

Features of Data Analytic Models Supporting Social Media Analysis toward Policy Modeling

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Abstract: *Living at the age of big data, requires intelligence to develop methods and techniques to benefit from it. With rising social media use by public and increasing awareness, citizen tends to participate in political, economic, environmental discussions and communicate with each other, express their opinion and feeling for a trending topic. Growing opportunities to collect and analyze the generated data from social media have led decision maker to employ these methods to shape their decisions and take advantage of them during the process of policy making. This paper study the social media analytics and their applications in policy making life cycle, and introduce six different EU funded projects which develop and use data driven policy modeling techniques.*

Keywords: *Big data analytics, Social media analytics, Policy making, Data driven policy modeling*

1. Introduction

We are at the age of big data. A Huge amount of data that would be a waste if we can't extract no knowledge and information from it. However, data itself cannot solve any problem, conducting analytical methods can steer the use of data in solving many problems, which policy making is one amongst them. Many projects around the world, especially in EU are designed in a way to advance policy making through the use of big data analysis and its applications. Data-driven approaches are of the most important approaches when policy-makers want to impose regulation. When the goal is to have the data-driven policy-making, it is important to pay attention that what data policy-makers should use and how they are going to use those data. One important source of data is data generated from social media. However, the presence of social media data is of great importance; data can bring invaluable insights to the process of policy making. Therefore, an essence of data analytics step is necessary which can monitor, analyze and visualize data and provide feedback to feed the policy modelling process. Data driven policy modeling refers to the employment of data, to extract relative knowledge to inform the policy makers and improve the process of policy making. Therefore, it is necessary to integrating the big data and its applications within policy making cycle to inject public knowledge, expert knowledge, and objective data.

The overall aim of this paper is to study and introduce big data and its analytical methods, more specifically the social media analysis model and its applications. Social media open up a public space to discussing and challenging the European project and help to bring citizen together and transform them into one stakeholder with a voice. EU projects founders understood the importance of social media either for disseminating their project data or for participating citizens, or for analyzing their data and extracting project related knowledge out of topic-related content. This paper presents a six EU funded projects which benefit from social media analysis, to inform the policy makers and influence the policy making process.

2. Big Data

Moving toward data-driven policy making requires knowing the concept and essence of big data. We may explain the big data as the massive, heterogeneous, and unstructured datasets that cannot be analyzed by the mean of conventional database software traditional processes or tools [1]. Organizations, governments, academics, etc. are facing big data challenges, every day. Data, mostly are available, but the challenge is to exploit value out of it since it is sitting in an unstructured or semi-structured format. The largest component of big data is unstructured, and we can find them as audio, image and unstructured texts. These components involve valuable information for those who make decisions, and this is an impotent fact that one can't ignore.

To exploit required information and knowledge out of a Big database, we need accurate knowledge, which is data science. Data science is a set of basic principles, guidelines, and techniques which support and guide the extraction of information and knowledge from data [2]. Data in a black box, by itself, has no value. Therefore, it is required to use data science techniques and methods to explore and unlock its potential value and turn the high volume of different fast-moving data into usable information. The process of collecting, organizing, analyzing data sets for exploring useful information, is data analytics [3]. Data analytics include a set of techniques and technologies which can explore hidden values from the dataset. One of the primary goals of data analytics is to inform decision makers and help analysts, academic researchers and business to make better and informed decisions by using explored useful information from data which were raw, inaccessible or unavailable. Though the data is most useful if one can do something precious with it, the question remains that how it should be analyzed? Choosing a technique for data analysis requires knowing the type of data, whether it is structured or unstructured. However, advanced analytics provides algorithms to analysis for either structured or unstructured data [4]. There are several analytics methods which differ with the data type. The relevant methods are (a) Predictive modeling, which is the use of statistical algorithms and machine learning techniques on data for predicting the likelihood of the future outcome. However, the descriptive models help to understand key relationships and show what happened, the main aim of predictive modeling, of course, is to extend the knowledge from “what has happened” to forecast “what will happen” [4]. (b) Audio and Video Analytics, which extracts useful information from unstructured audio and video data. According to Verma [3], there are many applications of audio analytics like 1) surveillance application which uses a systematic choice of audio classes in order to discover suspicious kind of activity 2) Mobile Networking System which uses audio analytics to find information that has been lost or not transferred correctly due to noise, network loss, etc. 3) telemonitoring systems which use audio analytics techniques for detecting sudden unwanted emergency related sound like explosion or gun sound, etc. 4) call centers which use audio analytics to enhance sales rates, to improve customer experiences and earn knowledge about customer behavior [5]. Video content analysis or video analytics approaches involve techniques to monitor and analyze video streams. However, there exist methods for processing real-time or recorded videos, Abraham et al. [6] mention that video analytics is still immature. (c) Text Analytics, refer to process of analyzing textual data (structured or unstructured) for exploiting desired relevant information and structure them to use them for different purposes. There are several text analytics methods like information extraction from text, text summarization techniques, text clustering algorithms, opinion mining and sentiment analysis [7], [8], [9]. (d) Social Media Analytics, which combine previous analytics techniques, i.e. text analysis, audio analysis, etc. to exploit useful information from data generated by social media. The next section will explain more about these techniques.

3. Social Media Analytics

However, one cannot research the influence of media on policy without considering factors like social, political, economic and organizational power, yet, the media are simple one albeit important factor of many influencing policies. Kepplinger [10] acknowledge that the media are a powerful source in society since they are part of many different sectors of society and since because of their involvement in various spheres of society and their reciprocal influence on these areas. Media can have different roles within policy making lifecycle. The general policy making life cycle is a dynamic cycle and consist of five high-level stages [11]: 1) Agenda setting, which defines what is the problem and establishes a need for policy and action. 2) Policy Design, which

develops possible solutions, invest on potential impacts that the solutions may have 3) Adoption, in which the formulated policy is adopted to be put into effect [12], 4) Implementation, which includes all the activates for implementing the actual policy, 5) Evaluation, which determines if the policy is accomplished, and its goals are achieved or not? What is necessary to change or improve?

Media analysis can have different roles within policy making lifecycle. For instance, they may play a part as an agenda setter. Bryan et al. [13] argued that through its influence in public, the media indirectly influence policy makers and policy decisions, either by its influence on public opinion the media affect the attitudes and behavior of the public in responding to policy issues or by its coverage of public opinion. The media influence policy makers who use this coverage to gauge public sentiment on policy problems and react to this by changing or discussing those policy issues. Nowadays, one form of media is social media, which is very popular. These media generated a massive amount of data every day. According to Pethuru et al. [14], the level of data which is generated by social media is growing exponentially. For example, 48 hours' worth of content is getting uploaded to YouTube every minute or Twitter users produce 100000 tweets per minute. Without a doubt, there is useful information beneath this massive amount of data which can be used by governments or businesses for decision making and policy modeling. Embracing social media can bring improvement in areas like effective implementation or transparency by providing low-cost solutions for governments to advert policy information, communicate with the public and gather their feedback [15]. In general, social media brought different characteristics with themselves which is highly beneficial for the knowledge of policy making in these days. Features like instant access to broader range of opinions and issues in comparison to traditional media, the power to express a view by only sending a brief message, discovering issues that traditional means of assessing public opinion can ignore them, stronger connectivity between users which enable easy exchange of opinions in real time. Essential characteristics that came along with social media is the power of remaking and remolding the political environment by high public participation, changing communication between government and citizens from indirect to direct contact. Moreover, citizen can express their view to politicians and civil servants, and be aware of opinion leaders of enhancement in public judgment about the information they provide [15]. These characteristics, bring several changes in the policy making process like changing agenda-setting from group-led to individually-led or accessing more open and crowd sourced policy decisions. Social media able governments with the power of adopting citizen's idea in the policy cycle either in proposal making or decision making, however, before social media, policy discussion, and the setting was led only by government officials and experts mostly in a closed door process. Social media, not only change the role of governments and experts but also they change the role of citizens as only consumers, to both consumers and producers [16]. Considering the importance of social media, which we explained in the previous paragraphs, methods, techniques, and tools are required to exploit information and knowledge out of data produced by social media for the benefits of organizations, governments or businesses.

As we explained in section 2, there different data analytics methods, based on the data type. However, all mentioned analytics methods are useful; some specific techniques are most important. For example, text analytics techniques are essential since they are the most powerful analytics methods to perform analysis on the most common source of data, text, on the web and the social media. One can name opinion mining or sentiment analysis, topic modeling, social network analysis, trend analysis and visual analysis as key social media analytics techniques.

Overall, social media analytics is a process with three steps, capture, understand and present [17]. The first step, capture, obtain relevant data from social media by monitoring several social media sources (various pre-processing steps may be performed. Including data modeling, data/record linking of data from different sources, stemming, part of speech tagging, feature extraction, and other syntactic and semantic operations that support analysis), archiving them and extract relevant information. When the relevant data is ready, in the, understand step, model the data and perform various advanced data analytic methods like sentiment analysis, text clustering

to gain insight from it. Understand step, is the core for social media analysis. Finally, in the present step, finding from previous steps will be displayed in meaningful ways, i.e. graphs, charts, etc.

4. Social Media Analytics in EU Funded Projects

An online presence is necessary. When it comes to result's dissemination, being online becomes necessary for the success of the project. Therefore, a website is a good supporting tool to represent the online image of a project. On the other hand, rising advanced technology in everyday life has led to more connected people to online information. Therefore, the audience is connected 24/7, and they expect a constantly update, which brings a bigger chance of success, and the key is social media. Understanding the abilities of web 2.0, bring each project closer to the audiences, which are consumers and can be producers as well. Web 2.0 gives the followers of the project the chance of communication with experts quickly and easily. Besides, social media help to increase the level of transparency within EU projects by tracking project's activities and offering access to project's data (inputs, results, reports, etc.). Social media can also open up a public space to discussing and challenging the European project, and help to bring citizen together and transform them into one stakeholder with a voice. EU projects founders understood the importance of social media either for disseminating their project data or for participating citizens, or for analyzing their data and extracting project related knowledge out of topic-related content. Also, they know that it is important to strengthen their relations with citizens to improve the quality of their services, products, etc. On the other hand, integrating public into the policy making process is of great importance. Several EU funded project tried to engage and integrate public input into the policy-making process, to hear their voices, consider their expectation and their views. However, active participation and efforts for engaging citizens in policy making are limited [18], the implemented ones had been undertaken on a pilot basis only in a very few OECD countries.

Data analysis and social media analysis are of great importance when it comes to policy modeling and decision making. The European Union funded several projects across Europe to invest and develop efficient methods, techniques, and toolsets to explore useful information out of massive data and improve the process of policy modeling. Projects like E-policy, Render, IMPACT, ARCOMEM, COCKPIT, PADGET, NOMAD, EUcommunity, UniteEurope, FUPOL, etc. Below, we introduce and briefly explain six different EU funded projects that benefit from social media analytics.

4.1 FUPOL¹

The FUPOL project focuses on creating a new comprehensive policy design by employing data analytics methods like multi channel social computing, crowd sourcing, and simulation, etc. to drive the demand of citizens and political decision makers for supporting policy design and implementation in policy domains in urban regions [19]. FUPOL tends to change traditional politics building and provides a whole new approach by major innovations like multi channel social computing, collective intelligence based on crowd sourcing, and simulation. The project has developed a comprehensive new governance model to support the policy design and implementation lifecycle.

To understand citizen's demand, FUPOL managed to use several data analytics methods and innovations in a different step of policy life cycle. Data analysis becomes handy when it is about to identify the policy problem and set an agenda. Collecting data from social networks is a pathway which leads governments, institutions, organizations, and businesses to identify topics and generate relevant agenda points [20]. FUPOL benefits from this fact and perform a subjective identification of policy problem [19], with software modules and functions for the social network aggregation and single window display, the Hot Topic Sensing Tool & Topic Summarization, Opinion Maps, visual social data analysis and of course, polling with questionnaires [21]. Moreover, the project manages to identify problem objectively through analysis of statistical data and deviation of indicators from outlined thresholds. Once the objective problem is identified, the project manages to validate it by social media

¹ <http://www.fupol.eu>

analysis and news analysis methods like Hot Topic Sensing & Topic Summarization, opinion maps, visual social data analysis, and determine whether they are a real problem for the citizens and stakeholders [19]. FUPOL is consist of a core platform with several external systems, like decision maker, facilitator, statistical institutions, web 2.0 community, and summarization system. The summarization system is the primary interest in this paper since it employs summarization tools (topic analysis, summary extraction, sentiment analysis, user feature extraction) use sophisticated algorithms to extract various aspects from the social media data [22].

4.2 NOMAD²

Project NOMAD delivers ways and tools to transform people's collaboration and self-motivation which has rendered web 2.0 into a repository of content on various topics, including political and public policy related content, and valuable information. NOMAD's primary goal through the use of social media is to create a two-way dialogue between citizens and government and empower citizens' role by increasing their participation in governmental decision making [23]. NOMAD aspires to create a two-way dialogue between citizens and government and empower citizens' role by increasing their involvement in governmental decision making; it aims to deliver ways and tools to transform political content produced in social media into valuable information for policy makers [24]. The philosophy of NOMAD project is to enable policy makers to Listen and effectively monitor what citizen's conversation in social media, Analyze them and get the main opinions, Receive all the data and responses entirely and Act on this information [25]. For accessing to web information from a variety of Web 2.0 applications, NOMAD use a data acquisition module and include a set of topical crawling modules, which selects appropriate keywords and phrases, and define the topics from web 2.0 sources which ensure the acquisition of user-created content. Moreover, NOMAD benefits from an opinion mining and argument extraction module through opinion identification (i.e. subjective statements) which is related to a concept in the scope of a given policy model, argument extractions and polarity determination of the statement towards the related concept [26]. After collecting the arguments and opinions which are related to the policy-related topics, NOAMD uses an argument summarization module and social reaction visualization module to compile multi-dimensional quantitative data and provide the policy maker with multi-faceted aggregates based on the analyzed and summarized results. Employing data analytics methods, NOMAD empowers the exploitation of the vast amount of user-generated content and provide better understanding citizen's wishes, commands, and beliefs to formulate better socially rooted policies [27].

4.3 SENSE4US³

The SENSE4US project integrates the benefits of quantitative open data sources, qualitative social media data and map of Internet-based information for a particular topic to tackle the challenge of policy making and implementation. The sense4us main objective is to accelerate policy modeling and simulation by finding and presenting relevant sources of information through search tools and by building social media analytics tools to discover and track what people are talking about, relevant to the topic of interest [28]. The project, provide a mean for policy makers to collect and summarize information from different sources to use most relevant and updated information effectively when forming policies. Moreover, it helps to simulate the impacts of different policy options which allow policy-makers to choose the proposal that best fits their objectives and avoid unintended consequences [29]. SENSE4US implements the main feature of data analytics within a Tool Libraries module, which computes sentiment and opinions from user generated content and provides these insights to the policy maker. Approaches for identifying the sentiment of textual data, like Tweets extracted from Twitter, can be categorized into two main groups: a) Supervised approaches which create sentiment classifiers by use of labeled data [30]. And b) Lexicon-based approach which determine the overall sentiment of a specific text by using pre-built lexicons of words weighted with their sentiment orientation [31]. However, lexicon-based approaches counter various limitations, Sense4Us experts investigated on a novel sentiment analysis models that

² nomad-project.eu

³ <http://www.sense4us.eu/>

can account for contextual semantics to enhance the accuracy of existing lexical-based sentiment classification methods and can be applied to data of different domains, name SentiCircle [32].

4.4 EUcommunity⁴

EUcommunity is a project which helps to make sense of today's EU policy-making by creating a series of tools and services. Improving the quality and efficiency of EU policy making, by formulating informed policy options to EU decision makers, curating unstructured content from different online sources, is the primary goal. To supports decision makers with better policy options, EUcommunity integrates social media interactions, qualified contributors, document curation, visual analysis and online trust-building tools. EUcommunity based on an architecture with seven core components [33]. The main interest for this paper is three social media analytics components. EUcommunity benefits from a Crawler component which collects data available i.e. the information about people and comments and discussions and documents that may influence the policy-modeling process, from targeted sources and social media. Furthermore, the project employs an Opinion mining component that can identify and extract subjective information and characterize inputs as "positive" or "negative" by use of natural language processing, text analysis, and computational linguistics. It also performs feature based opinion mining and emotional opinion mining to determine emotional states like "angry" or "sad." Also, EUcommunity uses a Visualization component to provide a direct and automatic access to the data crawled, processed, and analyzed by the other technical components.

4.5 WeGov⁵

To take the advantage of a wide range of existing well established social media sites with their valuable contents, Wegov developed a toolset that enables the ability to detect, track and mine opinions and discussion which is related to a specific policy on the social networks. WeGov employes three different components. Topic opinion analysis component which represents the topics within a discussion by creating groups of words. The user activity analysis component, which can predict which posts are going to generate more attention. And, user behavior analysis component which classifies users according to their behavior and interactions within the social network sites [34]. Furthermore, WeGov developed two major tools for data analysis; Content and User analysis which can distinguish the users who are most active than the others, which is important especially for policy makers since they can focus their attention on those users who have a higher potential to influence and affect the public opinion. And, Topic and Opinion analysis, which can gain a quick overview of long and complex discussions in social media, including understanding its theme and also finding the most influential users. While reading hundreds of posts is a time-consuming process, Topic-Opinion Analysis tool develop summarization techniques which can identify latent themes of discussion (topics), most relevant contributions and arguments for each topic [35].

5. Conclusion

This paper focused on big data analysis methods, especially social media analytics and the description of projects which used and took advantage of these methods in real life and on real data. Social media, social network and global participation platforms like Facebook or Twitter and a large number of local blogs and web communities, offer a great potential for improving and advancing governance and policy modeling. Therefore, there is a high demand for more investigation, development, and implementation of tools which can facilitate exploring relevant directed information from the massive amount of data which is extracted from social media. The importance of social media and public-generated content online has created a new opportunity for improving the interaction between citizens and policy makers. Policy makers and politicians did not consider their citizen's opinion and feeling, mostly because they were not aware of the benefits that they could bring, and the shortage of techniques and methods for exploring citizen opinions available. Inaccessibility of what public

⁴ <http://project.eucommunity.eu/>

⁵ <http://www.wegov-project.eu>

felt and thought about policy topics, cause the imprecise assessment of policy impacts. However, active participation and efforts for engaging citizens in policy making are limited [18], the implemented ones had been undertaken on a pilot basis only in a very few OECD countries. Nevertheless, today the big data analysis methods and techniques assist policy makers through the policy making process by collecting and analyzing valuable ideas and discussions, more approaches, pilots, and experiments are needed to expand the implementation of these methods worldwide.

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