Policy Intelligence in the Era of Social Computing: Towards a Cross-Policy Decision Support System

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Abstract. The paper presents a policy analysis framework developed through a process of interdisciplinary integration as well as through a process of endusers needs elicitation. The proposed framework constitutes the theoretical foundation for the decision support component of a technological platform bringing together Social Media and System Dynamics simulation developed withinthe PADGETS project. The main novelties introduced have to do with the possibility to provide decision makers with a set of synthetic, fresh and relevant data in a cost effective and easily understandable way.

Keywords: ICT Governance, Policy Intelligence, Policy Modeling, eParticipation, Social Media, Decision Support Systems, Public Sector Innovation, eGovernment, PADGETS.

1 Introduction

In the second decade of the millennium European Governments are confronted with three important long term trends.

1. The combined effect of an increase in the rate of change and in the level of interdependence and interconnectedness among regions, activities and groups is leading to a fast-evolving and unpredictable world characterized by significant levels of complexity and uncertainty. The concept of "liquid modernity" [1] proposed by Zygmunt Bauman represents a useful attempt to frame part of such phenomenon. According to the Polish sociologist, in fact, social forms and institutions no longer have enough time to solidify and cannot serve as frames of reference for human actions and long-term life plans to the extent they served in the past, so individuals have to find other complementary ways to organize their lives.
2. A push towards a more participatory and inclusive style of policy making poses significant challenges in terms of striking the right balance between openness and

control, defining new and appropriate styles of management and, finally, integrating participatory activities into existing decision making processes.
3. A forecast, for the years to come, of low economic growth and financial instability is leading to tighter budget constraints and less room for mistakes in the allocation of tax payers' money for Government'saction.

The concurrence of such socioeconomic, institutional and financial trends calls for a reconceptualization of Government's roles and *modi operandi*.

The creation of the PADGETS (its full title being "Policy Gadgets Mashing Underlying Group Knowledge in Web 2.0 Media") project [2] may be placed in such scenario. The project has been financed in the context of the "ICT for Governance and Policy Modelling" call of the seventh European Framework Program of research (FP7). The main underlying idea of such research endeavor is to bring together social computing with System Dynamics simulation in order to help Governments to render policy making processes more participative and, at the same time, to provide advanced and more effective types of support to public sector decision making processes. In particular, the platform developed within the project will allow Public Administrations to set up a cost effective participatory process by moving the political discussion from official websites to Social Networks where citizens are already debating and take advantage of enhanced policy intelligence services based on fresh and relevant data. In particular, this platform will enable a centralized posting of contents and micro-applications (termed "Policy Gadgets"or, coining a *portmanteau*,"Padgets") to many different Web 2.0 Social Media at the same time, followed by the collectionof various types of users' interactions (e.g., views, likes/dislikes, ratings, comments) and by advancedprocessing and analysis of resulting data in order to provide effective decision support to policy makers.

The aim of this paper is to present a policy analysis framework for this purpose, developed drawing from theories and concepts belonging to different scientific disciplines. The proposed framework constitutes the theoretical foundation on which the Decision Support Component (DSC)of the PADGETS platform has been designed. The development of such a decision support tool represents a first attempt to provide policy makers with a set of tools that may be precious in tackling grand challenges discussed at the beginning of this section.

Concluding these introductory comments, the paper is structured in five sections. Section two provides a theoretical background to the work presented. Section three illustrates the policy analysis framework proposed. Section four explains how such framework has been integrated into the PADGETS platform. Finally, section five provides some conclusive remarks on the value proposition of the decision support system proposed as well as some directions for future research.

2 Theoretical Background

The present section offers a concise overview of the most relevant strands of literature in order to provide an adequate theoretical background to the framework proposed.

2.1 E-Governance

There is no doubt that e-Governance has become in recent years a widely debated and researched topic among scholars. Despite this remarkable trend, "Governance" is still a problematic concept on which no agreed definition and vision exists. This uncertainty seems to amplify when the prefix “e-” is put before, which implies the exploration of some questions surrounding the impact of the Internet on Governments and Public Administration. Indeed, in order to arrive at a working definition of e-Governance, it is paramount to delve into whether ICTs change, eliminate or modify existing aspects of Governance and/or they create new problems and challenges.

In the resulting *mare magnum*, some authors [3] focus attention on the fact that one view of e-Governance entails an intense nexus with e-Democracy, particularly in terms of consultation and its mechanisms. A different perspective is reported by [4], whose vision is more operational and pragmatic, since the focal point is the application of ICTs to deliver governmental services, exchange information, perform transactions and integrate various standalone systems and services. Furthermore, a pure “institutional” vision is provided byMisuraca [5], according to whom “Governance is the exercise of political, economic and administrative authority necessary to manage a nation’s affairs. Governance is the process of decision-making and the process by which decisions are implemented (or not implemented)”.

In general, striving to put dissimilar visions under a common roof, it becomes visible that Governance connotes far more than just rudimentary functioning of Government: Governance is what the Government does in the exercise of its management, power and policy. Consequently, migrating to the electronic world, the concept and practice of e-Governance further encompasses e-Government: according to [6], the e-Governance concept, in fact, covers three distinct, yet related fields of application, i.e., e-Administration, e-Government, e-Democracy.

Taking into account the quality of a country's Governance, it emerges that this concept reflects the degree to which its institutions and processes are transparent and accountable to the people and allow them to participate in decisions that affect their lives. According to OECD, good Governance has eight major characteristics or dimensions [7]: it is participatory, consensus oriented, accountable, transparent, responsive, effective and efficient, equitable and inclusive and follows the rule of law. At a European level, five principles underpinning good Governance have been outlined in the White Paper on European Governance [8]: openness, participation, accountability, effectiveness, coherence.

2.2 E-Participation

As can be seen from the above lists of criteria, the participative dimension plays a vital role in the perspective of good Governance, since the participation demonstrates considerable potential to change the broader interactions between citizens and Government, improving the overall quality of engagement and decisionmaking whilst widening the involvement of all citizens [9].

From a knowledge management perspective, in participative deliberations valuable “tacit knowledge” possessed by stakeholders is transformed into “explicit knowledge” by means of the so called “externalization” [10]. This process paves the way for a

new model of democracy, which is termed "participatory democracy" [11], combining decision making by citizens' elected representatives with citizens' participation, with the latter not replacing but supporting and enhancing the former.

However, despite rosy expectations and fervent impulses coming from the scientific community, the way Government's consultation currently works never satiate the appetite of policy makers, due to the presence of notable difficulties (e.g., lowattractiveness of ICT tools, limited set of questions, enormous wave of textual comments that hits policymakers) for citizens' input to have a clear impact, as pointed out by [12]. As a remedy, new mechanisms are required to enable a public decision process open, transparent and participative in which citizens' contribution is a paramount ingredient characterized by a significant impact.

Along this trajectory, the rise of social computing has recently attracted significant interest. In particular, the increased capabilities for Internet users to create contents, coupled with the birth of Social Networks, which have encountered dramatic success in terms of take-up, have driven the development of more and more virtual spaces for the expression of political views, problems and needs, which may ideally symbolize modern *agorae*[1].

Since Web 2.0 applications are already being used in Government not only for soft issues (e.g., public relations, public service announcements) but also for core internal tasks (e.g., intelligence services, reviewing patents, support decision making) [13], it is highly desirable to proceed towards a systematic exploitation of the emerging Social Media by Government organizations in the processes of public policies formulation, aiming to enhance a frictionless e-Participation: by doing this, Governments make a step towards citizens rather than expecting the citizenry to move their content production activity onto the "official" spaces created for e-Participation [14].

2.3 Decision Support Systems in the Public Sector

All different kinds of organizations, business, public, and non-governmental alike, are becoming aware of soaring complexity in decision making situations [15] [16]. Such complexity, inextricably related to the intricacy of systems [17], can be addressed through decision support tools which can enhance the quality of the decision process[2].

However, in a bevy of situations, multidisciplinary teams, top-notch skilled resources and world class computer suites do not suffice to cope with actual problems: a further need concerns the sharing and "externalization"of tacit knowledge already existing in the society. In fact, collective intelligence emerges as a key ingredient of a "distributed problem-solving" system [18] whose output can significantly enrich the decision process traditionally carried out by experts: in

[1] The term *agora*(Greek: *αγορά*) (pl. *agorae*) indicates the open place of assembly in ancient Greek city-states (*poleis*). Agora is many times used as equivalent of the roman *forum*(pl. *fora*), i.e., the public space located in the middle of a Roman city.

[2] The organizational decision making has its roots in the seminal contributions of renowned mavens such as Simon, Cyert and March; for a comprehensive discussion of these issues, see [19].

accordance with this trend,politics is progressively moving towards higher public engagement and cooperation in decision making processes.

Even though, as underlined by [20], the number of solutions in the area regarding e-Democracy, e-Participation and related fields is increasing, support systems for decision making are, however, still used mainly in narrow professional circles and have not found their way to political decision makers or to the public. The challenge of successful implementation of DSSs in the public sector, with engagement over the whole spectrum of decision making, is still unmet. In particular, in order to enhance the quality and effectiveness of the decision through knowledge harvesting, simulation of future scenarios and structured comparison of alternatives, DSSs depend on the availability and accessibility of timely, relevant and accurate information [21], which frequently represents the scarce resource.

To sum up, the implementation of successful e-Governance programs, which heavily leverage on the participative dimension, cannot ignore the presence of DSSs, as computer-based systems that help decision makers confront ill-structured problems through direct interaction with data and analytical models, notwithstanding the access to privileged channels aimed to enable a fully-fledged engagement: the evidence that "it has become impossible to restrict knowledge and its movement to castes of specialists" [22] makes researchers aware that "crowd wisdom" is not merely a Web 2.0 catchy buzzword, but is instead a strategic model to attract an interested and motivated platoon of stakeholders.

3 Towards a Cross-Policy Decision Support Framework

In order to design a decision support component for the PADGETS platform we started from two key broad categories of elements. Firstly we adopted a policy maker's perspective, meaning that we focused on the manifold needs of daily policy making. Secondly, we considered the potential novelties introduced by the project, that is to say the several innovative approaches the project promises to introduce in the relationship and interaction between policy makers and stakeholders[3]: from this angle, the *leitmotif* is the exploitation of many Social Media at the same time in a systematic and centrally managed manner.

Keeping in mind these two cornerstones, we developed the architecture of a service that aims at informing the policy maker's decision process (i.e., a decision support tool) by effectively using the knowledge collected in Web 2.0 Social Media through the engagement with a plethora of stakeholders.

Furthermore, we identified some potential threats to the effectiveness of our tool andwe considered them as designing principles. These potentially critical issues concern the vast fields with which policy makers have to deal, such as the cognitive problem of synthesizing the distributed knowledge collected from stakeholdersin

[3] We prefer the generic term "stakeholders" to "citizens" because we think that citizens are only the largest kind of stakeholders interested in interacting with policy makers, and that institutions, which cannot be reduced to their single individuals, can be interested too in the innovative ways of participatory policy making introduced by the project.Hence, actors such as, for instance, producers' and consumers' associations, political parties,trade unions, corporations and charities, could be encompassed under the label "stakeholders".

many different environmentsin order to take decisions, and the intrinsic dynamics of public knowledge and opinion.

Starting from the rich variety of policy fields, we decided to develop a decision support tool capable to be as much as possible "generic" and "horizontal", meaning that it should be easily and effectively employed for any kind of public policy. This was done, among other reasons, toenhance the appeal of the DSS in terms of commercialization, i.e.,in order to be turned into a marketable product. As a matter of fact, the possibility to reach a wider pool of potential institutional adopters allows to benefit from economies of scope and scale, that contribute to lower the unit cost of service provision. Secondly, considering the issue of synthesizing the widespread information collected through many different Web 2.0 participatory tools provided by the project, we started by interacting with local policy makers in order to identify the support they expect from such kind of a tool. In particular, policy makers would like to receive answers to the following five questions which are relevant during each phase of a public policy lifecycle(agenda setting, policy analysis, formulation, implementation, monitoring):

1. Are stakeholders aware of the public policy?
2. Are stakeholders interested in the public policy?
3. What stakeholders think about the specific public policy solution that the policy maker has proposed? To what extent they accept it?
4. Which are the barriers to policy awareness and interest, and which are the barriers to changes in public opinion about the policy?
5. Which suggestions are coming from stakeholders?

The identified relevant questions allowed us to design a support tool capable of collecting stakeholders' suggestions through text mining and opinion analysis in order to answer question 4 and 5, and to synthesize the most relevant information collected from the stakeholders concerning the policy proposal along three basic dimensions(awareness, interest, acceptance) in order to devise responses to the first three questions.

We conceived the awareness-interest-acceptance-opinion framework by taking into account the needs of public policy makers and at the same time drawing from relevant theoretical frameworks developed in the disciplines of innovation studies and political science. According to innovation research of Rogers [23], the diffusion of an innovation occurs, in fact, through a five–step process, which is a type of decisionmaking: awareness, interest, evaluation, trial, and adoption. Furthermore, OECD [7] identifies three stages of on-line engagement: information (for increasing stakeholders' awareness), consultation (providing opinions about the policy) and active engagement. Also, the concept of policy acceptance is well-recognized in political science as it allows to understand the coherence between the proposed public action and the systems of values present in society, a necessary precondition for a successful implementation of the policy. The concept of acceptance may be seen from a normative point of view, or from innovation point of view[4].

Finally, in order to capture the dynamic natureof the information we collected, we designed a component of the decisions support tool which relies on a System

[4]For an example of EU funded research project on policy acceptance see [24].

Dynamicsmodel strongly based on the collected data in order to provide policy makers with near future forecasts of stakeholders' awareness, interest and acceptance.

Summarizing, from a policy maker's perspective the value proposition of the decision support tool we designed may be recapitulatedas follows:

1. A methodological contribution related to information classification, since the toolprovides a well-grounded conceptual framework aimed to classify and aggregate data stemming from social engagement in light of an increasing level of stakeholders' involvement (awareness, interest, acceptance).
2. A reduction of information complexity, given by a set of peculiar traits (e.g., data aggregation along multiple dimensions, cross-platform data analysis, data projection into the real world, simulation of phenomena evolution in the near future) leading to a well-framed synthesis of unstructured (and sometimes inadvertent) society's input which could be used in order to forecast possible impacts of policies in light of surfacing*voxpopuli*.
3. A support to emerging Governance models, since it enables new ways for collecting, organizing and delivering informationat different authority levels, opening-up on-going Governance models by letting a wider audience to contribute to the political debate.

4 The Architecture of the PADGETS Decision Support Component

The PADGETS Decision Support Component (DSC) is the analytic engine processing and analyzingthe results of the PADGETS Campaign[5] in order to extract useful information for the policy maker. It is, in other words, the software components which prepares the information for supporting policy makers.

The DSC relies on information coming from the policy maker, from Social Media platforms, and from the Padget[6], and consists of two main modules: the PADGETS Analyticsand the PADGETS Simulation Model.Whilstthe Analytics module aims at grouping and synthesizing raw information and at solving possible problems of statistical nature in collected data, the Simulation Model aspires to provide future scenarios of opinion change.

In the following paragraphs we sketch the basic working mechanisms of the DSC, concluding with a discussion on the effectiveness of the proposed design.

4.1 Inputs

The inputs of the DSCmodel come from three sources, i.e., Social Media, Padgets and policy makers.

[5]In the project jargon, a PADGETS campaign entails a set of activities covering creation, distribution, interaction, monitoring and termination of one or more policy messages oriented towards a specific goal and related to the same theme.

[6]In line with the project dictionary,aPadget is a resource (application or content), typically instantiating within a variety of Social Media platforms,which provides interactivity with stakeholders through an *ensemble*of native and "augmented" social functionalities.

Data coming from Social Media (retrieved by public APIs) and from the Padgetsmay beunstructured (i.e., open text content) or, otherwise, structured (i.e., users' actions and selections).Unstructured dataflow intotext mining activities which work inside the PADGETS Analytics module;structured data, for their part, constitute the inputs of quantitative analysis taking place in both PADGETS Analytics and PADGETS Simulation Model.

The inputs database contains two broad categories of information in terms of data organization:

1. policy maker data referring to the target stakeholders' group (socio-demographic data);
2. data stemming from social engagement, collected at the finest granularity (individual users' data)and structured according to the two dimensions of user and time (the user who acted and the time of action).

4.2 Basic Output Indicators

DSC outputs are developed along three different concepts in accordance with section 3:awareness, interest and acceptance.

From a Padgetend user's perspective, each concept is a set containing the following ones, but not vice versa. Thus, a user interested in the policy must be also aware of the policy, but the opposite might not hold (i.e., an aware user can be not interested in the policy).

The distinction between the concepts is that acceptance concerns polarized judgments (i.e., positive and negative) collected by means of the Padget, interest regards all data generated by a proactive behavior by users in Social Media, and finally awareness is a matter of an only passive reception of the policy message in Social Media (i.e., without further spreading or commenting the Padget announcement owing to a lack of interest).

The typologies of outputs that it is possible to compute are three. Firstly, it is possible to draw the distribution of data over the main categories of stakeholders identifiable according to socio-demographic variables. Secondly, it is possible to project the data to the actual world. Lastly, estimates on how policy awareness-interest-acceptance will change in the near future can be computed through algorithms included in the Simulation Model.

4.3 Modeling and Simulation

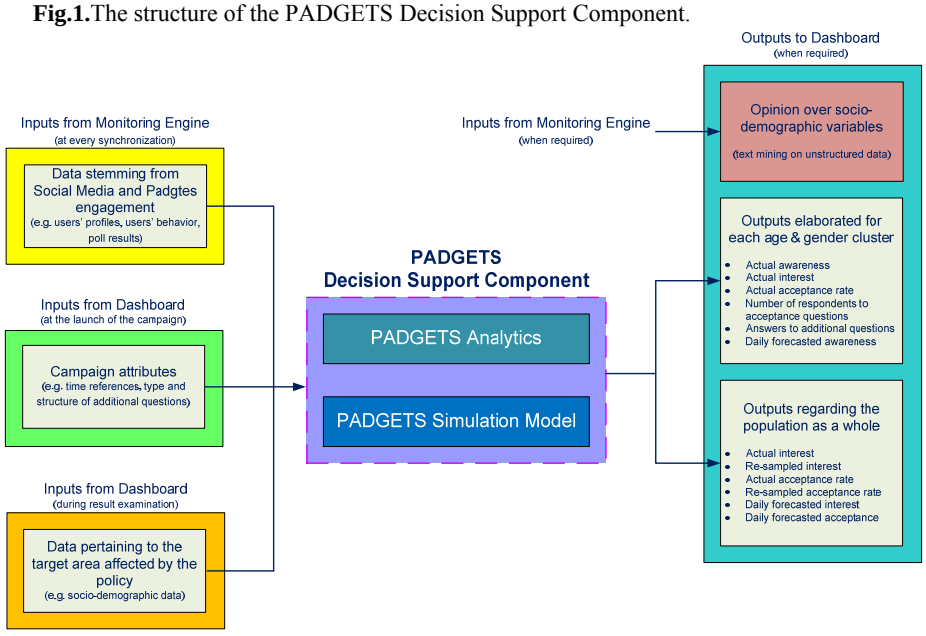
The PADGETS Decision Support Model structure(**Fig. 1**) shows how the two DSC modules transform the structured inputs coming from different sources in outputs useful for policy makers, while an external module carries out text mining and opinion analysis in order to determine stakeholders' suggestions. The figure, moreover, underlines that only the relevant information is presented to policy makers among the many we identified above.

Passing to the description of how the components work, actual distributions of awareness-interest-acceptance are obtained by simply grouping raw Social Media and Padgetdata according to socio-demographic variables.

In addition, in order to increase the real world significance of obtained results the re-sampling of raw data is computed:moving in this direction represents an attempt to remedy to possible underrepresentation of specific groups of stakeholders in the Social Media realm. To exemplify, older generations are likely to show lower penetration rates in Social Media: the resampling activity is thus aimed at reducing this bias in the estimation of current and future awareness, interest and acceptance rates.

Finally, awareness-interest-acceptance future scenarios are the most complex outcome.They start from the re-sampling of raw data, on which a procedure computes trends evolution along the dimensions of output concepts and of socio-demographic variables: a System Dynamics simulation is run in order to estimate the possible future outcomes and their probability of occurrence. Being the Simulation Model a System Dynamics one, there is the need for two main kinds of elements[7], stocks and flows. Thus the Simulation Model is based on the identification of relevant stocks according to socio-demographic variables, and flowsaccording to the above mentioned trends of evolution. In particular, the simulation is focused on how different socio-demographic clusters of stakeholders will change their level of awareness/interest/acceptance in the near future in light of intertwined social connections and resulting "viral" contagious phenomena;the rationale underlying the model entails that clusters are not independent, therefore several feedback loops and cascade effects can be at work testifying a blurred overlap of endogenousevolution and external influences.

Fig.1. The structure of the PADGETS Decision Support Component.



[7] For a complete introduction to System Dynamics, to its concepts and terminology, please refer to [25].

A final remark concerns the Simulation Model outcomes and their probability of occurrence. Given the stochastic nature of the simulation,the heterogeneity of collected data and the uncertainty on some parameters, the simulation will be run to explore all the possible outcomes of variations in parameters (including the random seed for stochastic processes);the resulting distribution of scenarios will be studied and presented to policy makers.

4.4 Effectiveness

The outputs of the DSC directly answer the first three policy makers' questions out of the five we want to address (section 3): presenting detailed basic and elaborated data about the three concepts of awareness, interest and acceptance, policy makers will obtain extensive answers to their questions, and they will also get an idea about future trends in society towards the policy on focus.

The remaining two policy makers' questions we plan to answer pertain to perceived barriers and suggestions coming from stakeholders. In this case the answers to policy makers are provided by the DSC as a whole, that is to say by all the results coming from the Analytics and the Simulation Model**,** on which we focused in this paper,and by analytic activities on unstructured data such as text mining.

In particular, the first three policy questions we considered as aims of the DSC are directly answered by singular groups of indicators provided by the DSC. For instance, if the policy maker is interested in evaluating the policy awareness in the population, the DSC provides a set of indicators related to awareness which describe the contemporary level of awareness and its near future trend. On the other side, the two remaining questions concerning emerging barriers and public suggestions are *per se* unforeseeable in their structure and content, and it thus becomes impossible to identify *ex ante* a structure to organize such information. For this purpose opinion mining [26] methods will be used.In this field, the effort is geared towards extracting opinions from unstructured human-authored texts (posts, comments *etsimilia*) having recourse to techniques such as feature-based sentiment analysis, topic identification and sentiment classification. Semantic analyses in this vein provide an insightful glimpse on "what people think" capable to conspicuously reinforce the governmental policy intelligence.

In conclusion, for the implementation of the DSC architecture we chose to rely on autonomous and platform independent software classes with data interfaces for communicating inputs and outputs with other parts of the project software architecture. Our choice has been to code this software entirely in Java (avoiding recourse to external libraries for System Dynamics modeling) in order to guarantee platform independence, eventual Web distribution and for relying on well-established libraries for the required activities of data management and regression.

5 Conclusions and Limitations

In this article we presented the preliminary results producedduring the first year of activity of the PADGETS research project.In particular, the discussion focused on the policy analysis framework underpinning the DSC of the PADGETS platform. Such analytical framework was generated through a process of interdisciplinary integration

(mainly drawing form the diffusion of innovation and political science literature) as well as through a process of endusers needs elicitation.

The intent behind the development of the analytical framework was to provide a first contribution towards the creation of a Decision Support System that could help policy makers in facing a number of relevant questions often arising through the policy cycle.This was done by introducing an innovation bringing togetherSocial Networks and System Dynamics simulation.To date, in fact, the use of ICT tools for decision support has traditionally been a "closed door" activity usually carried out with static external inputs in the form of codified or unstructured data coming from different sources (e.g., statistical offices). Such approach presents a number of important limitations: the lack of a direct connection with the recent external reality on which the policy decision has to impact, an inherent delay present in the policy response due to the lead time necessary to collect and process the relevant data required for the analysis. To exemplify with a metaphor, such process could be compared to driving a car by only looking at the rear view mirror (an indirect and delayed input) rather than through the windscreen. The innovation brought by PADGETS consists in opening up the decision support process by integrating it with the activities carried out over Social Media Platforms. This allows to establish a direct link between the decision process and the external world as well as to reason on fresh and relevant information. This, once the necessary organizational processes are in place, should contribute to produce a much more responsive and effective style of decision making in Government. Going back to our metaphor, the innovation introduced by the Decisions Support Component of PADGETS aims at allowing decision makers to drive looking through the windscreen supported by an intelligent navigation systems able to anticipate some of the obstacles lying ahead (i.e., the predictive functionalities of the simulation module).

Finally, it is important to discuss also some of the limitations that characterize the solution presented, as they may represent an interesting starting point for future research. The resampling activity used for the generalization of the results in terms of interest and acceptance, for example, contributes to decrease some of the biases inherent in Social Media usage (e.g., age distribution) but it is far from producing a statistically significant representation of society. In addition, the implementation of a meaningful cross-platform tracking systems still presents a number of challenges having to do with identity management.

Concluding, although far from being error free, it is our firm belief that the framework presented constitutes a significant step ahead in helping policy makers in dealing with the challenges arising from the complexity that more and more may be found in modern societies.

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