefore we need to be able to limit the number of problems to address in the deliberation. This can be done by factoring in a number of criteria: a) matching of problem to topic (automated metric) b) problem importance rating (user-generated aggregation) c) problem work group projected size (based on number of participants who join problem work groups) d) organisational preference, expressed via deliberation administrators. In order to support this process annotation, rating, group-creation and discussion mechanisms for each candidate problem are provided by appropriate tools.

The outcome of the problem formulation step will be a number of problems, therefore we introduce an idea management step in the process in order to collect ideas for dealing with each problem. Again, ideas can either be formulated using an online wizard-like tool that supports idea posting in compliance with the idea ontology, or they can be harvested from the SW. This is another matching task, so we need to match problem descriptions that are the result of step 2 to ideas either submitted by participants or found in other idea management systems.

The result of this process will again be a number of ideas for each problem, therefore we need to be able to limit the number of ideas to further develop in the deliberation. This can be done by factoring in a similar set of criteria as in the previous step, providing support to the process by a similar set of tools.

We have thus refined the general discussion step into discrete problem formulation and idea management steps, focusing the attention of participants to specific aspects of the open innovation process. A Proposal Shaping step has also been introduced in order to refine Ideas into well-rounded proposals for adoption by the hosting organization. Furthermore, by applying Social Technographics concepts certain user types (Creators, Conversationalists, Collectors etc) may be identified and asked to contribute in the parts of the process where they best fit - e.g. Creators may be asked to submit ideas and Collectors to investigate Problems. Finally, the voting step on completed proposals gives participant input for the decision making that takes place in the Online Council step, determining proposal adoption, implementation and deployment. Thus with respect to the aforementioned Idea Management lifecycle, while the Implementation and Deployment phases take place internally in the organization, we insert an additional phase which we term Idea Scoping prior to Idea Generation. Idea Scoping consists of the Agenda Setting and Problem Formulation steps in the deliberation and represents what we believe is a necessary phase in open deliberation scenarios such as the ones conducted by Public Authorities, in which input on any given topic may be provided. Consequently, the process needs to be scoped and targeted carefully in order to be effective. The resulting deliberation process is shown in Figure 4 - omitting reporting steps for readability.

3.3 Using Linked Data to share and match problems and ideas

There are 2 non mutually exclusive ways in which problems and ideas may be shared via the corresponding ontologies, both of which require a mapping from the underlying structure of the tools used (e.g. DB, CMS) to ontology concepts:

Fig. 4. Methodology steps for Open Innovation eDeliberation

1. Direct sharing as Linked Data via SPARQL endpoint. Using RDB2RDF tools, an outbound Linked Data entry point to community content may be provided. Interested parties may then query endpoints directly via SPARQL.
2. Embedding RDFa in the generated web content. Using appropriate plugins, RDFa describing the content of generated web pages may be embedded in them, allowing for semantic indexers such as Sindice to harvest this information and make it accessible via their API.

Linked Data enable matching problems formulated with existing and new ideas, thus catalyzing problem solution and idea utilization.The enabling factor for this kind of matching is the tagging and categorization capabilities of the problem and idea ontologies. The availability of tags and categories in both problems and ideas allow for the semantic matching between the latter through the use of techniques ranging from simple SPARQL queries to methodologies such as Case Based Reasoning.

4 Conclusions and future work

Although this line of research is gaining traction and has a solid theoretical and technical anchoring, there is still gaps to be addressed before it becomes widely applicable. We identify the major gap to address not so much in terms of technical development (e.g. refined matching algorithms or widespread adoption of problem/idea ontologies), as the techniques we rely on have been successfully applied in a number of cases, but mostly in adoption in terms of organizational culture and governance. We remain hopeful however that the advantages of the Open Innovation paradigm and the ever more widespread adoption of Social Media will result in a change in organizational culture that fosters innovation and openness as the drivers for policy modelling and governance.

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