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A Comparative Analysis of Tools and Technologies for Policy Making

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Abstract

Latest advancements in information and communication technologies offer great opportunities for modernising policy making, i.e. increasing its efficiency, bringing it closer to all relevant actors, and enhancing its transparency and acceptance levels. In this context, this chapter aims to present, analyse and discuss emerging ICT tools and technologies presenting the potential to enhance policy making. The methodological approach includes the searching and identification of relevant tools and technologies, their systematic analysis and categorisation and finally a discussion of potential usage and recommendations for enhancing policy making.

1 Introduction

Policy making may be defined as *"the process by which governments translate their political vision into programmes and actions to deliver 'outcomes' desired changes in the real world"* (UK Government, 1999). Policy making encompasses any activity relevant to discussing political issues, identifying areas of improvement or solutions, creating and implementing laws and regulations, monitoring and evaluating current policies, etc.

Policy making is a multidisciplinary scientific field referring mainly to political science but it may also refer to social, economics, statistics, information and computer sciences. These diverse scientific fields are essential in order to perform policy-making in a more effective and informed manner. Information and communication technologies (ICTs) in specific, have supported decision-making processes for many years. However, the current ICT advancements and good practice offer even greater opportunities for modernising policy making, i.e. increasing its efficiency, bringing it closer to all relevant actors and increasing participation, facilitating its internal processes (e.g. decision making), enhancing its transparency and acceptance levels.

In this context, this chapter aims to present, analyse and discuss emerging ICT tools and technologies presenting the potential to enhance policy making. Our approach includes searching and identification of relevant tools and technologies, their systematic analysis and categorisation and finally a discussion of potential usage and recommendations for enhancing policy making.

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The chapter is structured in a respective way: section 2 describes our methodological approach, section 3 provides the comparative analysis and section 4 discusses the findings and concludes the chapter.

Before proceeding to the rest of the chapter, we should provide further clarifications as regards its scope. First, for work presented in this chapter, policy making is considered as a broad and continuous process that commences from the need to create a policy and ends when a policy is abandoned or replaced. In this context, the policy making process is usually described with a circular staged model called "the policy cycle". There are differences in the number, names and boundaries of the stages adopted in each proposed policy cycle (e.g. Jann and Wegrich, 2006, Northern Ireland Government, 2013); however every policy cycle includes an initiation stage, a drafting stage, an implementation stage and an evaluation stage. The scope of our work refers to all these stages of the policy cycle.

Second, we consider all stakeholders relevant to policy making within the scope of work presented in this chapter. Obviously, the main actor involved in policy making is the government with its different roles, bodies and institutions. However, non institutional actors are also involved such as political parties, political consultants and lobbyists, the media, non-governmental organizations, civil organizations and other interested parties depending also on the policy topic at hand. Last but not least, individual citizens are also actors of policy making; as the final policy recipients and beneficiaries they should actively participate in policy making. Hence, in this chapter we do not consider policy-making as a close, internal government process, but rather as an open, deliberative process relevant to the whole society.

2 Methodology

In order to analyze the existing ICT tools and technologies that can be used to enhance the policy making process, we adopted a simple methodology comprised of four main steps.

Before introducing the adopted methodology, we provide a short description as regards the difference between ICT tools and technologies. ICT tools normally include software applications, web-based environments and devices that facilitate the way we work, communicate and solve problems. These are developed by individual software developers, big software providers, researchers and scientists (Phang and Kankanhalli, 2008). Technology, on the other hand, refers to knowledge and know-how, skills, processes, tools and/or practices¹. Therefore, technology not only refers to tools but the way we employ them to build new things. In the current survey, we organise the findings of our literature analysis based on tool categories.

Step 1: Identification

¹ <http://en.wikipedia.org/wiki/Technology>

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During this step, we surveyed the current state of the art to identify ICT tools and technologies that have been (or have a clear potential to be) used to reinforce the policy making process. These tools have been collected mainly from project deliverables, posts, electronic articles, conference papers, scientific journals and own contacts and expertise.

In particular, we searched for tools and technologies that have been highlighted, used or created by existing research and coordination projects in the area of eGovernment and policy modelling, i.e. CROSSOVER², e-Policy³, FuturICT⁴, OCOPOMO⁵, COCKPIT⁶ and UbiPol⁷, OurSpace⁸, PuzzledbyPolicy⁹ etc. This investigation resulted in a collection of more than 30 ICT tools and technologies mainly coming from project deliverables, posts, electronic articles, conference papers, scientific journals and own contacts and expertise.

Thereafter, we expanded our research on the web to include additional tools that were not previously identified. To this end, we tried multiple searches in the major research databases of computer science, e.g. ACM Digital Library and Google Scholar using a combination of different keywords such as tools, technologies, policy modelling, online participation, engagement, government, policy making, decision making, policy formulation etc. The references of the selected papers were checked and additional papers were found. Some of the journals that have been reviewed include *Government Information Quarterly*, *International Journal of Electronic Government Research*. In addition, we surveyed similar initiatives that summarize tools or/and methods, i.e. the Participation Compass¹⁰ launched by Involve¹¹ (not-for-profit organisation in public participation), the ParticipateDB¹² by Intellitics¹³, and the ReformCompass by Bertelsmann Stiftung¹⁴ (providers of digital engagement solutions). The final result of this exercise was a list of 75 tools and technologies.

Step 2: Categorisation

Analysing the identified tools and technologies, it was evident that most of them fall under a number of categories. We defined therefore eleven categories of tools and technologies for policy making. Each category has a specific application focus e.g. opinion mining, serious games, etc. and may be further divided into one or more sub-categories.

² <http://crossover-project.eu>

³ <http://www.epolicy-project.eu/node>

⁴ <http://www.futurict.eu>

⁵ <http://www.ocopomo.eu>

⁶ <http://www.cockpit-project.eu>

⁷ <http://www.ubipol.eu/>

⁸ <http://www.ep-ourspace.eu/>

⁹ <http://www.puzzledbypolicy.eu/>

¹⁰ <http://participationcompass.org/>

¹¹ <http://www.involve.org.uk>

¹² <http://participatedb.com/>

¹³ <http://www.intellitics.com/>

¹⁴ <http://www.reformkompass.de>

We then organised tools and technologies' analysis according to the defined categories. There are few cases, however, where the same tool could be classified under more than one category, i.e. in the case of visualisation and argumentation tools and in the case of serious games and simulation tools. In the first case, argumentation tools represent and structure arguments and debates and usually exploit visual means in order to clearly represent the arguments. However, the main focus remains the representation of arguments. On the other hand, the visualization tools present in a graphical form any type of input data. Thus, it was selected for the sake of simplicity to analyse each tool in one category according to its most prominent feature. Similar difficulties in categorisation have also arisen in the case of simulation tools and serious games. Serious games are created for educational and entertainment purposes or for helping citizens to further understand some processes by playing the role of a key stakeholder. On the other hand, simulation tools are usually created on a more serious context (e.g. within a research project, taking into account accurate real-world data) in order to help real policy makers or governments to simulate long-term impacts of their actions. Therefore, the categorization of tools in these two categories was made based on the context and the goal of the tool.

Step 3: Comparative analysis

A comparative analysis of identified ICT tools and technologies per category was then performed. Initially, we analyzed tools' functionality to identify core capabilities per category. Then, we examined the key features for each tool. The outcome of this analysis is a comparative table for each category that shows at a glance an overview of different features found in each tool of the category.

Step 4: Conceptualization

During this step, we performed an overall discussion of the presented tools and technologies and their potential for enhancing policy making. To this end we examined three main aspects for policy making, the type of facilitated activities, the type of targeted stakeholders and the stages of the policy cycle. Finally, we drafted overall recommendations and conclusions.

3 Tools and Technologies for Policy Making

Based on the literature survey, we identified eleven main categories of ICT tools and technologies that can be used for policy making purposes as follows:

- **Visualization Tools** help users better understand data and provide a more meaningful view in context, especially by presenting data in a graphical form;
- **Argumentation Tools** visualize the structure of complex argumentations and debates as a graphical network;
- **eParticipation Tools** support the active engagement of citizens in social and political processes including e.g. voting advice applications and deliberation tools;

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- **Opinion Mining Tools** help analyze and make sense of thousands of public comments written in different application contexts;
- **Simulation Tools** represent a real world system or phenomenon and help users understand the system and the effects of potential actions in order to make better decisions;
- **Serious Games** train users through simulation and virtual environments;
- **Tools specifically developed for Policy Makers** have been recently developed to facilitate the design and delivery of policies;
- **Persuasive Tools** aim to change users' attitudes or behaviours;
- **Social Network Analysis (SNA) Tools** analyzes social connections and identifies patterns that can be used to predict users' behaviour;
- **Big Data Analytics Tools** support the entire big data exploitation process from discovering and preparing data sources, to integration, visualization, analysis and prediction.
- **Semantics and Linked Data Tools** enable large amounts of data to become easily published, linked to other external datasets and analyzed.

We present an analysis of each category of tools and technologies in the rest of this section.¹⁵

3.1 Visualization Tools

Visualization tools enable large amounts of "raw" data to become visually represented in an interpretable form. Moreover, they provide appropriate means to uncover patterns, relationships and observations that wouldn't be apparent from looking at it in a non-visual format. Therefore, users can explore, analyze and make sense of data that otherwise may be of limited value (Osimo and Mureddu, 2012). Today, there are many data visualization tools, desktop- or web-based, free or proprietary, that can be used to visualize and analyze raw data provided by the user. Examples include Google Charts, Visokio Omniscopoe, R and Visualize Free. Besides visual presentation and exploration of raw data they provide additional features such as data annotation (e.g. Visokio Omniscopoe), data handling and other statistical computations on raw data (e.g. R).

Over recent years geovisualization (shortened form of the term geographic visualisation) has gained considerable momentum within the fields of geographic information systems (GIS), cartography and spatial statistics. Some consider it to be a branch of data visualisation (Chang, 2010). However, geovisualization integrates different approaches including data visualisation such as cartography, GIS, image analysis, exploratory data analysis and dynamic animations, to provide visual exploration, analysis, synthesis and presentation of *geospatial data* (MacEachren and Kraak, 2001). Geovisualization tools have been widely used to visualize societal statistics in

¹⁵ All tools mentioned in this section are summarized in the end of the chapter along with their links

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combination with geographic data.

Several visualization and geovisualization tools have been developed to visualize and analyze demographic and social statistics in several countries across the world. Most tools are used for data coming from the United States. However, many efforts have been made lately to visualize statistics coming from all over the world (e.g. Google Public Data Explorer and World Bank eAtlas). The most important source of information for these tools is governmental reports which are made available by each state. Most tools support data transparency mainly for downloading data and figures while uploading of users' data is available only in few cases. Visualization tools are organized into static and interactive based on a categorization proposed for web mapping tools (Kraak and Brown, 2001). A static tool contains a figure or a map displayed as a static image (Mitchell, 2005) while interactive tools allow users to access a set of functions to have some interaction with the tool or the map, such as zooming in and out (Mitchell, 2005). Table 1 summarizes well known visualization and geovisualization tools and compares their main characteristics. In particular, the table provides information on: (a) the number and subject of indicators e.g. if they deal with demographic, health, environmental or other social issues, (b) the coverage, namely the countries supported, (c) the period for which statistics are available, (d) data transparency and (e) whether it is a static or interactive tool.

Table 1 Visualization and geovisualization tools for analyzing regional statistics

	Indicators and Topic	Coverage (countries)	Period	Data Transparency	Static/ Interactive
Gapminder	>400 Demographics, social, economic, environmental, health	>200	Over the past 200 years	Download and upload	Interactive
Worldmapper	~696 maps Demographics	All	N/A	Download (No custom maps)	Datasets, static
Dynamic Choropleth Maps	Multiple social, economic, and environmental	United States	N/A	Download (free to adjust the threshold criteria)	Interactive
DataPlace	~2360 Demographics, health, arts, real estate	United States	After 1990	N/A	Interactive
Data Visualizer- World Bank	~49 Social, economic, financial, IT, and environmental	209	1960-2007	N/A	Interactive
World Bank eAtlas	~175 Development challenges	200	After 1960	Download and upload	Interactive
State Cancer Profiles	Demographic data related to cancer	United States	2006-2010	N/A	Interactive
Health Infoscapes	Health conditions	United States	January 2005- July 2010	N/A	Interactive
OECD eExplorer	~40 Demographics, economic, labour market, environment, social and innovation	34 (335 large regions 1,679 small regions)	1990-2005	Download and upload	Interactive (time animation) Storytelling

Other tools investigated but not included in the above table include STATcompiler, Google Public Data Explorer, NComVA, Social Explorer (USA), PolicyMap (USA), All-Island Research Observatory (UK) and China Geo – Explorer II.

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Demographic, social, environmental, health, and other public data, provided by governmental and public authorities in raw form, can be transformed and presented through visualization and geovisualization tools into a more interpretable way. Thus, information and current trends hidden in this data can easily become apparent. This can assist policy stakeholders and decision makers to make more informed decisions. In addition, incorporating geographical knowledge into planning and formation of social and political policies can help derive more accurate spatial decisions. Obvious fields where visualization and geovisualization tools can be applied for policy making are investment, population, housing, environmental assessment, public health, etc.

3.2 Argumentation Tools

Argumentation tools visualize the structure of complex arguments and debates as a graphical network. In particular, they allow a large number of stakeholders to participate, discuss and contribute creative arguments and suggestions which then become visualized. This visual representation provides a better and deeper understanding of topics discussed. Thus, complex debates can become easily analyzed, refined or evaluated e.g. by pinpointing possible gaps and inconsistencies or strong and weak points in the arguments, etc (Benn and Macintosh, 2011).

Table 2 summarizes well-known argumentation tools and depicts their main characteristics (i.e. whether they are open source, whether they enable importing/exporting data, whether they are web-based or collaborative, the argument framework, whether they support visual representation argumentation structure modification and manipulation of layouts). DebateGraph, Rationale, Cope It! and bCisive constitute proprietary solutions while Cohere, Araucaria, Compendium and Carneades were developed during research studies within universities and research projects. Most argumentation tools enable users to share ideas and collaborate upon "wicked problems". For example, DebateGraph allows users to collaboratively modify the structure and the content of debate maps in the same way they can collaboratively edit a wiki. In addition, MindMeister and Compendium constitute desktop-based solutions that support collaborative argument analysis while MindMeister and bCisive also enable real-time collaboration. Though most argumentation tools provide, even partially, a visual representation of discussions, only few support an easy layout manipulation; such tools are Compendium, Araucaria, Cohere and DebateGraph. Besides argument analysis, argumentation tools offer additional features such as argument reconstruction, discussion forums, argument evaluation, etc. For example, Araucaria and Argunet enable users to reconstruct and map debates; Cohere enables any content on the web to serve as a node of information in the argument map; and Rationale allows users to judge the strength of an argument by evaluating its elements. These judgments are also represented on the map. Similarly, Carneades allows users to evaluate and compare arguments as well as to apply proof standards. Finally, Cope It! supports a threaded

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discussion forum while bCisive incorporates group planning, decision-making, and team problem-solving capabilities.

Table 2 Argumentation tools

Tool	Open source	Import /Export	Web-based	Collaborative	Argument Framework	Visual Representation	Modify Arg. Structure	Manipulate Layouts
Araucaria	Yes	Yes	No	No	Walton, Toulmin, Wigmore, Classical	Partially	Yes	Partially
Argunet	Yes	Yes	Yes	Yes	Classical	Yes	Partially	N/A
Carneades	Yes	Yes	Yes	No	Walton	Partially	Yes	N/A
Cohere	Yes	Yes	Yes	Yes	IBIS	Yes	Partially	Partially
Compendium	Yes	Yes	No	Yes	IBIS	Yes	Partially	Partially
Cope_it!	N/A	No	Yes	Yes	IBIS	Yes	Partially	N/A
DebateGraph	No	No	Yes	Yes	Multiple (including IBIS)	Partially	Partially	Partially
Rationale	No	No	No	No	Classical	Partially	Partially	N/A
bCisive	No	No	Yes	Yes	IBIS	Partially	Partially	N/A
MindMeister	No	Yes	Yes	Yes	N/A	Yes	Yes	Partially

(source of the table (Benn and Macintosh, 2011))

Argumentation tools facilitate better informed public debate, policy deliberation and dialogue mapping on the web about complex political issues. For example, DebateGraph has been used by the Dutch Foreign Ministry in its recent consultation on its human rights policy¹⁶, the UK Prime Minister’s Office¹⁷ and the White House’s Open Government Brainstorming¹⁸. Compendium has been used in a case study for consultation on regional planning in southeast Queensland (Ohl, 2008). Carneades has been developed during the European Estrella project¹⁹ that aims to help both citizens and government officials to take part more effectively in dialogues for assessing claims and has been used in several applications.

3.3 eParticipation Tools

eParticipation tools have been specifically developed to involve citizens in the policy making process, i.e. to enable citizens to get informed, to provide feedback on different policy issues and to get actively involved in decision-making (Gramberger, 2001). These tools are mainly based on web 2.0 features including a variety of social networking tools such as discussion forums or message boards, wikis, electronic surveys or polls, e-petitions, online focus groups and webcasting.

eParticipation may entail different types of involvement which are supported by different tools and functionalities ranging from the provision of information, to deliberation, community-

¹⁶ <http://debategraph.org/MR>

¹⁷ <http://debategraph.org/No10>

¹⁸ <http://debategraph.org/WH>

¹⁹ <http://www.estrellaproject.org/>

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building and collaboration, active involvement through consultations, polling and decision-making. The International Association for Public Participation (IAP2) has produced a Public Participation Spectrum²⁰ which shows how various techniques may be employed to increase the level of public impact.

Recently, eParticipation tools have been widely used by governmental and public authorities. Through actively engaging citizens in the planning, design and delivery process of public policies, they have moved towards improving democratic governance, preventing conflicts and facilitating citizens' active participation in the solution of issues affecting their lives. Table 3 presents a set of such recently developed eParticipation tools.

Table 3 eParticipation tools developed to improve people involvement in government

	Typical Actions	Examples
Citizen Space	Consultation and engagement software <ul style="list-style-type: none"> - Create, organize and publish public consultations across the net on complex policy documents - Share consultation data openly in a structured way - Provide a way to easily analyze consultation data (both qualitative and quantitative) 	Used by government bodies to run e-consultations around the world
Adhocracy.de	Participation and voting software <ul style="list-style-type: none"> - Present and discuss issues - Collaborate (develop and work on texts together) - Make proposals, gather and evaluate proposals - Add polls for decision making - Vote on issues 	Used in the Munich Open Government Day where citizens could propose policies, projects and actions of the city
MixedInk.com	Collaborative writing software <ul style="list-style-type: none"> - Large groups of people work together to write texts that express collective opinions - Post ideas - Combine ideas to make new versions - Post comments and rate versions to bring the best ideas to the top 	Used by the White House to let citizens draft collective policy recommendations for the Open Government Directive.
Loomio.org	Decision making and collaborative software <ul style="list-style-type: none"> - Initiate discussions and present proposals that can then be discussed, modified, and voted (Agree, Abstain, Disagree or Block, along with a brief explanation of why) - Change their position any time 	Used by the Wellington City Council for discussion with their citizens.
CitySourced	Mobile civil engagement platform <ul style="list-style-type: none"> - Identify and report civic issues (graffiti, trash, potholes, etc.) and comment on existing ones 	Used in San Francisco, Los Angeles and several other cities in California.
Puzzledbypolicy	Consultation and opinion mapping software <ul style="list-style-type: none"> - Learn about policy issues concerning immigration in the European Union - Give their voice - Graphically compare their views on immigration with national and EU immigration policies as well as with the opinions of relevant stakeholders - Encourage to join discussions on particular aspects of immigration policy they feel strongly about 	Used by the Athens and Torino municipalities and other stakeholders in Tenerife, Hungary and Slovenia
Opinion Space	Opinion mapping software	Used by U.S. State Department to engage

²⁰ Available at: <http://www.iap2.org/associations/4748/files/spectrum.pdf>

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	<ul style="list-style-type: none"> - Collect and visualize user opinions on important issues and policies (rate five propositions on the chosen topic and type initial response to a discussion question) - Show in a graphical "map" where user's opinions fall next to the opinions of other participants - Display patterns, trends, and insights - Employ the wisdom of crowds to identify the most insightful ideas 	global online audiences on a variety of foreign policy issues
CivicEvolution.org	Collaboration platform <ul style="list-style-type: none"> - Engage citizens in structured dialogue and deliberation and develop detailed community-written proposals to make constructive changes 	Used by the City of Greater Geraldton, in Australia, to facilitate collaboration and deliberation among participants in Participatory Budgeting Community Panels
	-	
	-	
UbiPol	Mobile civil engagement platform <ul style="list-style-type: none"> - Identify and report problems or suggestions - Report policy issues 	Used by TURKSAT, a publicly-owned but privately-operated company in affiliation with Ministry of Transportation in Turkey
OurSpace	Youth eParticipation platform <ul style="list-style-type: none"> - Engage young people in the decision making process - Enable collaboration 	European and National Youth Organisations already using OurSpace
Dialogue App	<ul style="list-style-type: none"> - Setup a dialogue - Share, rate, comment and discuss ideas bring the best ideas to the top 	Department for Environment, Food and Rural Affairs in UK is using Dialogue app to get thoughts, ideas and input on how to improve and formulate policy.

3.4 Opinion Mining Tools

Web's widespread use over the last decade has significantly increased the possibility for users to express their opinion. Not only can now users post text messages, they can also see what other users have written about the same subject in a variety of communication channels across the web. Moreover, with the advent of Twitter and Facebook, status updates and posts about any subject have become the new norm in social networking. This user-generated content usually contains relevant information on the general sentiment of users concerning different topics including persons, products, institutions, or even governmental policies. Thus, an invaluable, yet scattered, source of public opinion has quickly become available.

Opinion mining tools (or otherwise called sentiment analysis tools) perform a computational study of large quantities of textual contributions in order to gather, identify, extract and determine the attitude expressed in them. This attitude may be users' judgment or evaluation, their affectual state (that is to say, the emotional state of the author when writing) or the intended emotional communication (that is to say, the emotional effect the author wishes to have to the reader) (Stylios et al., 2010).

In social media, opinion mining usually refers to the extraction of sentiments from unstructured text. The recognized sentiments are classified as positive, negative and neutral, or of a more fine-grained sentiment classification scheme. Examples include Sentiment140, Sentimentor, Repustate, etc. Opinion mining tools may also integrate a broad area of approaches including natural language processing, computational linguistics and text mining. Text mining, for example,

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can provide a deeper analysis of contributions; it summarizes contributions, helps highlight areas of agreement and disagreement and identifies participants' main concerns, the level of support for draft proposals or suggestions for action that seem necessary to address. Opinion mining tools providing such approaches include DiscoverText, RapidMiner and Weka.

Classifying statements is a common problem in opinion mining and different techniques have been used to address this problem. These techniques follow two main approaches; these based on lexical resources and neutral language processing (lexicon-based) and these employing machine-learning algorithms. Lexicon-based approaches rely on a sentiment lexicon, a collection of known and precompiled sentiment/opinion terms. These terms are words that are commonly used to express positive or negative sentiments, e.g., "excellent", "great", "poor" and "bad". The method basically counts the number of positive and negative terms and decides accordingly the final sentiment. Machine learning approaches that make use of syntactic and/or linguistic features and hybrid techniques are very common, with sentiment lexicons playing a key role in the majority of methods.

Table 4 presents several opinion mining tools that have been recently developed to analyze public opinions.

Table 4 Opinion mining tools

	Purpose	Sources	Classification
SwiftRiver	Aggregate, manage, filter, and validate web data Discover relationship and trends in data	Twitter, SMS, Email and RSS feeds	Machine-learning
DiscoverText	(Text analytics) Search, filter, collect and classify data Generate insights	Email archives, social media content, and other document collections	Machine-learning
Repustate	Categorize and visualize social media data Extract text sentiment Predict future trends	Twitter or Facebook Multiple languages	Machine-learning
Opinion observer	(Opinion mining) Extract text sentiment Discover patterns	Web pages	Lexicon-based (feature categ.)
AIRC Sentiment Analyzer	Extract text sentiment	N/A	Lexicons-based
Social Mention	Aggregate and analyze social media data Extract text sentiment Discover patterns	Blogs, comments, social media including Twitter, Facebook, Social bookmarks, microblogging services, Images, News, etc	Lexicon-based
Umigon	Sentiment analysis	Twitter	Lexicon-based
Convey API	Sentiment analysis	Social media records	Machine-learning Natural-language processing Statistical modelling
Sentiment140	Sentiment analysis for tweets on a subject or keyword	Twitter	Machine-learning Natural-language processing
Sentimentor	Sentiment analysis for tweets on a subject	Twitter	Machine-learning
Corpora's Applied Linguistics	Document summarization, and sentiment analysis.	Documents	Natural-language processing in combination with an extensive English

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			language lexicon
Attentio	Sentiment analysis	Blogs, news and discussion forums sites	Lexicon-based Machine-learning
Opinmind	Sentiment analysis of bloggers opinion	Blogs	The recall of the classification is unknown
ThinkUp	Archive and analyse social media life	Twitter and Facebook	Machine-learning

Opinion mining tools can help derive different inferences on quality control, public relations, reputation management, policy, strategy, etc. Therefore, opinion mining tools can be used to assist policy stakeholders and decision makers in making more informed decisions. In particular, knowing citizens' opinion about public and political issues, proposed government actions and interventions or policies under formation can ensure more socially acceptable policies and decisions. Finally, gathering and analyzing public opinion can enable us to understand how a certain community reacts to certain events and even try to discover patterns and predict their reactions to upcoming events based on their behaviour history (Maragoudakis et al., 2011).

3.5 Simulation Tools

Simulation tools are based on agent-based modelling. This is a recent technique that is used to model and reproduce complex systems. An agent-based system is formed by a set of interacting and autonomous "agents" (Macal and North, 2010) that represent humans. Agents act and interact with their environment, including other agents, to achieve their objectives (Onggo, 2010). Agents' behaviour is described by a set of simple rules. However, agents may also influence each other, learn from their experiences, and adapt their behaviour to be better suited to their environment. Above all, they operate autonomously, meaning that they decide whether or not to perform an operation, taking into account their goals and priorities, as well as the known context. The analysis of interactions between agents results at the creation of patterns that enable visualizing and understanding the system or the phenomenon under investigation.

In this sense, simulation tools are particularly suited to explore the complexity of social systems. A social system consists of a collection of individuals that interact directly or through their social environment. These individuals evolve autonomously as they are motivated by their own beliefs and personal goals, as well as the circumstances of their social environment. Simulating social systems and analyzing the effects of individuals' interactions can result in the construction of social patterns (e.g. how society responds to a change) that can be used for policy analysis and planning as well as for participatory modelling (Bandini et al., 2009).

There are several general-purpose simulation tools. Most of them are open source and free to be accessed by anyone. Some of these are specially designed to focus on social systems. For example, MASS is a software package intended to enable modelers to simulate and study complex social environments. To this end, it models the individual together with its imperfections (e.g. limited

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cognitive or computational abilities), its idiosyncrasies and personal interactions. Another tool focusing on the development of flexible models for living social agents is Repast.

An increasing number of tools for the simulation and analysis of social interactions has been developed over recent years. These aim to help policy stakeholders and decision makers to simulate the long-term impact of policy decisions. Table 5 presents such simulation tools that have been used in the field of health, environment, developmental policies, etc.

Table 5 Simulation tools simulating the long-term impact of policy decisions

	Purpose	Input	Interface	Scale
Threshold 21	Simulate the long-term impact national of socio-economic development policies	About 800 variables concerning economic, social and environment factors	Flexible-	Customizable to suit the needs of any sector and country
GLEaMviz	Simulate global epidemics	Detailed population, mobility and epidemic-infection data (Real-world data) Compartmentalized disease models	Visual tool for designing compartmental models	30 countries in 5 different continents
C-ROADS	Simulate long-term climate impacts of policy scenarios to reduce greenhouse gas emissions (CO2 concentration, temperature, sea level rise)	Sources of historical data	Flexible Equations are available and easily auditable	6 region and 15 region mode
UrbanSim	Simulate the possible long-term effects of different policies on urban development (land use, transportation, and environmental planning)	Historical data	Flexible	Any country
MEL-C	Simulate the effects of policy-making in the early life course and issues concerning children and young people	Data from existing longitudinal studies to quantify the underlying determinants of progress in the early life course	Flexible adapted for new data and parameter inputs	N/A
Global Buildings Performance Network (GBPN) Policy Comparative Tool	An interactive tool that enables users to compare the world's best practice policies for new buildings (residential and commercial).	N/A	N/A	N/A
CLASP's Policy Analysis Modeling System (PAMS)	Forecasts the impacts of energy efficiency standards and labeling programs Assess the benefits of policies, identify the most attractive targets for appliances and efficiency levels	N/A	N/A	Support basic modelling inputs for over 150 countries Customizable where country-specific data is available
EUREAPA tool	Model the effects of policies on environment, consumption, industry and trade	Detailed carbon, ecological and water footprint indicators	N/A	N/A
Budget simulator	Budget consultation platform that enables to adjust budget items and see the consequences of their allocations on council tax and service areas	N/A	Flexible	Any country

3.6 Serious Games

Agent-based modelling is used also in serious games, providing the opportunity for experiential and interactive learning and exploration of large uncertainties, divergent values, and complex situations through an engaging, active and critical environment (Raybourn et al, 2005). Serious games enable players to learn from the accurate representations of real-world phenomena and the contextual information and knowledge and data embedded in the dynamics of the game. Abt (1987) defines serious games as games with “an explicit and carefully thought-out educational purpose and are not intended to be played primarily for amusement”.

In policy making, serious games provide the opportunity for players to assume roles of real-world critical stakeholders whose decisions rely on extensive data collected from the world around them. In this way, players get educated on the process of decision making as well as on the limitations and trade-offs involved in policy making. Serious games may be used in fields like defence, education, scientific exploration, health care, emergency management, city planning, engineering, religion, and politics (Caird-Daley et al., 2007).

Table 6 summarizes a number of serious games aiming to tackle different social and political problems. In some of these, users assume the role of critical stakeholders. For example, in 2050 Pathways users play as if they were the Energy and Climate Change Minister of UK while in Democracy users act as the President or the Prime-Minister of a modern country. Other games enable users to apply policies/strategies and explore their potential impact. Such an example is the Maryland Budget Map Game that gives the option to make cost-cutting decisions and consider short-term and long-term budget effects. Serious games also help users gain virtual experiences for solving real-world problems. Thus, such games could be used to train citizens and public authorities on how to enforce a policy, e.g. a disaster or crisis management policy. For instance, Breakaway simulates critical incidents and risk scenarios and help players train and plan their responses. Last, they improve imaginary thinking by exploring possible futures and sparking future-changing actions. For example, Urgent Evoke invites people to come up with creative solutions to the most urgent social problems. Other games focusing on a better world can be found in World Changing Game²¹ and Purposeful Games²²; however, they are not included in Table 6 due to their loose connection with the policy making process.

Table 6 Serious games focusing on policy making

	Purpose	Features	Scope
2050 Pathways	Users act as the Energy and Climate Change Minister and explore the complex choices and trade-offs which UK will have to make to reach our 80% emission reduction targets by 2050 while matching energy demand	It covers all parts of the economy and all greenhouse gases emissions Users create their emissions reduction pathway, and see the impact using real scientific	Scientific exploration and Engineering

²¹ <http://www.scoop.it/t/world-changing-games>

²² <http://purposefulgames.info/>

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	and supply	data	
Democracy	Users are in the position of President (or Prime-Minister) of a modern country and the objective of the game is to stay in power as long as possible	It recreate a modern political system as accurately as possible Users influence the voters and the country by putting in place policies.	Education, Political strategy
Maryland Budget Map Game	Users act as the Administration and General Assembly of a state Gives the options to make cost-cutting decisions, weight revenue options, and consider short-term and long-term budget effects	It explains how budgeting decisions are made	Education, Political strategy
NationStates - create your own country	Users build a nation and run it according to their political ideals and care for people	N/A	Entertainment, Education
Breakaway(Disaster Management-Incident Commander)	Help incident commanders and other public safety personnel train and plan for how they might respond to a wide range of critical incidents	It models acts of terrorism, school hostage situations, and natural disasters	Education, Emergency management
The Social Simulator	Train communications, policy and front line staff in a variety of sectors using a number of crisis scenarios Users use the language, tools and norms of the social web for crisis response	It models terrorist attacks, a leaked report spreads anger about a government policy, etc.	Education, Emergency management, Political strategy
CityOne	Users are poised with a series of problems concerning energy, water or commercial investments (such as banking and payment systems) and are asked to address specific challenges	Planner-players think through the sorts of energy, water or commercial investments that might be needed for particular urban environments in the years to come	Education, awareness
World Without Oil	Engage people concerned with the world's dependence on oil and both educate and move them to action and contribute "collective imagination"	Risks that oil extraction poses to our economy, climate and quality of life	Awareness, public good
Urgent Evoke	Empower people all over the world to come up with creative solutions to the most urgent social problems.	N/A	Awareness
MP For A Week	Enable users to learn about the work of an Member of Parliament (MP) and key features of democracy in the UK	N/A	Education
Budget Hero	Allow players to build a balanced budget	Create and test a budget policy and see the effects of those cuts or increased expenses on the federal budget	Education, Political strategy

3.7 Tools specifically developed for Policy Makers

Policy making tools are designed to facilitate governments, industry, construction experts and other stakeholders to design and deliver national renovation policies and strategies. Below we present two illustrative examples of such tools.

Table 7 Political Analysis tools

	Purpose	Features	Scope
PolicyMaker	Help users to analyze, understand, and create effective strategies to promote point of view on any policy question or political issue	Conduct a stakeholder analysis Identify political dynamics of policymaking Analyzing systematically who supporters are, why a policy may face opposition, and what strategies might help it be more effective	Policy planning

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		Design political strategies to support a policy	
Oracle Policy Automation for Social Services	Transform complex policies in human language Assess impact of policy changes by enabling what-if analysis of proposed amendments	It includes debugging, regression testing, policy simulation, and what-if analysis for policy changes	Policy delivery

3.8 Persuasive Tools

Persuasive tools aim to change users’ attitudes or behaviours, such as exercising more or sticking to medication, by enhancing feedback, persuasion and social influence, but not through coercion (Fogg, 2002). Persuasive tools can be applied in policy making for promoting different political causes and enhancing policies’ adoption by the public. The Behavioural Insights Team has published a paper on fraud, debt and error that presents a completely new way of doing policy based on citizens’ behavioural reactions (Behavioural Insights Team (BIT), 2012).

Until recently only indirect efforts have been made to persuade or motivate citizens adopting a specific policy. For example, United States²³ and Australia²⁴ have developed smart phone applications that enable taxpayers to keep up to date with their tax affairs. In addition, the Australian Tax Office offers a “Tax Receipt Log” app that makes it easier to keep up to date on expenses and tax receipts by using the phone camera to take a photo of a receipt, which is then processed and stored. These can serve as persuasive tools reminding citizens of their delayed fees or motivating them to ask for receipts for their purchases²⁵.

3.9 Social Network Analysis (SNA) Tools

A social network consists of nodes representing individual actors within the network and ties which represent relationships between the individuals. SNA tools facilitate the study of social structure, providing the means (methods) to determine if there are regular patterns in social relationships and how these patterns may be related to attributes or behaviour (Tang et al., 2011). In addition, SNA could identify and map informal networks around any given issue. It can be used to identify who is connected to whom and thus adds value/doesn’t add value, and who should be connected to whom to solve the issue at hand. It also identifies conflicts and broken links that need attention to facilitate more functional action-orientated relationships to achieve goals (Rowena, 2010).

SNA can be used in policy making in order to identify a social network’s patterns and key actors and try to influence these (and therefore their networks) by applying appropriate targeted policy

²³ <http://www.irs.gov/uac/New-IRS2Go-Offers-Three-More-Features>

²⁴ <http://www.taxreceiptlog.com/blog/gst/tax-calculator/>

²⁵ Due to the limited number of the identified tools for this category and the following ones, we decided not to summarise them in a table format

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interventions. For example, SNA could be used to think through and tackle social issues such as unemployment. To do this, SNA may pinpoint the most influential key actors relevant to entrepreneurship or employment (e.g. pioneering entrepreneurs, venture capitalists, etc.) and target these for promoting entrepreneurship or employment policies.

Magus Networker²⁶ was designed to illuminate complex, informal networks so that they become understandable. Powerful querying functions enable key patterns to be identified quickly, displaying where opportunities for improving performance can be developed.

3.10 Big Data Analytics Tools

Over the past decade much information has gradually become open. Sources of such information include machine-operated sensors, video, digital images, email, social media, and open data from government, research institutes and non-governmental organizations. The aim of open data movement is to make information freely available, without restrictions and in standard machine readable format (United Nations-Department of Economic, 2010).

Open data creates significant opportunities for achieving deeper and faster insights towards knowledge development, decision-making and interdisciplinary collaboration. However, it has little value if people can't use it. Thus, new tools and technologies were lately developed to address this problem. One of these technologies is big data analytics.

Big data analytics tools have emerged due to the increasing volume and variety of open data that became available on the web. Big data refers to datasets so large and complex that are difficult to process using traditional data management and processing techniques.

Big data analytics tools aim to tackle several technological and analytical challenges such as analyzing unstructured data, uncovering hidden patterns, exploiting social media, making fast decisions on massive data volumes, etc. Furthermore, big data predictive analytics aim to unlock the value of big data and make predictions about future, or otherwise unknown events, in a near-real-time mode (Nyce, 2007).

Big data analytics tools can be used by government agencies for information purposes, e.g. for understanding what people are saying about government, and which policies, services or providers are attracting negative opinions and complaints. Moreover, they can find out what people are concerned about or looking for, e.g. from the Google Search API or Google trends, which record Google's search patterns of a huge number of internet users. Based on analyses of current and "historical" facts, they can develop accurate models and forecasts about the future.

In addition, big data can contribute to "smart" cities and governments and to transformational government. In particular, big and open data can foster collaboration; create real-time solutions

²⁶ <http://www.magus-toolbox.com/Networker/>

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to tackle challenges in agriculture, health, transportation, and more; promote greater openness; and introduce a new era of policy- and decision-making (Bertot et al., 2014).

Several applications are already available utilizing the power of big data. An example is the case of an insurer company, named The Climate Corporation, which examines massive streams of climate data to assess future risk and current damage and provide insurance to farmers who can lock in profits even in the case of drought, excessive rains or other adverse weather conditions.

Despite the wide adoption in the private sector, big data has still limited applications in policy making. One of the few initiatives is this of New Zealand that has recently expressed their intention to reform and/or create new governmental services to improve people, society, and economy. In particular, the Ministry of Education in New Zealand is already processing population projections, building consent data and school enrolment data to work out where new schools are needed. In addition, using geospatial, population, traffic, and travel-to-work information, it's possible to locate the best place for a hospital, school, or community facility, to serve communities most at need, or cut travel times. Moreover, Ministry of Social Development is using data to better learn which of its services get better outcomes for individuals and communities in order to waste less public expenditure on services that don't work and invest more on what does work (New Zealand Data Futures Forum).

3.11 Semantics and Linked Data Tools

Semantic technology enables users to enrich their documents and contents with machine-processable semantics of data that make use of metadata to enable more sophisticated data mining (Berners-Lee and Fischetti, 1999). The explicit representation of the semantics of data is accompanied by domain theories, namely ontologies. Linked data is based on semantic web philosophy and technologies but in contrast to the full-fledged semantic web vision, it is mainly about publishing structured data in Resource Description Framework (RDF) using uniform resource identifiers (URIs) rather than focusing on the ontological level or inferencing (Hausenblas 2009). Thus, Linked Data refer to the ability to link together different pieces of information published on the Web and the ability to directly reference to a specific piece of information (Cyganiak et al., 2011, Heath and Bizer, 2011).

Responding to this trend traditional content management systems (CMS) have been improved to support semantic technology and provide semantic lifting of the textual content (Auffret, 2001). For example, new CMS enable users to (collaborative) elaborate their documents and online texts submitting comments and annotations (e.g. Enrycher, Annotea). In other cases, users can define and store data based on custom ontologies created by them (e.g. WebNotes). Furthermore, some CMS have tried to support Linked data techniques such as automatic detection of entities such as persons, places and locations and their linking to external sources, e.g. to dbpedia descriptions of

resources (e.g. Apache Stanbol). On the other hand, several tools have been created to address collaborative creation of ontologies (OntoMat-Annotizer, OntoGen)

Considering the recent shift towards massively offering open non-personal government data, one can easily understand the importance of linked data in the field of policy making (Kalampokis et al. 2011). One example of how Linked Open Data may be effectively used to inform discussions held by policy makers and others is the clean energy information portal, Reegle²⁷. This portal interprets raw data in order to provide useful information and context for end users: it provides high quality information on renewable energy efficiency and climate compatible development around the world as easily navigable graphs and tables with a lot of additional information on hand too.

4 Summary and Discussion

In the previous section we presented emerging tools and technologies with the potential to enhance policy making. In this section we would like to provide an overall discussion of this potential, especially as regards three main aspects for policy making:

- The **main activities** facilitated by each tool and technology. Previous analysis showed that each tool category presents a different way for enhancing policy making. For example, some tools focus on providing information in a user-friendly manner, other tools promote deliberation, other tools are used to gauge public opinion, etc. Analysing this characteristic we can draw conclusions on the different ways each emerging tool and technology may be used in policy-making.
- The **stage of the policy cycle** facilitated by each tool and technology. It was previously mentioned that the policy making process is composed of a number of stages; these stages describe the policy lifecycle. Analysing the 'fit' of each tool and technology in the policy cycle stages, promotes understanding of how each tool and technology can enhance the policy making process. We will consider four main stages of the policy cycle as they were defined by Jann and Wegrich (2006): Agenda setting, Policy formulation & decision-making, Implementation, Evaluation & termination.
- The **stakeholder types** that can use each tool and technology. We categorise the previously identified stakeholders in policy making as follows: Institutional stakeholders (i.e. the government), non institutional stakeholders (i.e. political parties, political consultants and lobbyists, the media, non-governmental organizations, civil organizations and other interested parties) and the public. Analysing who of these stakeholder groups could use each tool and technology and in what ways, promotes understanding of how these tools and

²⁷ <http://www.w3.org/2012/06/pmod/report>

technologies can be adopted in policy making.

Following, we examine each category of the identified tools and technologies as regards these three aspects.

Visualisation tools are ideal for mainly for information provision, namely for presenting data in a user-friendly, easy-to-grasp representation. These tools can be used in any stage of the policy cycle, wherever the need for demographic, social or spatial data representation emerges. For example, they can be used during the decision-making stage in order to fine-tune new policies, during the implementation and evaluation stage in order to understand whether the application of a certain policy brought any changes or even during the agenda setting stage in order to identify problems that should be addressed with policies. All types of stakeholders may be potential users of visualisation tools depending on the topic addressed and due to the fact that no specialisation is required in order to use and understand them.

Argumentation tools are ideal for structured deliberation, namely for discussing specific issues with the aim to reach a common understanding or a commonly accepted decision. As such, these tools can be useful in all stages of the policy cycle, whenever a targeted deliberation is needed; maybe they are more relevant for the agenda setting, the policy formulation & decision-making, and the evaluation & termination stages where such discussions are usually performed. As regards potential users, in principle all stakeholders can use argumentation tools. However, previous experience in the field has shown that argumentation tools require a certain degree of logic and critical thinking. It is therefore not easy for the wide public to productively use these tools without prior training (Tambouris et al. 2011 and Panopoulou et al. 2012). For this reason, argumentation tools may be more effectively used for somewhat 'closed' deliberation groups targeting a specific issue within a certain policy field.

eParticipation tools are ideal for involving the public in the policy making process. They refer to many different activities such as information provision, deliberation, consultation, gauging public opinion, citizen engagement and community building, etc. eParticipation tools may be initiated by an institutional stakeholder (top-down participation) or a non-institutional stakeholder or even the public (bottom-up participation). Thus, all stakeholder types are potential users of these tools, although typical usage refers to interactions between the government and the public. Due to the wide spectrum of supported activities, eParticipation tools may be used in any stage of the policy cycle.

Opinion mining tools are ideal for gauging the public's opinions and sentiments, thus, they can be used in any stage of the policy cycle whenever such a service is needed. For example, they can be used for gauging the acceptance potential of a new policy or for detecting negative evaluations of a policy. Due to their technical complexity opinion mining tools are better suited to be used by

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trained institutional stakeholders or non-institutional stakeholders, but not the wide public.

Simulation tools are useful in policy making for detecting and simulating social interactions and behaviour patterns. For example, they can be used for simulating the long-term impact of different policy alternatives and thus assist in the policy formulation & decision-making stage. Simulation tools are technically complex to implement, therefore they are mostly suited for usage by a few specialised institutional or non-institutional stakeholders.

Serious games are useful in policy making for educational purposes. They are mostly relevant to the policy formulation and decision making stage of the policy cycle, as players may assume a stakeholder's role in order to explore different policy scenarios on a given topic and make relevant decisions. Serious games can also be used in the implementation stage of the policy cycle, for educating citizens on how to apply a certain state policy, e.g. a health or environmental policy. The main stakeholder group of serious games is the wide public.

The two tools included in our analysis that were specifically developed for policy makers are relevant to the policy formulation & decision-making stage and to the evaluation & termination stage of the policy cycle. Of course, their user group includes only institutional or non-institutional stakeholders.

Persuasive tools can be used by institutional or non institutional stakeholders for influencing public attitudes and behaviours. Thus, it is mostly relevant to the implementation stage of the policy cycle, for strengthening policy adoption.

Social Network Analysis tools are useful for identifying key actors and social patterns relevant to specific policy areas. These can be used in the policy formulation & decision-making stage and in the implementation stage of the policy cycle for deciding alternative policies or for strengthening policies' implementation. SNA is a complex process requiring specialised knowledge, thus it can only be used by trained institutional or non institutional stakeholders.

Big data analytics tools can be useful in policy making for processing huge amounts of information and, through this, for detecting and predicting patterns and trends of the public. These activities are relevant to all stages of the policy cycle, maybe less relevant to the implementation stage. Nonetheless, the users of this technology can be the government per se or non institutional stakeholders interested in analysing data for a specific topic.

Semantics and Linked Data tools can be exploited for enhancing interoperability of government data and for creating linkages between open government data and social data. Thus, linked data tools can facilitate better understanding of social data and public opinion and better prediction of public reactions e.g. to different policy alternatives. For this reason, semantics and linked data tools seem relevant to all stages of the policy cycle. Again, the specialty required for applying these technologies means that only institutional or non institutional stakeholders may

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be the immediate users of such technologies.

Table 8 Potential of emerging tools and technologies for enhancing policy making

Tools and Technologies	Main activities	Policy cycle stages	Stakeholder types
Visualisation Tools	Information provision	All	All
Argumentation Tools	Structured deliberation	All (possibly less in the implementation stage)	All (though not easy for untrained public)
eParticipation Tools	Information provision, Deliberation, Gauging opinions, Citizen engagement	All	All, typically for interaction between the public and the government
Opinion Mining Tools	Gauging opinions and sentiments	All	Institutional or non institutional stakeholders
Simulation Tools	Detecting and simulating social interactions and behaviour patterns	Policy formulation & decision-making	Institutional or non institutional stakeholders
Serious Games	Policy education	Policy formulation & decision-making, Implementation	The public
Tools specifically developed for policy makers	Policy analysis and assessment	Policy formulation & decision-making, Evaluation & termination	Institutional or non institutional stakeholders
Persuasive Tools	Influencing public attitudes and behaviours	Mostly relevant to Implementation	Institutional or non institutional stakeholders
Social Network Analysis Tools	Identifying key actors and social patterns	Policy formulation & decision-making, Implementation	Institutional or non institutional stakeholders
Big Data Analytics Tools	Information processing, Detecting and predicting patterns and trends	All (possibly less in the implementation stage)	Institutional or non institutional stakeholders
Semantics and Linked Data Tools	Understand opinions, predict public reaction	All	Institutional or non institutional stakeholders

The table above shows that a policy stakeholder has a number of different ICT tools and technologies at hand. From these, they could choose the most appropriate ICT mix depending on the targeted activity and policy making stage. For example, we can draw the following conclusions:

- Visualisation tools, argumentation tools, opinion mining tools, big data, linked data and eParticipation tools may be used at any point of the policy making process depending on the activities needed.
- Serious games and persuasive tools are the most appropriate in order to strengthen the implementation stage and promote policy adoption.
- The policy formulation & decision-making stage of the policy cycle is the most frequently addressed stage. This is not surprising as this stage involves multiple and diverse activities such as scenarios' analysis, policy drafting, public consultations, and decision making.
- Visualisation tools, big data analytics tools and linked data tools can help enhance provision and analysis of large amounts of information.
- A number of different technologies have emerged for detecting opinions, sentiments, trends and other patterns of behaviour: opinion mining, simulation, social network analysis, big

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data analytics tools and linked data tools. There is clearly a trend for using modern ICT towards analysing crowd's knowledge already available online.

- For exploiting advanced tools and technologies expert skills are needed that can only be hired in the context of big (institutional or non institutional) organisation.
- For involving the public, visualisation tools, eParticipation tools and serious games are the most appropriate choices.

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Appendix A

Visualization Tools

- China Geo – Explorer II** <http://chinadataonline.org/cge>
- Data Visualizer-World Bank** <http://devdata.worldbank.org/DataVisualizer>
- DataPlace** <http://www.dataplace.org> <http://devdata.worldbank.org/DataVisualizer>
- Dynamic Choropleth Maps** <http://www.turboperl.com/dcm.html>
- e-Atlas of Global Development–World Bank** <http://data.worldbank.org/products/data-visualization-tools/eatlas>
- Gapminder** <http://www.gapminder.org/tag/trendalyzer>
- Google Charts** <https://developers.google.com/chart>
- Google Public Data Explorer** <http://www.google.com/publicdata/directory>
- Health Infoscapes** <http://senseable.mit.edu/healthinfoscapes>
- NComVA** <http://www.ncomva.com>
- OECD eXplorer** <http://stats.oecd.org/OECDregionalstatistics>
- PolicyMap** <http://www.policymap.com>
- R** <http://www.r-project.org>
- Social Explorer** <http://www.socialexplorer.com>
- STATcompiler** <http://www.statcompiler.com>
- State Cancer Profiles** <http://statecancerprofiles.cancer.gov/micromaps>
- Visokio Omniscopoe** <http://www.visokio.com>
- Visualize Free** <http://visualizefree.com>
- Worldmapper** <http://www.worldmapper.org>

Argumentation Tools

- Araucaria** <http://araucaaria.computing.dundee.ac.uk/doku.php>
- Argunet** <http://www.argunet.org>
- bCisive** <https://www.bcisiveonline.com>
- Carneades** <http://carneades.github.io>
- Cohere** <http://cohere.open.ac.uk>
- Compendium** <http://compendium.open.ac.uk/institute>
- Cope_it!** <http://copeit.cti.gr/Login/Default.aspx>
- DebateGraph** <http://debategraph.org>
- MindMeister** <http://www.mindmeister.com>
- Rationale** <http://rationale.austhink.com>

eParticipation Tools

- Citizen Space** <https://www.citizenspace.com/info>
- Adhocracy.de** <http://code.adhocracy.de/en>
- CitySourced** <https://www.citysourced.com>

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CivicEvolution.org <http://civicevolution.org>
Dialogue App <http://www.dialogue-app.com/info/>
Loomio.org <https://www.loomio.org/>
MixedInk.com <http://www.mixedink.com>
Opinion Space <http://opinion.berkeley.edu>
OurSpace <http://www.ep-ourspace.eu/>
Puzzledbypolicy <http://www.puzzledbypolicy.eu>
UbiPol <http://www.ubipol.eu/>

Opinion Mining Tools

AIRC Sentiment Analyzer <http://airc-sentiment.org>
Attentio <http://www.attentio.com>
Convey API <https://developer.conveyapi.com>
Corpora's Applied Linguistics <http://www.corporasoftware.com/products/sentiment.aspx>
DiscoverText <http://www.discovertext.com>
Opinion observer <http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.79.8899>
Opinmind <http://www.opinmind.com>
Repustate <https://www.repustate.com>
Sentimentor <http://sentimentor.co.uk>
Sentiment140 <http://www.sentiment140.com>
Social Mention <http://http://socialmention.com>
SwiftRiver <http://www.usahidi.com/products/swiftriver-platform>
ThinkUp <https://www.thinkup.com/>
Umigon <http://www.umigon.com/>

Agent-based Modelling and Simulation Tools

Budget simulator <http://www.budgetsimulator.com/info>
C-ROADS <http://climateinteractive.org/simulations/C-ROADS>
CLASP's Policy Analysis Modeling System (PAMS)
<http://www.clasponline.org/en/Tools/Tools/PolicyAnalysisModelingSystem>
EUREAPA tool <https://www.eureapa.net/>
GLEaMviz <http://www.gleamviz.org/simulator>
Global Buildings Performance Network (GBPN) Policy Comparative Tool <http://www.gbpn.org/databases-tools/purpose-policy-comparative-tool>
MASS <http://mass.aitia.ai>
MEL-C <http://code.google.com/p/jamsim>
Repast <http://repast.sourceforge.net>
Threshold 21 http://www.millennium-institute.org/integrated_planning/tools/T21
UrbanSim <http://www.urbansim.org/Main/WebHome>

Serious Games

2050 Pathways <https://www.gov.uk/2050-pathways-analysis>
Breakaway(Disaster Management-Incident Commander) <http://www.breakawayltd.com>
Budget Hero <http://www.marketplace.org/topics/economy/budget-hero>
CItyOne <http://www-01.ibm.com/software/solutions/soa/innov8/cityone/index.html>
Democracy <http://www.positech.co.uk/democracy>
Maryland Budget Map Game <http://iat.ubalt.edu/MDBudgetGame>
MP For A Week <http://www.parliament.uk/education/teaching-resources-lesson-plans/mp-for-a-week-game/>
NationStates - create your own country <http://www.nationstates.net>
The Social Simulator <http://www.socialsimulator.com>
Urgent Evoke <http://www.urgentevoke.com>
World Without Oil <http://worldwithoutoil.org>

Policy Making Tools

Oracle Policy Automation for Social Services <http://www.oracle.com/us/industries/public-sector/059171.html>
PolicyMaker <http://www.polimap.com/default.html>

Semantics and Linked Data Tools

Annotea <http://www.w3.org/2001/Annotea>
Apache Stanbol <http://stanbol.apache.org>
Enrycher, <http://ailab.ijs.si/tools/enrycher>
OntoGen <http://ontogen.ijs.si>
OntoMat-Annotizer <http://annotation.semanticweb.org/ontomat>
Reegle <http://www.reegle.info>

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WebNotes <http://www.webnotes.net>