Handbook of Research on Advanced ICT Integration for Governance and Policy Modeling

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A volume in the Advances in Electronic Government, Digital Divide, and Regional Development (AEGDDRD) Book Series

Information Science REFERENCE
An Imprint of IGI Global

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Typesetter: Kaitlyn Kulp
Cover Design: Jason Mull

Published in the United States of America by
Information Science Reference (an imprint of IGI Global)
701 E. Chocolate Avenue
Hershey PA, USA 17033
Tel: 717-533-8845
Fax: 717-533-8661
E-mail: cust@igi-global.com
Web site: http://www.igi-global.com

Library of Congress Cataloging-in-Publication Data

Handbook of research on advanced ICT integration for governance and policy modeling / Peter Sonntagbauer, Kawa Nazemi, Susanne Sonntagbauer, Giorgio Prister, and Dirk Burkhardt, Editors.
pages cm
Includes bibliographical references and index.
ISBN 978-1-4666-6236-0 (hardcover : alk. paper) -- ISBN 978-1-4666-6237-7 (ebook) -- ISBN 978-1-4666-6239-1 (print & perpetual access) 1. Internet in public administration. I. Sonntagbauer, Peter, 1957- editor of compilation.
JF1525.A8H3618 2014
352.3’802854678--dc23
2014018601

This book is published in the IGI Global book series Advances in Electronic Government, Digital Divide, and Regional Development (AEGDDRD) (ISSN: 2326-9103; eISSN: 2326-9111)

British Cataloguing in Publication Data
A Cataloguing in Publication record for this book is available from the British Library.

Advances in Electronic Government, Digital Divide, and Regional Development (AEGDDRD) Book Series

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ISSN: 2326-9103
EISSN: 2326-9111

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The successful use of digital technologies (including social media and mobile technologies) to provide public services and foster economic development has become an objective for governments around the world. The development towards electronic government (or e-government) not only affects the efficiency and effectiveness of public services, but also has the potential to transform the nature of government interactions with its citizens. Current research and practice on the adoption of electronic/digital government and the implementation in organizations around the world aims to emphasize the extensiveness of this growing field.

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Table of Contents

Foreword

Policy modeling: what it is and why it matters and how emerging technologies are changing the policy-making process are at the heart of this edited volume. The volume responds to the changes being seen in the way technology and data are imagined as tools in the policy making process and how the possibilities are impacting our understanding of the policy making lifecycle.

The editors, Peter Sonntagbauer, Kawa Nazemi, Susanne Sonntagbauer, Giorgio Prister, and Dirk Burkhardt, provide a rich treatment of policy modeling and the related concepts and contextual elements that influence how we think about and consider ICTs as part of the modern policy making process. The volume provides scholars and practitioners with a well-rounded consideration of the foundations, tools and techniques, leading practices and emerging models and outlines a roadmap for ICT enabled policy lifecycle going forward.

Each section of the book deals with a specific aspect of research in the policy modeling domain providing the reader with the necessary foundation for considering ICT integration into the policy making process. Opening chapters on e-government, open government data, semantic web standards for publishing and integrating open data, and policy modeling methodologies set the stage for the book and the ongoing dialogue. A chapter on FUPOL (The Future Policy Modeling Project), a project funded under the 7th framework program of the European Union makes the transition from the context setting chapters to a specific discussion of FUPOL as a new model of policy making. FUPOL, a new and detailed policy lifecycle model builds on previous models, enhancing those models by linking to ICTs and to the specific benefits of its use for governments, citizens and other stakeholders. The unique characteristics of FUPOL and the significance of those characteristics in terms of making it "future proof" as a methodology for linking technology to the various phases of the policy making lifecycle are described.

Chapters on specific simulation techniques and software tools being used in policy modeling then provide the reader with an appreciation of the range of techniques available to policy makers and those who drive the policy design and modeling processes. Chapters on causal modeling, simulation and fuzzy logic models, among others, and their use in the policy modeling process ensure the reader has a deep appreciation for the variety of tools and techniques being employed under the umbrella of policy modeling and for enabling more active engagement of citizens in the policy making process. A chapter by Rumm, Ortner, and Löw, calls for a reflection based on new understanding of the policy making process and the role of technology. The authors provide an important contribution by encouraging the reader to step back from the specific to examine the policy making process and how an ICT system, newly considered as a tool in the process, must be designed to maximize impact on that process.

A global tour of leading practices in ICT-enabled policy making processes provides the reader with an understanding of the current state-of-the art in many places around the world. From Zagreb, to China, Brazil, Macedonia, Singapore and beyond, the chapters in this section provide the reader with a rich selection of case examples of the use of technologies as part of the policy making process. Whether seeking to increase participation in discussions of low equity in neighborhoods in Kenya or examining an effort to foster bicycle use in cities; each chapter also brings forward new models or frameworks for thinking about and enabling the policy lifecycle. The chapter regarding Fostering Bicycle Inter-Modality in Skopje for example, by Gusev, Guseva and Veselinovska, draws on complexity science to introduce a new governance model to support the policy design and implementation lifecycle in their case study of bicycle modality in Macedonia.

Finally the book provides a living roadmap for policy making. A chapter authored by Mureddu, Osimo, Misuraca, Onori, and Armenia, draws on the work of the CROSSOVER project, also funded by the FP7, which “aims to establish the scientific and political basis for long-lasting interest and commitment to next generation policymaking.” Among other topics, the chapter outlines the opportunities for involvement in the development of the roadmap and provides the reader a bridge between the book and the larger community of scholars and practitioners focused on the future of policy modeling, policy making processes, and ICTs.

With their extensive literature reviews, rich conceptual models and compelling case studies the chapters in this volume provide an important contribution to efforts to understand recent shifts in dominant models of policy making processes and to our basket of tools, techniques, methods and models focused on ensuring data is ready and available for use, and that the integration of emerging technologies into the policy making process will deliver the expected benefits to the governance process.

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Preface

OVERVIEW OF THE SUBJECT MATTER

The increasing role of Information and Communication Technologies (ICT) has changed the way that people interact with each other and with their environment. It also initiated changes in policy design and the way citizens and politicians engage with legislation, administration, and government.

As a consequence of this ongoing change, the European Commission has initiated a research stream on ICT solutions for governance and policy modeling. This book, *Handbook of Research on Advanced ICT Integration for Governance and Policy Modeling*, originates from the largest project of this research stream, the Future Policy Modeling (FUPOL) project. FUPOL itself aims at developing a new governance model to support the policy design and the whole policy life cycle by the use of innovative ICT tools. A novel, detailed policy lifecycle model linked each step to new ICT technologies and explains its benefits for governments, citizens, and other stakeholders. FUPOL has also outlined how different available technologies can be integrated in such a model that fit into ICT infrastructures of governments. This cutting edge governance model is applicable worldwide, irrespective of the region or social and political context.

It has been realized that the methods and the ICT tools to support the policy lifecycle and the political decision making process have drastically changed with the emergence of social media, advanced simulation techniques, open government data, big data, opinion mining, advanced text analytics and visualization, amongst others.

Subsequently, the status of information and communication technologies play an increasing and leading role with worldwide impacts on economic, social, and political structures and development of nations. The importance of social media tools to foster stakeholder participation in the policy decision-making process by opinion collection is growing. Cities, municipalities, or government institutions ask for citizens' opinions to identify the need for a new policy or a change in policy. In a next step, comments are requested regarding challenges, risks, and opportunities connected to new policy measures. The whole e-participation process is assisted by social media tools and visualization techniques that offer the essential information at a glance.

Simulations and statistical predictive measurements combined with visualization methods allow a prediction of future impacts. The application of machine learning methods for mining information from the Web and other open resources leads to the analysis of historical or recent data. Based on these, information solutions can be identified, which leads to transparent decision making.

The book addresses a broad range of ICT tools and implementation guidelines for governance and policy modeling. It aims to provide a comprehensive and comprehensible view on different approaches, methods, and models of ICT integration, e-Participation, and social involvement in political processes. One main aspect is the analysis of citizens' opinions and their influence on political decisions.

It is essential to understand how models from traditional policy modeling can be combined with ICT-based techniques. This book illustrates the adoption of different ICT methods on established traditional policy modeling methodologies and the linking of technical features with the different tasks of the policy lifecycle. All relevant technologies, for instance the Policy Indicator Dashboard, the Opinion Maps, and the Fuzzy Cognitive Maps, are brought into the context of the policy modeling process. Simulation and machine-learning methods, for example, are used to predict possible illustrated scenarios or extract information from various and heterogeneous resources (e.g. text or multimedia). Information visualization techniques will illustrate the value of pictures to convey information and amplify human cognition. Other technologies like fuzzy cognitive maps or semantics will lead to a comprehensive picture of today's technological possibilities and the related advances for policy modeling.

One of the main objectives of this book is to explain how the new technologies can be applied in traditional policy design and decision making. It further introduces and illustrates precisely how these technologies are applied in real world scenarios. The technologies are investigated as well as various application scenarios across the world.

ADDRESSED TARGET AUDIENCE

This book addresses a wide range of audience with its interdisciplinary character of politics, social, and computer sciences.

Academic readers from technical disciplines will benefit from the presented ICT concepts, techniques, and system-specific attributes, as well as from best practices for electronic government solutions. Methodological approaches and description of use cases will be of benefit for academia from social and political disciplines.

Practitioners from businesses, such as consultants and service managers, are provided with solution approaches for the selection and implementation of the ICT tools and guidelines.

Handbook of Research on Advanced ICT Integration for Governance and Policy Modeling is also a valuable resource for civil servants and political decision makers.

ORGANIZATION OF THE BOOK

The book is grouped into 5 major sections and divided into 22 individual chapters.

Section 1 starts with an overview of the fundamental aspects of eGovernment and Open Government. This section outlines aspects and terms in e-Government and e-Governance and introduces some general requirements for providing an open government environment. Section 1 comprises five chapters.

For this purpose, Chapter 1 gives an encompassing overview of the structure and terms of e-Government. It also outlines the e-Government terms in a clear fashion. Furthermore, it introduces a practical picture of what e-Participation and related terms are. Chapter 2 has a focus on Open Government Data (OGD), which is explained based on the experience in Austria. It includes the informal approach of OGD consensus finding, the OGD specifications, the organizational setting, and harmonization approaches in the DACH countries (Germany, Austria, and Switzerland) and pan-European region.

Chapter 3 explains various standards from the W3C´s Semantic Web activity and the role they play in the context of Open Data, as for instance RDF as a standard data format for publishing and consuming structured information on the Web, the Linked Data principles for interlinking RDF data, and RDFS and OWL. The chapter offers current deployments and potential, risks, and challenges.

Chapter 4 gives an overview of the existing policy modeling processes and explains their major focus. It further introduces how ICT can be integrated in practical processes and public authorities. Based on these descriptions, the general requirements on a new ICT-oriented policy modeling process that allows the inclusion of ICT into a valid and useful process for public authorities is described.

Chapter 5 outlines an advanced policy lifecycle, the FUPOL model, with its ability to link technical features in the area of policy modeling. The FUPOL Policy Lifecycle is based on six stages, which are further divided into main tasks and subtasks to provide a very detailed policy lifecycle structure. The detailed breakdown permits the linking of each task to various technical features, such as opinion maps, policy indicator dashboard, knowledge data base, and simulation and visualization tools. This methodology has the potential to accommodate new technologies in the future.

Section 2 is focused on simulation methods and software for policy modeling. Causal models and fuzzy cognitive maps to foster the policy life cycle by the support of visualization are the focal point. In addition, the role of simulation and social factors in the designing of policy decision-making support tools are emphasized. Section 2 is divided into four chapters.

Chapter 6 provides an illustration of the benefits of causal modeling with respect to other commercialized approaches. The aim is to develop simulation models that could fulfill the transparency and acceptability requirements to foster e-participation taking into consideration the demands and skills of the multiple and heterogeneous users of urban policy models.

Chapter 7 is based on the fact that policy decision making is implemented in a framework that has to respect technical and social aspects. It deals with socio-technical systems design peculiarities, emphasizing the role of simulation and social factors in the designing of policy decision-making support systems.

Chapter 8 presents an overview of research attempts where fuzzy cognitive maps have been employed as a simulation tool in order to support policy decision makers in their assessment of the impact of policies and help them adopt the most suitable policy to implement.

Chapter 9 describes a novel adaptive approach to supporting and assisting the user during different tasks. For certain tasks and interactions of the user, different technical features that support and assist the user can be enabled or disabled. In consequence, experts will get less restrictive features and tools that make solving tasks more effective, whereas novices will mostly get a restricted feature set where they are more strictly guided.

Section 3 outlines technologies for the Active Involvement of citizen in the policy process, as for instance stakeholders feedback platforms, information visualization, hot topic sensing and topic summarization, real-time multimedia policy analysis, and approaches for the integration of various technologies for policy modeling. Section 3 comprises five chapters.

Chapter 10 is focused on e-Participation with stakeholder feedback platforms. Social media platforms allow a crowd of individuals to answer questions but do not support a “one-to-many” dialogue, where the communication manager, acting on behalf of the public authorities, can interact with the crowd. In this chapter, a software platform is outlined that aims to address this gap and describe the system envisioned in the FUPOL project.

Chapter 11 introduces information visualization as a solution for enabling the human information access to heterogeneous data that are necessary during the policy modeling process. Therefore, the steps of policy design are identified. A foundational overview of information visualization is given, investigating, besides visualization techniques, the entire spectrum of data to visualization. In this context, data and interaction methods are introduced. The chapter concludes with a conceptual example of visualizing social data in the domain of policy modeling.

Chapter 12 presents a set of data analytics tools that can help public authorities to extract and summarize textual content from Internet forums and social media feeds. There are many potential applications of these tools, such as the visualization of the main political discussion in the city, early detection of disagreement with the local politics, or city services connected to social media.

Chapter 13 presents common real-time multimedia content analysis methodologies and core technologies to analyze multimedia content from a practitioner's viewpoint, highlighting their primary impact, best practices, current limitations, and future trends in this domain. In addition, the impact of multimedia content analysis within a governance-oriented applied context based on two use cases is presented.

The purpose of Chapter 14 is to outline various aspects of the technical design and architecture of an ICT system that is capable of handling the requirements that are typical for the policy-modeling domain. An overview of the relevant technologies for each step of the FUPOL policy modeling lifecycle, the standards that they build upon, and how to integrate them into a coherent system is provided. As FUPOL is currently the only existing system that is capable of covering the full policy-modeling process, the practical application of these architectural and technical concepts with examples taken from the FUPOL system is illustrated.

Section 4 introduces best practice cases and research projects in Zagreb, Skopje, Brazil, China, Singapore, and in low-income neighborhoods. This section is divided into seven chapters.

Chapter 15 explains the implementing of the FUPOL policy model and FUPOL platform in the current policies of the city of Zagreb. Two pilot initiatives, based on the whole policy lifecycle, have been selected. The chapter covers the background of these pilots, the challenges faced by the city of Zagreb, the results, and the solutions, too.

Chapter 16 presents an optimization model intended to support the policy design regarding the scheduling of different recreational activities at the Vodno Mountain, which should not interfere with each other. It is aimed to explore barriers and facilitators, while preserving the natural environment, minimizing noise pollution and criminal activity, and avoiding conflicts as much as possible. Optimization functions are defined as an input to a simulation model, which will be developed in the future. In addition, citizens are included in the process of policy decision making by creating social media surveys and gathering online public opinion.

Chapter 17 outlines a comprehensive new governance model to support the policy design and implementation lifecycle in the domain of urban planning to foster bicycle inter-modality in the city of Skopje. The innovations are driven by the demand of citizens and political decision makers. The scientific approach is based on complexity science. The proposed optimization model is aimed to explore barriers and facilitators to using bicycles as a transport means in Skopje, considering bicycle riding for transport on private bicycles and different share schemes.

Chapter 18 analyzes the effectiveness of citizens' engagement in the e-Democracy initiative through the case study of the discussion of the Internet Civilian Landmark in Brazil. It analyzes two types of participation—comments and suggestions to the draft bill—and measures the effectiveness of user-participation.

Chapter 19 seeks to research the information society construction in China during the 12th 5-year plan period (2011-2015), especially the efforts to involve citizens in participating in the decision-making process. The chapter summarizes the strengths and weaknesses in the practice of public participation and e-Participation.

Chapter 20 provides an overview of Singapore's IT strategy development and the relation between government and key stakeholders to define and establish new policies, governance, and the framework implemented through the added value provided by IT and visual solutions ad-hoc utilized.

Chapter 21 presents the conceptual framework for e-Participation in low- and middle-income neighborhoods, reviewing first the main features of traditional participation and later the strengths and weaknesses of e-Participation. This framework is applied to a slum-upgrading project in Mtwapa, Kenya. The underlying platform is proposed to be implemented in low-income countries to facilitate effective and inexpensive ICT-enabled citizen participation.

Section 5 addresses future directions regarding Policy Making 2.0.

Chapter 22 is based on current research conducted by the authors as part of the "CROSSOVER Project – Bridging Communities for Next Generation Policy Making," an FP7-funded support action of the European Commission. In particular, the chapter identifies the opportunities and benefits resulting from applications of ICT tools for collaborative governance and policy modeling, and provides an outline of what technologies are and will be available to meet the needs of policymakers.

CONCLUSION

Handbook of Research on Advanced ICT Integration for Governance and Policy Modeling provides comprehensive information about state-of-the-art approaches, methods, models, and IT-systems for policy design and implementation.

The reader of this book will understand how the technologies are linked with each other and support the policy-modeling process.

Apart from the theoretical background, this book provides an insight into practical solutions and application scenarios across the world.

This will enable readers to apply the introduced approaches for advanced solutions in policy modeling.

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Acknowledgment

The process of understanding ICT-supported governance and policy modeling and its implementation on a global scale has brought together the experience and insights of many researches, consultants, technicians, managers, and scholars worldwide.

In addition to the authors whose excellent contributions provide a well-rounded overview on the foundations, methodologies, approaches, technologies, and use cases, we are very grateful for the comments received from the reviewers and the editorial board. Advice given by our English native speakers Shaun Topham, Dominic Tyreman, and Gay Jonathan during their proofreading has been a great help.

We would also like to express our gratitude to the publication team, who has supported us rapidly and comprehensively.

This book comprises a variety of ideas, collected from conference proceedings, book chapters, articles from journals and newspapers and web based information. All these documents and information have underpinned our research work and conclusions.

The list of those to thank is too numerous; however, we would like to thank our colleagues and counterparts from the FUPOL project, whose participation in discussions and debates helped to shape our way of thinking regarding "Advanced ICT Integration for Governance" and "Policy Modeling."

Finally we are also very grateful for the full support provided by our organizations namely Cellent AG, Fraunhofer IGD, and Major Cities of Europe.

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Section 1
General Remarks

Chapter 1
Fundamental Aspects for E-Government

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ABSTRACT

The upcoming initiatives using ICT in the government process should strengthen the benefit of e-government in most countries. Since e-government among other e-related terms is a widely (interpreted) term, it is sometimes challenging to understand the objective and goals of an initiative. Therefore, in this chapter, the authors introduce and explain most e-government related terms. Even more, they outline some interesting initiatives and implementations to explain the benefits of using ICT in the government domain. Concrete activities are aligned to the terms to explain their practical use in a better way. The authors conclude with several challenges that arise when thinking of the implementation of e-government services. Overall, this chapter should give a good overall view of e-government and the related issues.

INTRODUCTION

E-Government is a current challenge in many countries, where the existing possibilities of ICT should be used to raise the government goals mostly in regards of their players such as the citizens or enterprises on higher level. It is not unusual in the mind of stakeholders to implement E-Government tools through such initiatives in the area of E-Government to decrease the paper work of public authorities, next to the provision of added value such as providing services to citizens and enterprises 24/7. But in most discussions to E-Government - especially in western countries

DOI: 10.4018/978-1-4666-6236-0.ch001

- there is also the idea in mind to increase the engagement of citizens in the political process. Most countries deal with the challenge of an increased lack of interest in politics, mostly in the younger generation.

For many people the E-Government term is most likely related to that what the term e-Participation implies. This perception is in a way retraceable, as far as citizens are interested in getting a higher influence in the policy making process. In regards of the focus on electronic participation it needs to be distinguished between normal participation possibilities, e.g. voting for politicians or maybe candidate as politician or demonstrating for a specific issue, and how ICT can contribute to involve citizens in the entire political process. ICT provides on the one hand a couple of new possibilities, such as debating with citizens from all parts of a country, also the information gathering is easier and it allows – depending on the provided services in the specific country – to contribute to political debates in parliaments and councils, what, for instance, the e-petition platform[1] provides to German citizens. On the other hand there are also some limitations, it makes less sense to make an electronic demonstration, because is harder to get heard by politicians. So the way ICT can be considered in E-Government provides some new innovative and sustainable options, but in fact it do not provide just benefits, it comes along with significant limitations.

In this chapter we want to outline the E-Government topic in a more clear fashion. The term E-Government and related terms like E-Participation, E-Administration and E-Governance are widely used in relation to current activities of countries and some organizations to show their future oriented strategies. The more terms are used that sound similar the more it get complex to understand the differences and the major goals. These terms suggest more or less the same aspects and it seems that they imply the same goals, but indeed this is often not true. Therefore in this chapter we will introduce and explain the meaning of these words, and how they are related to each other. In the second part of the chapter we will focus on interesting initiatives and implementations. This should on the one hand provide a more practical picture of what E-Participation etc. is, and on the other hand how it allows to show established technology development that strengthens the benefit of ICT to achieve an improved (e-)government. We will conclude with the last section, where we will consider several challenges that arise when thinking of the implementation of E-Government services. Among other things we will take a closer look at ways to guarantee private data security and possible problems with the equality of citizens in an E-Government world.

E-GOVERNMENT AND E-PARTICIPATION

Before we outline interesting initiatives, we want to introduce the major terms and want to give an overview about E-Government. Our focus in E-Government lays on E-Participation, more precisely on how to gather citizens' opinions and ideas in the governmental decision making process.

Overview and Definitions

"Government has always been dependent upon technology" (Coleman, 2008). This statement admits certain modernity to governments, which often are perceived as technically rather backward. However, e.g. the possibility for governments to publish data via the Internet is given for already over 30 years (Sheridan & Tennison, 2010).

The public sector uses technical innovations concerning E-Government approaches and techniques only as a passive participant. But in contrast it acts as a major sponsor of science, where it rather takes a quite active role in the development of new technologies. Considering the development of the World Wide Web, we notice it was largely based on the results of government organizations: in

1993 agencies with scientific backgrounds, such as NASA, introduced the Mosaic browser and the Apache server. This was an important milestone in the history of the Internet. From this time on governmental usage of technological innovations became more and more intense (Brandt & Gregg, 2008). In the future governments' capital investment for instance will promote projects in "Horizon 2020 - The EU Framework Program for Research and Innovation" (Horizon 2020).

The term E-Government (for electronic government, also digital government [Hovy, 2008]) describes the use of information technology by the public sector. This includes the use of the Internet by public authorities. However, E-Government also encompasses the automation of processes in the public sector in general, for example, digital identity cards that speed up identification processes (Heeks, 2005, p.4). But also online portals for civic participation or online elections are a part of E-Government.

In order to differentiate the various dimensions of E-Government, the terms E-Administration and e-Democracy have been established (Friedrichs, Hart, & Schmidt, 2002, p.107), and will be discussed below. The objective of E-Administration is to provide information services and other electronic services for citizens (Friedrichs et al., 2002, p.107). The term encompasses services supporting every kind of interaction between citizens and every governmental agency or authority. An example for E-Administration would be the possibility to request your passport online, or to obtain your driving license over the Internet. But not only services that allow you to process formalities remotely are part of E-Administration. There are also pure information services, such as the mobile app of the Federal Council of Germany. The advantage of all these internet services is the enhanced accessibility for citizens. On the one hand this applies to the business hours, which are extended to 24/7, on the other hand it is no longer necessary to be on site in a particular agency.

Friedrichs et al. (2002, p.107) define E-Administration as the handling of user-based services by public institutions based on information and communication technologies (ICT). This definition also includes offline, non-internet based services. A good example for this was the Facilitating Administrative Services for Mobile Europeans project (FASME project, 2001) described by Oostveen & van den Besselaar (2004): the aim of this EU-funded project was to facilitate bureaucratic procedures for citizens moving from one EU country to another. In this project, the researchers planned to use smartcards to store official data regarding the relocating person as files certified by the native country. Once arrived in the new country, the project planned that only the smartcard is required -e.g. to take up residency- and no other documents are necessary.

Taking a closer look to the above definition of E-Administration, we can see that the authors do not limit the recipients of E-Administration services to citizens. Thus, E-Administration implicitly includes enterprise services. Here also exist potentials to simplify bureaucratic processes. To sum up, it can be said that in a country with an appropriate implementation of E-Administration, the public sector acts as a customer-oriented service provider, which likes to serve citizens and enterprises by using information and communication technologies. One benefit for governments utilizing E-Administration is a possibly increased civil, and respectively enterprise, satisfaction. Another advantage could be cost savings resulting from enhancing the degree of automation.

The other dimension of E-Government is called E-Democracy, which encompasses every kind of citizen involvement in public processes and political decision-making using ICT. In other words E-Democracy wants to use ICT to assist in exercising democratic procedures and hereby strengthening democracies (Friedrichs et al., 2002, p.107). To split this further, we can think of sophisticated electronic voting machines or technical solutions that facilitate the process of voting, which can be summarized by the term E-Voting. Besides E-Voting, Macintosh (2004) uses the term E-Participation to describe those parts of E-Democracy that are not immediately dealing with the process of voting, for instance the use of ICT to find out the opinion of the people regarding political decisions or explaining such decisions to citizens.

As E-Voting is mainly a technical challenge (Friedrichs et al., 2002, p.33; Macintosh, 2004; Macintosh, 2008) we only outline some challenges in this area and some strategies to handle them. For further details on this topic, please consult, e.g. Herrnson et al., (2008). As mentioned earlier E-Voting deals with all kinds of E-Democracy activities that immediately address the process of electronic voting - whether through stationary machines, over the Internet or using your mobile phone.

Today there already exist different kinds of voting machines and additional electronic helpers for the process of voting. For instance there are voting machines that use buttons to choose who to vote, others make use of touchscreens and still others use optical scanners to evaluate the completed ballot paper. The Massachusetts Institute of Technology (MIT) introduced another system, which uses a microphone and headphones to cast a vote (Herrnson et al., 2008).

So-called Vote Verification Election-Audit Systems (VVEAS) can also be assigned to E-Voting as they take up concerns like "How do I know, that the system properly recorded my choice". These machines use artificial voices or paper prints to certify that the system recorded the choice as intended (Herrnson et al., 2008)

There are some countries that already started using voting machines in elections - mostly not all over the country but as test runs at selected polling locations. According to Hernnson et al. (2008) those test runs showed, that there are still some usability issues left for future work before the systems should be used extensively.

Fundamentals of E-Participation

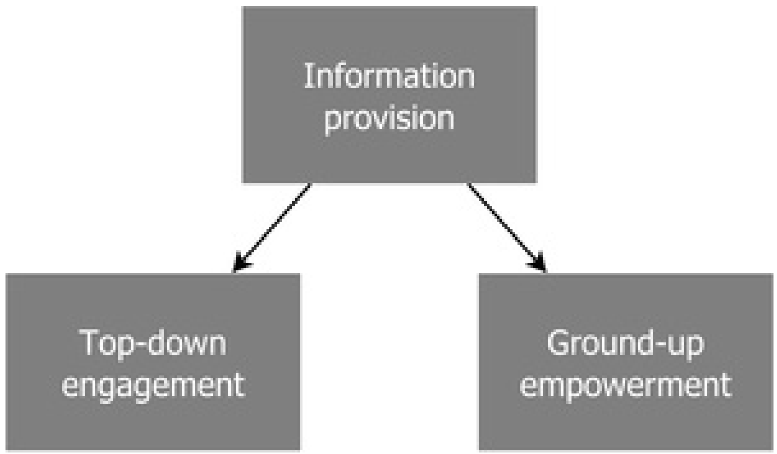
The second part of E-Democracy is, as mentioned earlier, E-Participation. Macintosh (2008) defines this term as "the use of ICTs to support information provision, top-down engagement which is concerned with the support for government-led initiatives, and ground-up empowerment which is mainly concerned with the support to enable citizen, civil society organizations and other democratically constituted groups to engage with their elected representatives and officials".

In other words E-Participation wants to improve the public's interest in politics, simplify and promote political commitment and collaboration, and make the whole process more transparent. One important reason, why this is necessary, is that the legitimacy of legislation can only be ensured if the opinions of a majority of the population is taken into consideration (von Engers, van Haadten, & Snellen, 2011; Macintosh, 2008). If too few people play a part in this process, legitimacy is in danger. Intuitive indicators of participation might be, for instance voter turnouts or the number of members of political parties.

Fundamental for the implementation of E-Participation is what Macintosh (2008) calls information provision - the availability and accessibility of information. This, for example, includes plain numbers describing the facts concerning a special topic as well as other people's opinions and ideas regarding this issue, and expert views and estimates about it. As shown in Figure 1, according to Macintosh (2008), information provision is vital to the other parts of E-Participation, namely top-down engagement and ground-up empowerment. The provision of open government data (see section transparency through public data) is one application possibility of governmental information provision.

Top-down engagement, the second part of E-Participation, is "concerned with the support for government-led initiatives". This can encompass a government's call for contributing in a specific

Figure 1. The different objectives of E-Participation according to Macintosh (2008)



political discussion, promoting recent decisions as well as reasons that led to this decision, and in general making people care for political affairs.

The third term used by the definition is ground-up empowerment, which should simplify and improve interacting with elected representatives to express opinions and suggestions, but also dissatisfaction with certain decisions or processes (Whyte, 2008). Ground-up empowerment not merely should be a possibility to respond to topics that are part of the current political agenda, but rather should offer the chance to add an issue to the current agenda in order to discuss subjects that seem important to individuals and come up with solutions (Macintosh, Davenport, Malina, & Whyte, 2002; Macintosh, 2008; Phang & Kankanhalli, 2008). With E-Participation in some cases it might be possible to use the wisdom of the crowd to come up with new, and sometimes even better solutions for different challenges (von Engers et al., 2011).

Involved Stakeholders

Implementing E-Government and E-Participation has an impact to several stakeholders. To explore the effects, both positive and negative ones, it makes sense to put oneself in the position of each of those participants. Although one might argue that this is a very high-level classification not really considering all differences inside those groups, we will outline the positions of the three stakeholders that we consider the most important, namely 1) the public sector, 2) the citizens, and 3) enterprises. If necessary we will slightly refine this high-level classification to consider different aspects of some of those stakeholders.

The public sector is one of the main beneficiaries of E-Government when thinking about all the governmental agencies that gather, store, process and draw inferences from data. Von Lucke & Geiger (2010) state that it is necessary for a country's administration to stay (or become) up-to-date regarding technology in a world that values transparency more and more. Staying up-to-date in this case includes the application of modern ICT to improve the efficiency in handling data (Hovy, 2008). In fact, automating information processing could lead to a considerable acceleration for present manual processes. Of course, in a huge and sophisticated structure like a state it is challenging to apply such changes, as von Lucke

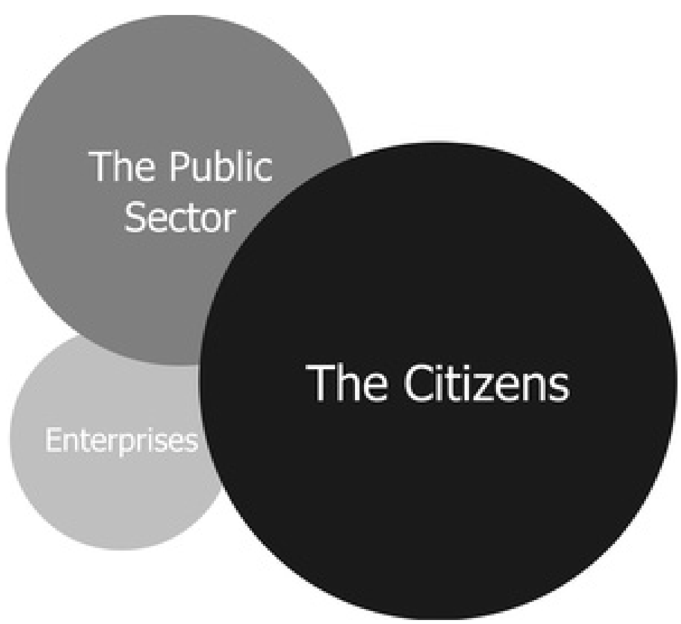
& Geiger (2010) also mention. But there are also a lot of advantages in doing this. As previously mentioned, E-Administration deals with that.

Hovy (2008) suggests to divide the tasks of the public sector into three parts. In the previous passage we considered the public sector as an information processor. E-Participation affects the other two parts in a more intense way: the public sector as a function and the public sector as an organization. According to Hovy (2008), taking the function perspective, governments should ask themselves what would improve the quality and velocity of their decision making to act in the best interest of the citizens. Several research projects explore how to make the public opinion more accessible to policymakers - for instance the FUPOL project (2013) and the work of Kalampokis, Hausenblas, & Tarabanis (2011) are dealing with this issue.

The third perspective of the public sector, as an organization, highlights the effect of changes implemented. Here, we want to evaluate how well, e.g. the integration of public opinions, works (Hovy, 2008). Is there an increase in public interest in politics after applying new processes? Are citizens happier with political decisions, both short-term and long-term? Do people think they can contribute in political decision making more than in the past? As mentioned earlier, improvements in decision making can lead to a higher legitimacy of legislation, which should be one of the public sector's goal (von Lucke & Geiger, 2010).

The second group of stakeholders we want to consider are the citizens of a community. E-Government promises lots of benefits to citizens. Implementations of E-Administration are supposed to facilitate the interaction between citizens and public authorities. Government-to-Citizen (G2C) is a term to describe these points of intersection, where citizens are treated as costumers and an important goal is to maximize customer satisfaction. So E-Administration often can be seen as an immediate benefit for citizens

Figure 2. The three stakeholders of E-Government. The circle sizes refer to each stakeholder's importance regarding developments in e-Participation.



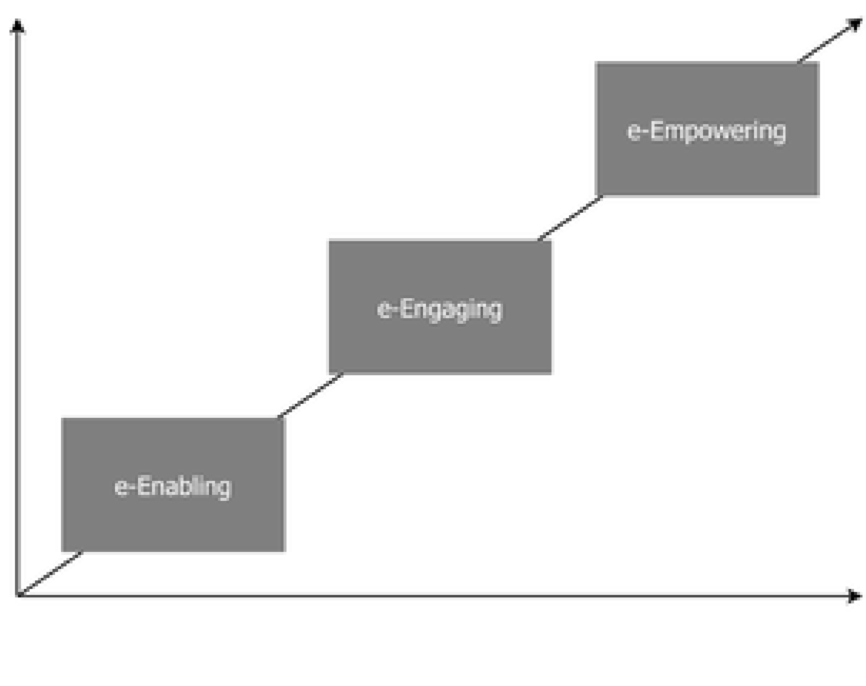
- although Heeks (2005) determined that some projects drift away from customer satisfaction as the main goal (p.136).

Likewise E-Participation can be identified as such an advantage mainly designed for citizens. Figure 3 sketches which stakeholder benefits most from E-Participation projects. As mentioned earlier, E-Participation tries to improve the public's interest in politics, as well as to simplify and promote political commitment and collaboration. It is important to note here, that any interest in politics and any contribution should happen on a voluntary basis and should explicitly not be forced by any other stakeholder. As different people want to participate to a different extent, and therefore assess the value of various possibilities to participate by one means or another, it makes sense to distinguish different levels of participation. We will use the three categories that Macintosh (2004) came up with (and that are very similar to the ones, Jankowski & van Selm (2000) describe): 1) e-Enabling, 2) e-Engaging, and 3) e-Empowering (see Figure 3).

As Macintosh (2004) states, e-Enabling addresses the "two aspects of accessibility and understandability of information". In other words, in a state where E-Government is implemented to a high degree, for someone looking for certain information, it is easy to access different kinds of data and using opportunities of help to understand the exiting information. The more data is accessible and understandable, the more transparency is guaranteed. The public data that is available can be economical data, results from social surveys or information from a variety of other areas.

If someone is not only interested in certain information, but also wants to form an opinion on a particular issue, it is useful to have access not only to the information itself, but also to other's opinions and arguments, as well as to have the chance to discuss ideas with others. Macintosh (2004) summarizes this level of participation as e-Engaging. For example Macintosh, Malina, & Farrell (2002) introduce an Internet platform where citizens are invited to create petitions, to view and sign them, as well as to add background

Figure 3. The levels of citizen participation according to Macinthos (2004)



information. There are also forums to discuss open questions.

As the third and most intense level of participation, we consider e-Empowering. E-Empowering "is concerned with supporting active participation and facilitating bottom-up ideas to influence the political agenda" (Macintosh, 2004), and therefore bringing citizens' ideas to the attention of representatives and policymakers. This immediately improves the degree of citizens' influence to the political agenda and political decision making. E-Participation includes these ideas of empowerment among other things to achieve an early involvement of the community in the policy modeling process, and therefore a better overall acceptance of decisions taken.

As the accessibility to understandable information, the chance to discuss political issues and the chance to bring ideas to the attention of policymakers is vital for E-Participation, it is equally important to guarantee these possibilities to all citizens. In the section challenges and limitation we will describe this and other challenges in more detail.

Enterprises are the members of the third group of stakeholders that also need to be considered when thinking about the impacts of E-Government. In E-Administration there are the most points of intersection between businesses and public authorities. For example, in 2013 Germany started to gather income tax information via software, which is supposed to accelerate and facilitate the process for both enterprises and government agencies (ELSTER, 2013). Sometimes the term Government-to-Business (G2B) is used to describe projects like this.

While E-Administration, amongst others, aims to improve the communication between businesses and the government, E-Democracy does not consider enterprises fully as a stakeholder. Most ideas here are supposed to facilitate things for citizens or to strengthen their power. However, when things are changing, there is a potential growth market for enterprises involved. Developing and producing voting machines is a task in E-Voting, where enterprises with appropriate expertise can make money. Likewise with the development and support for, e.g. online platforms, that government agencies want to utilize, and lots of consulting services, where specialized businesses can play a role. As the release of public data is an important first step for E-Participation, it is also possible to start a business using these data in a commercial way - as the commercial use of public data is explicitly claimed by the open data principles (von Lucke & Geiger, 2010).

What might be a disadvantage for large, influential companies that currently engage in lobbying activities is a possible decrease in their influence. Implementing E-Participation could potentially lead to a higher regard of the public opinion and therefore a possible decrease in a company's power in politics.

E-GOVERNMENT INITIATIVES AND IMPLEMENTATIONS

In the previous chapter we outlined E-Government. In this chapter the praxis is in focus, and what solutions support the idea of including citizens in E-Government.

Transparency through Public Data

Providing governmental transparency is one of the main issues to increase trust in governments. Using ICT to release public data and therefore increase transparency hence is one aspect of E-Government. As mentioned earlier, having access to such data is the foundation to form an opinion regarding a political topic. Statistics, for example, can give insights into the status quo and historical developments. Likewise forecasts can give some indication of what may be expected and therefore be a good basis for one's opinion making. Of course it is an important issue to collect data properly and comprehensively. However, at this point we focus on the appropriate publication of available data, rather than giving extensive suggestions about what kind of data needs to exist.

When thinking about how to publish data, the idea of open data provides some noteworthy recommendations. Von Lucke & Geiger (2010) define open data as the complete amount of data that is accessible free of charge for the public benefit without any limitations regarding its usage, its retransmission, and its re-utilization. As the authors continue, no limitations explicitly include the permission to use open data for commercial or military purposes. Licenses usually define the conditions under some data can be used. According to the Open Knowledge Foundation published data can only be considered as open data, if the data's license only dictates the user to mention the original author when sharing the processed data, and requires the user to distribute any work that is including the data under the same open data license. The Open Knowledge Foundation provides licenses for open data on their website www.opendatacommons.org.

Besides these definitions, open data should be accessible in an easy way, for example over the Internet via download and without a login needed. Also the data should be available in an open file format that is free-to-use (von Lucke & Geiger, 2010; Open Knowledge Foundation, 2009). Using the CSV file format should be chosen over using a Microsoft Excel file format, using a HTML or TXT file should be preferred over using a Microsoft Word file format. Another issue is the machine readability of data. For an as straightforward as possible data processing, information should not (only) be provided as graphics, pictures or PDF files. Providing machine readable file formats, at best even access via an application programming interface (API), enables programmers and businesses to process the data fully automatic (von Lucke & Geiger, 2010). For instance, searching for files or file contents, comparing data and executing calculations on the data available are possible benefits of machine readable file formats.

The ideas of open data are general ones. Applying them to the public sector leads us to open government data. Von Lucke and Geiger (2010) are using this term to summarize the specific challenges and key ideas for the public sector when thinking about, what data should be published, and how this should happen. The authors draw on the considerations from the Open Data Network (2013), an organization that aims to promote, among others, transparency and open data. The authors state that all raw data available to any public authority should be published as open data, with the addition that personal data security laws must still be obeyed. Furthermore they demand to publish related metadata like what calculations have been made to get these results, and a documentation of the preceding data collection.

Another issue in dealing with open government data is the temporal proximity of publishing the data. Unfortunately the authors are answering this question quite vaguely: data should be published within an appropriate timeframe (von Lucke & Geiger, 2010). It is very likely that there is a difference in importance of different kinds of data and various data sets. Taken as a whole data should be published as soon as possible, valuing the importance of current data for citizens willing to participate in politics. Once a data set has been made public, it should keep being available permanently. In the next section, we will introduce some currently available online data platforms, where open government data is published.

Data of public interest include but are not limited to geological data like the locations of bus stops and fire hydrants, multimedia data (enriched with metadata to ensure machine readability) like records of congress sessions, and textual data like laws and transcripts of political speeches. Statistical data are available comprehensively to public authorities, and often are the basis for political decisions. As mentioned above, these raw data should also be published, as they can give an insight for interested citizens as well.

Public Initiatives and Directions

Now as we have described the theory behind E-Government and E-Participation, we want to take a closer look at what governments and other organizations have already implemented and where there still is some potential to transform current approaches. The preceding section covered ways to make public data available to citizens. In practice there are already some platforms in use, where citizens can download raw open government data. Especially noteworthy are the platforms www.data.gov.uk and www.data.gov were all kinds of governmental agencies of respectively the United Kingdom and the United States publish historical and current data sets. To assess the amount of data available to government agencies, it makes sense to take a look at the number of data sets available on data.gov.uk: more than one year after the site's public launch in January 2010 over 8700 data sets were available. One year later the number of data sets increased by two thirds to about 14500 (whereby at this time about 4000 data sets were marked as unpublished). The number of available datasets on data.gov in November 2013 was around 91000.

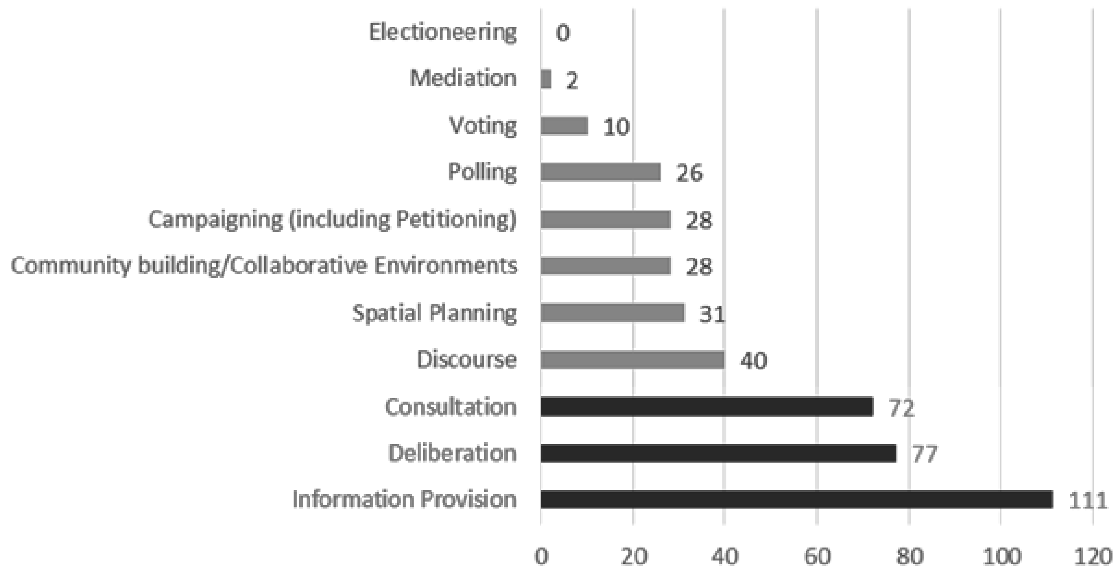
Published data sets on either platform include, for example, health surveys, emergency data, pupil teacher ratios, organograms of different agencies, expenses of departments, water quality, and census data. To help users drawing inference from available data, both platforms provide possibilities to find related or linked data sets (Cyganiak, Field, Gregory, Halb, & Tennison, 2010; Lebo & Williams, 2010; Kalampokis, et al., 2011).

Both the government of the United Kingdom and the government of the United States want to transform their countries to provide transparency and implement E-Government in more detail. Sir Tim Berners-Lee and Professor Nigel Shadbolt are part of the project data.gov.uk trying to steadily improve the platform (Cyganiak et al., 2010; Sheridan & Tennison, 2010; von Lucke & Geiger, 2010; Shadbolt et al., 2012). A sign of the declared intention to promote E-Participation in the US, for instance, is the E-Government Act of 2002 (Pub.L. 107-347, 116 Stat. 2899, 44 U.S.C. § 101, H.R. 2458/S. 803[2]), and Obama (2012) declared in a speech: "Government should be transparent", "Government should be participatory", and "Government should be collaborative".

Although the governments of the United Kingdom and the United States can be considered as pioneers and most advanced providers of open public data (Ahmed, 2006; Kalampokis, et al., 2011), they are not the only organizations pushing E-Participation. Canada (Brandt & Gregg, 2008), New Zealand (Ahmed, 2006), Australia (Hsu, Hu, & Chen, 2008), Germany (GovData, 2013), Singapore (Ahmed, 2006), China (Xing, Yang, He, Zhang, & Chen, 2008), and many other countries[3] have similar data platforms. The European Union is another E-Participation booster. Via the platform Eurostat, EU citizens have access to a wide variety of statistical data regarding all EU countries which makes it easy to compare the figures directly. Eurostat also offers a large amount of metadata to make available data easily interpretable (von Landesberger, Knuth, Schreck, & Kohlhammer, 2008; Shadbolt et al., 2012).

But not only databases are already implemented and ready for use. There are also a large number of other E-Participation systems operating. Panopoulou, Tambouris, & Tarabanis (2009) analyzed the situation in Europe, examining 255 E-Participation initiatives from 18 different European countries. 144 of these initiatives did not mainly focus on information provision which shows the variety of different approaches (see Figure 4). Currently running projects, for instance, are the online petition platform Askbristol (Phang & Kankanhalli, 2008) and a similar project for Scottish citizens

Figure 4. Participation areas of the E-Participation initiatives, analyzed by Panopoulou et al. (2009)



(Macintosh et al., 2002), the urban development simulation system UrbanSim (2013) used in Tel Aviv (Ahmed, 2006) and Melbourne (Borning, Waddell, & Förster, 2008), a South African discussion forum for educational issues, and a discussion possibility for politics provided by the Brazilian government (Ahmed, 2006).

This list is only a small sample of projects - and additional projects are expected to be released as E-Government research is being promoted and funded by various governments and organizations: the United Kingdom is investing heavily in technology for data administration and data publishing (Cyganiak et al., 2010). There are various E-Administration research projects funded by China (Xing et al., 2008), and most of the 255 E-Participation projects mentioned by Panopoulou et al. (2009) were funded by the European Union, which heavily promotes further initiatives. The EU funded research project Future Policy Modeling (FUPOL project, 2013) for example aims at automatically collecting, analyzing and interpreting opinions expressed over the Internet and therefore is implementing E-Participation to a high degree. To promote and appreciate successful projects as well as to provide an incentive for others, in 2001 the EU started the eEurope Awards (Gieber, Leitner, Orthofer, & Traunmüller, 2008; eEurope Awards, 2005). For the 2005 awards 234 projects applied for four categories. To motivate E-Government implementations the United Nations publish an E-Government readiness ranking[4] on a regular basis. International Organizations like the UN or the World Bank emphasize that more collaborations in E-Government research and implementation could accelerate and improve achievements for the benefit of all citizens (Brandt & Gregg, 2008).

Challenges and Limitations

Implementing E-Government and E-Participation bears a lot of challenges. In this section we will outline three of the main questions arising with the transformations aiming to facilitate G2C and G2B interaction, to provide governmental transparency, and to empower citizens. We will focus on the following three issues: 1) despite the enormous amount of data, that should be published, how can data privacy still be ensured? 2) How can we guarantee, that no one gets excluded from the new possibilities? 3) Who fund the initiatives and are they economically reasonable? These are not the only challenges, but they exemplify the wide range of issues that need to be considered along with all the E-Government benefits.

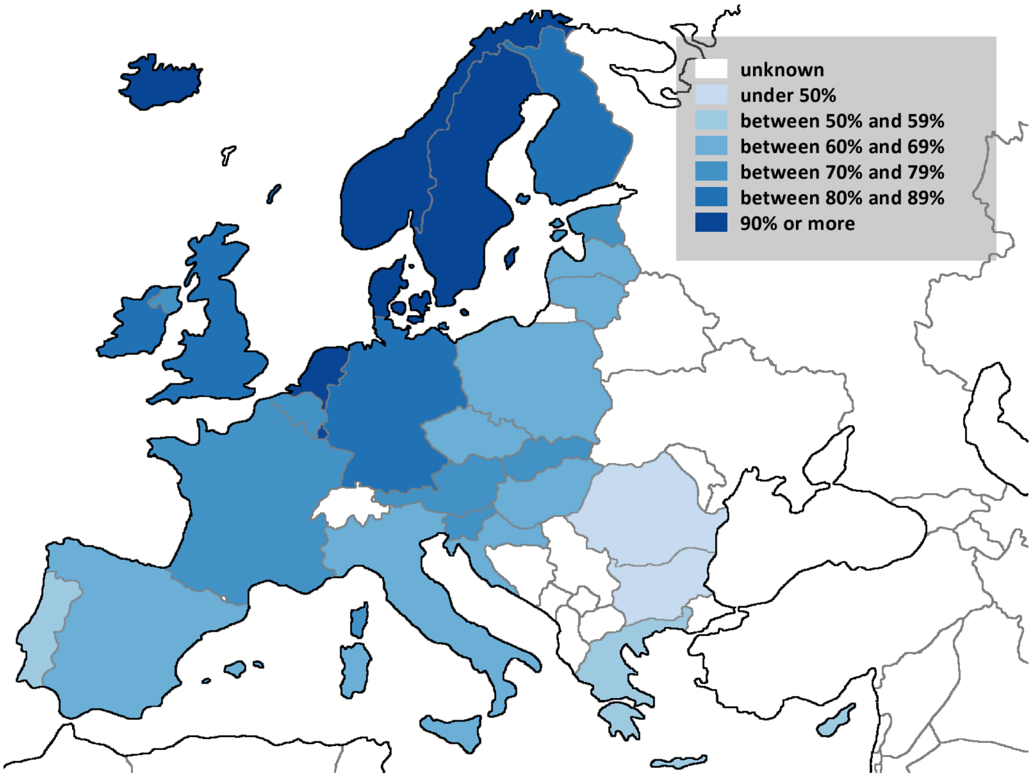
Public authorities have a heavy responsibility holding a huge amount of sensitive personal data. As summarizing these data to provide insightful statistics is claimed by the definition of E-Participation, there is a risk of (inadvertently) publishing personal data without prior agreement. Regan (2008) mentions “if individuals do not believe that their privacy will be protected, the will not use available E-Government features”. So citizens’ trust in the protection of private data and careful data handling is vital to the success of E-Government. Also Heeks (2005, p.254) emphasizes that public authorities need to establish and maintain a relationship of trust with citizens. Von Lucke & Geiger (2010) expand this statement and say that likewise the third stakeholder - enterprises - needs to be considered in this issue. They often hold valuable corporate trade secrets that must not made public.

Fully automatic methods to anonymize data sets and to blur or eliminate secret data already exist for a long time (for instance Rubin (1993)), so a lack in technical solutions is not the case. The point is that public officials’ awareness of the high degree of sensitivity of the data handled must be guaranteed. Trainings can help officials to distinguish what data needs to be anonymized and what data sets are ready to be released safely to the public. Being trained to be conscious of the responsibility and citizens’ trust is essential to avoid inadvertent mistakes in public data provision and hence is vital to E-Government’s success.

The offer of new and more possibilities to citizens for information purposes about political issues is good for the user in general, but more important, it is a necessary aspect of a valuable E-Participation strategy in a country. Especially, if the new methods are substituting familiar procedures rather than being supplements to them, decision makers need to make sure that nobody gets excluded from using the new possibilities. For instance, if someone wants to access statistics from an online governmental data base, she needs the technical infrastructure like a computer, and an appropriate Internet connection. These days it might seem unlikely not to have access to the Internet, but like Eurostat data of households with Internet access show, in Europe there are still a lot of people without access to this tool (see Figure 5). In fact these averaging numbers conceal the fact that inside countries and regions, Internet access is not uniformly distributed (Nixon, Koutrakou, & Rawal, 2010). Outside metropolitan areas or wealthy neighborhoods, for example, it is more likely that the technical infrastructure to be able to use E-Participation services is missing (Heeks, 2005, p.141). In literature the term digital divide is often used to characterize this phenomenon. Digital divide also encompasses differences in ICT knowledge, which probably discourages certain groups of citizens to use E-Participation possibilities (Nixon, et al., 2010).

Whatever reasons keep someone from using the newly available services, compared with citizens having access to them, there is a considerable disadvantage and inequality in participating in politics and make one’s voice heard, unless there is an alternative non-ICT way to actively participate in democracy. Hence an important subtask of implementing E-Participation is either to guarantee equality in infrastructure access, ICT knowledge and service usability, or to provide alternative ways of participation. Whereby physical or mental disabilities making it harder to use E-Participation services need to be considered along with the financial and physical possibility to access these services and everyone’s ease of handling them (Becker, 2008).

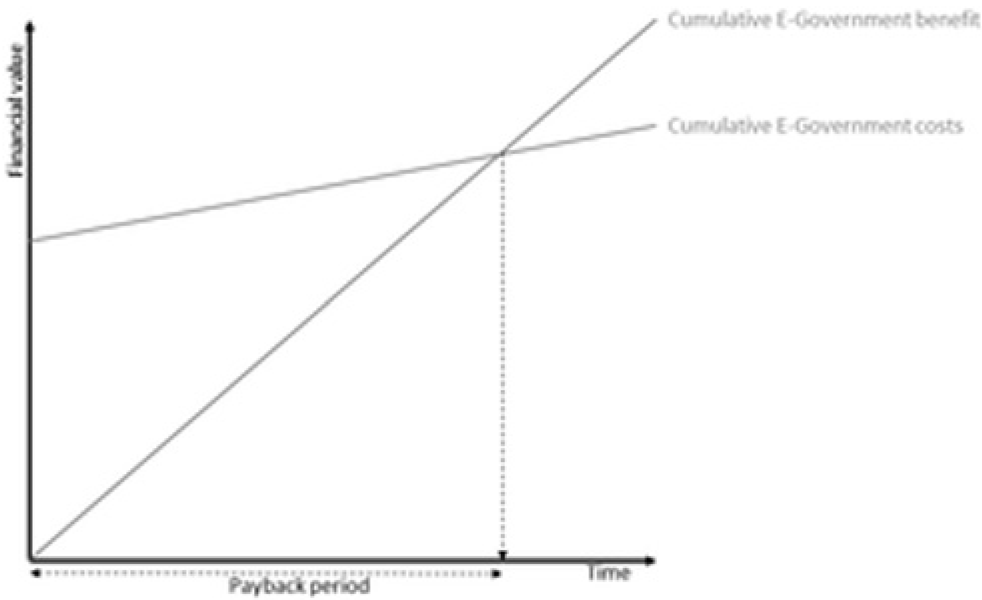
Figure 5. Percentage of European households having access to the Internet at home as of 2011, according to Eurostat data. (Map taken from http://www.digitale-europakarte.de).



The last challenge we want to consider here, is the question regarding the profitability of E-Government. As mentioned earlier, governments and organizations like the European Union are the main funders of E-Government research and implementation. Therefore in the end primarily taxpayers - citizens and enterprises - are paying to transform the current way of political participation. But is this money invested rationally? Is E-Government research and implementation economic? To answer this question we need to examine both sides of the equation and figure out what are the one-time costs, what are the costs of operation, and how we can measure the utility of new services and processes (see also Figure 6).

Unfortunately, estimating the development expenses accurately often fails. Especially in large-scale IT projects it is hard to estimate costs and, in fact, expenses are likely to be underestimated or some costs simply are not taken into account in the first place (Dawes, 2008; Heeks, 2005). Hence, development expenses often are known not until the project is in a final state. The case is similar with the costs of operation. Measuring the utility of implemented E-Government services is a nontrivial task as well. What is the value of better political decisions? How much is it worth to improve the speed of decision making? How to assess the improved availability and accessibility of governmental services? One thing that is probably slightly easier is to estimate the benefit of generating new jobs, new private investments, and, associated with that, enhanced tax revenue. Those benefits, for example, can go along with the professional development of mobile apps that use some newly available open government data (von

Figure 6. Payback period of E-Government projects according to Heeks (2005, p.209)



Lucke & Geiger, 2010). According to an article in a German broadsheet newspaper, the publication of open government data has a multi-billion Euro commercial value (Süddeutsche Zeitung, 17/11/2012).

A problem concerning the profitability of E-Government initiatives, that Heeks (2005) came across in his investigations, is that some implemented services are hardly used by citizens. He mentions an example were only 2% of the target citizens made use of an online E-Government service. Another service, he mentions, was ready to use for 2 years, but not a single citizen utilized the investment (Heeks, 2005, p.253). The author traces the failure of these services back to a lack in proper announcement and appropriate marketing. Thus, his advice for future projects is to inform citizens more about the advantages of newly available service, like shorter processing time, or new possibilities, traditional services did not even offer.

CONCLUSION

With this chapter we provided a basic overview about the general and technical aspects of E-Government. It aimed to wrap-up the major past activities concerning the E-Government domain in research and development, and identify the most relevant aspects that should be taken into account in new project and initiatives. Therefore we introduced the fundamental terms and definitions like E-Government, E-Administration, and E-Democracy first. To make it easier to understand the major aspects behind the broad ideas were described and we provided some real-life examples. We investigate efforts on defining the characteristics of e-Participation. Here we found out that it is important to have access to a wide variety of information to participate in politics, and that there are two general ideas of how to participate. As E-Government affects different kinds of stakeholders, we introduced the positions of the public sector, the citizens and enterprises and illustrated the main advantages and concerns for each group of stakeholders. We also explained that different parts of E-Government are very specific to certain stakeholders, for example, E-Participation is more likely citizen-centric.

In the second part of this chapter we took a closer look at actual E-Government initiatives and implementations. As online data platforms play a major role in information provision, we introduced the theory behind open government data to improve transparency as well as some concrete suggestions on how to publish public data. With data.gov.uk and data.gov, we presented two platforms that already provide open data, held by government agencies. We also gave some examples of data that is publicly available at these platforms. Along with these open government data services, there is currently a huge amount of E-Administration and E-Participation services running. We listed some interesting projects to show the variety of different approaches pursued. In the field of E-Government there also exists a couple of researches promoted and funded by governments, as well as transnational and international organizations. We also mentioned some current research projects and initiatives to encourage E-Government research.

Afterwards, we considered several challenges that arise when thinking of the implementation of E-Government services. We took a closer look at ways to guarantee private data security and possible problems with the equality of citizens in an E-Government world. We also investigated in this section, what the cost effectiveness of E-Government research and implementation is.

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KEY TERMS AND DEFINITIONS

E-Government: E-Government is the modernized form of Government, but under consideration of Information and Communication Technologies (ICT).

E-Participation: E-Participation is the modernized form of Participation, with the goal of engaging citizens in policy making. Through the use of ICT it is aimed to allow citizens to influence the political agenda by their options. In contrast to the traditional form, by the use if ICT it is easier to organize in groups and to realize e.g. petitions.

Information and Communication Technologies (ICT): Under Information and Communication Technology technologies for information provision, sharing, using and visualizations are summarized. A major benefit lays in the exchange of data for the use with other technologies and therefore the use in a number of different use cases.

Open Data: Open Data is a term that is commonly used for statistical data that are provided by governments and can be almost used for free. These Open Data (sometimes also mentioned as Open Government Data) consisting a number of indicator data about a country or a region. Such data are often provided and mentioned in relation to initiatives for a better transparency.

Policy Modeling: The term policy modeling deals with the making of (political) policies, which can result in the creation of new laws. Policy modeling covers all necessary steps beginning at the identification of a problem, analysis, decision making, implementation, end evaluation of a policy.

Policy: Under the policy a theoretical or practical instrument can be understood that aims to solve a specific problem. In the political domain, a policy can represent a new law.

ENDNOTES

1 The e-Petition platform allows Germany citizens to set a topic on the political discussion agenda and allows to discuss it with other citizens: https://epetitionen.bundestag.de (last accessed: 29/10/2013).

2 The full text of the government act can read at: http://www.gpo.gov/fdsys/pkg/PLAW-107publ347/pdf/PLAW-107publ347.pdf (last accessed: 29/10/2013).

3 A good overview about existing open data portals for different countries is available on: http://www.data.gov/opendatasites (last accessed: 29/10/2013).

4 Documents about the rankings are available at: http://unpan3.un.org/egovkb/global_reports/index.htm (last accessed: 29/10/2013).

Chapter 2
The Development of Open Government Data in Austria

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ABSTRACT

Open Government Data has become an integral part for European governments at all federal levels. However, varying jurisdictions and government structures have also contributed to different operational models. The UK is pursuing a more central approach, expressing political will through its prime minister and with the ODI providing the technical and organisational framework. Austria is a much more federated country, yet also on the edge of OGD. This chapter presents the inception of OGD in Austria, the informal approach of OGD consensus finding, OGD specifications, organisational setting, and harmonisation approaches in the DACH and pan-European region.

INTRODUCTION

The concept of Open Government Data (OGD) in Austria has its origins in the digital administration of federal law in Austria (Rechtsinformations-system, RIS). This system became one of the first large-scale ICT projects in administration providing complete, unabridged information for everybody. The origins of the RIS go back to 1973. At this time information technology (IT) was exclusively used as a tool to help the governmental system to deal with its paperwork, but since then much has changed. Administering data without technical support is nowadays inconceivable. Nowadays "RIS is an excellent open-access official government website managed by the Austrian Federal Chancellery that provides comprehensive access not only to national laws, but also to European community law, and the judicature of high courts, commissions and tribunals" ("IALL 2013 Website Award Winner," 2013). As of 2004, basic project information has been online and since

DOI: 10.4018/978-1-4666-6236-0.ch002

April 2012 all the legal information has been universally accessible as OGD. A year after RIS was released as OGD, five software applications were implemented based on information obtained from the database. Today, Austria's OGD portal www.data.gv.at presents among more than 1,400 data sets. However, raw data is only useful for a tiny fraction of the society: it's the reusable information which can be intelligently combined and presented using electronic devices (Open Knowledge Foundation, 2012).

Before delving into the history of OGD in Austria and processes in place, it is important to distinguish between data and metadata portals. The primary function of a data portal is storing data and administering the corresponding metadata. Data portals can evaluate the contents of data and are able to link them to specific matters. The main task of metadata portals is to provide a service to interconnect these individual data portals (Braunschweig, Eberius, Thiele, & Lehner, 2012, sec. 4.1) . The uniform description of data at every data portal supports the creation of a central administration portal.

CONCEPT OF OPEN GOVERNMENT DATA

Open Data permits third party to use someone's data freely. When this service is provided by the government or the bureaucratic system, it is called Open Government Data. OGD is non-personal information which might be used to leverage public welfare, to tackle large-scale societal challenges or for personal economic interests. The goal of this process is to conceive the government as a platform of useable information for its citizens (Lucke, von & Geiger, 2010).

The goal of Open Government Data is to strengthen democracy and to increase the efficiency and effectiveness of different types of administrative processes (Office of the President of the United States, 2012). In this respect, the level of participation is important. Participation means incorporating people's interests and respective knowledge in the bureaucratic process. All of these means – from open information to the actual vote – should simplify complex matters, so that a vast majority of citizens are able to understand and follow the decision making process (Janssen, Charalabidis, & Zuiderwijk, 2012). Decisions based on Open Data should yield better results and should be better understood by the people who are affected by these decisions.

COOPERATION OGD AUSTRIA

The federal co-operation on E-Government issues in Austria has a long history and goes beyond legal obligations between the state, provinces, cities and municipalities. The platform "Digital Austria" (http://www.digitales.oesterreich.gv.at/) was specifically created to coordinate the cooperation of E-Government affairs between these administrative entities. This formal structure was successful in working out specifications in the area of E-Government. However, when incepting the OGD process in Austria, concerns about the relatively inflexible structure of the E-Government processes resulting from a hierarchical system were raised. Open Government initiatives are often bottom-up and difficulties are solved in a cooperative working process, sometimes lacking political legitimation (Teorell, 2006, p. 789).

On July 13th 2011 the Austrian Chancellery and the cities Vienna, Linz, Salzburg, and Graz established the open-ended "Cooperation OGD Austria". Involved in the process were the "Open Knowledge Forum Austria (OKFN-AT)", a precursor to the Open Knowledge Foundation Chapter Austria, "Danube-University Krems" (Center of E-Governance) and the "open3.at" association.

The cooperation OGD Austria represents the federal, regional, urban and municipality interests of Open Government Data in Austria. Initially, the Austrian Chancellery nominated a spokesman of that cooperation, a role which was handed over to the City of Vienna by the end of 2013. The Cooperation OGD Austria is also keeping ties to the “Kompetenzzentrum Internetgesellschaft” (KIG, a think tank of ministries’ to shape the digital future of Austria by administrative measures) and the aforementioned platform “Digital Austria”. The partnership is based on voluntary participation and mutual independence.

Very early in the process the Cooperation OGD incorporated knowledge from different disciplines to shape processes, specifications and recommendations for open government data in Austria. The interdisciplinary collaboration consisted of administration, computer science, and jurisprudence. One of the first major points on the agenda was to formulate common metadata standards. Due to the fact that some projects were already in progress, this particular issue needed to be resolved very quickly. The following topics were deemed urgent: legal questions with regard to licensing (user rights), description of the datasets (metadata), process models for publishing open government data and Content Cooperation (Integration of metadata and data of other portals). The solution consisted in forming different groups for each issue, with each reporting their findings to the Cooperation OGD. The result was a White Paper, which was published on the E-Government Reference Server (http://reference.e-government.gv.at/Veroeffentlichte-Informationen.2774.0.html).

OGD STANDARDS IN AUSTRIA

Three fields of action were identified by the cooperation: technical aspects, organisation and law. These areas will be illustrated in the next three sections of the paper.

Technical Standard: Metadata, URI and Co.

The main target was to work out a structure which could frame all government data and respective services. All local portals should utilize the same Metadata description fields to describe their OGD assets. This also has positive effects for individuals who search for specific information, as they don’t have to look through diverse descriptions. The second benefit is that this facilitates the creation of a centrally organized portal that can be used to reach different local information. To make the searching process easier, partners agreed to fill in eleven obligatory keywords, accompanied by 20 optional fields for better clarification.

In addition to the metadata, another goal was to agree on a categorisation of 14 different administrative fields of action which were in accordance with the “Bund-Länder-Städte-Gemeinden (BLSG)”-Convention and were tuned to existing Open Data portals from Vienna, Linz, Berlin, and London. A univocal agreement wasn’t possible, which made this categorisation optional as well.

The third and final technical issue was to identify the different types of data records. An URL- (Uniform Resource Locator) Schema has been chosen as a best practice. While URI gives providers a better option to link data to different local platforms and makes it easier to define special categories (education, health etc.), this task has been postponed to a linked data sub working group and is still ongoing. As a unique identifier the Austrian system uses GUIDs (Globally Unique Identifiers), which are merely decipherable electronically and are created by the software itself. This guarantees a worldwide uniqueness and prevents issues of changing data ownership (Hyland, Atemezing, & Villazón-Terrazas, n.d., Chapter 5) as might be the case after elections and restructured administrative entities due to shifts of power.

The agreed URL-Schema can refer to the specific data resource from a data portal. To keep it simple, all partners agreed on the following general way of naming data records:

data.name.gv.at/catalog/category/name-of-data-record

All existing OGD projects in Austria use the agreed metadata scheme as well as the URL scheme.

Legal Standards: Licensing

The issue of licensing and the legal conditions of use are a key part of Open Government Data. Legal frameworks regulate the obligations of the providing organisation (administration) and indicate legal security for the users (eg developers). This is necessary in order to develop sustainable solutions. Legal frameworks also regulate the users rights and obligations (what they are allowed to do with the data and according to which obligations) as well as administrations liability. These questions are inseparably connected with a fee model. One dominant argument is to provide data for free, as people have already paid for the creation of data with their taxes (Joel, 2013) whereas another argument would support to charge users for data they intend to work with (Rob, 2013). This viewpoint comes out of the "New Public Management"-approach where the government system wants to increase income by selling information to companies. Another approach can be derived from the "Public Sector Information (PSI)"-Guideline (2003/98/EC) of the European Commission, which attributes a high value to this information and data and also encourages the resale of data by the State.

The Cooperation OGD decided to provide both open access to the portal and free of charge data re-use. The reasons were not purely idealistic, but should help to enable OGD projects to be decoupled from the PSI way of thinking and associated guidelines.

The chosen licensing model for Austria was the already existing and well know Creative Commons Attribution (CC-BY) license. Instead of creating a new license as Great Britain, Norway or Germany did - it was decided to use an already established model, also to encourage international usage. By using one sole license it is also possible to eliminate legal grey areas which would arouse when mashing data of different license and guarantee all developers the same user rights. The Creative Commons license umbrella has many similar licenses, but the Cooperation OGD agreed on the toll-free use of data under the premise that the responsible publisher must get quoted (CC-BY). In the future more than one license might be accepted for OGD Austria, however a change to that policy is likely to happen together with the PSI guidelines, "The Act on the Re-use of Information" (German: Informationsweiterverwendungsesetz IWG). A future PSI regulation could establish Freemium - certain pieces of information are free - and Premium fee models that already exist in Europe.

ORGANIZATIONAL RECOMMENDATIONS

As the issue of interfering with the organisational autonomy is conspicuous, this chapter considers only recommended aspects on how to organise the institutional portals. The most used Open Government Data Software is CKAN. The European Commission and Great Britain organise their federal OGD-portal using CKAN, which shows that it is an proven tool for this purpose. Because of these characteristics the Cooperation OGD also suggests using the CKAN software. The second concern is data assessment. For the assessment and monitoring of the increasing data resources a criteria catalogue was developed by the KDZ, the Centre for Administration Research. This catalogue is recommending an organisational setup, responsible roles and an assessment model according to which the publication of data can be prioritized (Krabina, Prorok, & Lutz, 2012).

THE AUSTRIAN METADATA PORTAL

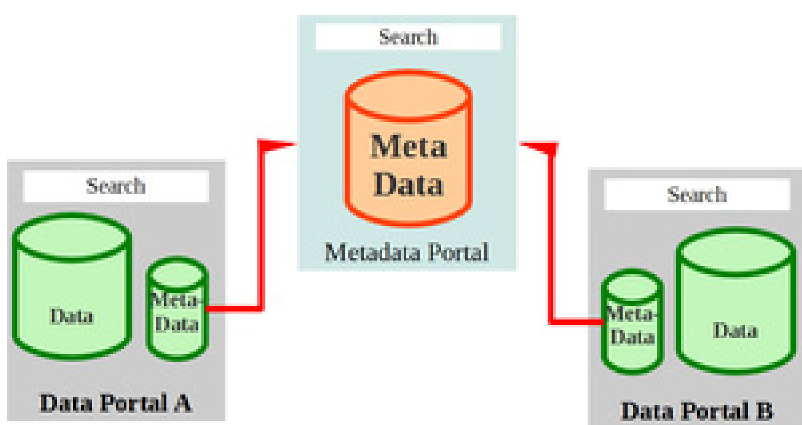
At the inception of OGD most of the portals were metadata portals. Metadata portals are portals which keep metadata about data, with the actual data located on a different (physical) location. Search facilities on the metadata portal guide users to concrete URLs where the data is available. With this kind of data organisation it becomes possible to distinguish between the operators of data and metadata portals. The founding document of the Cooperation OGD Austria declared it important to create a Single Point of Contact between the (at that time expected) European metadata portal and the national OGD portals which should be based on CKAN. The Austrian Chancellery is responsible for this task and ultimately led to the creation of “data.gv.at”.

Since April 2012, all Austrian government institutions are able to link their specific data portal to data.gv.at. This metadata portal is the key point to all Austrian open data resources.

This way of connecting resources created a few disadvantages. As mentioned earlier, data.gv.at is based on CKAN and funding was acquired by the Austrian Chancellery and the Ministry of Finance. Often smaller regions or even municipalities do not have the financial or administrative resources to work with CKAN and are at risk of being left out. This caused a considerable amount of work for the data.gv.at-providers, because it was necessary to convey these data sets directly to the Austrian Chancellery, whose staff had to then put it manually into the metadata portal. The solution was to modify the portal in a way that makes it possible for every government unit to upload its data directly on data.gv.at in a secure and authorized manner without using its own CKAN-based data portal. The final result of this process is a hybrid portal model with data and metadata portal features.

There are still some challenges the providers are facing - for instance the issue of financial stability. Initially a cost model was drafted, based on the numbers of the provided data resources which

Figure 1. Conceptual model of an OGD metadata portal, federating local data portals



was not practicable. A compatible charging system which is common in the field of Cloud Computing might be a proper option to solve this kind of problem. Instead of punishing administrative units for being an active part of data.gv.at by requiring a contribution for each data record - which doesn´t honour the active - it is the prevalent opinion to conceive Open Government Data as a basic digital infrastructure. This would result in base financing using flat rates.

METADATA STANDARDS IN THE DACH REGION

The different Open Data Projects in Germany, Austria, and Switzerland (D-A-CH-Region) are showing high potential, especially in those areas where new published data records can be compared and connect to existing data records. To make these connections available, it is important to find similar data sets and to make them compatible. Germany, Austria, Switzerland, and Liechtenstein realised this need, created the special interest group OGD DACHLI and also agreed on a closer cooperation when it came to metadata standardisation.

It was mentioned, that the structure of the Austrian metadata portal consists of eleven obligatory key fields and 20 optional fields for better clarification. The mandatory fields are defined as:

- A numerical ID encoded as a GUID,
- An identifier, which is held in German and readable by people,
- A OGD-Nickname,
- A mapping to the particular CKAN Field,
- Cardinality,
- A definition and explanation of the data record,
- A reference to the INSPIRE standards (ON A 2270:2010),
- A reference to the ISO metadata field 19115 (ON/EN/ISO 19115:2003),
- A RDF vocabulary reference,
- An English definition of the record,
- 14 pre-defined categories, for a better clarification of the record.

These mandatory fields have been designed in regard to the parallel evolving European specification, which was released as DCAT-AP and has become a W3C technical recommendation. Today, the Austrian metadata scheme to describe OGD is a DCAT-AP profile. Metadata describing data on the Austrian metadata portal data.gv.at can thus be semantically exchanged with the forthcoming EU institutions data portal https://open-data.europa.eu which will use DCAT-AP.

The German data portal consists of 15 obligatory key fields and 35 optional fields (cf. http://htmlpreview.github.io/?https://github.com/fraunhoferfokus/ogd-metadata/blob/master/OGPD_JSON_Schema.html). Most of these mandatory fields are semantically identical to the Austrian key fields. Unlike using just one licence (CC-BY) as is the case in Austria, Germany supports 35 licences and allows providing entities to charge for data provision. Another sematic issue are the different areas of administrative work. For instance the Austrian national government is responsible for the educational system while in Germany it is the duty of the regional governments. This makes it hard to easily define a semantically comparable metadata standard and makes it clear that sustainable, comparable OGD requires the adoption of semantic technologies.

CONCLUSION

Although a legal framework is missing, Open Government Data has become an integral part of the Austrian administration. The next target is to find better ways to interconnect the portals of Germany, Switzerland, and Austria. Currently this effort is concentrating on harmonizing the metadata standards used by the different countries. Another methodology of expected high potential is Linked Data, which involves presenting sets of data with their interrelations in a computer comprehensible manner. In the future it will be possible to generate new information and data records simply using the connection between existing data records. This would also strengthen the possible exchange of data between the EU Member States and will have a positive effect on the European Administrative System.

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KEY TERMS AND DEFINITIONS

CKAN: The Comprehensive Knowledge Archive Netwok, worlds leading software for the world's leading open-source data portal platform.

DACH: The region comprising Germany, Austria and Switzerland, often extended by Liechtenstein, then abbreviated as DACHLI.

GUID: An identifier, usually generated by an IT system using different heuristics to guarantee a very high level of uniqueness.

Hybrid Data Portal: An open government data portal hosting both metadata and data sets which do not necessarily belong to the organisation hosting the portal.

Metadata Portal: A web site providing access to data which is stored on IT appliances of another premise.

Open Government Data: Data provided by the government to be freely used and re-used.

URI: An identifier suitable to point at concrete as well as electronic things, preferably resolvable using a web browser.

Chapter 3
Semantic Web Standards for Publishing and Integrating Open Data

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ABSTRACT

The World Wide Web Consortium (W3C) as the main standardization body for Web standards has set a particular focus on publishing and integrating Open Data. In this chapter, the authors explain various standards from the W3C's Semantic Web activity and the—potential—role they play in the context of Open Data: RDF, as a standard data format for publishing and consuming structured information on the Web; the Linked Data principles for interlinking RDF data published across the Web and leveraging a Web of Data; RDFS and OWL to describe vocabularies used in RDF and for describing mappings between such vocabularies. The authors conclude with a review of current deployments of these standards on the Web, particularly within public Open Data initiatives, and discuss potential risks and challenges.

INTRODUCTION

The Semantic Web was founded as an activity of the World Wide Web Consortium (W3C) and comprises a list of standards for leveraging the publication and consumption of structured data on the Web, with the ultimate goal of enabling machines to "understand" Web content, previously only understandable by humans. This list of standards is building up technology "stack", that consists of a lightweight interchangeable data model interchange format (RDF), alongside with publishing principles, that enable reusability and combinability of RDF datasets by exploiting basic Web principles of interlinking and dereferenceability and, last but not least, schema languages to describe such published and interlinked data (RDF Schema and OWL), as well as a standard query language for accessing and collecting RDF data (SPARQL). In the following, we will briefly

DOI: 10.4018/978-1-4666-6236-0.ch003

introduce those standards based on a running example revolving around data indicators for cities, which may well be part of data produced by emerging Open Data efforts within communities.

BACKGROUND: SEMANTIC WEB STANDARDS AND OPEN DATA

RDF

The *Resource Description Framework* (RDF) is the basic data model for the Semantic Web. It is built upon one of the simplest structures for representing data: a directed labelled graph. An RDF graph is described by a set of triples of the form <*Subject Predicate Object*>, also called *statements*, which may be viewed as connecting subjects to objects via edges labelled by the predicates. Since any of these can be - dereferenceable - URIs, these edges may be equally viewed as "typed" links between resources and other resources, where resources - unlike in the HTML Web, are no longer restricted to be documents, but arbitrary entities, that can be identified by URIs.

RDF's flat graph-like representation has the advantage of abstracting away from the data schema, and thus promises to allow for easier integration than customized XML data in different XML dialects: whereas the integration of different XML languages requires the transformation between different tree structures using transformation languages such as XSLT (Kay, 2007) or XQuery (Chamberlin et al., 2007), different RDF graphs can simply be stored and queried alongside, and as soon as they share common URIs, form a joint graph upon a simple merge operation accumulating their respective triples in one joint graph. While the normative syntax to exchange RDF, RDF/XML (Beckett and McBride, 2004), is an XML dialect itself, there are various other serialization formats for RDF, such as RDFa (Adida et al., 2008), a format that allows one to embed RDF within (X) HTML, or non-XML representations such as the more readable Turtle (Beckett and Berners-Lee, 2008) syntax; likewise RDF stores, that is, special databases for RDF, normally use their own, proprietary internal representations of triples, that do not relate to XML. Various RDF stores that can store and handle RDF data efficiently and at large scale are nowadays available off-the-shelf, both commercial systems and academic ones, such as YARS2 (Harth et al., 2007), Jena TDB (http://jena.apache.org/documentation/tdb/), OpenLink Virtuoso (http://virtuoso.openlinksw.com/), 4Store (http://4store.org), AllegroGraph (http://www.franz.com/agraph/allegrograph/), or Sesame (http://www.openrdf.org/) to name a few. For an overview of RDF Stores, see also (Haslhofer et al., 2011); a recent article also discusses the use of NoSQL graph databases to store and process RDF (Cudré-Mauroux et al., 2013).

RDF Example

A sample RDF graph consisting of Triples in Turtle syntax that contains information about the city of Vienna stored at DBpedia (Bizer et al., 2009b) - an RDF extract of structured Open Data published in Wikipedia – is shown in Box 1.

This RDF graph consists of four triples, separated by ".", where the latter three using the Turtle syntax shortcut ";" for grouping together predicate-object pairs of the same subject. Resource URIs are abbreviated using *namespace prefixes*, such as rdf:,:, or dpo:; that is, e.g. the abbreviated URI:Vienna corresponds to http://dbpedia.org/resource/Vienna, or, respectively, the predicate URI dpo:country corresponds to http://dbpedia.org/ontology/country, etc. Particularly, the rdf:type predicate plays a special distinct role, in that it allows to model is-a relationships, i.e., class membership; as we will see later, RDF&OWL will enable to define hierarchies of such classes. As the example shows, RDF triples cannot link resources (represented by URIs to other resources, but also model ordinary predicate-value pairs, by allowing datatyped values in the object position.

Box 1.

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix: <http://dbpedia.org/resource/> .
@prefix dpo: <http://dbpedia.org/ontology/> .
:Austria rdf:type dpo:Country.
:Vienna dpo:country:Austria;
dpo:populationTotal "1731236"^^xsd:integer;
dpo:populationDensity "4002.2"^^xsd:double.
```

Anonymous nodes in RDF graph, so called-blank nodes, allow one to also model incomplete information. In Turtle syntax, these are modeled by square brackets or identifying blank nodes by labels of the form _:var akin to existential variables in first-order logic. The following triples use this convention to model the incomplete information that there is *some* city in Austria with a population of 1731236 (without identifying this city).

```
:Austria rdf:type dpo:Country.
_:x dpo:country:Austria;
dpo:populationTotal
"1731236"^^xsd:integer;
dpo:populationDensity
"4002.2"^^xsd:double.
```

Obviously, the latter RDF graph in Example 1 does represent less concrete information than the former. In this context, it should be noted, that while blank nodes add to the flexibility of RDF as a data model, they also increase its complexity: in the general case, deciding whether two RDF graphs containing blank nodes represent the same information is intractable (Hayes, 2004, Mallea et al., 2011), but that this problem does not occur in most practical applications or datasets (Mallea et al., 2011).

RDFS and OWL

As mentioned above, although RDF itself is essentially schema-less, additional standards such as RDF Schema (RDFS) and the Web Ontology Language (OWL) facilitate formal descriptions of the relations between the terms used in an RDF graph: i.e., the predicates in an RDF triple which form edges in an RDF graph (properties) and types of resources in an RDF graph (classes). Formal descriptions of these properties and classes can be understood as logical theories, also called ontologies, which allow systems to infer new connections in an RDF graph, or link otherwise unconnected RDF graphs. Standard languages to describe ontologies on the Web are

- **RDF Schema (Brickley et al., 2004):** A lightweight ontology language that allows one to describe essentially simple class hierarchies, as well as the domains and ranges of properties; and
- **Web Ontology Language (OWL) (Smith et al., 2004):** Which was first published in 2004 and recently has been extended with additional useful features in the OWL2 (Hitzler et al., 2009) standard.

Both RDFS and OWL themselves can be syntactically embedded into RDF, that is, axioms are represented by RDF triples using the rdf:, rdfs: and owl: vocabularies; that is, URIs in the respective namespaces belonging to these prefixes, cf. the next section for an example, carry a special semantics, as described in the RDF Schema (Brickley et al., 2004) and OWL2 (Smith et al., 2004) W3C specifications, which allows to infer

Box 2.

```
@pmmrefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>.
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>.
@prefix owl: <http://www.w3.org/2002/07/owl#>.
@prefix dbo: <http://dbpedia.org/ontology/> .
@prefix geo: <http://www.geonames.org/ontology"> .
@prefix schema: <http://schema.org/> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
```

```
dbo:country rdfs:range dbo:Country .
```

$$\exists country^{-} \sqsubseteq Country$$

```
dbo:populationTotal rdfs:domain dbo:PopulatedPlace;
```

$$\exists populationTotal \sqsubseteq PopulatedPlace$$

```
rdfs:range xsd:nonNegativeInteger;
```

$$\exists populationTotal^{-} \sqsubseteq \mathbb{N}^{+}$$

```
rdf:type owl:FunctionalProperty .
```

$$> 1 populationTotal \sqsubseteq \bot$$

```
dbo:PopulatedPlace rdfs:subClassOf dbo:Place .
```

$$populatedPlace \sqsubseteq Place$$

```
dbo:country rdfs:subPropertyOf geo:locatedIn .
```

$$country \sqsubseteq geo : locatedIn$$

```
dbo:Place rdfs:subClassOf geo:Feature ;
```

$$Place \sqsubseteq geo : Feature$$

```
owl:equivalentClass schema:Place .
```

$$Place \equiv schema : Place$$

additional information from RDF graphs. OWL2 offers richer means than RDF Schema to define formal relations between classes and properties, such as intersection and union of classes, value restrictions or cardinality restrictions.

RDFS and OWL Example

The example in Box 2 shows a sample of various axioms expressible in RDFS and OWL describing the dbo: RDF vocabulary used within DBpedia and relating it to other vocabularies, such as Geonames (geo:) and schema.org (schema:).

As the example shows, the RDF triples using the rdfs: and owl: vocabularies semantically correspond to axioms in Description Logics (Baader et al., 2002). This correspondence allows using logical inference engines such as DL reasoners or rule engines to infer additional triples, such as - in the concrete example - the following:

```
:Vienna rdf:type dbo:PopulatedPlace .
:Vienna rdf:type dbo:Place .
:Vienna rdf:type schema:Place .
:Vienna rdf:type geo:Feature .
:Vienna geo:locatedIn:Austria .
```

Another thing that logical inference using reasoning engines enables is the detection of inconsistencies. For instance, in our concrete example, an additional triple

```
:Vienna dbo:populationTotal -1 .
```

SPARQL

Finally, a crucial puzzle piece which pushed the recent wide uptake of Semantic Web technologies at large was the availability of a standard query language for RDF, namely SPARQL (Prud´hommeaux and Seaborne, 2008), which plays the same role for the Semantic Web as SQL does for relational data. SPARQL's syntax is roughly inspired by Turtle (Beckett and Berners-Lee, 2008) and SQL (SQL-99, 1999), providing basic means to query RDF such as unions of conjunctive queries, value filtering, optional query parts, as well as slicing and sorting results. SPARQL's first version (Prud´hommeaux and Seaborne, 2008) was standardized in 2008, where the recently published SPARQL 1.1 (Harris and Seaborne, 2013) standards extended the original SPARQL language by commonly requested features such as aggregates, sub-queries, negation, and path expressions. Furthermore, SPARQL 1.1 provides means to query RDF data with additional considerations of triples entailed under RDFS and OWL (Glimm et al., 2013).

For the aggregation of Linked Data from various sources, SPARQL has become a particularly important factor, in so far that many open data providers serve their data directly as a SPARQL end- point (Williams, 2013), which enables federated queries over such end- points (Prud´hommeaux and Buil-Aranda, 2013,Buil-Aranda et al., 2013). One should note though that due to various factors the possibilities to combine SPARQL endpoints seamlessly are still limited, be it because of endpoint stability or workloads that these endpoints can handle (Paulheim and Hertling, 2013).

The following example illustrates a simple SPARQL queries and some of the challenges involved in querying Linked Data.

SPARQL Example

Does Berlin or Vienna have the higher population density?

Let us consider the data from DBpedia about Vienna from Example 1 alongside the following information for Berlin, also from DBpedia.

```
:Berlin dpo:country:Germany;
dpo:populationTotal
"3538652"^^xsd:integer;
dpo:areaTotal "891.85"^^xsd:double.
```

A simple SPARQL query for cities above 1M inhabitants cities ordering the results by their population sizes in SPARQL would look as follows:

However, due to the heterogeneity in RDF data, and also due to incomplete information, there are many queries that cannot be answered in such a straightforward manner. For instance, the following SPARQL query asks for both population densities of Berlin and Vienna in order to compare them.

Unfortunately this second query would not return any results, since there isn't any population density information for Berlin.

Query 1.

```
SELECT ?City ?Population
WHERE { ?City:populationTotal ?Population
FILTER (?Population > 1000000) }
ORDER BY (?Population)
```

Query 2.

```
SELECT ?DB ?DV
WHERE {:Berlin:populationDensity ?DB .
:Vienna:populationDensity ?DV .}
```

We note that the second query exhibits a kind of heterogeneity that cannot be simply resolved by OWL and RDFS inference, since it needs arithmetic calculations to compute the population density by area and population information; we refer the interested reader again to (Polleres et al., 2013) for a more in-depth discussion of such challenges and extensions of OWL and RDFS to address such cases.

MAIN FOCUS: LINKED DATA

Publishing RDF as Linked Data

In the context of publishing and using RDF, the W3C defined a handful of best practices, attributed to Tim Berners-Lee, which are commonly summarized in and referred to as the four Linked Data Principles (Berners-Lee, 2006):

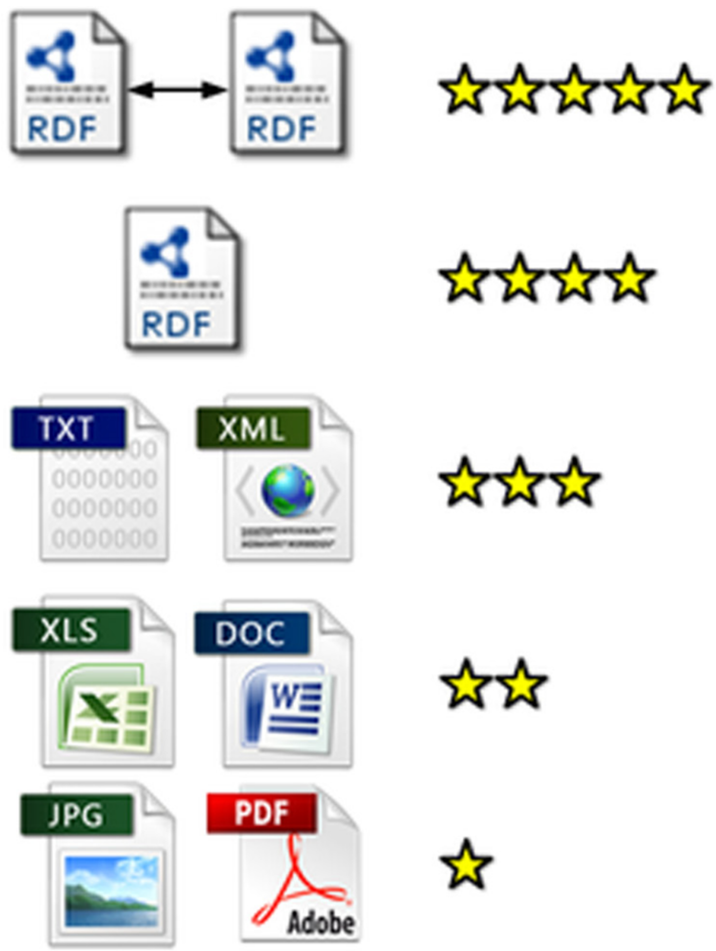
- (**LDP1**)**:** Use URIs as names for things;
- (**LDP2**)**:** Use HTTP URIs so those names can be dereferenced;
- (**LDP3**)**:** Return useful - herein we assume RDF - information upon dereferencing of those URIs;
- (**LDP4**)**:** Include links using externally dereferenceable URIs. That is, within your published RDF graph, use HTTP URIs pointing to other dereferenceable documents, that possibly contain further RDF graphs.

The idea behind these principles is that RDF datasets should use URIs that can be looked up, where a lookup in the form of an HTTP is assumed to return RDF data about the URI, plus the dereferences RDF data should contain links to other RDF data. Thus, these principles may be viewed as enabling a Web of Data, enabling the above-mentioned vision of RDF being just "typed links", where not only the subject and object, but also the predicate can again be looked up to find more information. Here, the accompanying RDFS&OWL (Brickley et al., 2004,Smith et al., 2004) standards enable the description and linkage of schema information, i.e., describing properties and classes, in a loosely coupled manner, within RDF itself.

Open Data published according to these Linked Data principles is often referred to as Linked Open Data (Bizer et al., 2009a,Heath and Bizer, 2011). Linked Open Data has been a considerable factor for the recent uptake of RDF on the Web, documented in the Linked Open Data cloud, a collection of 295 linked publicly available datasets, comprising over 31 billion RDF triples. While the LOD cloud was not updated since 2011, it is based on - http://datahub.io/group/lodcloud - which listed 337 LOD datasets at the time of writing. The effort to collect all open datasets in such a central repository seems though to have been discontinued due to increased maintenance effort by the rapid growth of available datasets.

Apart from the basic Linked Data principles, in 2010 Tim Berners-Lee proposed a 5-star rating system - illustrated in Figure 1 - for classifying the openness of data published particularly by government data owners (http://www.w3.org/DesignIssues/LinkedData.html). In order to obtain any star at all, the dataset must be published under an open license (e.g. Creative Commons CC-BY). Different Open Data licenses (along with an at-

Figure 1. 5 star deployment scheme for Open Data proposed by Berners-Lee



tempt to formalize their compatibility) are for instance discussed in (Governatori et al., 2013).

In brief, the 5-star rating system for open data assesses the following criteria (cf. Figure 1):

- **(1 Star):** Available on the Web (whatever format) but with an open license, to be Open Data.
- **(2 Star):** Available as machine-readable structured data (e.g. excel instead of image scan of a table).
- **(3 Star):** Providing machine-readable structured data in a non-proprietary format (e.g. CSV instead of excel).
- **(4 Star):** All the above plus, use open standards from W3C (RDF and SPARQL) to identify things, so that people can point at your stuff.
- **(5 Star):** All the above, plus: Link your data to other peoples data to provide context.

SOLUTION: LINKED OPEN DATA STANDARDS AND WORKING GROUPS

While the base W3C Semantic Web standards discussed so far enable the publication, linkage and processing (in terms of querying and reasoning) of open data in a coherent manner, they do not address all challenges in the context of open data publishing and consumption. In this section we discuss various additional initiatives and working groups that complement the base standards towards an open data interchange ecosystem.

Provenance (PROV)

In order to handle the unique challenges of diverse and unverified RDF data spread over RDF datasets published at different URIs by different owners across the Web, the inclusion of a notion of provenance, i.e., the consideration of the source of RDF data found on the Web, is necessary. The W3C PROV Working Group (Gil and Miles, 2013,Moreau and Groth, 2013), which recently completed its work, was chartered to address these issues and developed an RDF vocabulary to enable annotation of datasets with interchangeable provenance information.

The next section illustrates the enrichment of RDF data, retrieved from DBpedia with fictitious provenance information; unfortunately, while it might partially be auditable through Wikipedia's contributors' history, no such provenance information is contained in the information extracted by DBpedia.

Provenance Example

Is the retrieved information reliable?

The following RDF statements (Box 3) add provenance information to a specific resource using the W3C PROV vocabulary.

As the example shows, the PROV vocabulary allows to annotate the specific context and origin in which an information item was created, as well as further tracing back the reuse and aggregation of information coming from sources with different provenance. We note here, that such contextual information cannot be trivially traced along with e.g. SPARQL queries and RDFS/OWL reasoning. For some early attempt to embed contextual information within RDFS/OWL reasoning and SPARQL querying published by one of the authors of this present chapter, we refer the interested reader to (Zimmermann et al., 2012).

Vocabulary of Interlinked Datasets (VoID)

The Vocabulary of Interlinked Datasets (VoID) is an RDF Schema vocabulary published as a note by the W3C Semantic Web Interest Group, used to describe metadata about linked datasets (Alexander and Hausenblas, 2009). With VoID, publishers and users of RDF datasets can use linked datasets in a more effective and efficient way, since VoID offers the possibility to use different terms and patterns for describing RDF datasets, that can be used for discovery, but also query processing. An example of VoID metadata description is shown in the next section.

Vocabulary of Interlinked Datasets Example

The following RDF data (Box 4) shows how to use VoID to describe linking information between the DBpedia and GeoNames datasets.

In this example, a new void:Linkset is defined, which represents the fact that the two void:Datasets:DBpedia and:Geonames are linked through the owl:sameAs predicate. Other information that can be described in VoID includes dataset statistics, such as structural metadata (statistics about the size of the dataset, URI patterns for resources used in the dataset, links to data dumps or SPARQL endpoints that host the dataset, etc.

Government Linked Data (GLD)

W3C's Government Linked Data Working Group (Hyland and Beeman, 2013), started in 2011, aims at providing standards to help governments,

Box 3.

```
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
@prefix prov: <http://www.w3.org/ns/prov#> .
@prefix dbpedia: <http://dbpedia.org/resources/> .
@prefix dbprop: <http://dbpedia.org/ontology/> .
@prefix: <http://example.org#> .
dbpedia:Vienna a prov:Entity;
dbprop:populationTotal "1731236"^^xsd:integer;
dbprop:areaTotal "414650000"^^xsd:double;
...
prov:wasGeneratedBy:measureActivity;
prov:wasAttributedTo:Alice.
:Alice a foaf:Person, prov:Agent;
foaf:givenName "Alice";
foaf:mbox <mailto:alice@example.org>;
prov:actedOnBehalfOf:government.
:government a foaf:Organization, prov:Agent;
foaf:name "Austrian Government".
:measureActivity a prov:Activity;
prov:startedAtTime "2012-01-01T01:01:01Z"^^xsd:dateTime;
prov:wasAssociatedWith:Alice;
prov:used:countryData;
prov:endedAtTime "2012-02-02T02:02:02Z"^^xsd:dateTime.
:countryData a prov:Entity;
prov:wasAttributedTo:government.
```

governmental agencies and public bodies in publishing their Open Data by using Semantic Web technologies, following the Linked Data principles. The group has published a number of additional complementary standards and documents, some of which we will describe briefly in the following.

The Organization Ontology (ORG)

The Organization ontology (ORG), which is currently in the status of a W3C Candidate Recommendation (Reynolds, 2013) is an RDF vocabulary that allows the description of organizational structures, which supports the publication of Linked Data containing organizational information. Using the ORG ontology, data publishers are able to define classifications of organizations as well as roles and organizational activities.

Exemplified metadata description of a small excerpt of the organizational structure of Vienna's Open Data Office using the ORG ontology could look as follows (Box 5). Unfortunately, although there is a very active Open Data initiative in Vienna, it does as of yet not make use of the ORG ontology to publish their metadata.

Box 4.

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
@prefix dcterms: <http://purl.org/dc/terms/> .
@prefix void: <http://rdfs.org/ns/void#> .
:DBpedia rdf:type void:Dataset ;
foaf:homepage <http://dbpedia.org/> ;
dcterms:title “DBpedia” ;
dcterms:description “DBPedia: Wikipedia as Linked Data” .
:Geonames rdf:type void:Dataset ;
foaf:homepage <http://www.geonames.org/> ;
dcterms:title “GeoNames” ;
dcterms:description “The GeoNames geographical database
covers all countries and contains over eight million placenames.” .
:DBpedia void:subset:DBpedia2Geonames .
:DBpedia2Geonames a void:Linkset ;
void:linkPredicate owl:sameAs ;
void:target:DBpedia ;
void:target:Geonames .
```

Box 5.

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix skos: <http://www.w3.org/2004/02/skos/core#> .
@prefix org: <http://www.w3.org/ns/org#> .
<http://open.wien.at/vienna/department/co>
rdf:type org:Organization;
skos:prefLabel “Open Data Office” ;
org:hasUnit
   <http://open.wien.at/vienna/department/co/unit/cabinet-office-com> .
<http://open.wien.at/vienna/department/co/unit/opendata-office-com>
rdf:type org:OrganizationalUnit ;
skos:prefLabel “Open Data Office Communications” ;
org:unitOf <http://open.wien.at/vienna/department/co>.
```

The RDF Data Cube Vocabulary

A large volume of Open Data is representing statistical information. Using the Data Cube vocabulary (Cyganiak and Reynolds, 2013), data publishers are able to represent statistical information as Linked Data, which allows them to combine their data with related information in Linked Data. The Data Cube vocabulary is focused on the publication of multi-dimensional data on the Web and builds upon several existing RDF vocabularies such as VoID, ORG, FOAF and SKOS. While we do not provide a concrete example herein, we refer the interested reader to popular Linked Data initiatives such as the Linked Data version of Eurostat (http://eurostat.linked-statistics.org) which use the Data Cube vocabulary to describe their statistical data.

Data Catalog Vocabulary (DCAT)

Another vocabulary promoted by the W3C GLD group, the Data Catalog vocabulary (DCAT) (Cyganiak et al., 2010), is targeted to facilitate the interoperability between datasets on the Web. In contrast to other vocabularies such as VoID, DCAT is not only restricted to RDF datasets, but can rather be used to describe any kind of data source in RDF. It re-uses existing popular vocabularies such as FOAF (Brickley and Miller, 2007) and Dublin Core (Nilsson et al., 2008) and is well-suited to represent government data catalogs such as http://data.gov (US) and http://data.gov.uk (UK) (Fadi Maali, 2013).

We again illustrate DCAT metadata in a fictitious example to describe Vienna's Open Data catalog (Box 6).

The example above describes an example of a metadata description of Vienna's Open Data catalog.:catalog is of type dcat:Catalog and stands for the Open Data catalog itself, having various attributes which describe it in more detail.

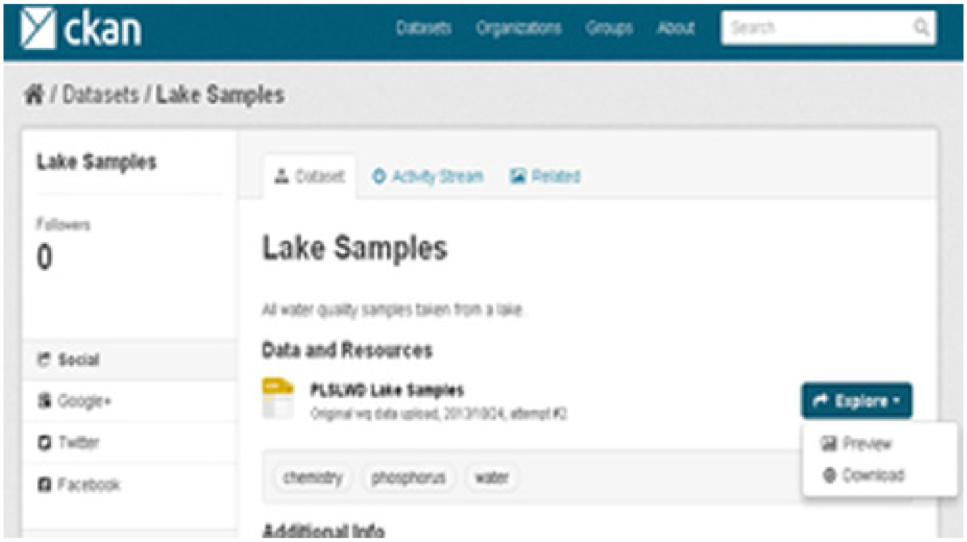
Comprehensive Knowledge Archive Network (CKAN)

In 2008, the Open Knowledge Foundation (http://okfn.org/) started their Comprehensive Knowledge Archive Network (CKAN), which offers the possibility to easily manage and publish

Box 6.

```
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
@prefix dct: <http://purl.org/dc/terms/> .
@prefix dcat: <http://www.w3.org/ns/dcat#> .
:catalog a dcat:Catalog ;
dct:title "Vienna Open Data Catalog" ;
rdfs:label "Vienna Open Data Catalog" ;
foaf:homepage <http://open.wien.at/> ;
dct:publisher:opendata-office ;
dct:language <http://id.loc.gov/vocabulary/iso639-1/de> ;
dcat:dataset:sample-data.
:opendata-office a foaf:Organization ;
rdfs:label "Vienna Open Data Office".
:sample-data a dcat:Dataset ;
dct:title "sample dataset" ;
dct:issued "2013-10-24"^^xsd:date ;
dct:modified "2013-10-24"^^xsd:date ;
dct:publisher:opendata-ministry ;
dct:language <http://id.loc.gov/vocabulary/iso639-1/de> ;
dcat:distribution:sample-csv.
```

Figure 2. An example dataset published on a website using CKAN's data publishing software



collections of data. It is a free and open-source data catalog based on software written in Python and is used by many national/local governments and organizations to advertise and catalog their datasets (Table 1). Besides the possibility to use CKAN's framework to setup an own data catalog, CKAN is hosting a data catalog by itself called Datahub (http://www.datahub.io/). CKAN is a free data management platform, built to support the publication and registration of datasets; the public Datahub provides access to many features of CKAN and furthermore offers a SPARQL Endpoint (http://semantic.ckan.net/sparql/) to query all datasets published there. There are currently 8921 datasets and 446 SPARQL endpoints registered in Datahub.

Table 1. Open Government Data efforts of selected countries

Country	Homepage	Available Datasets			SPARQL
		ALL	RDF	CSV/XML	Endpoint
AUT	data.gv.at	977	0	633/10	No
UK	data.gov.uk	10366	173(14)	2738/181	Yes
GER	govdata.de	4346	2	2295/?	No
FR	data.gouv.fr	353226	2	2614/120	No
ES	datos.gob.es	1170	21	359/74	Yes
AUS	data.gov.au	531	2	200/50	No
CA	data.gc.ca	197835	1	3519/185087	No
MX	datosabiertos.gob.mx	29	29	?/?	Yes
EU	open-data.europa.eu	6136	1387	?/?	Yes
US	data.gov	98871	144	3131/11666	Yes

Deployment of RDF and Applications of SW Technologies in Open Data Practice

Despite the promising activities regarding publishing Linked Open Data and the potential role that Semantic Web technologies described herein could play in this endeavour, big governmental data publishers barely use Linked Open Data for their datasets as of yet. While the majority of datasets are available in non-proprietary file formats such as CSV or XML, they barely use URIs to identify resources, nor are linked with each other (thus mostly only obtaining a 3 star LOD Rating) as shown in Table 1. In this table, we have classified various governmental Open Data initiatives with respect to their adoption of RDF and Linked data, and other formats. Approaches to overcome this issue of dominating 3-star datasets (i.e. embracing also data available in non-proprietary file formats such as CSV, JSON with Semantic Web technologies) are currently forthcoming with (i) a planned CSV on the Web Working Group (Brickley and Tennison, 2013) within W3C, which aims to transform CSVs into 5-star data, allowing it to be linked to other sources, as well as (ii) through the JSON-LD W3C Recommendation (Sporny et al., 2013), which allows the usage of a JSON-based serialization format for RDF to use Linked Data in common Web-based programming environments.

It should be noted that many more Government Linked Data efforts at lower than national levels (states, cities) exist that more actively pursue the adoption of RDF and Linked Data, mostly driven by collaborations at local level with universities or research partners. Examples include the Vienna Linked Open Data project (http://data.gv.at/anwendungen/vienna-linked-open-data/) or Spain's Linked Open Data efforts (including *geospatial data*, or *bibliographical data*).

Open Data Research Projects and Other Initiatives

Apart from official governmental efforts, many academic research projects at different national levels or at the level of EU projects actively drive the promotion of Linked Data and Semantic Web Technologies in the area of Open Data.

TWC Linking Open Government Data (LOGD)

In the US, the TWC Linking Open Government Data Portal(LOGD) (Ding et al., 2011) by Rensselaer Polytechnic Institute (RPI) contains a collection of RDF datasets extracted/converted from US government and other related sources available on the Web. The portal aims to publish Linked Data versions of available open government data (OGD) and offers tools, services and expertise supporting OGD applications. The TWC LOGD Portal is targeted to convert "raw" and unstructured data, provided by Open Government Data initiatives, into RDF and enhances these datasets by adding more links, by using their own TWC LOGD converter (http://data-gov.tw.rpi.edu/wiki/Csv2rdf4lod). The project deploys various Semantic Web technologies, as well as machine learning techniques (Ding et al., 2010). Interested readers can find the data publishing workflow used by the TWC LOGD Portal in (Ding et al., 2011)

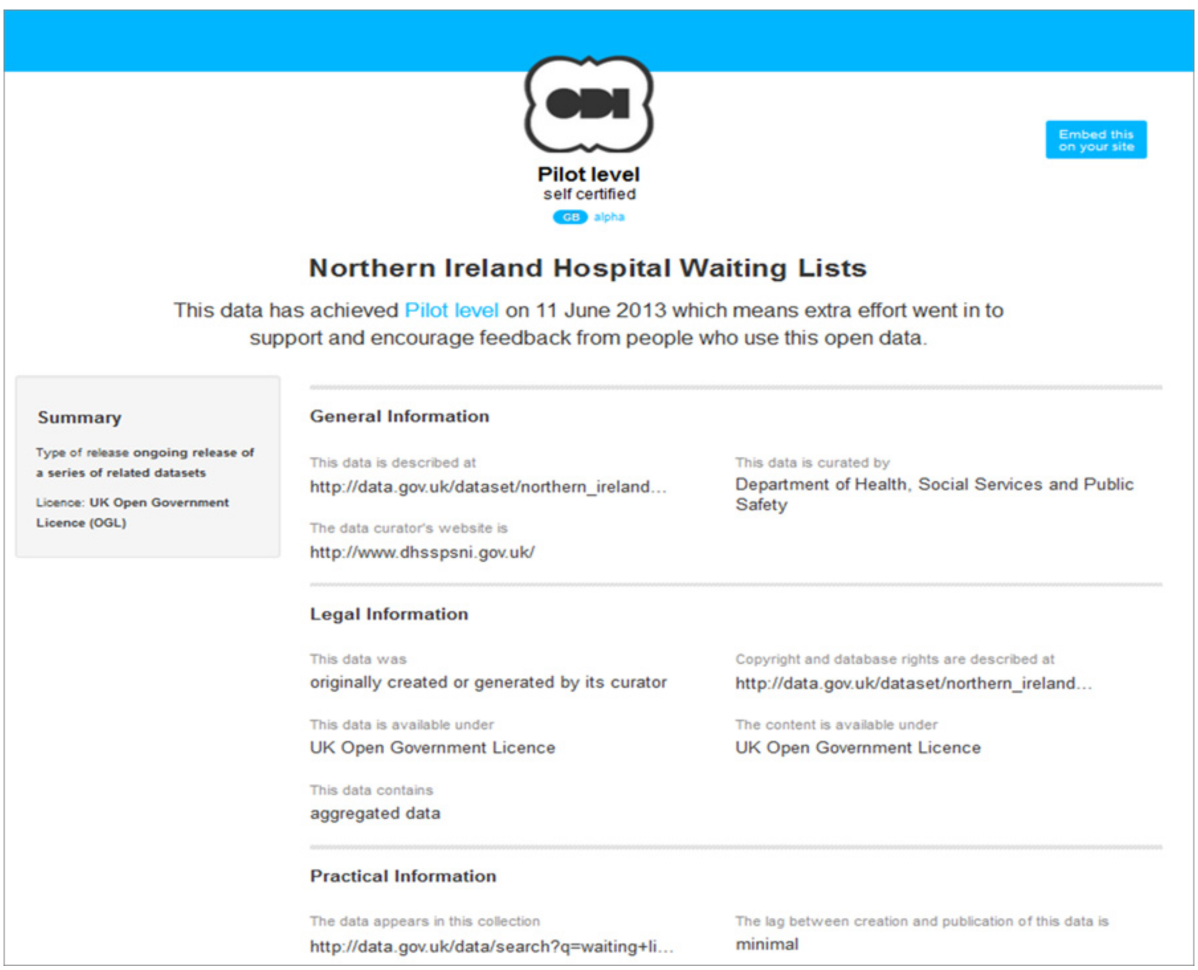
Open Data Institute (ODI)

In the UK, the Open Data Institute (ODI) is an independent, non-profit organization, founded by Tim Berners-Lee and Nigel Shadbolt. Its primary goals are forcing the evolution of Open Data culture and to engage anyone to provide their own Open Data catalogs, by offering professional coaching and mentoring programs. Furthermore the ODI provides the possibility to certify datasets, sharing information such as availability, privacy and licensing terms. There are four kinds of possible Open Data certifications, namely:

- **(Raw):** Basic certificate, which is achieved by the majority of Open Datasets if they are publicly available.
- **(Pilot):** Data users can provide feedback and receive support from the data publisher. (cf. Figure 3)
- **(Standard):** Trustworthy Open Dataset, which is regularly published and robust support.
- **(Expert):** The highest certification rank, which stands for an exceptional example of information infrastructure.

In the last years, several projects across the EU were founded to bridge the gap between organizations/governments and Linked Open Data. Although many organizations or governments have already established Open Government Data portals (cf. Table 1) they usually don't offer their data following the Linked Data Principles. Projects such as LOD2 (Auer et al., 2012), PlanetData (http://www.planet-data.eu/) or the European Data Forum (EDF, http://www.data-forum.eu) aim at lowering the entrance barrier for data publishers and users

Figure 3. Pilot level certification of North Irelands Hospital Waiting Lists OG Dataset



to start publishing Linked Open Data, improve the coherence and quality of data published and establishing trust on the Linked Data Web (cf. Provenance Example).

Other initiatives such as Eurostat (http://epp.eurostat.ec.europa.eu) aim at offering high quality data, such as statistics on Europe. By providing the European Union with data and statistics about countries and regions, it allows the comparison of that information in order to help decision makers at EU level in making those decisions. Eurostat contributes about 5907 datasets to the EU Open Data Portal (cf. Table 1) but mostly in a non-linked manner (3 star or less). To overcome this issue, a Linked Data version of Eurostat (http://eurostat.linked-statistics.org) was announced, which provides 5 star Linked Open Data on European Level in a contextually rich and up-to-date manner.

Listing 1. A sample SPARQL query, which calculates combined values for greenhouse

```
gas emissions per capita takes from eurostat.linked-statistics.org
PREFIX qb: <http://purl.org/linked-data/cube#>
PREFIX e: <http://ontologycentral.com/2009/01/eurostat/ns#>
PREFIX sdmx-measure: <http://purl.org/linked-data/sdmx/2009/measure#>
PREFIX skos: <http://www.w3.org/2004/02/skos/core#>
PREFIX g:
   <http://eurostat.linked-statistics.org/ontologies/geographic.rdf#>
PREFIX dataset: <http://eurostat.linked-statistics.org/data/>
SELECT ?country ?year ?population ?ghgtotal
   xsd:decimal(?ghgtotal)*1000/(xsd:decimal(?population)) AS ?percapita
FROM <http://eurostat.linked-statistics.org/data/demo_pjanbroad.rdf>
FROM <http://eurostat.linked-statistics.org/data/env_air_gge.rdf>
FROM
<http://semantic.eea.europa.eu/home/roug/eurostatdictionaries.rdf>
WHERE {
?popobs qb:dataset dataset:demo_pjanbroad ;
e:time ?uyear;
e:freq <http://eurostat.linked-statistics.org/dic/freq#A>;
e:age <http://eurostat.linked-statistics.org/dic/age#TOTAL>;
e:sex <http://eurostat.linked-statistics.org/dic/sex#T>;
e:geo ?ucountry;
sdmx-measure:obsValue ?population.
?ghgobs qb:dataset dataset:env_air_gge ;
e:geo ?ucountry;
e:time ?uyear;
e:airsect <http://eurostat.linked-statistics.org/dic/airsect#TOT_X_5>;
sdmx-measure:obsValue ?ghgtotal.
?ucountry skos:prefLabel ?country.
?uyear skos:prefLabel ?year
}
ORDER BY ?country ?year
```

In order to be able to provide 5 star LOD datasets, they interlinked them with other relevant datasets by using the SILK Link Discovery Framework (Volz et al., 2009,Jentzsch et al., 2010) and SPARQL CONSTRUCT queries.

As a result, SPARQL queries across multiple datasets, which calculate combined results, are possible as shown in Listing 1.

CONCLUSION

In this chapter, we gave an introduction into Semantic Web standards usable and used in the context of Open Data. We have illustrated the basic technology stack of RDF, Linked Data, RDFS, OWL and SPARQL by examples and briefly described various complementary initiatives and standards that are targeted to promote these techniques as an enabler for the interchange and aggregation of Open Data from various sources. Lastly, we have discussed early adopters within Open Data initiatives and given an overview of existing projects that are targeted to promote Semantic Web technologies and Linked Data in the context of Open Data.

FUTURE RESEARCH DIRECTIONS

Although most of the standards we have discussed in this chapter have passed several standardization audits, current governmental organizations mostly focus on publishing their datasets as Open Data only, rather than interlinking them with other data or enriching their data with additional information or annotations.

We consider the next steps to be (i) establishing Semantic Web technologies in Governmental Open Data and (ii) publish data following the paradigm of Linked Data.

After that, many interesting opportunities for possible future research directions in the area of policy modeling in Open Data using Semantic Web Standards are conceivable.

For example in the area of contextual information consumption, where large numbers of different types of contextual information make it difficult to define standardized ways to process such metainformation.

ACKNOWLEDGMENT

This work has been partially funded by the Vienna Science and Technology Fund (WWTF, project ICT12-015).

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KEY TERMS AND DEFINITIONS

CKAN: The Comprehensive Knowledge Archive Network is a free and open-source data catalog based on software written in Python and is used by many national/local governments and organizations to advertise and catalog their datasets.

GLD: Government Linked Data describes standards to help governments, governmental agencies and public bodies in publishing their Open Data by using Semantic Web technologies, following the Linked Data principles.

Linked Data: Linked Data describes a paradigm to publish structured and interlinked data on the Web, making it human readable as well as machine parseable. By interlinking relevant data from different data sources, it makes it easy to query and gather additional information in a structured way.

PROV: The Provenance Ontology enables the annotation of datasets with interchangeable provenance information.

RDF: The Resource Description Framework is the basic data model for the Semantic Web. It is built upon one of the simplest structures for representing data: a directed labelled graph. An RDF graph is described by a set of triples of the form <*Subject Predicate Object*>, also called *statements*, which may be viewed as connecting subjects to objects via edges labelled by the predicates. Since any of these can be - dereferenceable - URIs, these edges may be equally viewed as "typed" links between resources and other resources, where resources - unlike in the HTML Web, are no longer restricted to be documents, but arbitrary entities, that can be identified by URIs.

RDFS and OWL: Although RDF itself is essentially schema-less, additional standards such as RDF Schema (RDFS) and the Web Ontology Language (OWL) facilitate formal descriptions of the relations between the terms used in an RDF graph: i.e., the predicates in an RDF triple which form edges in an RDF graph (properties) and types of resources in an RDF graph (classes). Formal descriptions of these properties and classes can be understood as logical theories, also called ontologies, which allow systems to infer new connections in an RDF graph, or link otherwise unconnected RDF graphs.

SPARQL: The SPARQL Protocol And RDF Query Language is the standard query language for RDF and plays the same role for the Semantic Web as SQL does for relational data. SPARQL's syntax is roughly inspired by Turtle and SQL, providing basic means to query RDF such as unions of conjunctive queries, value filtering, optional query parts, as well as slicing and sorting results.

VoID: The Vocabulary of Interlinked Datasets (VoID) is an RDF Schema vocabulary, published as a note by the W3C Semantic Web Interest Group and is used to describe metadata about linked datasets.

Chapter 4
Policy Modeling Methodologies

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ABSTRACT

The process to develop sustainable public policies is done by public authorities ensuring the involvement of all stakeholders. ICT is rarely included in most of the today's applied policymaking processes. Other process definitions with a focus on ICT inclusion in policy modeling still exist, but they are not well defined. This chapter gives an overview of the existing policy modeling process types and explains their major foci and how they consider ICT and the practical process in public authorities. Afterwards, based on these descriptions, the general requirements on a new ICT-oriented policy modeling process that allows the inclusion of ICT into a valid and useful process for public authorities is given.

INTRODUCTION

The implementation of public policies follows a policy making lifecycle to ensure that all required aspects are well considered and so the requirements for an effective policy can be ensured. The process were defined through their practical use in the public authorities and got improved, based on changes because of problems or based on new findings in the governance research domain. The primary goal is a stable and valid process that can ensure an effective policy making. The policy modeling, as well as the policy making process, are a very complex circumstance with a couple of involved stakeholders. Furthermore the process has to follow the democratic idea of western countries, which includes a valuable routine that encounters the general good of citizens. The considering of all of these requirements is complex, so that the resulting structure for policy processes is complex too.

In this policy making process various institutions, departments, interest groups, experts and many more are involved. Their part of work is necessary to create new policies. But how they are involved and also their influences and limita-

DOI: 10.4018/978-1-4666-6236-0.ch004

tions need to be defined too. All of that issues are defined in the policy making process too. During past years the policy making process was refined and adapted in many ways, but from the today's point of view, they are less considering ICT.

Since the last decades ICT got more and more important for the society, especially for administrations, because of their new powerful ways to store and organize data. So of course, ICT is in general used in public authorities. But until the last years the used technologies were mostly limited on general data provision and analysis of quantitative data, which are mostly statistical data about indicators. In the last years the web has changed and got more social. There are now new opportunities to stay in contact with (interested) people and – what is more important – these opportunities are used by a wide range of citizens. In 2009 approximately 67% of internet users accessed social networking sites (Redecker et al., 2010; Nielsen Online, 2009). In fact this means that there are now new possibilities to engage citizens and consider their opinions, for instance based on the use of social media. But unfortunately these possibilities of using the engagements of citizens in the social web and others are currently not used and considered sufficiently. The current applied processes are not adequate since they focus on "offline methods". But to make use of these new opportunities and to allow the integration of new ICT features, it is necessary to change the existing approaches, but this sounds simpler than it is.

To enable such required changes on the existing process governance model, we want to give an overview about the current existing policy modeling methodologies. Most of the today's existing process models are conventional models that are primary used in public authorities. But we also want on introduce existing ICT and technology based process definitions that taking the ICT into a special account. So this chapter aims give an overview about the current existing types of process definitions and should outline their characteristics and handicaps concerning a process definition that can be used in public authorities, as well as their consideration of ICT.

OVERVIEW ABOUT POLICY MODELING

In the following sections we majorly focus on policy modeling. Estrada (2011) defines policy modeling as "an academic or empirical research work, that is supported by the use of different theories as well as quantitative or qualitative models and techniques, to analytically evaluate the past (causes) and future (effects) of any policy on society, anywhere and anytime." So the major focus lays on the policy and the causes and effects on the society. The creation of policies consists of a huge number of tasks and involved stakeholders. To bring them in an efficient and effective order, the policy modeling can be seen as a process, where it is defined what actor has what task at a certain time. This arrangement of task and stakeholders regarding the development of policies is commonly named as policy modeling process. We use the terms policy modeling policy creation synonymously.

TYPES OF EXISTING PROCESS DEFINITIONS

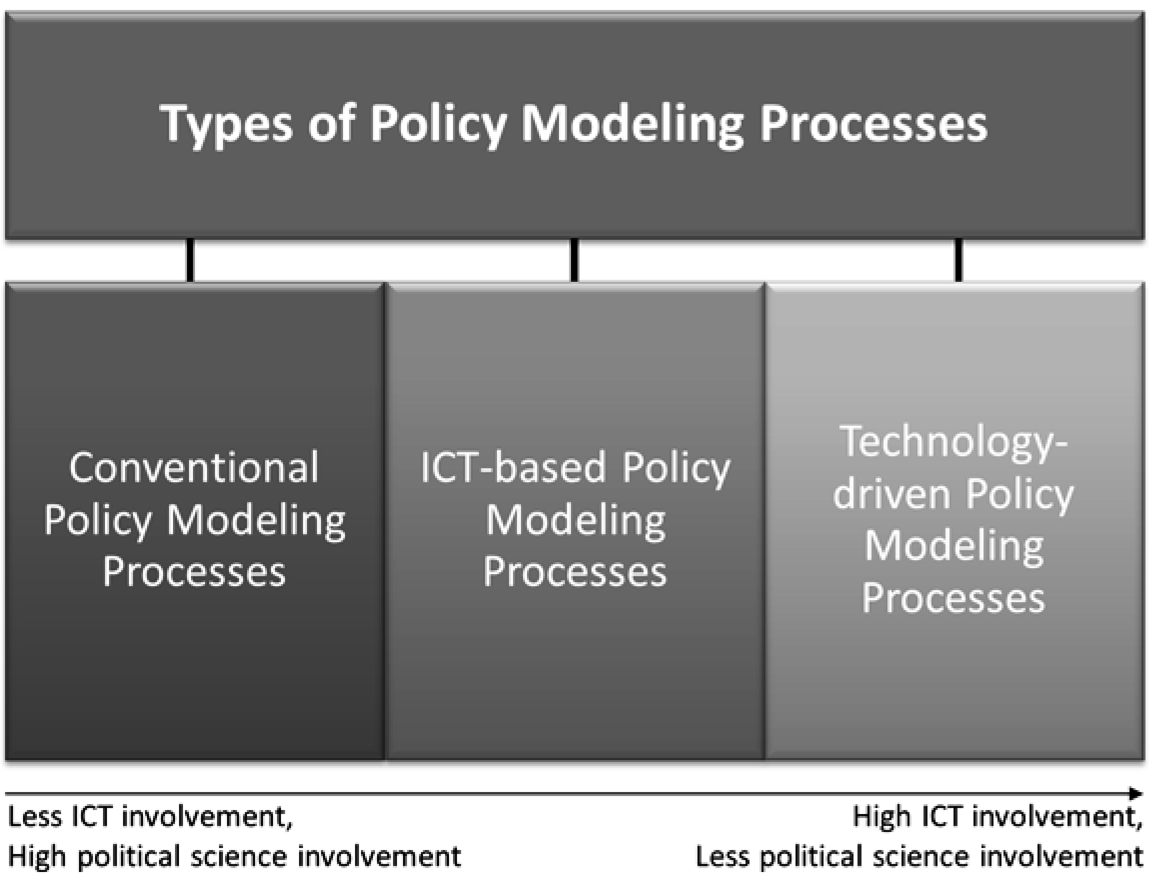
The process of Policy Modeling (PM) is a complex challenge, which includes various tasks with a predefined order to ensure the creation of an effective policy. To face this challenge the structure of the accruing tasks were investigated by several existing process definitions. The processes enable the definition of process-tasks and supporting tools for an efficient task-solving. In particular the supporting tools are nowadays brought by the

Information and Communication Technologies (ICT), with the rising role of internet, social web and further ICT-based technologies. The definition of PM-processes was often defined in existing works by setting goals for their categorization.

To structure the high number of existing definitions of policy making processes with regard of the ICT aspect, Burkhardt et al. (2013) classified the existing policy modeling process into three groups (see also Figure 1): (1) conventional policy modeling processes, (2) ICT-based policy modeling processes, and (3) technology-driven policy modeling processes. The characteristic of the ICT involvement and specialization increases from the group of conventional policy modeling processes to the technology-driven policy modeling processes. On the other hand, the political science involvement does decrease. This fact is also addressed as general important gap for the integrating of ICT in the political decision making (OECD Publication, 2001; Lallana, 2010).

The most established process-definitions are the conventional ones, which are mostly used in public authorities. We mean with conventional that the process definition does not involve ICT-based tools. Beside these conventional processes, few adaptations were applied to use ICT-tools in the PM-process. We sub-summarize in this paper the PM-processes that involve ICT-based tools for supporting tasks as ICT-based policy model-

Figure 1. Types of existing policy modeling process definitions regarding their integration level of ICT and the respected political science involvement



ing processes. A third group of PM-processes is technology-driven and constrains the PM-process to the limitations of technologies.

Conventional Policy Modeling Processes

The conventional PM processes are the most established definitions and primary used and implemented at public authorities. They have been researched since decades, but unfortunately they lightly consider the ICT-tools and their opportunities. Novel approaches for eParticipation and eGovernment cannot be reconciled with the conventional PM-processes. The most advantage of such conventional PM-process definitions is their accurate documentation. No other category of PM-process definition provides such a well described definition of each process step.

Overview and Classification

One of the first established and referenced policy modeling lifecycles was developed by Lasswell (1956). He introduced into a 7-phase life-cycle, which was later often reused and simplified by other researchers. Most of the conventional defined PM-process, i.e. in (Jones, 1984; Brewer & DeLeon, 1983; Howlett, Ramesh, & Perl, 2009; Wallace, Pollack & Young, 2010; Anderson, 1984; Hupe & Hill 2006), are not equal, but they describe the most necessary five steps in a similar way (Howlett, Ramesh, & Perl, 2009; Hupe & Hill 2006). For instance, Patton and Sawicki (1983) describing a 7-step process cycle, with an additional different step order. After problem definition, their process requires a definition of evaluation criteria, and after policy making, they define an evaluation phase of all alternative policies that results (in the following step 5) in the selection of the preferred. In general the most process definitions using a three to seven stage model and cover with the diverse stage-numbers the same issues. This fact allows the grouping of these approaches into a generalized five-stage model (Howlett, Ramesh, & Perl, 2009; Wallace, Pollack & Young, 2010), which is sketched in more detail also in Figure 2:

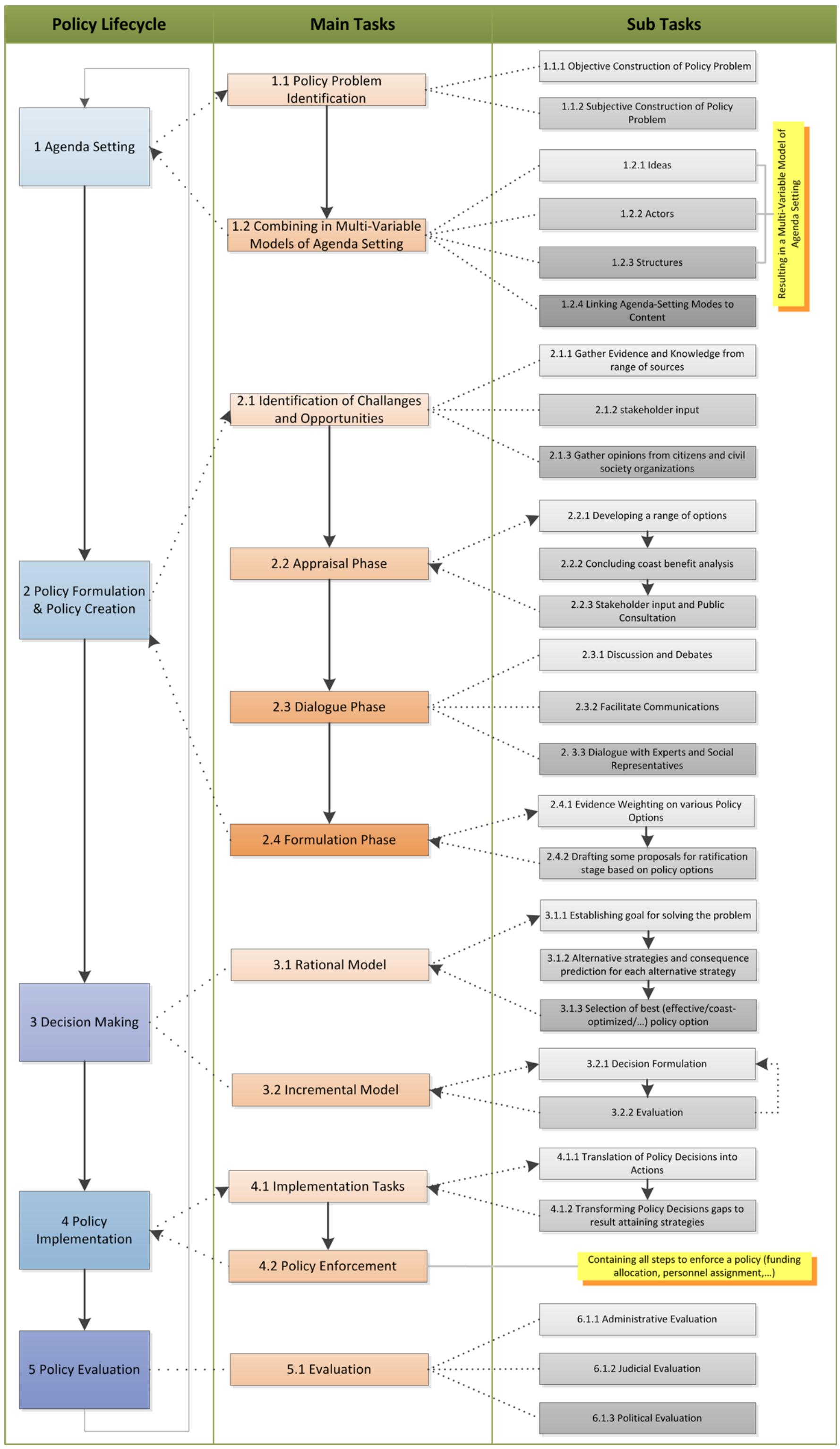
1. **Agenda Setting:** The function of this stage is to recognize a problem and to identify the related reasons.
2. **Policy Formulation:** Based on the identified problem, in this stage proposals for solutions are defined.
3. **Policy Decision:** Mostly Politicians in the role of decision-makers act in this stage to decide which proposal and with which condition a policy should be implemented.
4. **Policy Implementation:** The goal of this stage is the ratification of a new policy for validation.
5. **Policy Evaluation:** In this stage the implemented policy is analyzed and observed. The goal of this stage is to identify if the faced policy-problem is solved.

Application in Public Governance

The application of conventional policy modeling processes is well known, because they are commonly used in public authorities. These kinds of process definitions are defined mostly decades ago and just gently changed. In particular regarding the integration of ICT there were only very moderate changes, but they were essential to keep the administration effective. However, the overall integration of ICT needs for advanced consideration fundamentally adapted and changed, to be more effective and maybe for some use cases also more efficient.

Today the problem identification of agenda setting bases on the objective and subjective construction of an existing problem. Mostly only the objective problem construction based on observed indicators is used. Therefore the public authorities using ICT to analyze the indicators, but there is no automatic observation on an ICT-driven

Figure 2. The conventional policy making process (based on Howlett et al. 2009) with its major steps and its concrete tasks



in-depth analysis used. Instead of heavy use of ICT, analysts and experts try to get an overview only based on the existing indicator data. This work progress is similar to the combination of the multi-variable models that are required to define the problem context, such as involved actors or structural reasons for such a problem. The agenda setting is primary defined by the involvement of analysts and experts with just moderate (but ICT is here in prevalent use) use of ICT.

The policy formulation and creation phase is mostly defined without the use of ICT features. For instance, the identification of challenges and opportunities is mostly done by a group of experts. For this task the experts making propositions usually based on their experience. This is similar to the appraisal phase. If the employed experts of a public authorities do not have a deep understanding for a very special topic, they are involving external experts for this work. To bridge such expertise gaps it is not established to bridge these with intelligent/expert ICT features. The only sub-task where ICT is used is the public consultation. Here, the work etc. is sometimes announced on the authority website, next to the existing media like an official gazette. In the dialogue phase today no ICT platforms are used, instead the traditional meetings etc. are the usual platform for allowing discussions to an existing issue. In the formulation phase, the proposals for possible problem solutions will be developed and weighted – the weighting is mostly based on political interest, e.g. what solution will be more accepted by the citizen. But if there is a weighting based on the expected impact of a solution, there are sometimes simulation features of ICT used.

The decision making phase is today a complete offline tasks. Here the decision makers aiming to choose the best policy option to solve the problem. Decision makers are on the one hand experts from the domain, but also politicians.

The policy making phase is using ICT, but it is used to ensure that no mistakes will happened and so high quality implementation is guaranteed. Neither for the implementation tasks, nor for the policy enforcement ICT is used to achieve another goal then the optimal implementation.

In the policy evaluation the impact of a created policy will be measured. Therefore different criteria can be set to detect the impact. In the administrative evaluation the implementation of the policy, e.g. regarding the aligned funding or the involved intuitions will be analyzed. The judicial evaluation analyses the embedding of a policy in regards to the existing laws.

The description for these five stages of the PM process is just an outline, which is more explained in the above mentioned literature. In this paper we primary focus on the detailed description of the model proposed by Howlett et al. (2009), which contains an aggregation of most of the existing and established researches in that domain and describes the PM-process stage in a clear shape.

ICT- Based Policy Modeling Processes

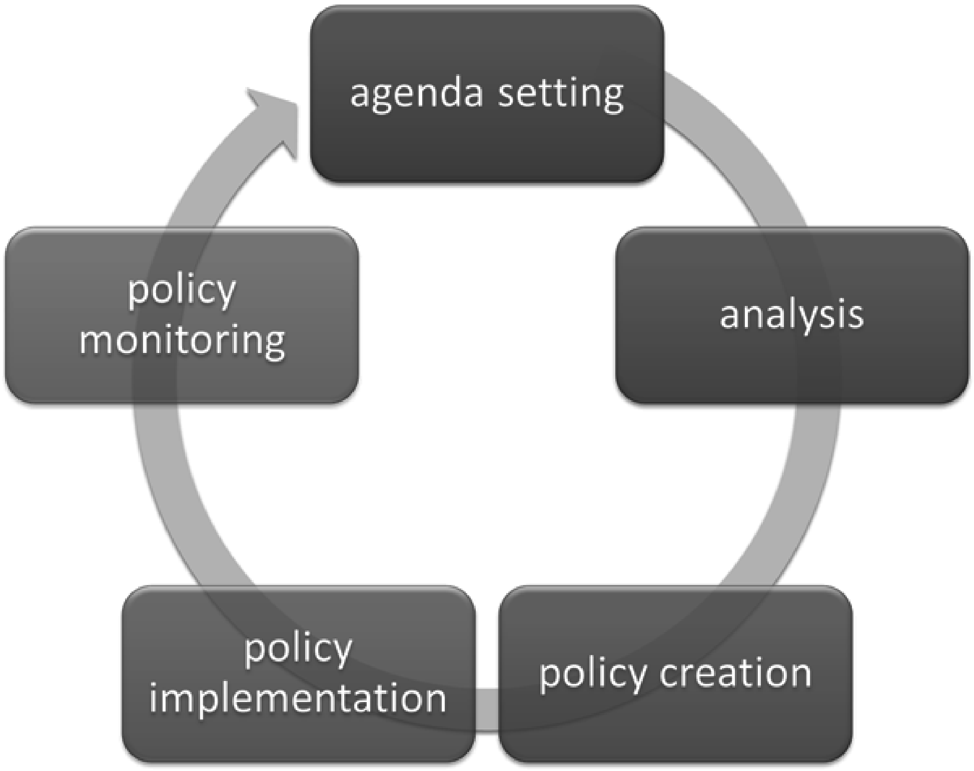
A more recent approach to define the PM-process is the inclusion of ICT-tools in the entire process. In particular the involvement of citizens and their opinions can be supported in a more sufficient way. These process models adapt the conventional PM-process to include ICT-tools.

Overview and Classification

There are two established and equal PM-process definitions that investigate ICT in the process model: The well-known definition of ICT-based policy making by Macintosh (2004a, 2004b) and published model proposed by the OECD (OECD Publication, 2003; OECD Brief, 2003) and other literature (Young, 2010) to reinforce eDemocracy. All these processes define a canonical five-stage PM-process model (see also Figure 3):

1. **Agenda Setting:** The Agenda Setting defines the need for a policy or a change to an exist-

Figure 3. An example (canonical) representation of an ICT-based policy modeling process that consists of the 5 major phases



ing policy. It further clarifies the problem that triggered the policy need or change.

2. **Analysis:** The Analysis clarifies the challenges and opportunities in relation to the agenda. This step's goals are examining the evidence, gathering knowledge, and a draft policy document.
3. **Policy Creation:** The Policy Creation aims to create a good workable policy document, taking into consideration a variety of mechanisms such as risk analysis or pilot studies.
4. **Policy Implementation:** The Policy Implementation involves the development of legislation, regulation etc.
5. **Policy Monitoring:** Policy Monitoring might involve evaluation and review of the policy in action.

Next to the above described process definitions, there are very similar definitions with a deviation in the number of stages. They address the same issues, similar to the parallel existing process definition for the conventional PM-processes. The process definition of Mashinini (2008) consists of four phases. His model combines the first two stages of Agenda Setting and Analysis in one stage. Another PM-process definition was proposed by the World Bank (2010). It describes a more structured PM-process with an assessing and coordination responsibility within the governments.

All of these kinds of process definitions do not describe the process in a detailed form. Neither the concrete tasks are named or described, nor are the possibly useful ICT-tools defined for supporting the tasks. Nevertheless the mentioned processes are for many eDemocracy project-ideas a well foundation, even if they are just defined on a very abstract level. The breach of a detailed description makes it difficult to use such a PM-process definition in planned concrete implementations. Concrete implementations needs to be developed for specific tasks to ensure that it help users. In consequence a detailed defined ICT-based PM process is also essential to determine appropriate visualizations for each PM-stage. This canonic process model is also often criticized as misleading, because of their non-discrete of the policy-making stages (Sabatier, 1999; Young, 2010) and the sometimes not well fitting process steps (Young, 2010).

Application in Public Governance

Nowadays no ICT-based policy making process is used or established in public authorities. To integrate some ICT just minor changes on the conventional policy making process were made, so that the main character of the process has not been changed. In the politic sciences and in some projects with inclusion of computer sciences some very canonical ICT-oriented policy making processes do exist (as introduced in the section above).

Therefore they generally describe the use of ICT in the agenda setting phase, to provide a more effective and efficient problem finding. Hereby they consider different strategies, beginning by techniques to analyze and explore social media to gather opinions of citizens, and finalizing with analysis and exploration of objective data, such as open government data. The high bandwidth of technical opportunities to extract problems from existing heterogeneous data-sources and kinds of data, do ensure the provision of a much higher spectrum of problems and problem reasons as the conventional methods do allow. Through the combination of different technical approaches, e.g. opinion extraction of social media and analysis of open data, a cross-validation of a determined problem can be done at an early stage of the policy making.

After problem definition, the analysis phase starts. The goal is to identify problem reasons and solution ideas. In contrast to the conventional policy making processes, where no explicit analyze phases exists, analysis tools are here considered explicitly. This should also indicate that the analysis is a very important stage where most technical abilities will be included to define an optimal solution approach. Similar to the agenda setting phase, the consideration of most available techniques to analyze a problem and to find a solution is also required in that phase.

Since the policy creation phase, the ICT-based processes become quite similar to the conventional processes. The traditional methods to discuss and making decisions are considered as well as new methods, which allows for instance a discussion with citizens on the web, e.g. with forums or other debating platforms.

In the policy implementation phase ICT can be involved to ensure an optimal anchoring within existing policies and laws. There are some technologies available that allow identifying conflicts with existing policies and laws. That helps to change new policies and to make them conform to the existing policies or it indicates which other policies need to be changed to ensure the full operate ability of the policies.

Policy monitoring, to observe the effectiveness of a made policy or to indicate occurring problems in an early stage, becomes more effective by the use of ICT. Instead of waiting for updates of government data, also data from social media can be considered, e.g. where small and medium size enterprises discuss about negative developments. But also the direct observation of government data can help to indicate economic changes, e.g.

beginning crisis, more preciously so that political programs can be planned and initiated early enough to allay the full consequences of a crisis.

Technology-Driven Policy Modeling Processes

The third group of PM-process definitions is defined for the use of specific technologies in the policy making. Some technologies allow the definition of specific processes, which addresses the challenges for this single type of technology. Therefore the PM-process is abstracted and adapted on the requirements of the technology. The goal of these technology-driven PM process is not to define a global process for public authorities, even more these definitions are focusing on the behaviors of a technology and thereby to ensure an optimal exploit of the technology's benefit. Thereby we can divide these kinds of approaches into *system-oriented* policy modeling processes and *domain-oriented* policy modeling.

Overview and Classification

A less number of approaches address general technical issues. On examples is the three-phase process of Misuraca et al. (2010). It provides a general idea to include technologies in the decision making process. The goal is not establish the inclusion of a concrete technique, even more it acts as a motivation factor to create more ideas and techniques that possibly can be considered by decision makers (Misuraca et al., 2010).

Another approach to support the analysis in the analysis is described by Ruppert et al. (2013). He adopted the process of Howlett et al. (2009) in regards to the tasks of analysis. Furthermore they defined the sub-processes and task in clearer shape- The benefit of this approach is better picture of the tasks for policy analysts and to develop analysis tools that support the analysts' behaviors in a better way.

Most of these PM process definitions are addressing a certain topic. Through the combination of multiple technologies, a new service is obtained that aims to improve a part of the policy making process. The resulting process definition does not always correlate with conventional or ICT-based PM-process, but this is also not the primer proposed goal. The goal of such PM-processes is to provide a beneficial process to improve a concrete aspect. An example for such a PM-process definition is the Policy Making Lifecycle of the European project ePolicy (Milano, 2012; Kohlhammer et al., 2012).

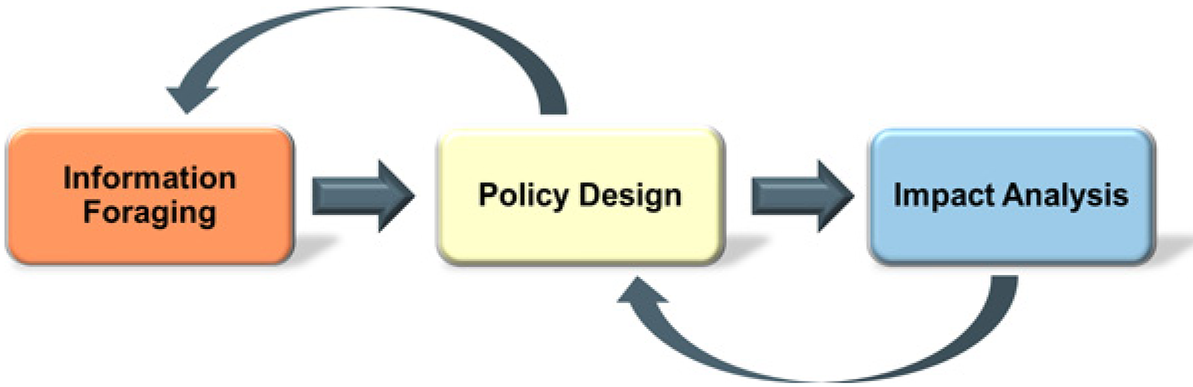
According to previous type, there are also process definitions that are defined for a specific technology type, i.e. for information visualization (Kohlhammer et al., 2012) or simulation techniques (Pahl-Wostl, 2002). The idea is to provide a process definition for this type of technologies, based on an abstracted and adapted general PM process definition that considers the technology's specific behaviors. An example of such a technology-driven process is the visualization-process of Kohlhammer et al. (2012). For this exemplary visualization purpose, they reduced the entire PM process on the relevant parts for the visualization on: (1) Information Foraging, (2) Policy Design, and (3) Impact Analysis.

Application in Public Governance

This kind of policy making processes is not designed for an explicit implementation in public authorities. They are just designed to make a technology more effective usable in the policy making process.

To integrate a technology beneficial in the policy making process, an existing policy process definition will be adapted to the technology's requirements. In consequence a step of the technological policy process covers one or more steps, or perhaps enriches the established policy making process by multiple additional sub-steps.

Figure 4. The technological process for visualizations in the policy modeling process (based on Kohlhammer et al. 2012)



The defined phases of the policy-making cover one or more phases of the conventional or ICT-based policy making process.

In contrast to the conventional or ICT-based processes, the technology-driven processes are acting primary as an application process. They are normally not presented to the user. They build the technical data flow in background of such a technology. Therefore next to the technology policy process, also a conventional or ICT-based process has to be used.

REQUIREMENTS FOR ICT-BASED POLICY MODELING PROCESSES

The introduced types of policy modeling processes in the previous sections showed the different perspective how policy making can be taken into account. Based on the viewpoint different aspect are more important than others. Also the consideration of stakeholders plays a different role for each of the policy modeling process types. The specification of requirements for ICT-based policy modeling process is in fact a challenging issue. Based on the fact that the conventional policy modeling processes are minor focusing on ICT, we can ignore them so far. Even more we want to use ICT for the entire process of policy making, which should be valid for all aligned technologies, which means that also the technology-driven policy modeling processes are not appropriate.

Overall just the class of ICT-based policy modeling processes is appropriate to define a general agenda to use ICT in the entire policy making. The introduced canonical five-phase process model provides a general overview, but to raise the entire governance on higher level, it is not satisfactory. The first requirement we can define at this point is, that a new ICT process is required with higher granularity to identify the task and techniques. Modern technologies can only be considered, as far as they can be aligned to the existing tasks and goals. However this can be very challenging, because new IT technologies provide new possibilities, and hence such a new technology can have impact on the process, which maybe needs then to be adapted.

Another challenge is the establishing and acceptance in public authorities. In these institutions processes are implemented that have been adjusted over many years, only to ensure a high effectiveness and efficiency. It considers the available resources as well as its interplay of them and the involved stakeholders, next to the validation and reciprocal control. To apply changes on the policy modeling process it is often an issue that can consume a lot of time, the implementation of completely new processes can often not be considered. Therefore it is recommendable if new processes orient on existing process lifecycles to have the general chances to get considered in future policy modeling. Another aspect is the usefulness of a new process definitions and the necessary effort for process changes. Only if the expected advantages have a significant impact, it makes sense for applying a change on the current routine. Therefore the integration of (new) ICT must significantly support decision makers and stakeholders in general. This includes that the changes on the current policy modeling process will not limit any other part of the process. The better and useful a new feature and the better it can be integrated in the current process without producing limitations, the more realistic is the possibility that the process get changed. One of these possibilities is the increasing importance of inclusion of citizens' opinions (OECD. 2003) in the policy making, i.e. through social media analysis. Not less important is that the changes on the existing process model do not strongly orient on a single technology, because technology can (and for the future it needs to be possible to) change, but the process needs to be valid anymore.

The presented canonical requirements are just an overview, in dependence of the changes there are a couple of further (more detailed) issues that needs be ensured. But only if the basically mentioned requirements are given, the general ability to implement the changes are possible.

CONCLUSION

The paper introduced into the challenges of creating new policy modeling processes with focus on the inclusion of ICT. Therefore the major point of well-defined process, with less consideration of ICT and less well-defined processes, but major focus on ICT was given. After that each of the existing policy process types were explained and described in a clear shape. The focus laid on the weighting of well-defined process and use in public authority and their inclusion of ICT.

The overview about the different policy modeling methodologies should allow the development of new policy making process with the benefit of all of these three types. First the conventional processes, because of their sustainable definition and arrangements of resources and involved stakeholders. As second the ICT-based process, which are generally considering the ICT advantages, but unfortunately there is not definition existing that is defined in a clear manner. And the third type, the technology-based policy making process, which aims to align a single technology into the policy making process. Afterwards the general requirements on a new policy modeling process were specified to develop a process that targets the objective of a valid process for authorities, as well as the usefulness for the inclusion of ICT.

Such a new ICT-based policy modeling process allows anchoring of new technologies, e.g. social media analysis for opinion mining, beneficially into the policy making. This in facts should ensure that decision makers can consider citizens opinions in a better way and define policies in more transparent and also more effective way. Another advantage is that new developed policies have a higher acceptance by citizens, since their opinions and thus their expectation are better comprised.

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KEY TERMS AND DEFINITIONS

E-Government: E-Government is the modernized form of Government, but under consideration of Information and Communication Technologies (ICT).

E-Participation: E-Participation is the modernized form of Participation, with the goal of engaging citizens in policy making. Through the use of ICT it is aimed to allow citizens to influence the political agenda by their options. In contrast to the traditional form, by the use if ICT it is easier to organize in groups and to realize e.g. petitions.

Information and Communication Technologies (ICT): Under Information and Communication Technology technologies for information provision, sharing, using and visualizations are summarized. A major benefit lays in the exchange of data for the use with other technologies and therefore the use in a number of different use cases.

Open Data: Open Data is term that is commonly used for statistical data that are provided by governments and can be almost used for free. These Open Data (sometimes also mentioned as Open Government Data) consisting a number of indicator data about a country or a region. Such data are often provided and mentioned in relation to initiatives for a better transparency.

Policy Modeling: The term policy modeling deals with the making of (political) policies, which can result in the creation of new laws. Policy modeling covers all necessary steps beginning at the identification of a problem, analysis, decision making, implementation, end evaluation of a policy.

Policy: Under the policy a theoretical or practical instrument can be understood that aims to solve a specific problem. In the political domain, a policy can represent a new law.

Process: A process is logical aggregation of activities. A process is defined by an initial state and an (to achieve) end state. Through the processing of the activities, the transformation from the initial state to the end state will be realized.

Chapter 5
The FUPOL Policy Lifecycle

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ABSTRACT

The purpose of this chapter is to outline an advanced policy lifecycle, the FUPOL model with its ability to link technical features in the area of policy modeling. The FUPOL Policy Lifecycle is based on 6 stages, which are further divided into 8 main tasks. These main tasks are split up into 19 subtasks to provide a very detailed policy lifecycle structure. The detailed breakdown allows one to link each task to various technical features, such as opinion maps, policy indicator dashboard, knowledge database, and simulation and visualization tools. The chapter further argues that the methodology applied is future proof and has the potential of accommodating new technologies in the future.

INTRODUCTION

Public policy is the domain of local and national governments. They address a public issue by laws, regulations, decisions or actions. Many topics are usually treated by public policy such as economy, social welfare, crime, tourism, traffic, education, etc.

Governments take decisions for their citizens primarily based on their policy concept and the current economic and social development. All these decisions originate in many analysis and discussions with all relevant stakeholders, such as companies, NGO´s, governmental organisations, citizens, unions, organizations representing commerce and industry etc. Most of the decisions are empirical and are based on previous experiences in the specific policy domain.

In a rapidly changing world a very cautious and deliberate policy making is required and routinely decisions might be dangerous, because circumstances and framework conditions alter quickly. Likewise available data as well as the technologies to support policy design and implementation are evolving quickly.

This gives to the policy decisions the opportunity to associate the knowledge of the experiences and the political and ideological background with the availability of data and information that go beyond the boundaries of the internal traditional gov-

DOI: 10.4018/978-1-4666-6236-0.ch005

ernment knowledge and include external sources on the internet, like Social Networks or Internet of Things. This leads to better fact based decisions, although these are likely to be still influenced by political and ideological considerations. Policy decisions are always risky but facts based decisions overcome or mitigate those risks

Therefore it is very important to approach the policy lifecycle in a systematic way, which means describing all steps in high detail. Such a detailed description is also required to provide a complete picture, which technologies can support the policy design and implementation

The objective of this chapter is to work out a new enhanced and detailed policy lifecycle which has the ability to link technical features in the area of policy modeling. The methodology applied must be future-proof and have the potential of accommodating new upcoming technologies

BACKGROUND

Policy

Before discussing the policy lifecycle it has to be specified what is a policy in this specific context. In the context of public policy a policy is understood as a course of action, authorized by the government, to achieve predefined specific goals. Such a course of action may take many forms. It could, for example, be expressed in the form of a strategy, a program, a law or a statement made by an executive authority. (Hewlett, Ramesh and Perl, 2009)

Policies are not created in a vacuum. Many people affected by these policies have an interest in determining the content of that policy. Policies can also be seen as processes. They change as they are implemented and rarely conform to plan. Policies can have intended and unintended outcomes.

Furthermore it is well known that public policy is a very complex task comprising many decisions influenced by citizens, politicians and companies on a national and on an international basis.

Policy Lifecycle Models

Hewlett, Ramesh and Perl (2009) point out that the most popular means of simplifying public policy making for analytical purposes has been to think of it as a process, that is, as a set of interrelated stages through which policy issues and deliberations flow in a more or less sequential fashion from "inputs" (problems) to "outputs" (policies).

The first one who tried to facilitate the policymaking process and to reduce it to different stages was Harold Lasswell. (Hewlett, Ramesh and Perl, 2009) The concept of policy lifecycle was developed by him in the USA in the 1950s. He was one of the pioneers of modern political science and he described public policy science as being multidisciplinary, problem-solving and explicitly normative. Based on these characteristics, he developed the concept of policy cycles, which he broke down into seven fundamental stages in decision-making (Hupe and Hill, 2006), such as intelligence, promotion, prescription, invocation, application, termination and appraisal.

After Lasswells definition of the seven-stages-model many variants of a process model, especially regarding the number of stages have been developed.

Jones (1984), Anderson (1996) and Brewer (1983) also defined policy modeling processes, which are not equal, but the specification of the required procedures for decision making and implementation of policies are analogical, using five to seven stages.

At present there is a consensus to use problem solving policy cycles, which are divided into five stages. Howlett et.al. (2009, p.12) suggest: a) agenda setting for problem identification, b) policy formulation for the proposal of different solutions, c) decision making for choice of solution, d) policy implementation for putting solutions into effect and e) policy evaluation for monitoring the results.

Ann Macintosh (2003) proclaims five stages, such as agenda setting, analysis, policy creation, implementation and monitoring.

The main advantage of the policy lifecycle is that this model breaks down the complex public policy process into a few stages.

The process of Policy Modeling (PM) is a complex challenge, which includes various tasks with a predefined order to ensure the creation of an effective policy. To face this challenge the structure of the accruing tasks were investigated by several existing process definitions. The processes enable the definition of process-tasks and supporting tools for an efficient task-solving. In particular the supporting tools are nowadays brought by the Information and Communication Technologies (ICT), with the rising role of internet, social web and further ICT-based technologies. The definition of PM-processes was often defined in existing works by setting goals for their categorization.

The conventional PM processes are the most established definitions and primary used and implemented at public authorities. They have been researched since decades. Modern ICT technology like Internet, social networks, simulation and graphical visualisation, structured and unstructured information analytics etc. did not exist initially when PM processes have been established. Therefore unfortunately public authorities do not often consider usually the ICT-tools and their opportunities. Novel approaches for e-Participation and e-Governance are not usually reconciled with the conventional PM-processes. The greatest advantage of such conventional PM-process definitions is their accurate documentation. No other category of PM-process definition provides such a well described definition of each process step. Most of the conventional defined PM-process, i.e. in (Jones, 1984), Hupe, 2006), are not equal, but they describe the required steps in a similar way according to (Howlett, 2009) and (Hupe, 2006). They are using a three to seven stage model and cover the same issues.

ICT Support and Policy Lifecycle Models

A more recent approach to define the PM-process is to consider the use of ICT-tools in the entire process. In particular the involvement of citizens and their opinions can be supported in a more comfortable way because they allow a quick interaction between citizens and governments. These process models adapt the conventional PM-process to include some ICT-tools.

The well-known definition of Macintosh (2003) and the associated published model is proposed by the OECD (Macintosh, 2003) to reinforce e-Democracy. Both processes define a five-stage PM-process: (1) Agenda Setting, (2) Analysis, (3) Policy Creation, (4) Policy Implementation, and (5) Policy Monitoring.

Next to these established process definitions, there are very similar definitions with a deviation in the number of stages. They address the same issues, similar to the parallel existing process definition for the conventional PM-processes. The process definition of Mashinini (2008) consists of four phases. His model combines the first two stages of Agenda Setting and Analysis in one stage.

Another policy lifecycle process definition was proposed by the World Bank (2010). It describes a more structured process with an assessing and coordination responsibility within the governments.

European Projects

A number of European research projects have also specifically addressed policy lifecycle models and related ICT support, namely

- Open Collaboration for Policy Modeling (OCOPOMO),

- Policy Gadgets Mashing Underlying Group Knowledge in Web 2.0 Media (PADGETS),
- Integrated Method for Policy Making Using Argument Modeling and Computer Assisted Text Analysis (IMPACT),
- Citizens Collaboration and Co-Creation in Public Service Deliverable (Cockpit)

Open Collaboration for Policy Modeling (OCOPOMO)

OCOPOMO is an agent-based policy model which shows two significant differences compared to previous policy modeling approaches.

The first is that the models are strictly evidence-based and built around the descriptions, expectations and beliefs of stakeholders in the policy process. The models are not driven by prior theories except to the extent that the theories have been developed in close connection with evidence and well validated independently of the models developed for the policy analysis. (Moss et al. 2011, p. 10)

The second important difference is that the nature of the models and their development implies a different relationship between the modellers and the clients – in this case the stakeholders – in the policy development, design and implementation process. The modeling process involves stakeholder participation so that the stakeholders and modellers are in effect partners. (Moss et al., 2011, p. 10)

In OCOPOMO the policy model is divided into phases, which will be merged in an integrated and iterative process. (Bicking et al., 2010). Phase 1 is the "Identification and Analysis of Potential Policy Areas" supported with stakeholder workshops and traditional research. This specific step is devoted to the design of problematic scenarios for relevant policy areas. After selection of the policy domains the scenarios have to be outlined by the use of scenario generation tools applicable for various policy domains. In Phase 2 "Agreement on one Policy Area" the policy domain to be modeled and simulated will normally be selected by using an opinion polling system on the common workspace. Phase 3 is devoted to "Detailing Objectives and Formulation of Scenarios" by using the common workspace and the use of a scenario generation tool, resulting in a narrative to outline the policy model. Phase 4 is reserved for "Extracting Particular Parameters" based on the narrative. Phase 5 is dedicated for "Detailing of Actors, Structures, Conditions, Environmental Factors and Behavior to Each Other" and results in the definition of the simulation the agents. (Bicking et al., 2010, p. 58)

Policy Gadgets Mashing Underlying Group Knowledge in Web 2.0 Media (PADGETS)

PADGETS was a project in the domain of eGovernance and Policy Modeling. The objective was to design a prototype to facilitate policy decisions by the use of social media tools and a decision support system (Padgets-Project, 2013).

In deliverable 2.1 the main novelties of the PADGETS platform are described as

- "A relaxation of current constraints in terms of size, frequency and quality of participation", which means easy access to participation for stakeholders and continuously interaction between policy makers and stakeholders (Ferro et al., 2011, p. 29);
- "An integrated management of multiple SMP & SNP channels", by using the web dashboard (Ferro et al., 2011, p. 29); and
- "Creation of an open decision support systems bringing together simulation models and SMP and SNP" (Ferro et al., 2011, p. 29).

The policy life cycle is supported by "padget campaigns", which are launched during the different stages.

Padget Campaigns are considered as a consultation tool. Policy decisions might differ from the results of the campaign. (Ferro et al, 2011).

Integrated Method for Policy Making Using Argument Modeling and Computer Assisted Text Analysis (IMPACT)

IMPACT was a specialized research project with a specific focus on the automatic processing of arguments, as for instance pros and cons. (IMPACT-Project, 2013) "IMPACT argumentation tools are designed to make it easier to collect policy proposals and arguments about the pros and cons of policy proposals, identify stakeholder interests and values, reconstruct arguments from natural language texts collected from weblogs and discussion forums distributed throughout the Internet, visualize networks of arguments, evaluate arguments, reveal implicit premises, and ask relevant critical questions. (Fraunhofer et al. 2010, p.3)

IMPACT was initiated to compensate the shortcomings of state of the art consultation tools. A major deficit of traditional consultation tools is the constraint of their argumentation support systems. The IMPACT argumentation has been specifically developed to foster stakeholder consultation about legislative Green Papers. A Green Paper is a preliminary government report presenting policy proposal which has to be discussed in Parliament to obtain consent. In general Green Papers are published so as to obtain and collect opinions and alternative proposals about the suggestion from all relevant stakeholders, such as citizens, companies, NGO´s, government officials.

Citizens Collaboration and Co-Creation in Public Service Deliverable (Cockpit)

Cockpit is a project in the area of eGovernance and Policy Modeling. The major objective was to design a prototype to facilitate the decision making process by use of social media and a specific decision support tool. The initial idea was to enhance the public participation in the new design of public services and to encourage the stakeholders to express their needs regarding the public services delivery. (Cockpit-Project, 2013)

The governance model was supported by a set of tools relevant for the decision making process, such as

- "The Citizens' Opinion Mining Tool,
- The Public Service Engineering Tool,
- The Public Service Simulation and Visualisation Tool,
- The Policy and Law Retrieval Tool,
- The Deliberative Citizens' Engagement Platform" (Koutras et al., 2010, p. 12).

The prototype was tested in three pilot cities and can be implemented for citizen empowerment in various policy domains.

MAIN FOCUS: ADVANCED POLICY MODELS

Issues, Controversies, Problems

The Challenge of Detail in the ICT Driven Process Definitions

Current technologies offer a broad range of features such as social media, automated advanced text and speech analytics, simulation, visualization or mobile.

None of the ICT-driven process definitions outlined in the section "ICT Support and Policy Lifecycle Models" describe the steps of the workflow

- To sufficiently explain the use of certain tools and their benefit;

- To design ICT tools based on existing technology; and
- To evaluate the use of new technologies to support them.

Challenges of Integration and Full Policy Lifecycle Support

The current ICT solutions supporting e-Participation and policy modeling are focused on solving a specific problem. Consequently ICT tools developed support a certain step of the policy design and implementation only. Moreover they are only partly integrated on the conceptual and the technical level. The conceptual level refers to the policy lifecycle, the technical level refers to data integration and user interface. Sometimes there are also limitations on the scope of stakeholder and citizen involvement.

The FP7 research projects mentioned clearly illustrate the above.

In OCOPOMO a number of tools namely "Common Virtual Work Space", "Common Virtual Participation", "Area Scenario Generation Tool", "Gap Tool" and scenario tools are provided to support the policy design process. The limitation of these tools is that the number of stakeholders that can be reached and processed in OCOPOMO is limited and does not include citizen participation. There is no ICT support for the policy implementation phase and subsequent evaluation.

PADGETS is intended as a consultation tool with social media. While the social media support is extensive across the whole policy lifecycle it does not offer the integration of other tools for example visualization and policy impact simulation.

The IMPACT project is focused on the automatic processing of arguments in a political debate, which is helpful once a specific policy topic has been identified. However the tools do not support the identification of a policy issue which is not yet on the public agenda as well as the policy implementation phase and subsequent evaluation.

The Cockpit project is focused only on the domain of new design of public services, which is a specific problem of policy design and implementation. Consequently the use of most of the tools is limited to this specific domain.

SOLUTION: THE FUPOL POLICY LIFECYCLE

Introduction

In order to address the linkage between policy process and ICT, a new model has been developed in the FUPOL project (FUPOL-Project, 2013). It uses the existing models as a base, but enriches them with a comprehensive, integrated and detailed breakdown of tasks as well as with a linkage to ICT technologies and benefits.

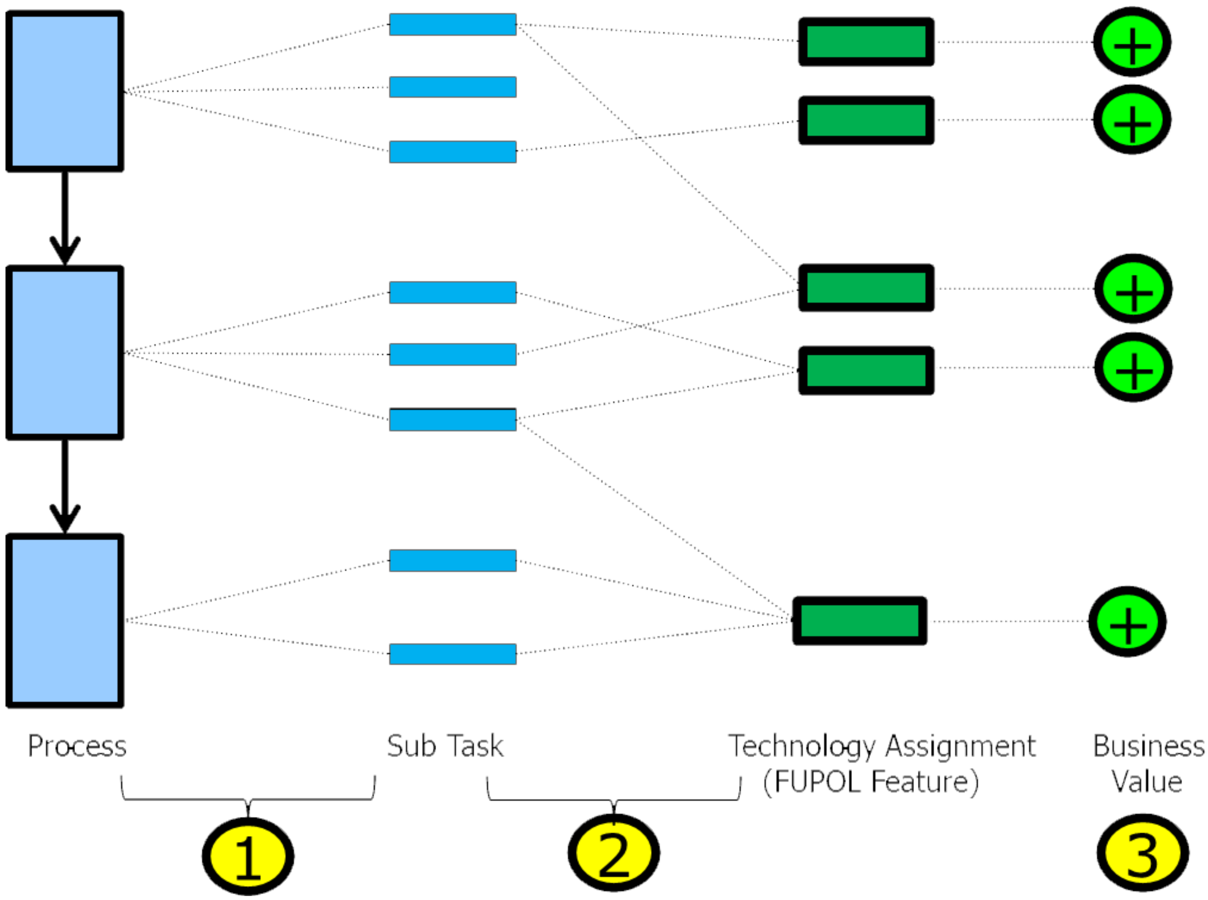
The novel FUPOL Policy Lifecycle is characterized by its six lifecycle stages, main-tasks and subtasks which are combined with technical features.

The picture shows the alignment of the several layers.

1. Each step in the policy lifecycle process has several subtasks.
2. For each step in the policy design process *one or more* technologies (FUPOL features) Support a specific step in the process.
3. Each feature has a business value for a certain stakeholder group.

The FUPOL policy life-cycle supports all levels of participation, such as

Figure 1. FUPOL Policy Lifecycle layers



- Information, which is a one way communication where the government or the policy distributes information to the stakeholders;
- Consultation, which is a two way communications and allows feedback from the citizens and other stakeholders based on issues previously defined by the government;
- Active participation, which is a partnership cooperation between the government and all relevant stakeholders (citizens, companies). The stakeholders are involved in the decision making process, respectively in the design of the policy document, in the implementation and evaluation of the policy measures; and
- Passive participation, to find out the citizens opinions about specific topics by crawling of media, social media, blogs etc.

In the following chapter we describe in detail the whole FUPOL policy process which can be divided into the following generic stages:

- Agenda setting, which allows the identification and the validation of a policy problem.
- Analysis, which is determined to identify the challenges and opportunities as well as the solution approaches linked to the identified policy problem.

- Policy Formulation & Policy Creation, which aims at drafting proposals for ratification based on policy options.
- Decision Making, which is the domain of the policy maker.
- Policy Implementation, which guarantees the implementation of the selected policy measures.
- Policy Monitoring & Evaluation, which includes forecast simulation, monitoring of key-indicators and impact evaluation.

The Figure 2 shows the overall process and the link between each stage of the Policy Lifecycle and its subdivision into single elements in relation to the main tasks and subtasks. Each of these elements of the overall process is described in the following chapters. The description of each element is supported by specific FUPOL software features. These software features are described in the chapter "Software modules supporting the FUPOL features and their Assignment to Subtasks" that follow after.

1. Agenda Setting

In the policy lifecycle stage called "agenda setting" the issues which should be addressed by the national or local government are discussed. It has to be found out either there is a need to define a policy measure for a specific topic or to amend an existing one. This is the first stage in the FUPOL Policy Lifecycle and indeed a very delicate one as it lays the cornerstone for the follow-up stages.

Ann Macintosh (2003) defines Agenda Setting

… establishing the need for a policy or a change in policy and defining what the problem to be addressed is. This may arise as the result of a change of government; a sudden change in the environment; a growing development; a new problem or a continuing problem. (Macintosh, 2003, p. 35)

Of course, the agenda setting stage is highly influenced by the media. They play an important role in the shaping of the political life and reality. It has to be considered that the constituents have access to all sort of medias like newspapers, radio, television, Internet etc. They are not only informed about the relevant topics which should be treated but also about their necessity and ranking. From the amount of information and the placement in the news the consumers of the mass media are briefed regarding the importance of the different political topics.

This insight is absolutely relevant for FUPOL, as the agenda setting process is supported by social media tools. The citizen and other relevant stakeholders are constantly addressed by campaigns to post their opinions with regard to specific topics. Especially the wording of the campaign text has a specific influence on the stakeholder´s response, in terms of quality and quantity.

1.1 Policy Problem Identification

Policy issues can be divided into two categories:

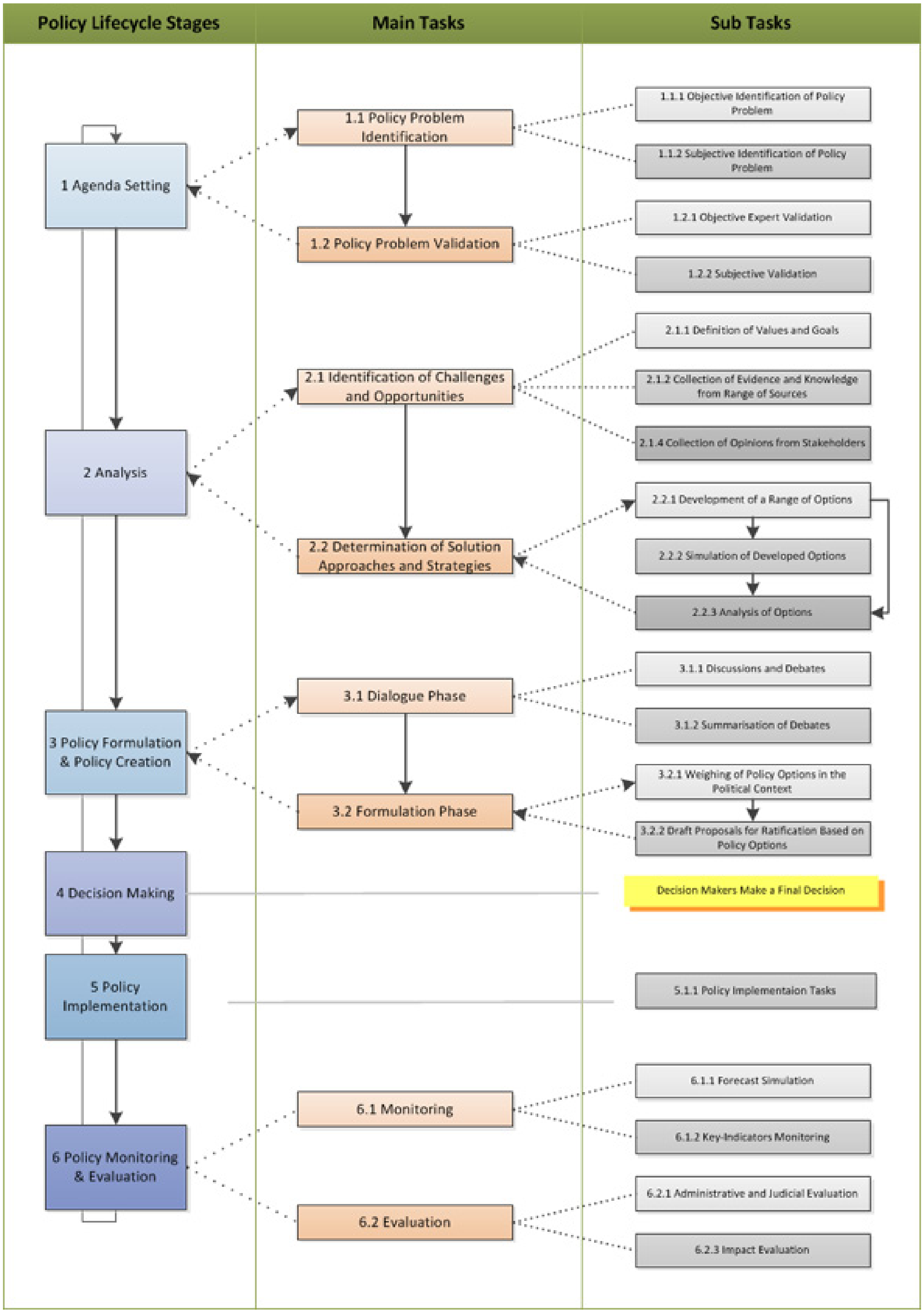
- Those which are already on the public policy agenda; and
- Those that are not.

If an issue is already on the public-policy agenda, it has a sufficiently high profile. A formal process to elaborate further on it is likely to be in place. If an issue is not on the public-policy agenda electronic tools can be used to identify it quickly.

Typically a policy issue will come up, appear and remain on the public policy agenda when it meets one or more of the following criteria.

The FUPOL Policy Lifecycle

Figure 2. Overview FUPOL Policy Lifecycle



- Involvement of a large number of people.
- Impact creation on the wellbeing of the citizens as a whole which has to be regulated (e.g. heavy traffic jams during rush hours which calls for alternative means of transport).
- Long-lasting existence and public discussion, which means this issue is of high relevance to the people.

But the selection of policy issues which will be considered by the government is highly influenced by international and domestic actors and the government itself. But this does not mean that the problem will be solved by passing through the whole policy lifecycle.

According to Ann Macintosh in the agenda setting the need for a policy or a change in policy has to be established. In addition the problem concerned has to be defined. This problem may arise as a result in changes in development or in the government. (Ann Macintosh, 2004). The active participation of citizen, civil servants and the chambers of commerce and industry association allows them to determine possible agenda items.

1.1.1 Objective Identification of Policy Problem

This refers to the identification of issues through analysis of statistical data. Issues are identified through deviation of indicators from predefined thresholds. Many studies and works around agenda setting concluded that cultural, political and other factors were less significant in the clarification of the public policy than economic factors.

The idea of the political business cycle was created and it assumes, that "the economy has its own internal dynamics, which on occasion are altered by political interference. In many countries the timing of this interference could be predicted by looking at key political events such as elections and budgets, which tend to occur with some degree of regularity in democratic states". (Howlett, 2009, p. 95)

In addition it has to be regarded that the political regime, the partisan ideology and the ideology of the political leaders outlines the frame of the economic policy.

Example: As described previously the objective problem identification is based on the analysis of the statistical data and or the deviation of indicators from predefined thresholds. The objective description of the policy problem is supported by the policy indicator dashboard and the visualization of statistical data. The most relevant indicators in urban economy which have to be monitored with respect of the development in this specific policy domain are described below. Definitions refer to the World Bank rules and guidelines.

- Gross Domestic Product, this is the market value of all officially recognized final goods and services produced within a city in a given period of time (The World Bank, 2013).
- GDP per capita, which is GDP divided by midyear population.
- GDP annual growth rate, that expresses the growth per year.
- National savings, which is the sum of private and public savings.
- Average personal income, which is the total personal income minus personal current taxes or the average household income.
- Percentage of households with less than half average income (or households below poverty line).
- Economic activity rate, what is the percentage of the population, both employed and unemployed resulting in the manpower supply of the labour market regardless of their current labour status.

- Proportion of skilled labour – this is a segment of the work force with a high skill level that creates significant economic value through the work performed.
- Proportion of unskilled labour, which is a segment of the work force associated with a low skill level or a limited economic level for the work performed.
- Purchasing power.
- Employment rate and employment growth rate.
- Informal employment rate.
- Unemployment rate.
- Average level of skills and education.
- Proportion of tertiary graduates.
- Public investment per capita.
- Private investment per capita.
- Energy consumption per capita.

The objective construction of a policy problem is supported in FUPOL by the visualization of statistical data.

1.1.2 Subjective Identification of Policy Problem

The subjective construction of a policy problem refers to the identification of topics from social media. In general world views, principal beliefs and causal ideas are relevant in the agenda setting process.

Example: The citizen or other stakeholders like government authorities or companies will discuss and identify their problems via social networks. Regarding the economic policy they most probably might complain about the following.

- High local taxes,
- Insufficient personal or household income,
- High unemployment rates,
- Bad business infrastructure,
- Missing business incentives to increase the employment rate.

The subjective construction of the policy problem is supported in FUPOL by 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.

1.2 Policy Problem Validation

In this stage it is checked, whether the problem identified is a real problem and should be taken further to an analysis stage.

1.2.1 Objective Expert Validation

The problems identified in the step subjective identification of Policy Problem (1.1.2) are checked again by experts, whether they are a real problem or not. The recommended methods are desk research and statistical data analysis.

Example: In case of complaints via postings in the social media domain experts are involved to validate either these postings are a real problem for the citizens, the companies and other stakeholders. This subtask is supported by the FUPOL Knowledge Database and the visualization of statistical data.

1.2.2 Subjective Validation

The problems identified in the step objective identification of policy problem are checked again by social media analysis and news analysis whether they are a real problem for the citizens and stakeholders.

Example: If the before mentioned indicators vary from the previously defined threshold values, the stakeholders will be further questioned via social media. It has to be found out if the deviation from predefined thresholds are a real problem for them or not. Let´s assume, in our example the current annual unemployment rate is 15%, which is above the threshold of e.g. 10%, especially for the younger generation up to 24 years. The government has to find out the acuteness and priority of the problem, in case it is one. In addition it is recommended to detect the alternatives such as provision of education and training and by whom they are supported.

The subjective validation is supported in FUPOL by the features for Hot Topic Sensing & Topic Summarization, social network aggregation and single window display, visual social data analysis and polling with questionnaires.

2. Analysis

2.1 Identification of Challenges and Opportunities

This phase refers to the identification of challenges and opportunities associated with an agenda item. In addition the goals and the development of criteria and indicators on how to measure the impact are required. During the analysis-phase knowledge and evidence has to be collected from a broad variety of sources. Consequently comprehensive desk research and statistical analysis is required.

2.1.1 Definition of Values and Goals

The FUPOL Policy Life Cycle proposes the definition of values and goals and the development of criteria and indicators on how to measure the impact in the policy topic in this phase.

Political actors set goals to meet the assumed needs of stakeholders. Consequently one of the steps in the policy analysis is the determination of goals. A goal answers the question "What is the policy supposed to do?" Note that a goal is an end, not a means to an end. Goals are abstract and general, whereas objectives are specific and concrete. A goal of a policy could be the strengthening of the families. The objective to reach the goal might be to enable mothers and fathers to take six weeks of unpaid leave to care for a new born and return to the job with no change in assignment or demotion.

The goals and objectives have to fulfil the S.M.A.R.T criteria (SMART, 2013) and specifies that they should be Specific, Measurable, Attainable, Relevant and Time-bound. In order to ensure that the targets are not forgotten, the goals and objectives should be evaluated and re-evaluated by reviewers. In order to facilitate policy goals their influencing factors must be determined from the very beginning.

Example: In the specific case with a low and declining employment rate the city will envisage a decrease of the unemployment rate from 15% to 12% within one year. This phase is supported in FUPOL by the features implementing the Knowledge Database and Visualization.

2.1.2 Collection of Evidence and Knowledge from a Range of Sources

This includes primarily collection of

- Research-based knowledge;
- Project implementation knowledge; and
- Statistics.

Research-based knowledge or scientific knowledge is perceived as highly credible and therefore used to underline certain positions in the policy process. However it has some shortcomings.

- It may take too long for the pace of the policy design.
- The scope and coverage may be too small.

Project and policy implementation knowledge is knowledge generated during the implementation of policy implementation projects and programmes, which is a very valuable source, because of its practical orientation.

Statistics and statistical information plays an important role in the policy modeling process, because of its objective character. It is also a very important input for simulations and forecasts.

Example: Evidence has to be collected from many resources such as case studies how the employment rate can be decreased under similar boundary conditions. This subtask is supported in FUPOL by the Knowledge Database and visualization and visualization of statistical data.

2.1.3 Collection of Opinions from Stakeholders

Already at this stage opinions can be collected actively from stakeholders as a preparation of the next phase.

Example: Opinions from the citizens and other stakeholders how the employment-situation could be improved have to be gathered by the use of social network aggregation and single window display, Opinion Maps and visual data analysis.

2.2 Determination of Solution Approaches and Strategies

2.2.1 Development of a Range of Options

In this phase a range of options including cost/benefit analysis have to be developed to support the decision making process. Cost/benefit analysis are well known as a systematic process for calculating and comparing benefits and cost of a project or of a government policy. Hence standard economic theories claim that economic efficiency, measured by the difference between benefits and costs, should be the criterion for making policy choices. This is highly criticized by governments and policy makers. Indeed, cost/benefit analysis can be very useful for comparing the favourable and unfavourable effects of policies. But cost/benefit analysis are not sufficient for the design of public policy, while they can provide an excellent basis and framework for subsequent analysis, which itself is required for the elaboration of options. In this phase much desk research, statistical analysis as well as social media and news analysis are required.

It has to be stated that the developing of options also include the identification of technical and political constraints (Howlett et.al., 2009, p. 112) actions. This seems very clear, but is not considered in policy proposals and might jeopardise the course of actions. Limitations have to be considered and feasibilities and un-feasibilities detected.

Example: In this stage civil servants, government staff and experts elaborate a range of options on how, for example, the unemployment rate could be decreased. Stakeholders are allowed to determine the range of options to improve the economic policy challenge. Unfortunately the range of options in the urban context is limited, because the economic policies are determined by national and international factors, such as taxes, GDP growth rate, infrastructure and business incentives.

In the case of economic policy there are many stakeholders to be involved, like companies, residents, representatives of business organisations and labour organizations, eventually environmental interest groups as well. The developing of options can be supported by the use in FUPOL of the features supporting the knowledge database and visualization, Visual Fuzzy Cognitive Maps and the Community Feedback Platform.

2.2.2 Simulation of Developed Options

This step is not mandatory and means that the impact of the policy is simulated. Typically policy issues are complex that is why Fuzzy Cognitive Maps are proposed to capture all aspects of an issue with related indicators.

Example: An economy is a very complex system in which the impact of interventions cannot easily be determined. The first main objective of the economic simulation is to determine the impact of local policy decisions on the economic parameters of the city. This means different alternatives can be simulated and the impact can be matched. It is suggested to compare the difference, if no policy change is implemented. This is shown as the initial, or so-called baseline forecast. The second objective is to forecast and anticipate future economic developments.

A simulation tool has the advantage that the impact of a policy can be tested in a de-facto laboratory environment and evaluated to decide whether a certain change is desirable or not. The simulated result or impact of the policy decisions can be visualized too. The output of the simulation can be discussed on social media to make it transparent to the public.

2.2.3 Analysis of Options

This includes various characteristics of the options such as impact, costs, efforts, risks etc. involved.

Example: After impact simulation of economic policy changes, the selected options have to be analysed precisely regarding their impact, risks, efforts and costs.

In addition to the impact in this phase the predicted costs have to be elaborated too. They might incur for the provision of additional infrastructure and land, tax cuts to attract these companies, etc. The risks might be an increase of air pollution caused by rising industrial production or an increase in passenger or freight traffic. These impact, effort, cost and risk analysis have to be elaborated for all selected options. Stakeholders are asked for their inputs too.

The option analysis phase will be supported in FUPOL by the knowledge data base and visualization.

3. Policy Formulation and Policy Creation

3.1 Dialogue Phase

This phase aims at establishing a dialogue for reaching a consensus based on the analysis of the options and finally chose among the various policy alternatives.

3.1.1 Discussions and Debates

This stage refers to discussions and deliberations through various channels such as

- Social media,
- Press,
- Television,
- Expert groups meetings,
- Meetings with interest groups,
- Public hearings,
- Town hall meetings, etc.

Example: In case the number of start-ups has to be stimulated, it would be advisable to arrange meetings with the different interest groups, such as residents, representatives of business organisations and labour organization. The social media should be used for further enhance the stakeholder participation. This stage is supported in FUPOL by social network aggregation and single window display, Opinion Maps, visual social data analysis, Community Feedback Platform and Outgoing Multichannel Social Media Single Window Messaging.

3.1.2 Summarisation of Debates

Results are summarized and published on electronic and non-electronic channels, such as press, conferences, etc., so they are available to the public.

Example: The results of the debates regarding the selected options based on the analysis will be provided to the general public. The results will be extracted by FUPOL via hot topic sensing and published via Outgoing Multichannel Social Media Single Window Messaging.

3.2 Formulation Phase

This phase should ensure the creation of a good policy document based on formal consultations, risk analysis and pilot studies. This is primarily the responsibility of domain experts, who could be external consultants and government officials. Active participation is limited in this phase.

3.2.1 Weighing of Policy Options in the Political Context

This refers to the evaluation and fine-tuning of the intended policy in the current legal, organizational and political context. For example a policy could achieve the intended impact, but it would not find a majority in the decision making bodies or it violates other laws or fundamental rights or exceeds organizational capacities. To reduce the risk of miscarried policy proposals the identification of constraints in the subtask developing of options subtask should be treated very carefully.

3.2.2 Draft Proposals for Ratification Based on Policy Options

One or more alternative fine-tuned policy proposals are drafted for ratification in the decision making bodies.

Example: This means in our example regarding economic development that a complete policy paper for the provision of business incentives and allocation of land for industrial settlement will be designed. Public participation is not foreseen in this stage.

4. Decision Making

The decision making stage of the Policy Lifecycle is nearly the same as that of the agenda setting, the analysis and the policy formulation and creation stage. It is completely affected by the domestic actors, their institutional setting and their ideas, the global or international influence and by the constraints under which decision makers operate. A focus on these variables can help to predict the type of outcome likely to arise from the particular style of decision adopted in the policy process in question (Howlett et.al., 2009, p.158).

Based on the fine tuned policy proposals and the resulting policy document elaborated in the policy formulation phase a decision is made by the relevant decision making body. This could be for example an assembly of representatives, a politician or a decision maker in the civil service. The policy document takes into account all the information from statistics, documents, social media and simulations. The decision making process itself is a political and not a technical one and public participation is not foreseen in this phase. At this stage the overall benefit of the FUPOL approach and its tools will be reaped. The decision will be better documented and will have a better acceptance level by the stakeholders.

5. Policy Implementation

After the authorization of a policy it has to be put into effect by the administrators or executives. The implementation inspires little interest among the general public, unless it fails. That's why the implementation process should be accompanied by citizen participation to guarantee a transparent, cooperative and successful one. The best policy paper is worthless without a well executed implementation.

The policy implementation is the process whereby a written policy is turned into actions which have a positive or negative influence on peoples´ lives. The policy inputs include all actions to be taken for the implementation of a policy. For example, the inputs for an economic policy could encompass the provision of specific schools, apprentice trainings, universities etc. After implementation, especially after policy enforcement, the policy outputs, which are goods and services produced by a policy, could be evidenced by the number of educated and trained people. This has to be evaluated in the evaluation phase. Policy outcomes represents the knowledge and skills required by the trained and educated people which could result, accompanied by the increased provision of working places, in a prospering economic development.

5.1. Policy Implementation Tasks

The implementation tasks comprise all activities required to implement the policy. These tasks include the creation or provision of organisations and the establishment of regulatory and legal frameworks to support the actions. Hence implementation has many facets and therefore cannot be described extensively. It includes tasks such as budgetary measures, public relation actions, organisation changes and staff recruiting. Budgetary measures in general are required for the funding of the policy strategy. Organisational changes might be required to carry out all the envisaged activities and additional staff might be required too to overtake the responsibilities.

An important aspect is the selection of the policy enforcement instrument. Policies can be implemented in a number of ways, with means by various policy tools or policy instruments. A policy statement indicates what should be received including the content of the policy, the organisation and the persons responsible for carrying out the activities. The tool or instrument is the method by which the desired effect is pursued.

The most important policy instruments are specified below.

- Regulations, such as taxes and fees, subsidies, tariffs and fines.
- Communication by the policy actors during speeches, conferences, debates and advisory committees.
- Funding via programs, grants, subsidies, transfers and market-based incentives.
- Public Ownership in form of corporations and mixed ownership.

People who are responsible for the policy enforcement have to be authorized. In general these are civil servants and administrate officials who establish and manage the change process.

Example: For fostering the economic development and the wellbeing of citizens many activities have to be launched. The most important ones are specified below.

- Budget allocations are required to grant subsidies and other incentives, to provide development of infrastructure and to guarantee suitable skill development.
- Organisational measures, such as the foundation of an office including recruiting of staff to support and finance start-ups.
- Public relations activities are essential to attract new businesses and to change the mind-set of companies and employees.
- Legal actions comprising legislation and elaboration of specific guidelines, will be required for implementation.

Economic development can be implemented by various policy tools, such as laws, regulations, action plans, etc. On the city level this is typically done by

- Local tax rate (taxes on the regional/city level),
- Laws on business incentives / direct subsidies,
- Laws related to land use policy (allocation of land).

This task will be supported in FUPOL by the features for Outgoing Multichannel Social Media Single Window Messaging, Community Feedback Platform, visualization of statistical data, Opinion Maps and social network aggregation and single window display.

6. Policy Monitoring and Evaluation

Policy makers, companies and the public want to know which policies work and which policies don't. Consequently the aim of the evaluation is to determine whether an implemented policy is doing what it is supposed to.

The terms 'monitoring' and 'evaluation' are often used together. This is why monitoring and evaluation are an embedded concept and essential in every policy process. It is seen as a dialog between the stakeholders and the development progress of the policy measure.

Monitoring the policy - and the values and goals defined in the analysis phase - enables a determination of positive or negative effects for the target group. Monitoring is a long-term process, because many programs have long-term effects that will not be known in the short term. Evaluation can be divided into formative and summative evaluation (CIVICUS).

Formative evaluation examines the operations of the program, usually for the purpose of improving the program and assessing its implementation with operational key indicators, such as number of people participating, etc. Summative evaluation checks whether the policy achieved its intended goals as defined in the analysis phase or not. Changes should be suggested in the policy monitoring and evaluation phase and the process can loop back into stage 1 (agenda setting) as the policy may be modified on the basis of experience with implementation.

6.1 Monitoring

Monitoring is usually understood to be an on-going activity that takes place during policy implementation. Monitoring is checking progress against plans. The aim is to trace and adjust the process as it is unfolding. Information gathered in relation to these aspects during the monitoring process provides the basis for the evaluative analysis.

6.1.1 Forecast Simulation

The simulation can be used to forecast future impact at any time using actual figures and as such contribute to the monitoring of the implemented policy.

Example: The permanent simulation of the impact can be used to forecast future impacts at any time using actual figures and contributes to the evaluation of the implemented policy. This might be the impact of attracting new companies on the employment rate that can be simulated continuously. In FUPOL the simulation can be supported by visualization too.

6.1.2 Key-Indicators Monitoring

Monitoring means to use quantifiable indicators to measure the policy implementation progress. It should help stakeholders to verify that targets are being met and policy makers to know whether the policy is working. It certainly involves the development of methods for effective data-collection and management.

Example: The key indicators specified in the analysis phase can be monitored continuously too. The monitoring of key indicators is supported by visualization.

6.2 Evaluation

Evaluation, on the other hand, is generally conducted at the end of an implementation period. Evaluations should help to draw conclusions about main aspects of the intervention (ESCAP Virtual Conference, 2003).

- Effectiveness, which expresses the degree to which the policy measure attains the previously defined objectives and goals.
- Efficiency outlines the extent to which the effort, costs and time is well used to reach the envisaged outcome. The total cost has to be lower than the benefits.

- Flexibility expresses the extent to which the policies can be adjusted to changing circumstances.
- Equity of policy measures means that they are fair to the people concerned.
- Institutional constraints which means that policies have to be in line with the existing legislation.
- Community acceptance expresses the extent to which the community accepts the policy.

The aim is usually to help decision-makers assess the overall difference a policy made compared with the previous situation.

6.2.1 Administrative and Judicial Evaluation

Administrative evaluation is generally practiced within governmental bodies to evaluate the policies and the effectiveness of the government services. Administrative evaluation should guarantee that the envisaged goals can be reached. Judicial or legal evaluation is concerned with the process on how government programmes are implemented. It is not concerned with budgets, etc.

Example: The evaluation focus on how the economic policy is implemented.

6.2.2 Impact Evaluation

The impact evaluation estimates the changes which result from the implemented policy. The impact evaluation even compares the outcome of the policy and what would have happened in case of the absence of the policy.

SOFTWARE MODULES SUPPORTING THE FUPOL FEATURES AND THEIR ASSIGNMENT TO SUBTASKS

The various FUPOL features and technologies can be used in several subtasks of the policy process and are described below.

- Data Integration and Storage.
- Unified Integrated User Interface
- Policy Indicator Dashboard.
- Social network aggregation and single window display.
- Hot Topic Sensing & Topic Summarization.
- Community Feedback Platform.
- Visualization of statistical data.
- Visual social data analysis.
- Knowledge database and visualization.
- Outgoing Multichannel Social Media Single Window Messaging.
- Opinion Maps.
- Simulation and impact visualization.
- Visual Fuzzy Cognitive Maps.

These set of these FUPOL software features represent a tool kit that support the integration and implementation of the overall Policy Lifecycle. Although the objective of FUPOL is to enable the integration of the full Policy Lifecycle it must be noted the FUPOL software features can be used separately to implement only portions of the Policy Lifecycle if this is required by specific policy needs (see Table 1).

Data Integration and Storage

One of the most important features of the FUPOL Core Platform is that it provides access to a comprehensive set of data. This includes statistical data from various sources (Eurostat, regional/local data,...), semantic data - mainly from social media, geographical data, knowledge data, operational data, such as user accounts, user activity data, clients, journals, etc.

Unified Integrated User Interface

User interface integration in FUPOIL means that two applications are integrated so that a user can carry out an operation that involves two different applications – without having to take into account that somebody is actually running two applications.

Table 1. FUPOL Policy Lifecycle subtasks and assigned technologies

Policy Life Cycle	Policy Indicator Dashboard	Social Network Aggregation and Single Window Display	Hot Topic Sensing & Topic Summarization	Opinion Maps	Knowledge Database and Visualization	Visual Social Data Analysis	Visual Fuzzy Cognitive Maps	Visualization of Statistical Data	Community Feedback Platform	Outgoing Multichannel Social Media Single Window Messaging	Simulation and Impact Visualization
Agenda Setting (1)											
Policy Problem Identification (1.1)											
Objective Identification of Policy Problem (1.1.1)	X							X			
Subjective Identification of Policy Problem (1.1.2)		X	X	X		X					
Policy Problem Validation (1.2)											
Objective Expert Validation (1.2.1)					X			X			
Subjective Validation (1.2.2)		X	X			X					
Analysis (2)											
Identification of Challenges and Opportunities (2.1)											
Definition of Values and Goals (2.1.1)					X						
Collection of Evidence and Knowledge from a Range of Sources (2.1.2)					X			X			
Collection of Opinions from Stakeholders (2.1.3)		X		X		X					
Determination of Solution Approaches and Strategies (2.2)											
Development of a Range of Options (2.2.1)					X		X		X		
Simulation of Developed Options(2.2.2)											X
Analysis of Options(2.2.3)					X						
Policy Formulation and Policy Creation (3)											
Dialogue Phase (3.1)											
Discussions and Debates (3.1.1)		X		X		X			X	X	
Summarization of Debates(3.1.2)			X							X	

continued on following page

Table 1. Continued

Policy Life Cycle	Policy Indicator Dashboard	Social Network Aggregation and Single Window Display	Hot Topic Sensing & Topic Summarization	Opinion Maps	Knowledge Database and Visualization	Visual Social Data Analysis	Visual Fuzzy Cognitive Maps	Visualization of Statistical Data	Community Feedback Platform	Outgoing Multichannel Social Media Single Window Messaging	Simulation and Impact Visualization
Formulation Phase (3.2)											
Weighing of Policy Options in the Political Context(3.2.1)											
Draft Proposals for Ratification Based on Policy Options (3.2.2)											
Decision Making (4)											
Policy Implementation (5)											
Policy Implementation Tasks (5.1)		X	X	X					X	X	
Policy Monitoring and Evaluation (6)											
Monitoring (6.1)											
Forecast Simulation (6.1.1)											X
Key-Indicators Monitoring (6.1.2)	X							X			
Evaluation (6.2)											
Administrative and Judicial Evaluation (6.2.1)											
Impact Evaluation (6.2.2)								X			

Policy Indicator Dashboard

The policy indicator dashboard visualizes various indicators and flags if they are below / above thresholds or certain conditions are fulfilled. The dashboard is intended as a tool for decision makers and advisors to set context and perspective when evaluating the current state of policy domains in the city.

Hot Topic Sensing and Topic Summarization

Hot Topic Sensing (HTS) is a web and social network analytics tool that analyses data from social networks, newspapers, forums, blogs, etc. and identify relevant topics. The purpose of the HTS is to help with the identification of community needs through Machine Learning and NLP (Natural Language Processing) algorithms. Postings from various social media are analysed and “Hot” topics are extracted.

Topic Summarization means that a summary of postings is created, which reflects the opinions of the postings in brief.

Community Feedback Platform

The Community Feedback Platform is inspired by Crowd Sourcing platforms and is designed to enhance cognitive processes in a similar vein as traditional Idea Management Systems (IMS). The purpose of the system is to facilitate the idea analysis and selection processes.

- Create a campaign focused in a desired topic.
- Start ideation process: communities write ideas comment and vote on them.
- Select promising ideas and ranking from different point of views.
- The best promising ideas can be implemented.

Though similar to a classical IMS, the FUPOL Community Feedback Platform is augmented with novel features that extend its functionality beyond what is normally associated with an IMS.

- A view on the collected space of citizens expression from different sources of information, such as blogs, social media and forums.
- Provision of the capability to enrich the space by different means such as commenting/voting as a facilitator.
- Analytics toolkit, such as computing: trends, topics, sentiments.

Visualization of Statistical Data

In the described process of policy modeling, the aspect of problem identification plays a key-role for the whole policy design process. The need for getting valid information about certain topics and policy indicators is essential for setting the agenda for a new possible policy. Visualizing these valid and proved data provides a more useful instrument to gather information by comparing, associating, correlating and identifying various data, data-attributes or indicators.

Visual Social Data Analysis

Besides valid and objective data, the investigation of subjective values is important for identifying problems and gathering information about the “social impact”. The method of choice to analyse based on ICT-tools the social impact is Social Network Analysis (SNA). SNA enables the analysis of social networks and the identification of opinion leaders by measuring and mapping the relationships and flows between people, groups, organizations and other connected information or knowledge entities. The nodes in the network are the people and groups while the links show relationships or flows between the nodes. Their interactive visual representation provides a quick comprehension of the relation of topics to influence actors or topics of general interest. Further it provides an explorative approach for navigating through such networks and gathering more knowledge about the related topics. Especially the identification of opinion leaders is important. An opinion leader is an active media user, who interprets the meaning of media messages or content for lower-end media users. Typically the opinion leader is held in high esteem by those who accept his or her opinions.

In all stages of the policy lifecycle process it is important to know the structure of the social network related to a policy issue and identify opinion leaders, follow them and eventually also contact them directly (peer influencing strategy).

FUPOL Knowledge Database and Visualization

In various steps of the FUPOL process model, the acquisition of information and the generation of knowledge play an essential role. The web provides increasing and rising knowledge repositories that enables for example to validate hypothesis for experts, or explores options. The FUPOL Knowledge Database stores multimedia documents and links them to campaigns and political topics, providing context related information to the user".

It enables a user to search for knowledge in different external (web) data and internal (FUPOL) sources and combines visualizations in visual cockpit metaphor for various policy tasks. A user is able to view on web-knowledge to validate for example an identified policy problem and gather related implicit information.

Outgoing Multichannel Social Media Single Window Messaging

This is the capability of posting messages to various channels (social media targets) at the same time without the need to manually post to each site separately. FUPOL supports active social media usage by providing posting messages to various channels (social media targets) at the same time without the need to manually use those sites directly.

Opinion Maps

Many political debates in a city have a reference to some specific spots. People have opinions on upcoming construction projects, on the place for a new bus station or they just want to tell you that there's some broken traffic light there.

FUPOL provides the Opinion Map as a tool for geo-referenced interaction. Opinion Maps are interactive electronic maps that can be integrated into almost any internal or external web site.

So for example the municipality can use the city's existing blog for starting a political debate related to some construction project. The opinion map can be integrated seamlessly into their blog and e-Citizens are now able to express their opinions by interacting with that map.

Simulation and Impact Visualization

The simulation enables a virtual evaluation of policies. Therefore the statistical history of indicators is used to generate forecast based on mathematical models, in dependency of identified influencing indicators which can be addressed with a policy.

A simulation tool has the advantage that the impact of a policy can be tested in a de-facto laboratory environment and evaluated to decide whether a certain change is desirable or not.

Fuzzy Cognitive Map

A fuzzy cognitive map (FCM) represents a system as a network showing the directed causal relations between its elements through arrows. It graphically represents the beliefs and perceptions that a person holds about a specific question or system and is created during interviews. A factor or node in the network stands for a key-factor of the system. The directed links show the causal relations between factors. The relations between the elements can be used to compute the "strength of impact" of these elements. FCM can be applied in group sessions or in interviews with single persons, depending on the requirements. In such session issues which are highly uncertain or to which conflicting views exist can be easily detected.

The "visual" element of FCM provides a comprehensive view on the underlying topic and relations. Therefore graph-based visualization with weighting algorithms for the FCM outcomes are used. The comprehensive view on the relations provides more transparency.

From the visualization point of view the FCM describes in its major presentation a graph, i.e. it can be shown as node-graph visualization. Therefore the used data for the definition of the FCM is close to existing graph-based definition formats. For the final integration into FUPOL the focus lays on the visualization just as graph with labels for additional explanations on the node and edges. To allow interactivity, a linking between the FCM and the considered model in the background and the simulation as analysis tool is provided. The new FCM will be visualized by the end users and they will be allowed to check the effects of changing the value-force assigned to the different concepts represented in the FCM.

FUTURE RESEARCH DIRECTIONS

An important milestone to meet future requirements in the domain of policy modeling is the FP7 crossover project, finalized at the beginning of 2013. The major objectives of this European Coordination and Support Action project was bridging the gaps between politicians, experts and the public at large for the sake of an improved and transparent policy making process. (Osimo, 2013)

The most important outputs of the crossover-project are an international research roadmap and a knowledge database. The international research roadmap for governance and policy modeling provides a detailed illustration of available and upcoming tools for the promotion of policy modeling. In addition a comprehensive set of worldwide use cases including solutions is offered. The knowledge database contains tools, methods and knowledge respecting the governance and policy modeling research domains.

In the policy modeling workflow specifically future research should focus on the lack of appropriate ICT support for the decision making itself. Research should focus on ICT-solutions which are able to at least propose optimized decisions to policy makers.

CONCLUSION

The chapter is focused on the policy lifecycle process itself and a methodology how to link the process to various supporting technologies. The policy lifecycle is analysed and described in a systematic way including all steps in high detail.

In order to work out current shortcomings conventional policy modeling models, process models which investigate ICT in the process model as well as European research projects (FP7) have been analysed.

The results reveal that the main shortcomings are

1. Existing Policy Lifecycle models are not detailed enough to allow a proper and future-proof assignment of technologies.
2. Current ICT solutions supporting e-Participation and policy modeling are focused on solving a specific problem. They are only partly integrated both on the conceptual and the technical level.

In order to overcome the above mentioned shortcomings a highly detailed process including six main processes, tasks and subtasks is worked out. Subsequently the subtasks of the process are linked to available technologies. The methodology is deemed future-proof and flexible, since it allows to easily assign future emerging technologies to the policy lifecycle. However it is the decision of the policy maker and supporting experts to evaluate if, for a specific policy model, all steps are necessary. FUPOL enables not only the implementation of the full policy modell process but also a subset of the process depending on needs and the specific policy to be addressed.

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KEY TERMS AND DEFINITIONS

eGovernance: Means that governance is driven by ICT whilst delivering government or public services and products.

eParticipation: The support and enhancement of public participation in the government decision making process by ICT, especially by social media.

FUPOL (Future Policy Modeling): An FP7 project providing an integrated approach to e-Governance, e-participation and policy modeling.

Hot Topic: A cluster with similar postings.

ICT Tools for Policy Design and Implementation: Are all features required and available to increase the quality and acceptance of policy measure by the public, such as social media tools, opinion maps, hot topic sensing, visualization and simulation tools.

Policy Lifecycle: The life cycle of a policy, beginning from its identification and analysation, its detailed formulation, the decision making process, its implementation and the monitoring and evaluation of the policy impact.

Policy Modeling: The representation of the real life policy in a model and to predict the impact of policy measures in a de facto laboratory environment.

Section 2

Simulation Methods and Software for Policy Modeling

Chapter 6
Causal Modeling to Foster E-Participation in the Policy Decision-Making Life-Cycle

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ABSTRACT

Digital simulation techniques could contribute increasing citizen participation in urban policy design by transforming their opinions into valuable knowledge by means of evaluating certain decisions in a digital urban scenario that would facilitate the understanding of the impact of different choices not only in the urban scenario under study but also in different, hidden indicators (i.e. dynamics not considered by a citizen due to limited cognitive horizons). Furthermore, the trial and error experimental approach inherent in simulation models could act as an enabler of open deliberations between citizens to foster a mutual learning process of the complex urban dynamics. The aim of this chapter is to illustrate the benefits of causal modeling with respect to other commercialized approaches to develop simulation models that could fulfill the transparency and acceptability requirements to foster e-participation, taking into consideration the demands and skills of the multiple and heterogeneous users of urban policy models.

INTRODUCTION

Since Web 2.0, several forms of collaboration and technical solutions have emerged as online applications for public participation with the aim of encouraging citizens to discuss current issues related to their environment and to improve the process of public participation in general. An example can be seen in the integration of geographic information systems (GISs) with public participatory tools, which has represented one of the latest innovations in this area. Despite several efforts providing better graphical user interface tools which can be used by non-experts without intense training, such as those based on Google Maps and Google Earth, Moody (2007) demonstrated that the use of GIS technology and other map-based applications to involve citizens

DOI: 10.4018/978-1-4666-6236-0.ch006

in participatory urban planning does not seem to empower them. Thus, a relevant question to enhance e-participation in urban planning still awaits a solution: how can we overcome present barriers and attract additional citizens to participate and contribute during the decision making process in urban planning?

When trying to involve citizens in different decision making processes, the effect of rational ignorance (Krek, A. 2005) has been observed, and according to rational choice theory, it states that ignorance about an issue is said to be rational when the cost of educating oneself about the issue sufficiently to make an informed decision can outweigh any potential benefit one could reasonably expect to gain from that decision, and so it would be irrational to waste time doing so.

Rational Ignorance is increased when citizens feel that they cannot really influence the final planning decisions due to opinion really lacks of a proper value to influence in the urban planning policy. This is a consequence of the alternatives in the decision making process, which are characterized by a complex process of interdependent relationship between controllable, observable and influence variables. For most citizens the personal benefit of getting involved in planning activities through an ICT platform is usually little while the cost of participation is rather high when they lack the solid knowledge to uphold their choices in a competitive context.

Among the different factors that make citizens become rationally ignorant, such as poor information dissemination and/or lack of understanding of the different dimensions of the planning problem, it is worthwhile to pay particular attention to the lack of understanding of a multi-minded social system in which conflicts, cooperation, competition and coalition emerge easily.

To reach a mutual understanding among neighbourhoods and different stakeholders (citizens, city officers, experts in the field, etc.), e-participation should be seen as the end result of a developmental approach instead of its beginning. The success of e-participation it to foster a mutual understanding of the different choices trying to accept a trade-off in which an acceptable compromise between the different targets can be accepted through a proper understanding of the interdependent relationships between the different forces, interests and constraints that emerge between the human, financial and technical domains.

It is worthwhile to note, that most e-participation tools which rely solely on social networks are oriented mainly to the emotional and the cultural dimension of the choice process, while the rational dimension is weakened. The emotional and cultural dimension used to contribute to opinion exchange in informal and casual discussions while the rational dimension contributes with instrumental and extrinsic values, which is a requirement to be involved in an interactive process in a multi-minded socio-cultural system in which a mutual learning approach is sought. So, the use of ICT to share with others who live in the same social setting their worldview (i.e. mental model or image) is not enough to move towards a shared image of a community in which the individual images have been transformed through an interacting process till coincides with common understanding of the problem and the trade-off solution.

In order to drive the e-participation process through a mutual learning methodology in which new sets of urban alternatives and planning objectives could emerge, looking for more desirable possibilities for the future, new tools to empower citizens with a better knowledge about the planning decision process will be required.

A successful and motivating approach to enhance the rational dimension of citizens in the urban planning through e-participation is the use of online serious games (Alenka Poplin, 2012) to potentially bring playfulness and pleasure to the serious processes of urban planning decisions with public participation. One important aspect on which urban planning can utilise serious games is the use of a model to represent the urban scenario together with a simulation engine that allows the end-user to experiment several times with different strategies to maximize a certain reward or minimize certain costs.

In FUPOL, the use of simulation models has been enhanced to potentially address the issue of rational ignorance by attracting more people to participate in and learn about urban planning situations. Their participation might provide valuable input for the urban planners and will hopefully result in new insights into urban planning.

Thus, this chapter focus mainly on the use of simulation models to enhance the rational choice of citizens when they are involved in a particular urban planning problem through e-participation.

BACKGROUND

Simulation Models: A Key Resource for Citizens' Participation in Urban Planning

Digital simulation can be defined as the imitation of the operation of a real-world process or system over time using a computer. In its broadest sense, simulation can be seen as a tool to predict the behaviour and the performance of a system, existing or proposed, under different configurations of interest and over long periods of real time. To deal with a simulation, first of all a description of how the system under study will perform in a certain operational context is required.

Thus, a digital simulation involves the design of the model of the system to carry out several experiments on it. A model can be used to describe how a real-world activity will perform, but also can be seen as a tool to enable hypotheses to be tested at a fraction of the cost of actually undertaking the activities which the models simulate. Among the several benefits of experimenting with simulation, the following list mentions the most relevant to urban planning:

- Predicting the performance of different urban designs.
- Understanding why observed events occur.
- Identifying problem areas before implementation.
- Exploring the effects of introducing major changes or minor modifications.

To enhance fruitful e-participation dealing with new insights into urban planning, the following aspects should be considered during the design of the simulation model:

- Acceptance of the boundary conditions: boundary conditions are exogenous variables that are initially fixed by the planning department; however, end users can modify them if they consider they are not good enough. The results of the simulation can be affected and they can be reported to the city council if they are trusted and relevant.
- Evaluate ideas and identify inefficiencies: End users should be involved in the exploitation of the simulation model by understanding the underlying dynamics specified in the model, and introducing modifications (mainly by changing parameter values) that could lead to the expected improvements.
- Gain insight and stimulate creative thinking: working in a simulation environment to deal with a trade-off solution of a complex planning problem contributes to increasing the users' understanding and acceptance, improving requirements determination and reducing problems.
- Communicate the integrity and feasibility of the results: a critical aspect of the use of simulation models instead of "serious games" is the acceptance that the results generated by the simulator would be similar to the ones obtained in the deployment

of the policy designed. Thus, this acceptability will provide the spark to mitigate the rational ignorance while motivating for rational choices in urban planning.

Coloured Petri Nets

Among the different modeling specifications, the coloured Petri net formalisms (CPN) (Moore and Gupta 1996, Jensen 1997, Christensen et al. 2001, Mujica and Piera 2011) has been widely used by the simulation community for different purposes. It has characteristics that allow modeling true concurrency, parallelism or conflicting situations present in dynamic systems. The formalism allows not only developing dynamic discrete-event oriented models without ambiguity and in a formal way but also it allows modeling of the information flow, which is an important characteristic and very useful in systems modeling and decision making.

The semantics of the modeling formalism can be defined as follows.

A Coloured Petri Net is a tuple:

$$CPN = (\Sigma, P, T, A, N, C, G, E, I)$$

where,

- $\sum = \{C_1, C_2, \ldots, C_{nc}\}$ represent the finite and not-empty set of colours. They allow the attribute specification of each modelled entity.
- $P = \{P_1, P_2, \ldots, P_{np}\}$ represent the finite set of place nodes.
- $T = \{T_1, T_2, \ldots, T_{nt}\}$ represent the set of transition nodes such that $P \cap T = \varnothing$ which normally are associated to activities in the real system.
- $A = \{A_1, A_2, \ldots, A_{na}\}$ represent the directed arc set, which relate transition and place nodes such as $A \subseteq P \times T \cup T \times P$
- N = It is the node function $N(A_i)$, which is associated to the input and output arcs. If one is a place node then the other must be a transition node and vice versa.
- C = is the colour set functions, $C(P_i)$, which specify the combination of colours for each place node such as
- C: $P \rightarrow \sum$.
- $C(P_i) + C_j \;\; P_i \in P, C_j \in \Sigma$
- G = Guard function, is associated with transition nodes, $G(T_i)$, G: $T \rightarrow$ EXPR. It is normally used to inhibit the event associated with the transition upon the attribute values of the processed entities. If the processed entities satisfy the arc expression but not the guard, the transition will not be enabled.
- E = These are the arc expressions $E(A_i)$ such as E: $A \rightarrow$ EXPR. For the input arcs they specify the quantity and type of entities that can be selected among the ones present in the place node in order to enable the transition. When dealing with an output place, they specify the values of the output tokens for the state generated when transition fires.
- I = Initialization function $I(P_i)$, allows the value specification for the initial entities in the place nodes at the beginning of the simulation. It is the initial state for a particular scenario.
- EXPR denotes logic expressions provided by any inscription language (logic, functional, etc.).
- The state of every CPN model is also called the marking, which is composed by the expressions associated with each place p, and they must be closed expressions i.e. they cannot have any free variables.

The formalism can be graphically represented by circles, called place nodes, rectangles or solid lines, called transition nodes and directed arrows called "arcs" that connect one transition with one place node or a place node with one transition.

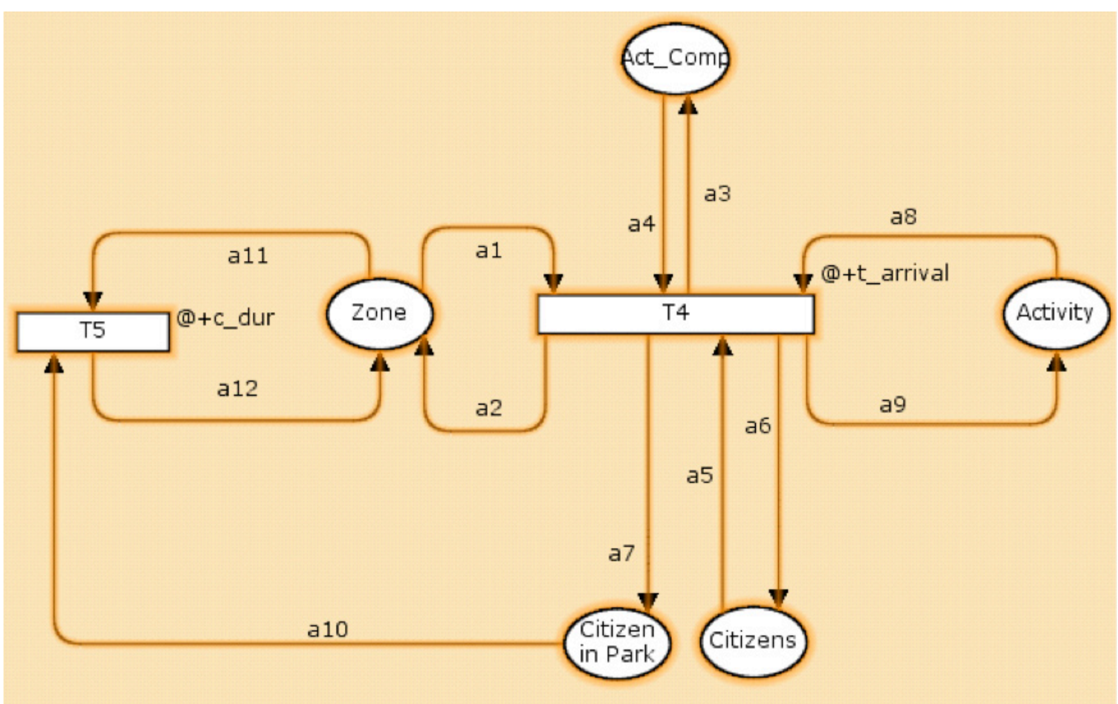
In order to model the occurrences of activities, the input place nodes to a transition node must have at least the same number of entities (called tokens) as the correspondent arc weight, and the colours of the potential tokens must satisfy the expressions associated with the colours in the arc expressions. The Boolean condition attached to the transition (guard) must be the final restriction that must be fulfilled in order for the transition to occur. When all the latter conditions are satisfied then the transition can be "fired" which means that the entities that satisfy the mentioned conditions are destroyed from the original input place nodes and new entities (i.e. tokens) are created in the output place nodes of the transition. The new tokens are created with the characteristics and quantities stated in the colours and output arc weights respectively.

Traditionally, place nodes are used to model resource availability or logic conditions which need to be satisfied. The transition nodes can be associated with activities of the social system or social actors.

In the case of social systems these transition nodes could represent activities or decisions to be taken by each agent. Thus, the information attached to each transition is used as a base to define the agent behaviour rules. These rules will depend on the token's attributes, and they will define the activities to be performed, the time frame and the companion when performing the activity. For example, in Figure 1, transitions describing the initialization and finalization of an activity in one zone of a Green Park are presented.

Transition T4 will start the performance of the activities if there is enough space in the zone, and there is not any incompatible activity being performed at the same time. After the end of the duration time, citizens will leave the zone (T5).

Figure 1. CPN of initialization and finalization of an activity in one zone



The 3 most relevant place nodes in Figure 1 are: "Zone", "Citizen" and "Activity". "Citizen in Park" and "Act_Comp" are additional nodes indicating park visitors information and compatible activities, respectively. Transitions T4 and T5 are initialization and finalization of the activity, respectively, and there is a Boolean expression (called Guard Function) which establish some preconditions on the variables included in the arc expressions, which are expressed as: 1`(z_id, z_cap,z_curact,z_ac,z_rej), where z_cap, for example, represents the capacity of the zone. Considering z_cap and the variable c_np, which represents the number of citizens performing the activity, the guard function of T4 would include z_cap > c_np (together with other Boolean expressions) and it means that T4 can be just fired (citizens can start performing the activity) when the inequality is satisfied.

Agent Based Simulation Models

Agent-based modeling and simulation (ABMS) will be used for simulation of urban policies in which citizens' preferences and affinities plays an important role in understanding the acceptability of an urban planning proposal and an estimation of its future performance (North and Macal 2007). Multi Agent Systems (MAS) is a modeling approach that suits the simulation of those systems or organizations that must be understood as collections of interacting actors, in which each one of these actors has its own rules and responsibilities.

Some actors may be more influential than others, but none completely controls the behaviour of a complete system. All of the actors contribute to the results in large or small ways. System reactions where the complete results are more than the sum of the individual components' outcomes are called emergent behaviour. The multi-agent technology systems combine this fundamental insight with proven, highly successful techniques to produce a new way to discover and analyse the dynamic of complex systems. Agents are the decision-making components in complex adaptive systems which have sets of rules or behaviour patterns that allow them to take in information, process the inputs, and then effect changes in the outside environment. The information processing within agents typically includes some form of adaptation or learning. Agents have sets of decision rules which govern their behaviours. These rules allow agents to interact with and communicate with other agents as well as to respond to their environments. One of the main advantages of ABMS with respect to traditional system modeling techniques (i.e. statistical modeling, risk analysis, optimization, systems dynamics, standard participatory simulation, or traditional discrete event simulation) is the capacity to capture the highly nonlinear interactions which are common in the problems addressed by urban planning and which regularly combine to produce emergent behaviour. However, one of the main shortages of ABMS technologies is the lack of transparency and traceability in the decision making process. This shortage matters specifically in the application of ABMS to the urban planning field since sometimes it is expected that the use of MAS will provide a better knowledge of the cause and effects of certain emergent dynamics.

To overcome this lack of MAS transparency, a causal modeling approach is proposed in which the agent behaviour is specified in CPN formalism taking into consideration as many factors as the ones identified in the human social behaviour. Some of those factors could participate in the dynamics of the systems in such a small way that it is possible to argue that the outcome would be the same as the one obtained from a traditional approach. The advantage of taking into account all the factors that play a role in the decision process is that when the conditions of the environment are vary from the one in which the historical data was taken, the factors whose contribution had been not determinant could become important under the new conditions, i.e. emergent dynamics.

Advantages of MAS

Some of the main advantages of formalizing an agent's behaviour rules by means of a causal approach to support simulation results transparency are:

- The approach allows to model at a very low level the behaviour of independent actors in several systems such as open space, transportation systems, political and societal systems among others.
- With agent interaction it is feasible to test the overall outcome of decisions taken over the system that affect all the individuals who interact within it.
- With the flexibility that agent technology allows, it is possible not only to have the same behaviour as the one obtained using classical simulation approaches but also it is possible to add more capabilities within the logic of the agents that result in more accurate simulation models for the different domains under study.

Moreover with the use of agent technology it is relatively easy to code the particular behaviour of the different entities that participate in a particular urban domain. This behaviour can be coded as a set of simple rules or as complex ones with the use of the causal relationships coded in a modeling formalism.

URBAN PLANNING MODELING APPROACHES TO FOSTER CITIZENS' PARTICIPATION

Most urban simulation models for policy decision making have been developed as a result of a deep cooperation between scientists and practitioners, which has contributed to producing relevant and useful results for practice and for coping with actual urban problems under certain boundary conditions and a tight hypothesis related to human behaviour. Unfortunately, the use of complex mathematical formalisms to represent certain urban planning dynamics, together with a lack of a proper human behaviour specification, which considers economical, cultural and social aspects, are a real blockage for model reusability and model acceptability.

In order that simulation could act as enabler to foster citizens' participation, the simulation models should be designed considering its main role as a tool for mutual learning processes, in which both sides, the policy decision makers but also the non-politicians actors, learn about the complex urban system from and with each other. This shall be reached by means of a proper neutral and transparent representation of the heterogeneous and implicit knowledge about citizens' behavioural preferences, and a formal specification of the assumptions as boundary conditions.

The modeling process would contribute to a better knowledge about the urban problem to be addressed under the mutual understanding approach while simulation will become a key tool to deal with a trade-off solution in which the different actors could agree in a cooperative-competitive solution. Furthermore, the learning capacity of users would be enhanced through a trial and error approach by experimenting in a simulation environment, contributing to capacity building among the involved non-scientific actors. Thus, a proper specification of urban dynamics in a reusable model would contribute to the different urban planning stakeholders learning about the complex system modelled and its behaviour as well as the impact of their actions or decisions on it.

Citizen participation is essential to generate acceptance and a feeling of ownership for the model and its results among the different actors, and to further increase legitimacy of the model's application and results in practice.

In order that citizens can be involved in the design of urban policies under an e-participation paradigm there are 2 key factors that the new urban modeling approach should consider:

- **Transparency of the Simulation Results:** This is both difficult and controversial since the model should provide the capacity to explore an almost infinite list of alternative urban investments proposed by citizens or local governments computing the benefits and shortages of each alternative in each particular urban context, and allow a systematic evaluation in a simulation platform.
- **Hyper-Comprehensiveness:** Ambitious modeling use to increase model complexity, additional data requirements, and in some cases the credibility of the overall modeling effort. To engage citizens in the use of urban simulators to transform their opinions into valuable knowledge, it is necessary to avoid modeling more and more aspects of the urban environment, focussing only in the relevant aspects that could affect the acceptability of the urban planning proposal by the community.

E-Participation should be seen as a research challenge that could be properly tackled by the modeling methodology to engage citizens for e-governance in urban modeling policies. The proposed modeling framework in FUPOL considers four dimensions:

1. A cognitive dimension, which concerns the user's acceptance of the knowledge specified in the model (set of rules, nº 1 in Figure 2).
2. A normative dimension, which involves interests, values and priorities, focused on setting and negotiating priorities and making a value-judgment (agents' affinities in nº 3 in Figure 2).
3. The contextual dimension, related to the specification of boundary conditions by citizens and end-users, which specifies the hypothesis and uncertainties about the future social context evolution.
4. The social dimension, which covers the relationship between the actor groups.

Figure 2. Modeling platform

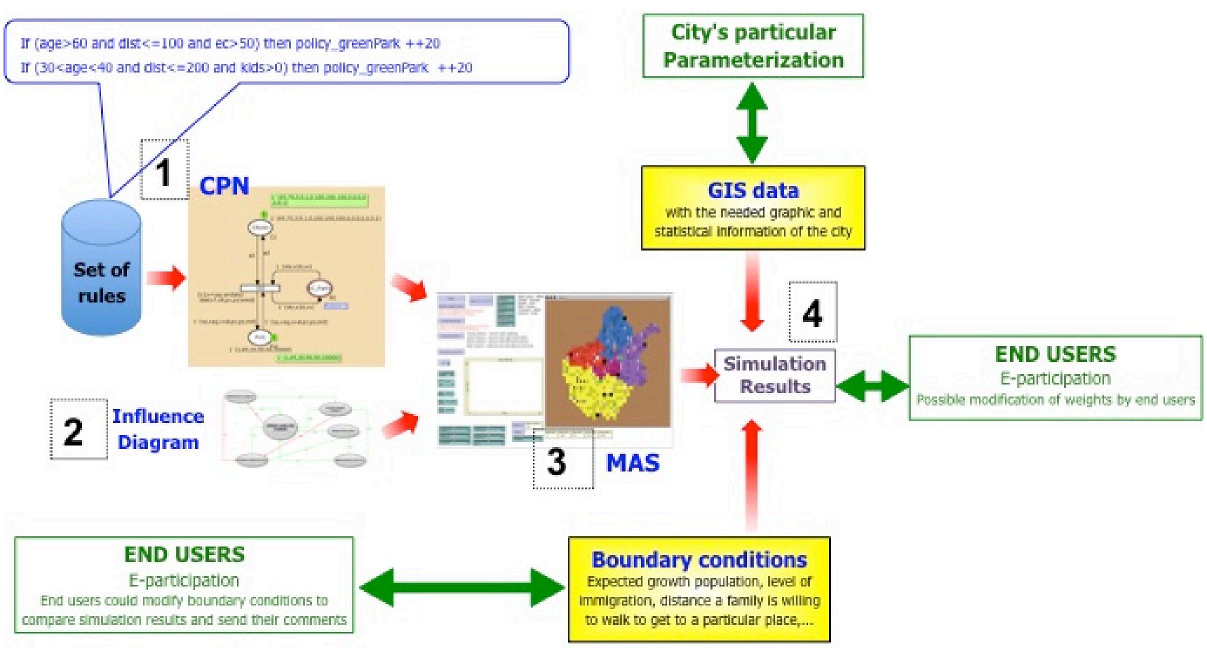


Figure 2 illustrates the main elements of the modeling methodology developed for multi agent systems simulation in which agent behaviour is specified using a causal formalism. CPNs and MAS approaches are combined in order to achieve a certain level of transparency by describing the causal models as a set of behaviour rules (they could be described in a natural language).

In 1 (Figure 2), a set of preliminary rules (set of parameters defining the actors behaviour) can be defined using the information and data obtained from pilot cities (field work based on current situations, for example, use of other green parks in the city for the case presented in this chapter), together with a review of scientific literature and also after some face to face meetings between modellers and pilot experts (i.e. public administration officers or private company workers in charge of FUPOL development in the city). A CPN model can be implemented to verify these rules by studying the CPN state space reachability.

In order to foster model acceptability by different end-user profiles, the causal models can be visualized as a set of rules in which users can check all the rules affecting a certain modelled concept by means of queries.

In 2 (Figure 2), a preliminary influence diagram between the different driving concepts is developed to better understand the behaviour of the elements in the system (the agents).

In 3 (Figure 2) a MAS model is implemented based on the verified rules (using CPN) and the influence diagram developed.

The GIS data plays a key role in the quality of the simulation results. If it is possible to use a high granularity of the information about the principal agents, the results will be better than if only statistical data is used. The parameterization of this data depends on the particular urban planning problem scope.

Boundary conditions are exogenous variables that are initially fixed by the modeller team; however, end users can modify them if they consider they are not adequate. The results of the simulation can be affected and they can be reported to the modeller team if they are trustable and relevant.

End users (citizens, officers, etc.) are allowed to modify some parameters of the MAS model to test other planning alternatives which could lead to a different trade-off in which a particular subset of the community would get better benefits penalising other targets that could be more relevant to the rest of the community. If the results are trustable and relevant, they can be used to feed a rational discussion between the community members through the social media support.

CASE STUDY: DESIGN OF A GREEN PARK CONSIDERING NEIGHBOURS PREFERENCES

The model to design community facilities areas can be used to design any kind of area in which it is possible to define possible zones to consider, activities to perform in these zones, possible users, possible conflicts between activities and users, etc. In this document, example of a green park design in Zagreb is presented.

The simulation objective for a green park design in Zagreb is to provide the best solution for the facilities to be included in the green park situated near the Autism Centre. The surface of the park is around 20.000m2, and the design must satisfy the potential users' demands and must encourage interactions between autistic people and non-autistic users, while avoiding possible conflicts between them. At the same time, possible conflicts between all kinds of users must be avoided. For example, nobody likes to have dogs around children while these are playing in a playground. Or, nobody is going to sit on the grass near 20 young people playing football.

The following paragraphs introduce a brief explanation of the developed model considering the simulation objectives and the data to be considered.

The green park consists of different zones and different activities to be performed inside these zones. Each activity will be related to one or more zones, depending on whether the activity is performable inside them. The zones will have a minimum surface if they are mandatory to be included. The surface of the park will be distributed along the zones depending on the activities performed inside them and the comfort area for each visitor, which is defined depending on cultural factors.

The types of visitors are citizens without autism, citizens with autism, their carers and their companions. Depending on different attributes (age, gender, children, amongst others), visitors are classified by profiles, which are linked with several activities to be performed in the park, in a specific time frame (which differs during the week and during the weekend), and with specific companions. These relations are called "rules", and the time frame indicates the interval of time that visitors go to the park for; however, each visitor decides how long they (inside the time frame) spend in the park. Each visitor has a predefined behaviour (depending on the profile) which is modified depending on their interactions (affinity by proximity, affinity by age, etc.) with other visitors inside the park and its neighbourhood area.

The information about visitors (time frame, activities performed, zone, ...) will be stored and used to determine the final zone's surface.

Model Specifications

The officers of the city of Zagreb together with experts on autism disorder have performed fieldwork in order to generate the data used in this particular case.

Table 1 presents the considered activities extracted from the fieldwork performed in other green parks in Zagreb.

These activities can be performed in some of the considered zones, which are described in Table 2. Notice that these activities and zones were defined for the particular case of Zagreb; however, for any other case, other activities and zones must be defined.

Table 3 presents some of the attributes used to identify the profile of the visitors, both, when defining the rules, and also during the simulation when deciding which activities the visitors will perform.

Some of the initial specific citizen behavioural rules that have been formalized in CPN and later on codified in the MAS are:

S1: Children between 3 and 5 years of age are mostly interested in playing (i.e. swings, sand area); however, sometimes they could prefer to sit on a bench or around a table to have a snack or even to have lunch.

S2: Children between 6 and 12 years of age are also mostly interested in playing (i.e. playing ball); however, their activities are quite different to those of children between the ages of 3 and 5.

S3: Young people between 13 and 19 years have other concerns and responsibilities. Some of them can be interested in sports (individual and collective), and they may be the owner of a dog. Preferences can also vary between males and females. However, if they don't like sports, males and females share preferences (it will suggest including them in the same rule), and these are sitting (could be on the grass, around a table, on a bench,...) or some pair situations like walking or sitting together. Due to the fact they can move around by themselves, walking through the park can be also one of their activities. Regarding sports, they have different preferences that can be summarized using statistics.

An example of a rule obtained from the CPN model described in plain text (even though the rules are actually expressed as a set of parameters) would be:

Table 1. Zagreb Green Park activities

ID	Activity Name
A1	Walking through the park pathway
A2	Sitting on a bench
A3	Sitting around a table
A4	Feeding children
A5	Playing in the Sandbox
A6	Sitting on the grass
A7	Sitting and playing on the grass
A8	Swinging
A9	Sliding down the toboggan (slide)
A10	Spinning on roundabouts
A11	Climbing on monkey bars
A12	Roller skating
A13	Playing ball on the grass
A14	Playing rackets on the grass
A15	Riding a bicycle
A16	Playing football
A17	Playing basketball
A18	Skateboarding
A19	Playing social games sitting around a table
A20	-
A21	Walking with a dog
A22	Touching objects and surfaces
A23	Playing frisbee
A24	Playing with a dog
A25	Playing bocce ball
A26	Resting
A27	Playing in the labyrinth
A28	Standing
A29	Standing with a pram
A30	Watching water movement and/or listening the sound of the water
A31	Following the paths with motoric tasks
A32	Walking through the labyrinth
A33	Sitting in the aromatic herb garden
A34	Walking through the aromatic herbs garden
A35	Listening bells sounds
A36	Playing passing obstacles (climbing, crawling, going in and out, etc.)
A37	Having a party in the amphitheatre
A38	Playing theatre games
A39	Playing in the Sensory Park

Table 2. Zagreb Green Park zones

ID	Description
Z1	Playground with games 1, for little children
Z2	Playground with games 2, for younger school age
Z3	Playground with games 3, for adolescents
Z4	Sandbox
Z5	Grass zone (with some trees to have some shade)
Z6	Picnic zone (with tables and benches)
Z7	Bike training ground (with basic traffic signs and rules)
Z8	Sensory Park: Labyrinth
Z9	Sensory Park: Music bells corner
Z10	Sensory Park: aromatic herb garden
Z11	Sensory Park: building in the nature zone
Z12	Sensory Park: amphitheatre
Z13	Sensory Park: paths with different colours, textures and training ground for motor tasks (jump, skip over, scrape through, reach and pull, etc.)
Z14	Sensory Park: Fountain
Z15	Pathways
Z16	Bocce ball fields

Table 3. Zagreb Green Park some visitors attributes

Data (Attribute)	Meaning and Ranges
Age	Age of the citizen. Range: 0 - 120
Gender	Gender of the citizen. Range: M (male) or F (female)
Dog	Having or not having a dog. Range: 0 (no dog) or 1 (dog)
CultLevel	Cultural level. Range: from 1 (no studies) to 5 (Master or PhD level). This information is useful to describe how the affinities can affect or can be influenced by their neighbourhood´s opinions.
HouseType	Type of house. It is different to live in an apartment than in a house. Range: 1 (Apartment), 2 (Town house without too much garden) or 3 (House with garden)
CitizenOrigin	Type of citizens depending on where they live. Range: 1 (Autism centre), 2 (Surrounding neighbourhood), 3 (Closest districts), 4 (Other town parts) or 5 (Outside the town)
Personality	Level of personality of the agent. High personality indicates that it can influence the other agents. Low personality indicates that other agents with higher personality can influence it. Range: 0 to 100.

- A mother with a child less than one year old. She used to go to the park at the same time, during the week and the weekend; however, during the week she goes alone and her husband may go with her at the weekend (this is the reason for the green colour). She always goes with her child (which belongs to profile P1) and used to walk through the park's pathways (A1), sit on a bench (A2) maybe talking with other mothers, or sit around a table while feeding the child (A3+A4). Each activity has its percentage of preference, and together they add up to 100%.

Once the rules are included in the MAS model, together with all the required data, by means of a multirun approach, the agent observer computes the best surface distribution between different zones which should allocate the different described activities, while minimizing the potential conflicts between activities in the same zone.

Figure 3. Test 1 zones occupancy

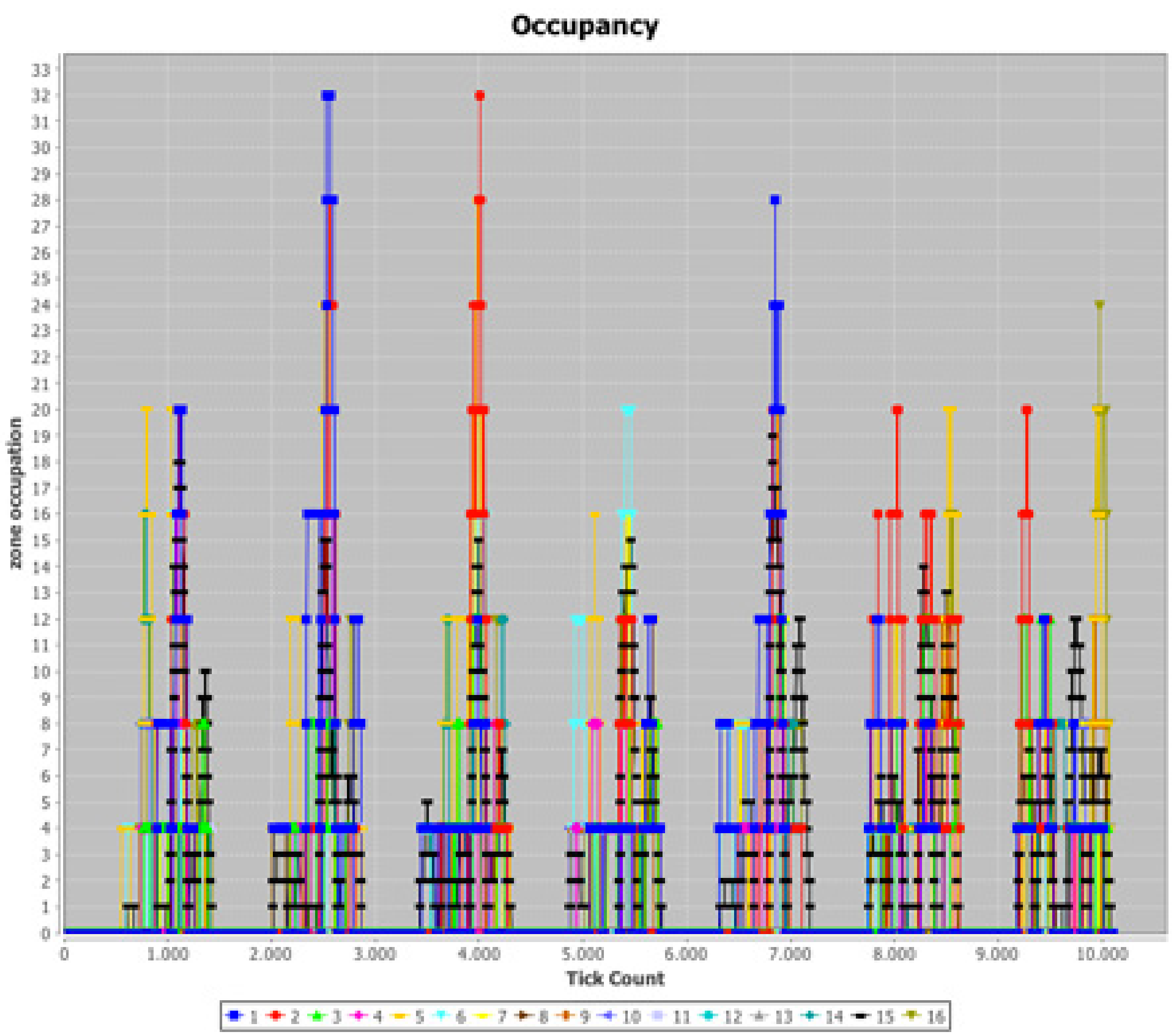
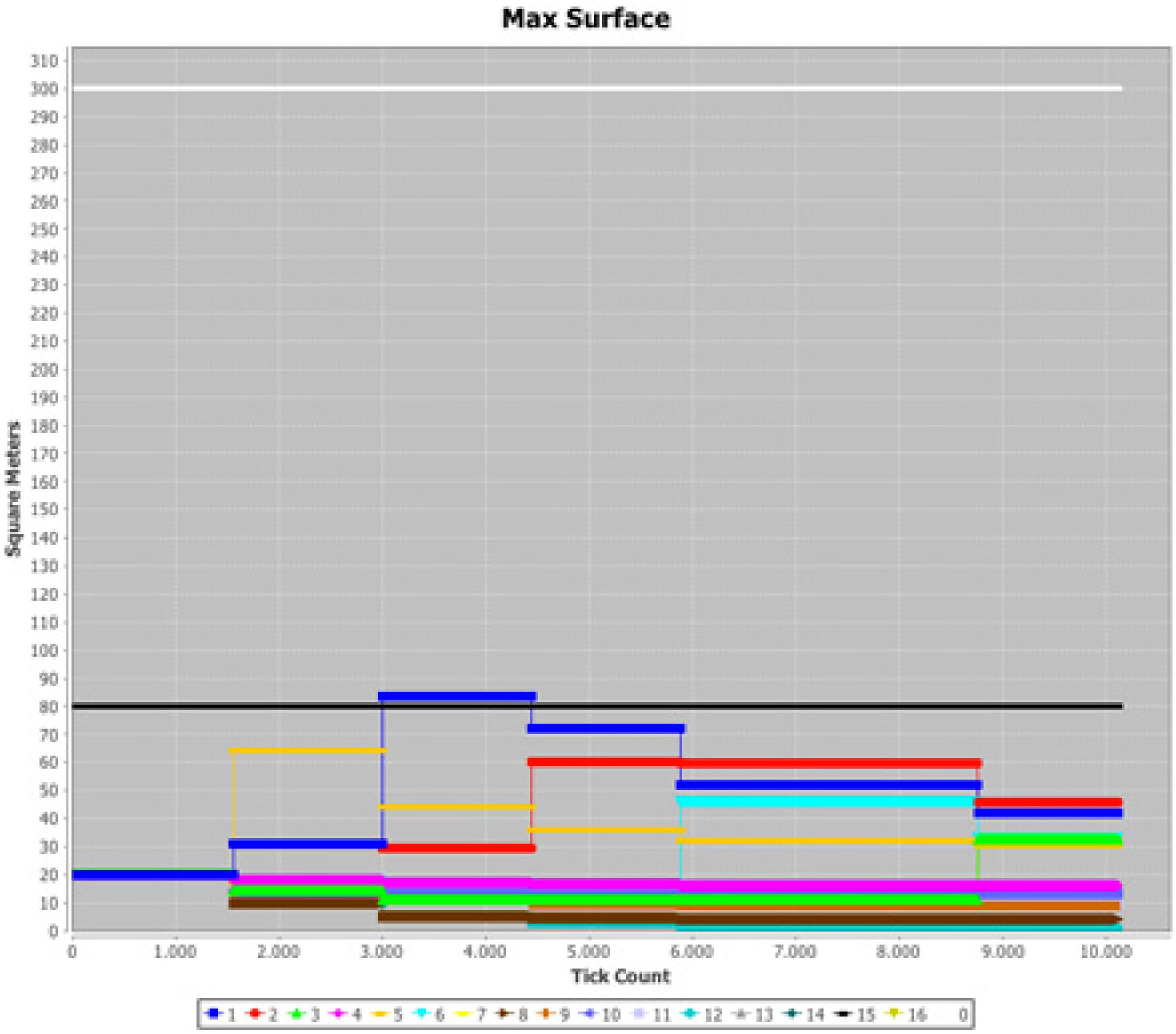


Figure 4. Test 1 zones surface



Test Results

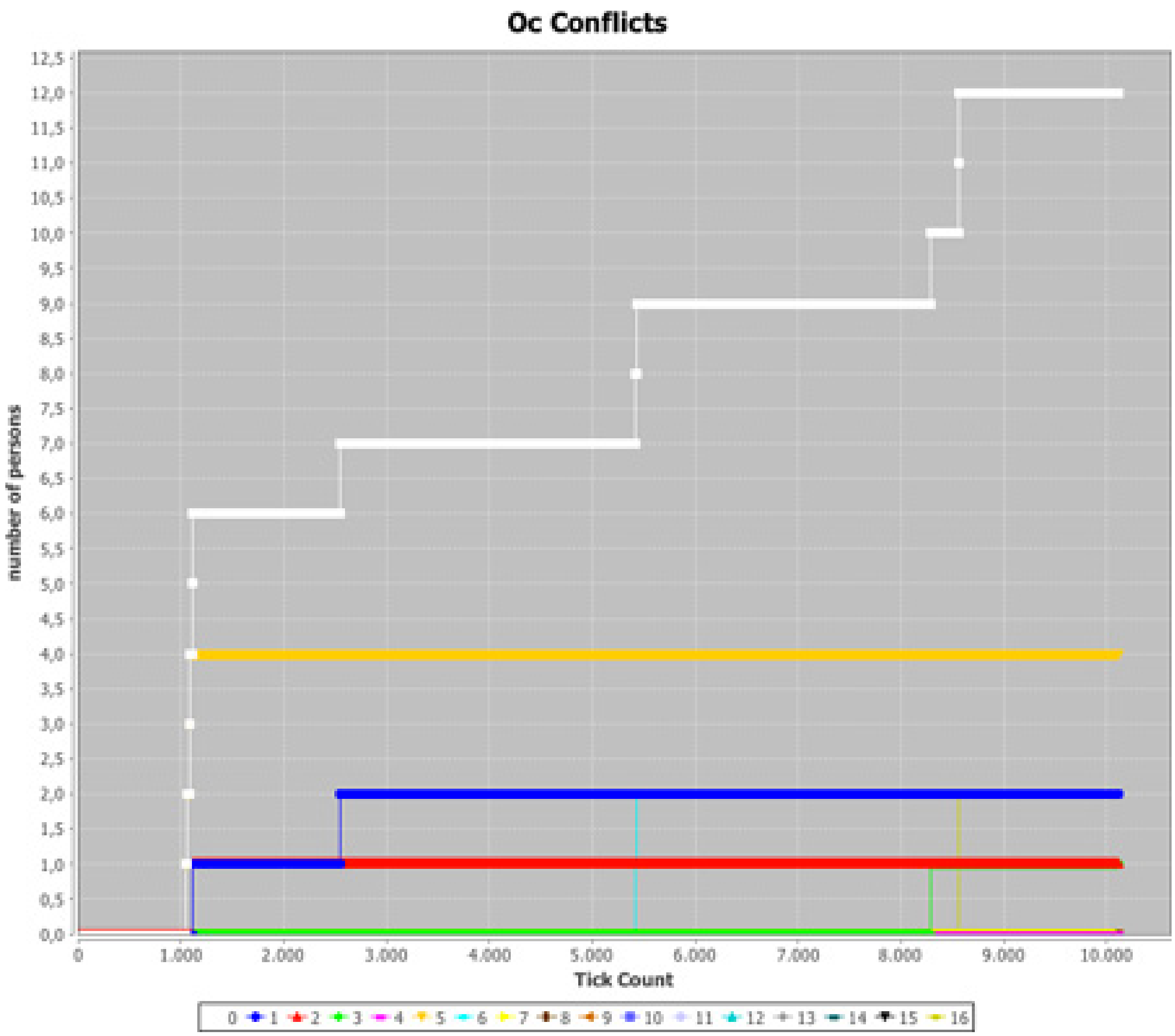
Three reduced size scenarios have been considered to test the model: All are zones of 20m2, apart from zone 15, which are the pathways, with a fixed surface of 80m2. The scenarios are differentiated depending on the visitors' attributes, and are:

1. Mostly families with children.
2. Mostly elders and 20% with dog.
3. Mostly elders and 80% with dog.

Tests consist on simulations of one week, from Monday to Sunday, and considering the following time frames:

- From 9:00 to 12:00,
- From 12:00 to 15:00,

Figure 5. Test 1 number of conflicts per zone



- From 15:00 to 17:00,
- From 17:00 to 20:00,
- From 20:00 to 00:00.

Outputs graphically presented in this paper are:

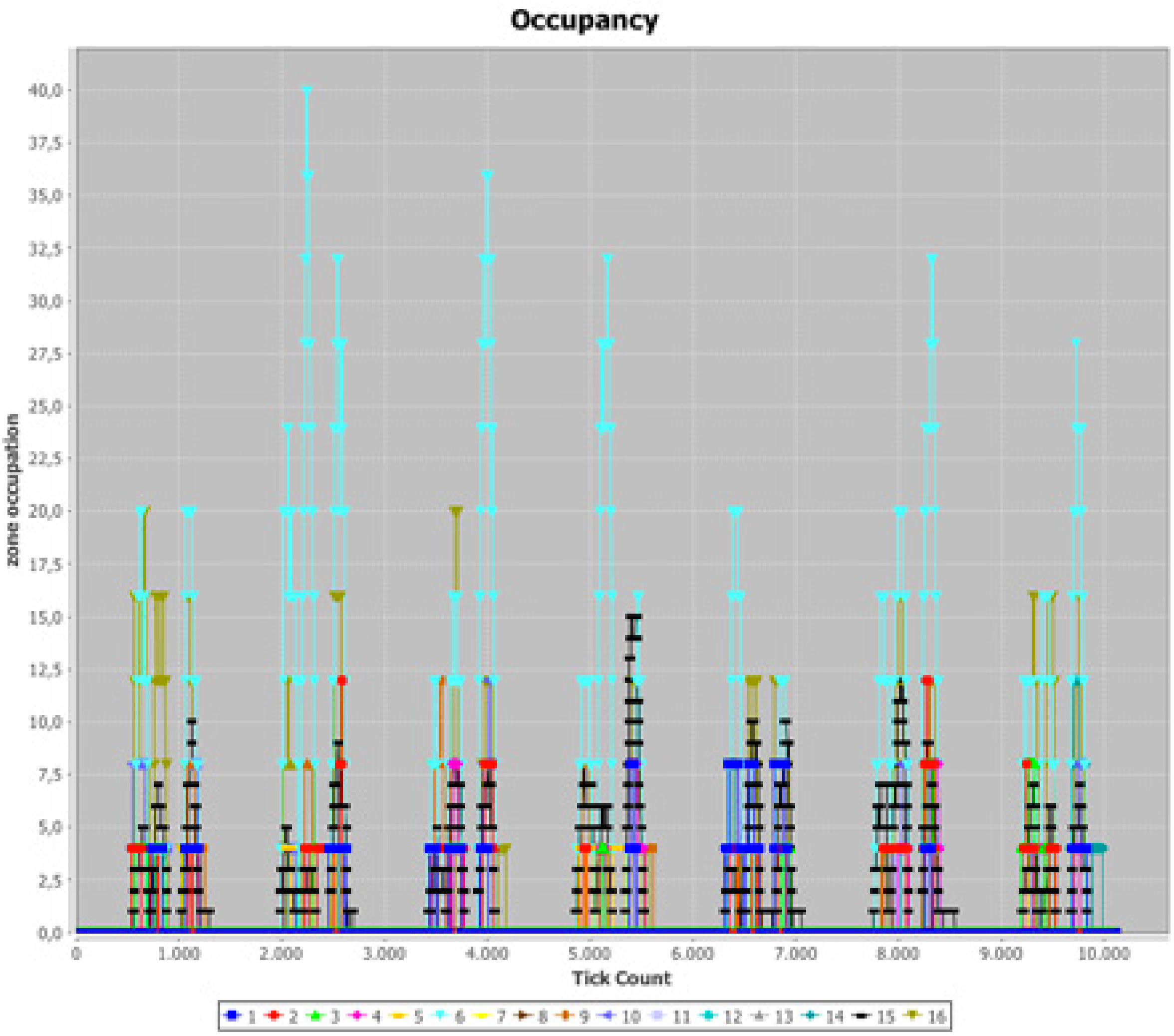
1. Zone Occupancy.
2. Zone Surface.
3. Number of conflicts.

Test 1: Mostly Families with Children

Outputs of Test 1, graphically presented in Figure 3, Figure 4 and Figure 5, show:

1. Zones 1 (playground for children), 2 (playground for younger school ages) and 5 (grass zone) are the most occupied (See Figure 3 representing the zones occupancy, where

Figure 6. Test 2 zone occupancy

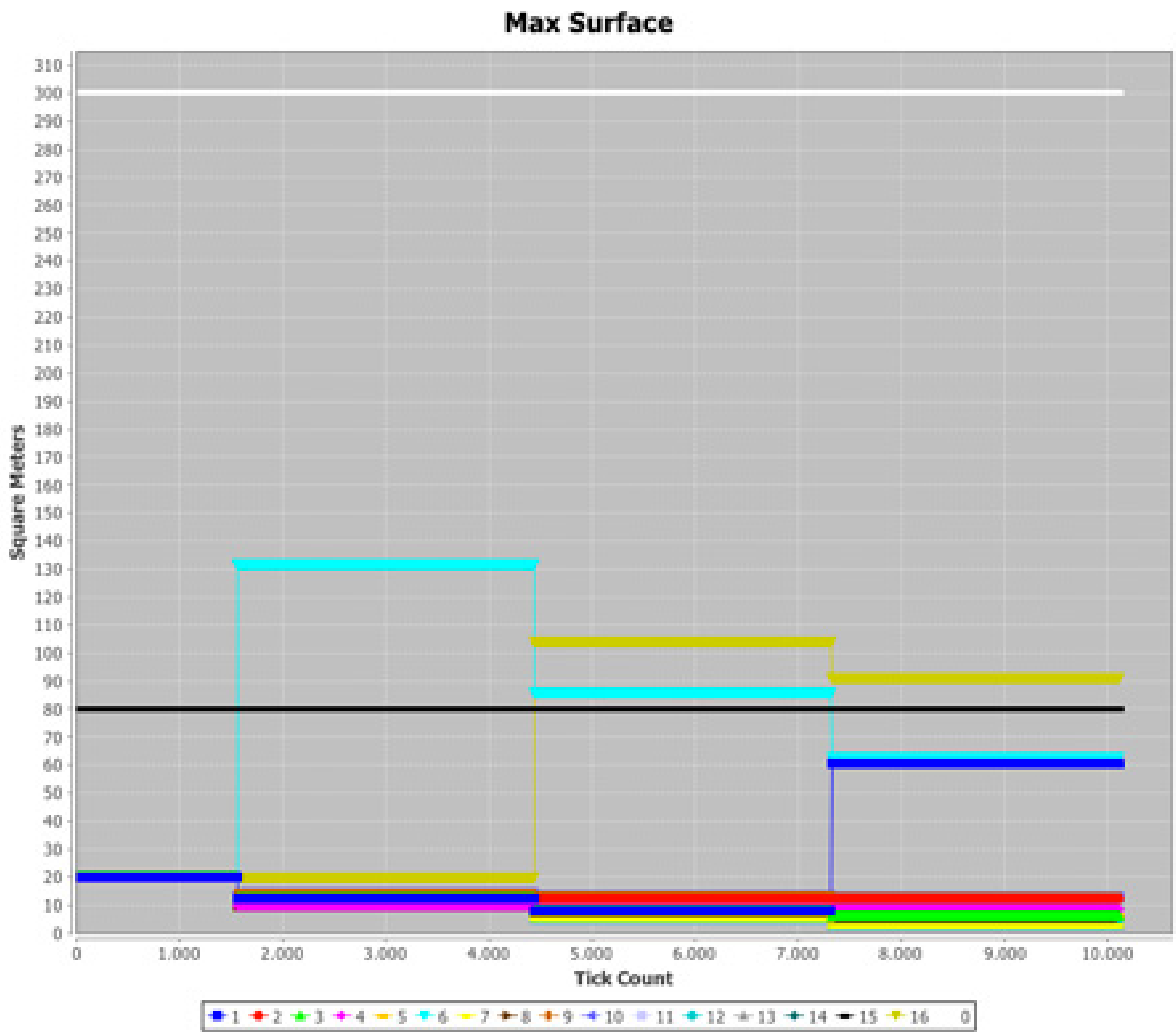


blue, red and yellow lines get higher values, and more often, than other lines); however, other zones are also occupied due to the test including members of the family that can be of any age, including elders.

2. Surface of 1, 2, 5, and partially 6, are the ones with a higher increment of square meters from the beginning of the simulation, which can be seen in Figure 4, which represents the square meters for each zone, and where it can be seen, for example, that zone 1 starts in 20 square meters, it goes up until more than 80, and then is converge to 40 square meters. Zones surface is modified depending on occupancy and conflicts, therefore, it is easy to understand that the zones with an increment of the surface are the ones presenting more occupancy and/or some conflicts.

3. Conflicts appear in zones 1, 2, 5. It is easy to understand after checking zones occupancy and zones surface modifications. Figure 5 represents the number of conflicts for each zone, and the total number of conflicts (white line).

Figure 7. Test 2 zone surface



Test 2: Mostly Elders and 20% with Dog

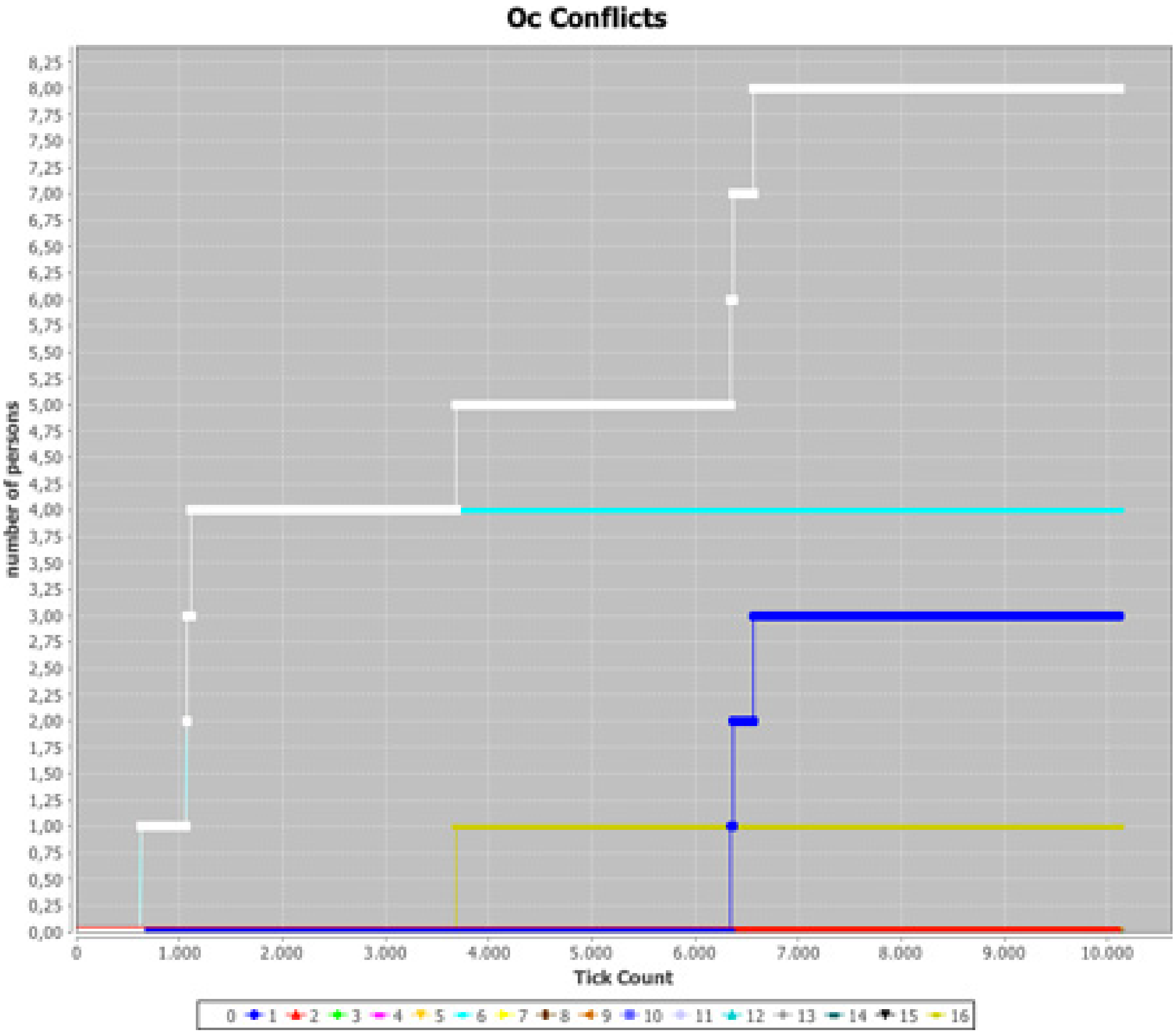
Outputs of Test 2, graphically presented in Figure 6, Figure 7 and Figure 8, show:

1. Zones 6 (picnic zones where elders play table games) and 16 (bocce ball fields) are more occupied than other zones.
2. Due to zones 6 and 16 are more occupied; they need more square meters (surface).
3. Initial conflicts are in zones 6 and 16 before more square meters are assigned to them. Later on, due to there being not solely elders and the reduction of zone 1's surface area more conflicts appear in zone 1.

Test 3: Mostly Elders and 80% with Dog

Outputs of Test 3, graphically presented in Figure 9, Figure 10 and Figure 11, show:

Figure 8. Test 2 number of conflicts per zone

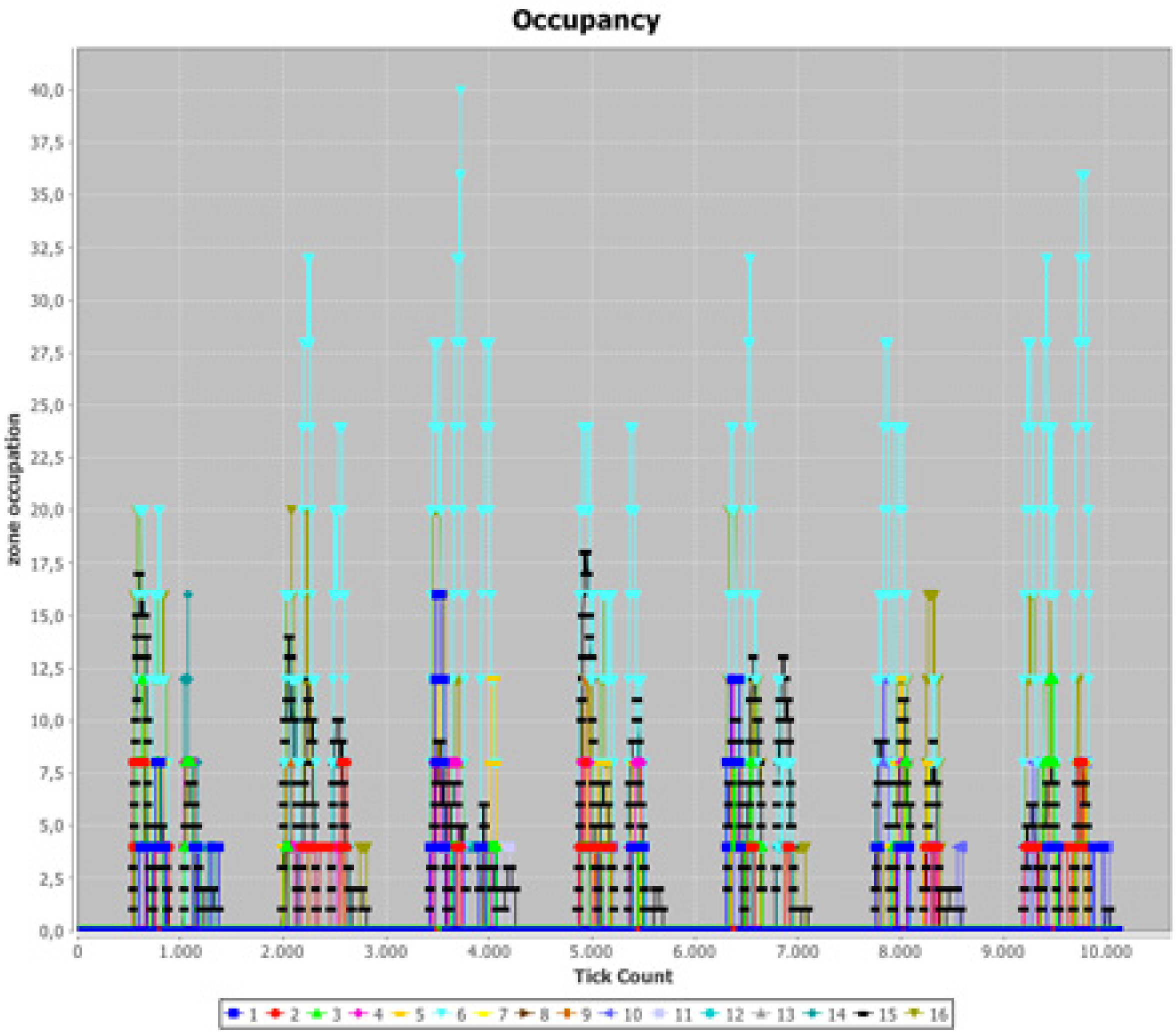


1. Occupancy of the pathways (Zone 15) increases compared with Test 2 due to more elderly people with a dog.
2. Zones 6 and 16 surface are not increased as in Test 2; and Zone 15, even though it has a high occupancy, does not increase because it is large enough.
3. Initial conflicts (just 2) are in zones 6 before more square meters are assigned to it. There are not too many conflicts in this particular case.

CONCLUSION AND FUTURE WORK

Citizens' participation in the urban planning process requires the design of simulation models which are transparent and easily understandable by non-experts in the modeling arena to enhance the process of interaction between citizens in order to deal with a mutual learning understanding that could contribute positively in the design of new planning policies.

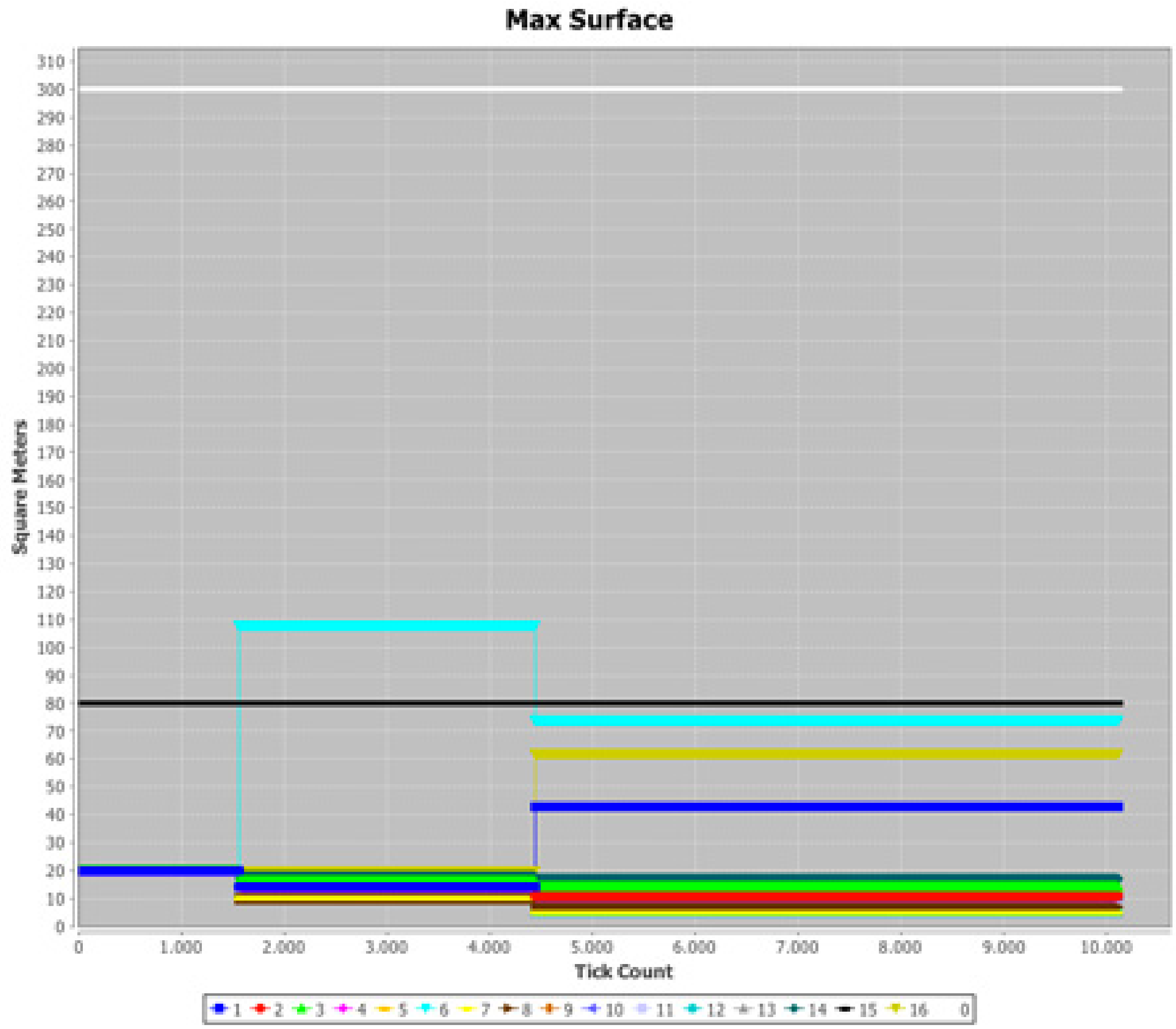
Figure 9. Test 3 zones occupancy



A new modeling approach to foster the engagement of citizens in the e-participation of urban policies through the integration of virtual and real worlds has been introduced in this chapter. The modeling proposal describes urban dynamics by means of "rules of the road" which should be accepted by the end users, but are analysed by the modeller using a causal analysis tool as a previous step to implement the causal model as agent behavioural rules.

An important aspect to motivate end users to perform different experiments in the simulation environment provided is the capacity to change the boundary conditions, which specify hypoth-

Figure 10. Test 3 zones surface

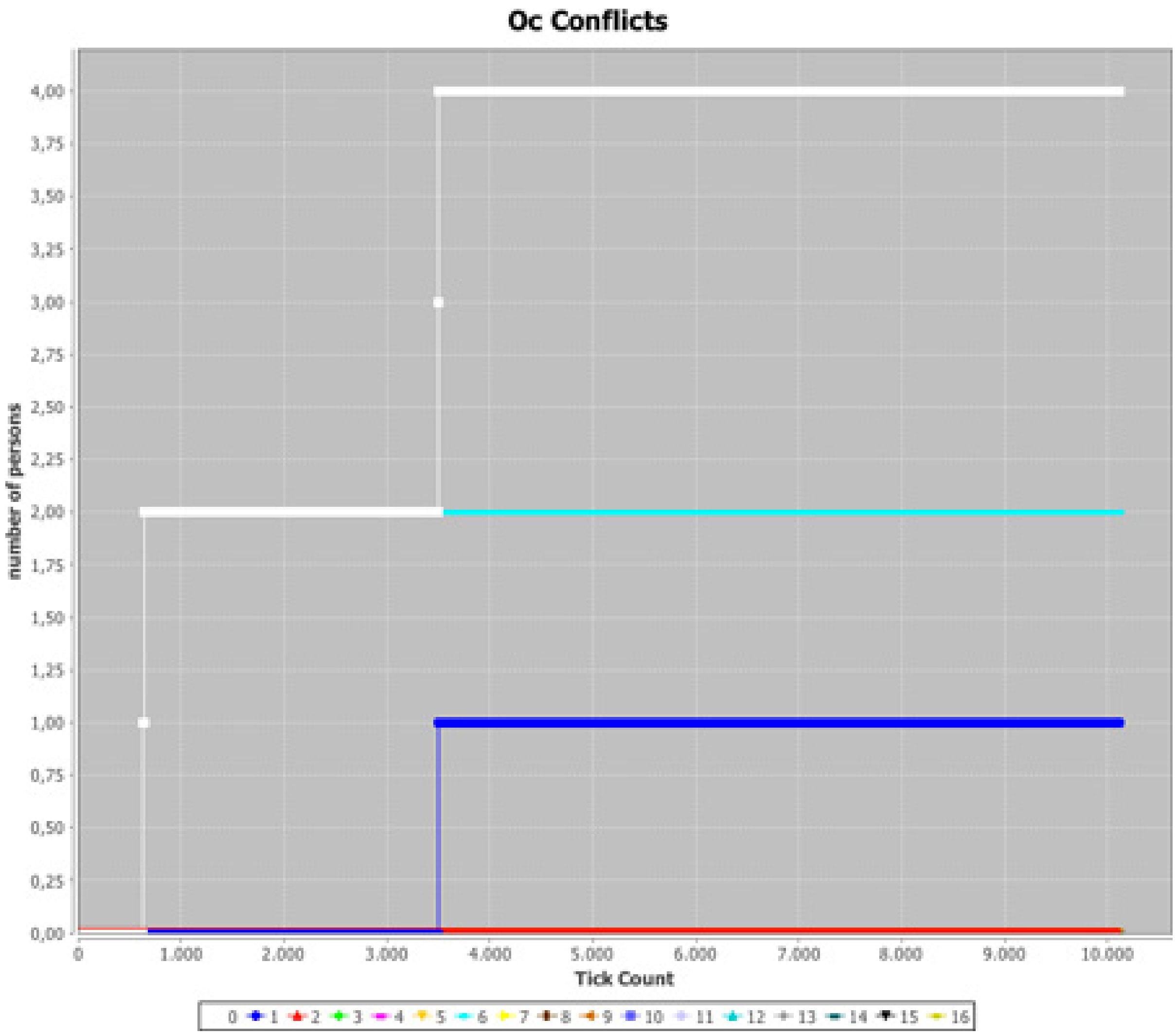


esis about the social context's time evolution. A good urban policy for a particular social context could deal with poor results in the predicted social context if it is different to the real one. Since the context evolution is an uncertain problem whose evolution depends on different stochastic and unpredictable events, it is important to involve citizens also in the specification of the boundary conditions according to their guess about the social context evolution.

In order to deal with an urban policy that could satisfy the expectations of the different stakeholders, the model must be formulated considering the different affinities and preferences of the citizens that integrate in the community, in such a way that a trade-off between the different interests could be achieved.

The proposed modeling approach has been implemented in different urban domains. In this chapter it the modeling of a green park design in

Figure 11. Test 3 number of conflicts per zone



the city of Zagreb has been presented to foster the integration of autistic with non-autistic users by minimizing the potential conflicts that could emerge when sharing activities.

The visualization of the "rules of the road" that specify the main social dynamics to be considered in the urban planning problem it is still an open question which should be considered as a key critical factor to allow non-experts to understand the underlying simulation model specification.

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KEY TERMS AND DEFINITIONS

Agent Based Simulation: It is a rule-based computational modeling methodology oriented to represent the interactions among the individual components in which the system is decomposed. Individues are represented by agents with sensing capabilities to collect information, decision making capabilities to transform the sensed information into actions, and actuation capabilities to execute the selected action.

Coloured Petri Net: It is a discrete event modeling formalism which allows to describe information and material entities which flow through the subsystems components. Each entity have attached data value called token colour, which enhance Petri nets with the capabilities of a high-level data representation in programming language. Main structural elements such as queues, resources and logical conditions are represented by place nodes while events are represented by transtions.

Decision Making: It is the process of identifying and selecting a course of action, among several available options, to achieve a specific objective or to solve a specific problem.

Digital Simulation: It is the experimentation by means of a computational model in order to improve the understanding of a system's behavior and/or to evaluate strategies for its operation, in explanatory or predictive schemes.

Emergent Dynamics: Are considered those phenomena that appear as a result of different interactions between system components (between agents and/or with the environment).

E-Participation: It is the use of Information and Communications Technology (ICT) for enabling and strengthening citizen participation in democratic decision-making processes.

Model: It is an abstract and simplified representation of a given reality, either already existing or just planned.

Modeling: It is understood as the abstraction process to deal with a model.

Chapter 7
Sociotechnical Aspects of Policy Simulation

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ABSTRACT

Political decision-making is implemented in the framework of a classic sociotechnical system where respect has to be shown for both technical and social aspects. The development of suitable support tools for the previously mentioned requirements is rather complicated because a fundamentally important factor is product functionality and algorithm conformity to objective requirements (e.g. political decision quality assurance). Traditional design methods mainly focus on the quality of the system design process. They do ensure the quality of the decision-making process but not the decision quality itself. The inclusion of simulation in the system development process permits face validation for the decision-making algorithms of the goal system. This substantially improves acceptance and sustainability indices for the developed political decisions support system. The chapter deals with sociotechnical systems design peculiarities, emphasizing the role of simulation and social factors in the designing of policy decision-making support systems.

INTRODUCTION

The mathematically justified planning of economic policy, including regional policy, is extremely important as each decision can have significant and even irreversible consequences. The economic crisis, which still significantly affects all countries, would be easier to overcome if all decisions were based on precise sciences (European Commission, 2009). It is no secret that mathematical modeling is rarely used for policy planning and decision impact prediction as it requires specific knowledge. As a result, public and private sectors as well as institutions make incorrect decisions

DOI: 10.4018/978-1-4666-6236-0.ch007

on economic governance, taxation, social and economic development, monetary policy etc. Global economy planners such as the International Monetary Fund's (IMF) chief economists Olivier Blanchard and Daniel Leigh are no exception. They have admitted mistakes in predicting the impact of austerity on European economics (Blanchard & Leigh, 2013). Planners had underestimated the rise in unemployment and the decline in domestic demand related to fiscal consolidation, as well as under-predicted the likely impact of reforms on economic growth. As a result, Greece, Spain and Portugal as well as Latvia were required to make swift budget cuts, which can lead to social tensions and disrupt national economies. The errors were caused by choosing incorrect action impact assessment methods because policy modeling requires respecting a considerable number of crucial factors that are mainly stochastic. This prohibits the use of analytical methods in real time. This is where simulation technologies can be applied. Regretably, the lack of suitable simulation tools creates problems for policy specialists and impacts regional policy planning in municipalities not only in Latvia, but also in Europe and around the world. There are several policy modeling tools in the world (Sonntagbauer, 2012), but their possibilities are limited by using incompatible simulation tools, which encumbers the design of widely usable, viable, and sustainable simulators that could be deployed on the Future Internet and/or the cloud to ensure accessibility (Ginters et.al, 2011).

Each project has to be transparent otherwise the user cannot take part in the design, and the expected result mostly will not be acceptable to the user. Result visualisation also has to correspond to guidelines accepted within the user's professional field. Using simulation solutions, policy planners can examine a variety of real-time solutions before their implementation as well as forecast the impact of potential decisions on the attainable goal in general (Silva et al, 2009).

The above determines designing a Graphic User Interface (GUI) which could simultaneously collaborate with the simulation model as well as serving as the interface in a manner that is convenient to the user.

POLICY DECISION-MAKING SUPPORT ENVIRONMENT: A SOCIOTECHNICAL SYSTEM

The concept of sociotechnical systems has been around since the 1950ties (Trist & Bamforth, 1951), when the sociotechnical principles were formulated. One of the first real applications was the implementation of changes in the organisational structure of textile mills in Ahmedabad, India (Rice, 1958), whereas one of the most known examples is the theory application at Volvo's Kalmar and Uddevalla car plants (Hammarström & Lansbury, 1991; Knights & McCabe, 2000; Sandberg, 1995). Despite its venerable history, there is no generally accepted definition. Admittedly, that is correct, because each definition is valid only under certain circumstances and only for as long as the length of its existence corresponds to the possible number of applications and limitations of newfound knowledge. One possible description (Walker et.al., 2007) explains that a sociotechnical system is a set of explicit concepts, inspired by general systems theory, aimed at jointly optimizing people, technology, organisations and all manner of other systemic elements. Conversely, some of the sociotechnical principles that determine a system are responsible autonomy, adaptability and meaningfulness of tasks. It is mentioned (Walker et al, 2007) that those principles create shared awareness (through peer-to-peer interaction) and agility (through effects based operations, semi-autonomous groups and increased tempo), and self-synchronization (joint optimisation and synergy).

To not get lost in various complicated formulations, the authors offer a rough, but useable definition of a sociotechnical system. A sociotechnical system is created when we combine a system "made by hand" (i.e. technical systems) with social systems that are not "handmade". In this case, "social" describes environmental, human as well as other systems. The following are typical attributes of sociotechnical systems:

- Wide amount of important factors, that can be stochastic;
- Wide interaction with different outer systems;
- Model of the goal system can vary during the session;
- Self-organization, cognition and continual evolution is typical.

Recently sociotechnical research has been focused on ICT and user collaboration analysis with special emphasis on the challenges of Future Internet and the use of semantic methods in social networking. From this perspective, political decision-making support environments are a classic example of sociotechnical systems as creating this environment requires not only respecting hardware and software, but also extremely complicated and subtle political and social phenomena. This is especially important as decisions can have serious consequences. Therefore, when creating policy decision-making support software special attention has to be paid to project transparency, providing policy decision makers, who are representing a client, with the possibility to "see everything". Even if these representatives are often arrogant and lack ICT and exact sciences competency.

SOCIOTECHNICAL FEATURES IN POLICY SUPPORT SOFTWARE DEVELOPMENT

Challenges in Development of Policy Decision-Making Support Tools

The conception about goal system functionality will always differ between the policy decision maker and the developer because the decision maker is guided by specific functionality requirements, nuances and particular conditions only known to him, whereas the developer places importance on technical solutions, development time and potential costs. The complexity of tools to be developed increases not only from a technical (territorially distributed systems, cloud computing, Future Internet architectures, semantic search etc.), but also from a functional standpoint (decision-making algorithms; fusion, mining and useable visualisation of complex data). This significantly complicates the development of suitable software.

Currently neither the beneficiary, nor the IT industry in general can keep up with the rate in which information technology advances. Such terms as choreography and orchestration, Future Internet and cloud computing emerge. Web services are now widely used in software development. Is this good or bad? Absolutism is not useful in this case as universalism is not such a good thing. That which suits everything, may not fit anything at all. The use of the cloud as an infrastructure would be a good thing; however, the storage of sensitive data as well as placing real-time and life-support software in the cloud would not be sensible. Reasonable suspicion also arises from using cloud communication mechanisms to create distributed simulation systems. Therefore, the question about placing a policy decision-making support system in the cloud could remain open and debatable.

A project's requirement specification has to be transparent and understandable for the developer as well as the decision maker. Is there currently an alternative to Business Process Model and Notation (BPMN2)? Probably not, if we wish for the solution to be transparent, widespread and repeatable. Currently BPMN2 continues its triumphal procession and is a phenomenon of sociotechnical manifestation. Engineers, system programmers and analysts, business process planners and other social sciences representatives use this notation, although both groups still look at each other with certain suspicion. The Object Management Group (OMG) (Object Management Group, 2013) continues the development and supplementation of the BPMN2 standards. There currently is no widely applicable alternative to ensure specification clearness for policy creators, as well as web service choreographers and Future Internet application designers.

It is important for the developer to repeatedly talk to the beneficiary; therefore, interdisciplinary knowledge gains an important role. This is advisable for the policy decision maker as well as the developer. Only in this way is it possible to understand one thing or phenomenon more or less similarly. Otherwise an "interpreter" with corresponding knowledge and skills is required. Unfortunately, an "interpreter" requires additional expenses and brings in his/her own interpretation, which will not always be correct.

If the developed policy decision-making support system does not correspond to the requirements of the decision maker, funding will have been spent pointlessly. The basic task of the sociotechnical approach is to bring together the wishes of the decision maker with the technical possibilities of the developer, thereby promoting project clearness and giving the beneficiary an opportunity to validate the offered solutions and establish conceptual mistakes in the early stages of the software designing.

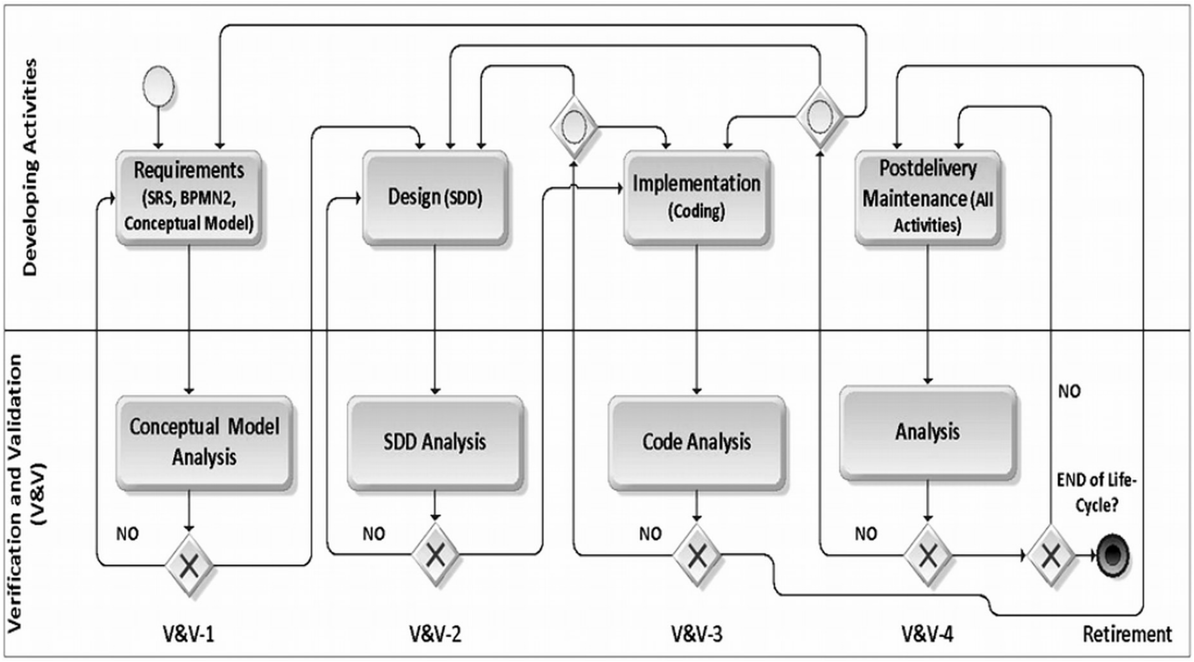
Classical Life-Cycle Models

The history of software design is more than 60 years old and in this time it has unmistakeably become clear that humans are the main cause for any errors. As a result, it is preferable to minimize their participation in software design as much as possible, at least in the implementation phase. As a result, software design gradually becomes more like philosophising than a technical and exact activity. A new generation of software engineers has already matured which has never written a string of Assembler code and has only an idea of how a computer works. Even though nowadays programming is far from coding, in the same way the kitchen of a Michelin restaurant resembles a scientific lab. Although, there are lifecycle stages (Xiaojun, 2013) where human presence still is a necessity (see Figure 1).

Usually a set of development activities is determined. This includes Requirements, Design, Implementation and Maintenance stages. Verification and validation (V&V) is performed after each stage. The post-delivery maintenance stage lasts for as long as one of the beneficiaries still requires the software or maintenance becomes unprofitable for the developer and it is suspended (Retirement Event).

The preparation of a requirement specification (SRS) is especially important when developing policy decision-making support tools. Generally, a conceptual model of the goal system is specified in BPMN2 notation, which is a necessary requirement, but regrettably often not sufficient as policy makers have trouble understanding the diagrams. V&V-1 validation of the conceptual model is

Figure 1. Software waterfall life-cycle model



usually performed using the face validation approach; therefore, transparency requirements are particularly important.

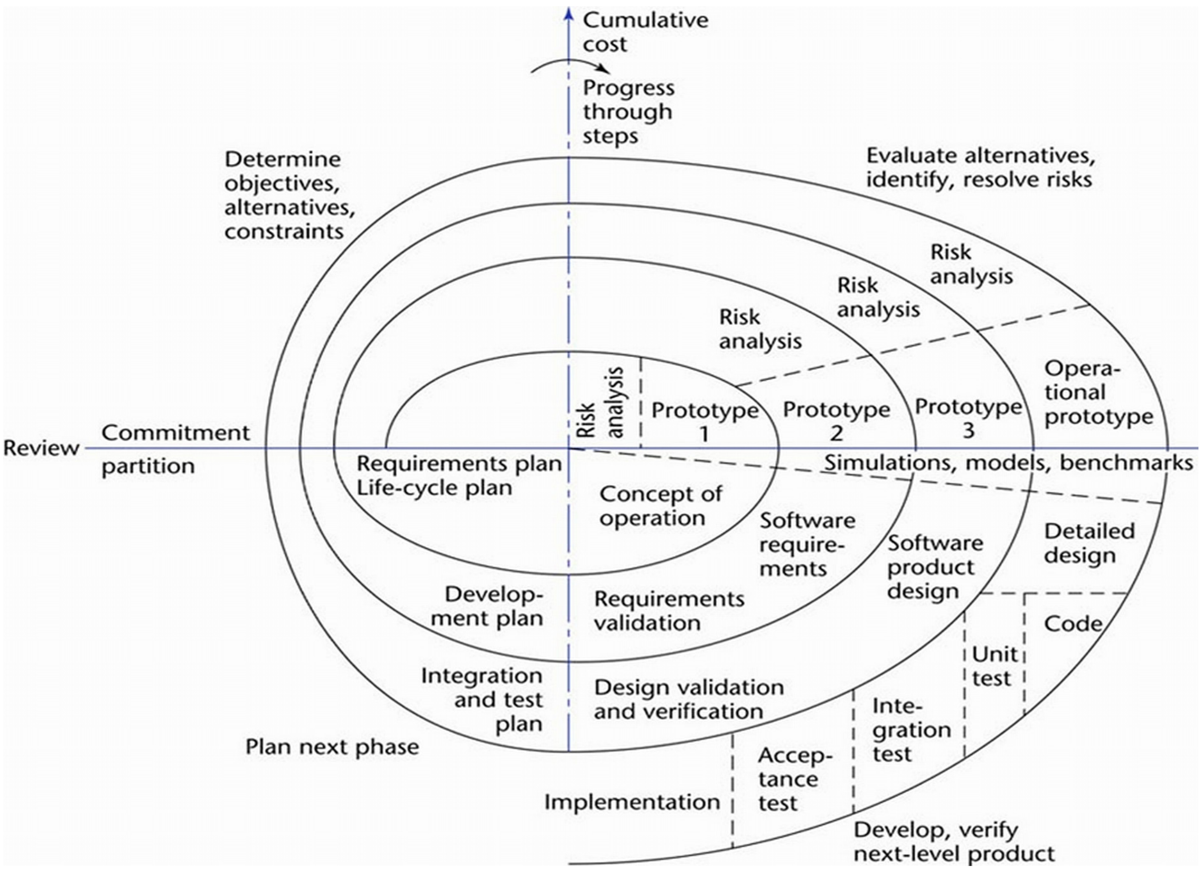
If the policy decision maker deems the promised functionality adequate, the software design stage follows at the end of which software design document (SDD) analysis is performed to understand whether the expected functionality corresponds to conceptual intentions and visualisation will conform to the habits of policy planners and their comprehension of displaying information. If V&V-2 validation has finished successfully, the implementation phase follows because of which the beneficiary receives a prototype of the policy planning support tool software. V&V-3 verification is usually carried out by checking border conditions, individual critical situations as well as some random situation tests. Software validation is performed for functional (face validation) and non-functional (statistical validation) requirements established by SRS. Only now, can the policy decision maker see the result and start voicing his outrage because of the mistakes made. Although much time has already been wasted, the maintenance stage when additions are made and V&V-4 is performed, is still rather far away.

The Waterfall model is good and correct; sadly, it is difficult to use in situations where experienced software design specialists (analysts, coders etc.) are constantly scarce. In addition, the beneficiary lacks skills to explain his/her wishes in formalized style. Moreover, both do not have sufficiently transparent and clear communication, which could limit potential misunderstandings and mistakes during software development.

Various software design methods (see Figure 2) such as agile programming etc. are introduced to somehow diminish the above-mentioned problems.

Concisely, the basic idea of agile technologies is to forgo careful preparation of software documentation because nothing good will come of it in any case. For the duration of the whole project, policy decision makers and software engineers sit at one table. There is hope that by working together they will create something useful. This

Figure 2. Software full spiral life-cycle model



is possible in simple and short projects, however complicated and labour intensive projects where there are plans for a long lifecycle and sustainability of the software is important, such an approach could be debatable.

An attempt to solve the problem is to improve software development management (Xiaojun, 2013), for example, using the Full Spiral Life-Cycle Model (see Figure 2), by implementing risk management, as well as projecting potential labour-intensity and pre-forming alternative analysis and non-functional parameter analysis. Simulation methods are sometimes used to validate non-functional parameters; however, these applications are rather primitive.

Unfortunately, these methods do not help to solve the main issues, which is insufficient transparency of the conceptual model leading to different understanding of the goal system concept by the policy decision maker and the software developers.

Simulation: A Stage of Policy Decision-Making Support Software Development

One method to improve the transparency and clearness of the conceptual model is to use simulation to visualize functionality. A series of description methods exist, which try to improve project transparency and accessibility for higher-level representatives of the customer. Several different languages with a reasonably high semantics level (4GL etc.) are offered, however, taking into account that most of humanity are visual beings, the demonstration of a simulation model leaves a more lasting effect that is followed by beneficiary questions. Firstly, "What did you demonstrate? We asked for something completely different." Secondly, incomprehension by the developer as to "Is this not what you ordered?"

Various simulation definitions exist, the simplest of which could be *"Simulation is the imitation of the operation of a real-world process or system over time"* (Banks, 1998). Traditionally this term applies to computer simulation. Simulation is used to forecast outcomes, test alternatives, ensure What-if analysis, teaching and training, as well as for edutainment purposes. Simulation is utilized when describing the system analytically is proving difficult, as there are many essential factors that influence goal system functionality and performance, as well as the real system is stochastic. Simulation is used as an alternative when experimentation with the real system is not possible i.e. too expensive, risky or unethical.

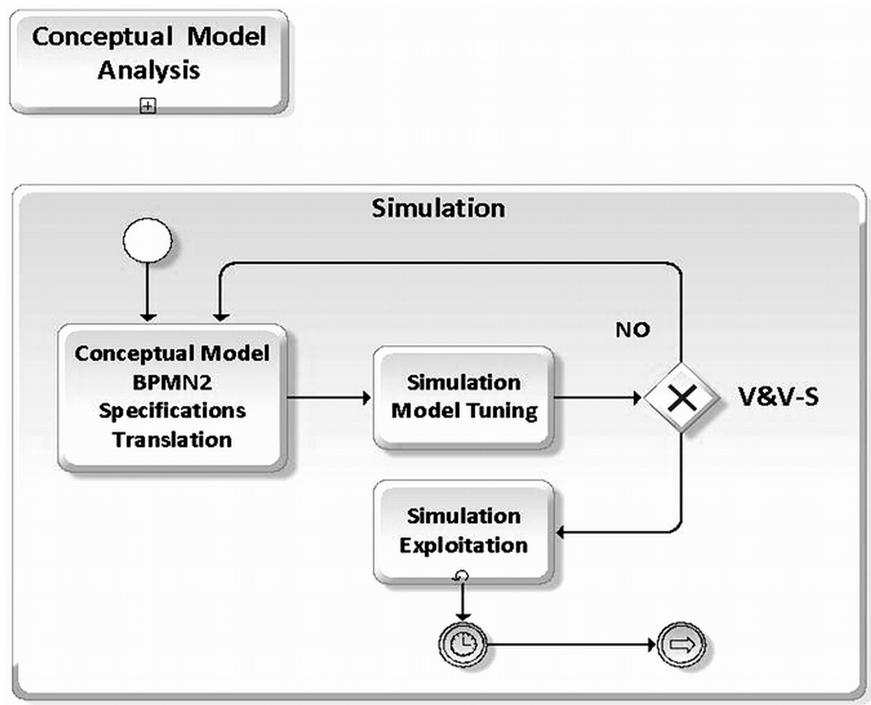
Sociotechnical systems can be static or dynamic, determined or stochastic, discrete or continuous, linear or non-linear etc. Policy systems usually are stochastic and non-linear, which makes developing their specification in terms understandable to the beneficiary significantly more cumbersome. Then the specification is reasonably simplified, but not too much not to lose the goal system's conformity with real life. Conversely, the simulation model must correspond to the characteristics of the goal system i.e. if the system is discrete; the model has to be created using discrete event simulation (DEVS) methods. If the system is continuous, system dynamics simulation must be used. To analyse policy processes on a more detailed micro level DEVS as well as agent-based modeling (ABM) tools can be used, whereas to analyse political changes for a prolonged period of time system dynamics could be utilized. However, real policy systems are complex; therefore, it is often necessary to create distributed and heterogeneous models. The "distributed" attribute means that the simulation model is territorially divided, heterogeneous – several simulation methods are united in one simulation model, for example ABM and system dynamics or others. Another question here is data exchange and interoperability between heterogeneous simulation models. This is traditionally ensured using the High Level Architecture (HLA) (Perumalla, 2009) environment but other communication environments and mechanisms such as Easy Communication Environment (ECE) (Aizstrauts & Ginters et al, 2012) or Corba (OMG, 2011) etc. can also be used.

The simulator has to maintain a beneficiary's alphabet, which is a set of terms that the beneficiary encounters during his/her daily professional activities, to ensure user-friendly visualisation. The simulator has to be open so it can be integrated into goal system software, preserving the Open Source Software (OSS) licensing model. Policy decision makers i.e. policy, tourism, economy and other specialists could create simulation models, but then the design syntax have to be understandable by people without specific programming knowledge. Simulation is included as a sub-process in the "Conceptual Model Analysis" block (see Figure 3).

One part of the conceptual model is the BPMN2 specification, which is translated into the language of simulation tools. V&V-S verification inspects whether the simulation model corresponds to the BPMN2 specification of the conceptual model i.e. translation quality, but face validation determines whether the simulation model conforms to the functionality intended by the policy decision maker. If no severe mistakes are found, the simulation model can be operated in different modes to validate the functionality of intended base algorithms as well as to determine potential critical modes as to the goal system's performance and/or expenses. Statistical validation is optional at this point.

The main target is to make goal system functionality transparent and understandable as early in the project as possible. When talking about

Figure 3. Modified software waterfall life-cycle model w/simulation



simulation, it would be expedient to remember one respectable statement: "Use simulation (the social systems) to develop theories, not accurate models" (Gilbert& Troitzsch, 2006).

ZAGREB OPEN GREEN PARK SIMULATOR

One distinctive application of the above-mentioned approach is the FP7 FUPOL project "Future Policy Modeling" case related with designing of the Zagreb Open Green Park simulator (Ginters & Aizstrauts et.al, 2013).

The territory of Zagreb Open Green Park is approximately 20,000 square meters. Autism Centre patients and visitors from other neighbourhoods are expected to visit the park. Zagreb municipality has statistical forecasts about the possible number of visitors on weekdays and weekends.

Zagreb Open Green Park simulator (http://dev.fupol.lv:8080/FupolSimulatorGui/) consists of two parts and is based on an ABM simulation designed in Repast Symphony and GUI implemented in Java environment (see Figure 4). The aim of the simulator is the realisation of two related tasks: area breakdown general planning through potential occupancy analysis and park layout design, and exploitation.

In this case, the simulation model is not only used for functionality validation of the concept, but also as a part of the unified simulator, which ensures draft assessment of park zoning.

The Occupancy Analysis part and the Layout Design and Exploitation part can be used together or separately. The Occupancy Analysis Simulation model (see Figure 5) is based on statistical data (typical visitor and accompanying person characteristics, time of arrival, list of desirable activities and probability of their choice), profile

Figure 4. Zagreb Open Green Park simulator architecture

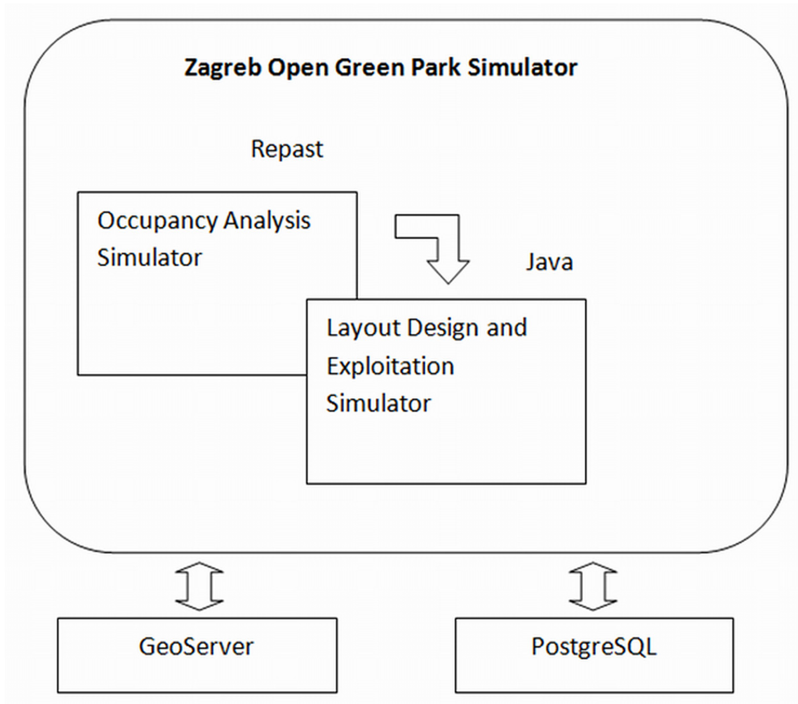
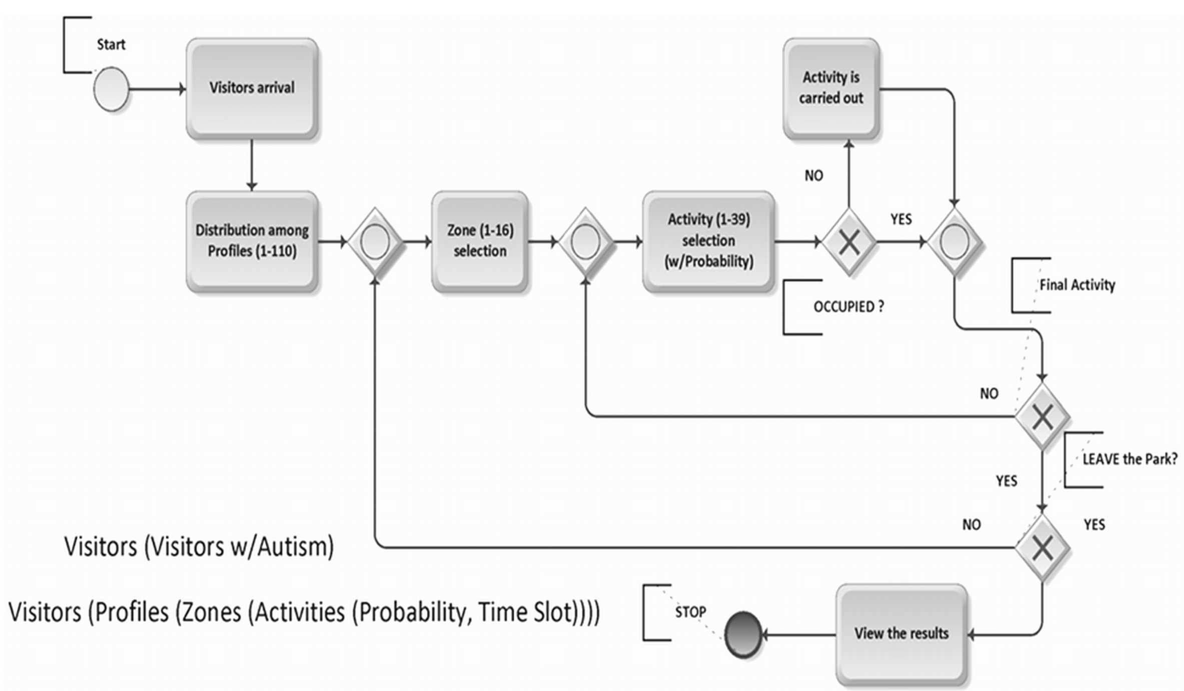


Figure 5. Zagreb Open Green Park Occupancy Analysis simulation

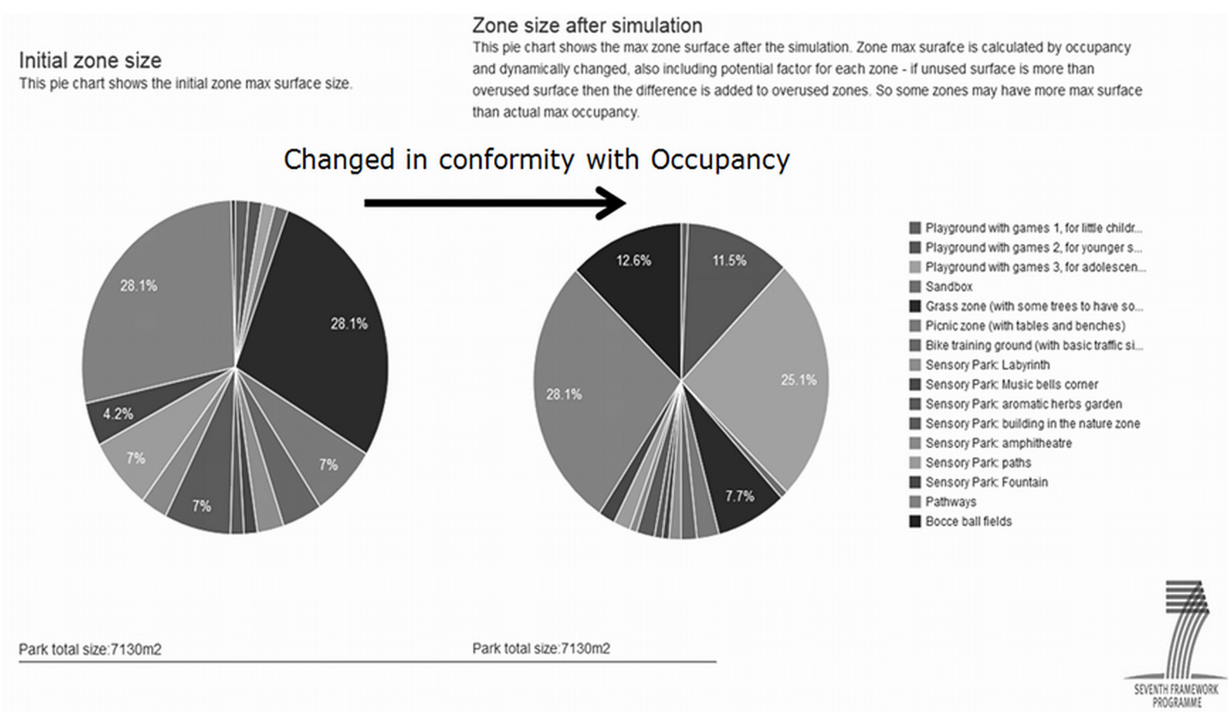


distribution on weekdays and weekends, as well as the minimal determined visitor comfort area. For each park visitor a corresponding profile is chosen according to recommendations of Zagreb municipality and Autism Centre, and other statistical data (see Figure 5). Thirty-nine activities have been determined to be implementable in Zagreb Open Green Park. Each profile has been appointed several most typical activities. These priority activities have been determined with a certain probability for each profile. The most likely time slot for visiting the park is provided for each profile. Simulation days include weekdays and the weekend i.e. one full week. Depending on the date entered, the weekday is determined and simulation is performed for the selected amount of days. Simulation length determines result credibility because it anticipates the distribution of simulation results to conform to the normal distribution of probabilities. Result levelling can be observed visually but in keeping with statistical methods, it can be assumed that a 95% credible result can be achieved if the number of simulation cycles (days) exceed around 30. All activities in the park are distributed over 16 zones. The park's designer specifies these. Activities with the same name can be located in different zones.

The potential maximum number of visitors (comfort area for visitor is defined) determines the required minimum area of a zone. If the initially determined zone area is too small, the disappointed visitor goes to another priority activity or leaves the park. If the presence of people with autism as well as other visitors is detected within one activity, the possibility of contacts is predicted and registered.

The simulation allows creating a rough and hypothetical breakdown of park zoning. It is possible to ascertain the number of visitors in each zone in the simulated time slot, as well as determine the number of rejected visitors if the particular zone/activity was fully occupied (see Figure 6).

Figure 6. Zagreb Open Green Park draft zoning based on Occupancy simulation



The use of the Zagreb Open Green Park Occupancy Analysis part ensures the possibility to answer the following questions:

- What is the minimal area breakdown of the park zones?
- How many people had limited access (rejected) to their favourite activity?
- Are some potential conflicts (incompatible activities in one zone) or contacts among visitors w/autism and without in the same zone?

However, the above-mentioned model provides information on the possible size of the zone area based on the potential number of visitors and each visitor comfort area but it does not take into account the locations and square size of activities/facilities and reasonable distances between intermediary activities.

The Zagreb Open Green Park Layout Design part can use the operational data from a preliminary park zone area size assessment provided by Zagreb Open Green Park Occupancy Analysis and allows park layout interactive design using spatial graphical information.

The Zagreb Open Green Park Layout Design ensures (see Figure 7):

- Activities/facility area size calculation and inspection deadline forecasting;
- Taking into account weather conditions;
- The opportunity to make changes to profiles by entering real data after commencing park operations;
- Interactive layout design (see Figure 8);
- The opportunity to report occupancy and conflicts/contacts prediction for potential visitors through the Zagreb Municipality website;
- Conflict predictions for intermediary activities;
- Park maintenance service job scheduling and event planning.

The Zagreb Open Green Park Layout Design simulator provides an opportunity to create a more accurate breakdown and zoning distribution, because it is based on visualization of different distribution proposals, providing designers with an extra capacity to distribute zones considering the maximum number of simultaneous visitors for a certain activity.

The development of the Zagreb Open Green Park simulator software prototype will be continued after functionality validation.

CONCLUSION

Simulation role in transparency ensuring and conceptual model validation is approved. However, still the actual is problem of heterogeneity and incompatibility of simulation models and tools, which would be solved by converting simulation data streamed through a distributed simulator.

Policy decision-making support tools correspond to classic sociotechnical system features, which are inherently open, have a large number of essential and stochastic influence factors, cognition and complexity, which encumbers the creation of specifications using analytical methods.

Transparency and clearness are particularly important when developing a conceptual model of the software, because they ensure model validation in earlier stages of the software life cycle, avoiding unnecessary spending of time and resources. Policy decision makers must understand the functionality of the goal system a long time before the end of the implementation stage.

The advancement of programming and design technologies improves project monitoring, minimizes timely development risks and decreases the number of potential mistakes, but does not solve the main issue of sociotechnical systems software development, the lack of transparency and clearness of conceptual models, which is the main reason for project failure.

Figure 7. Zagreb Open Green Park Layout Design simulator operation

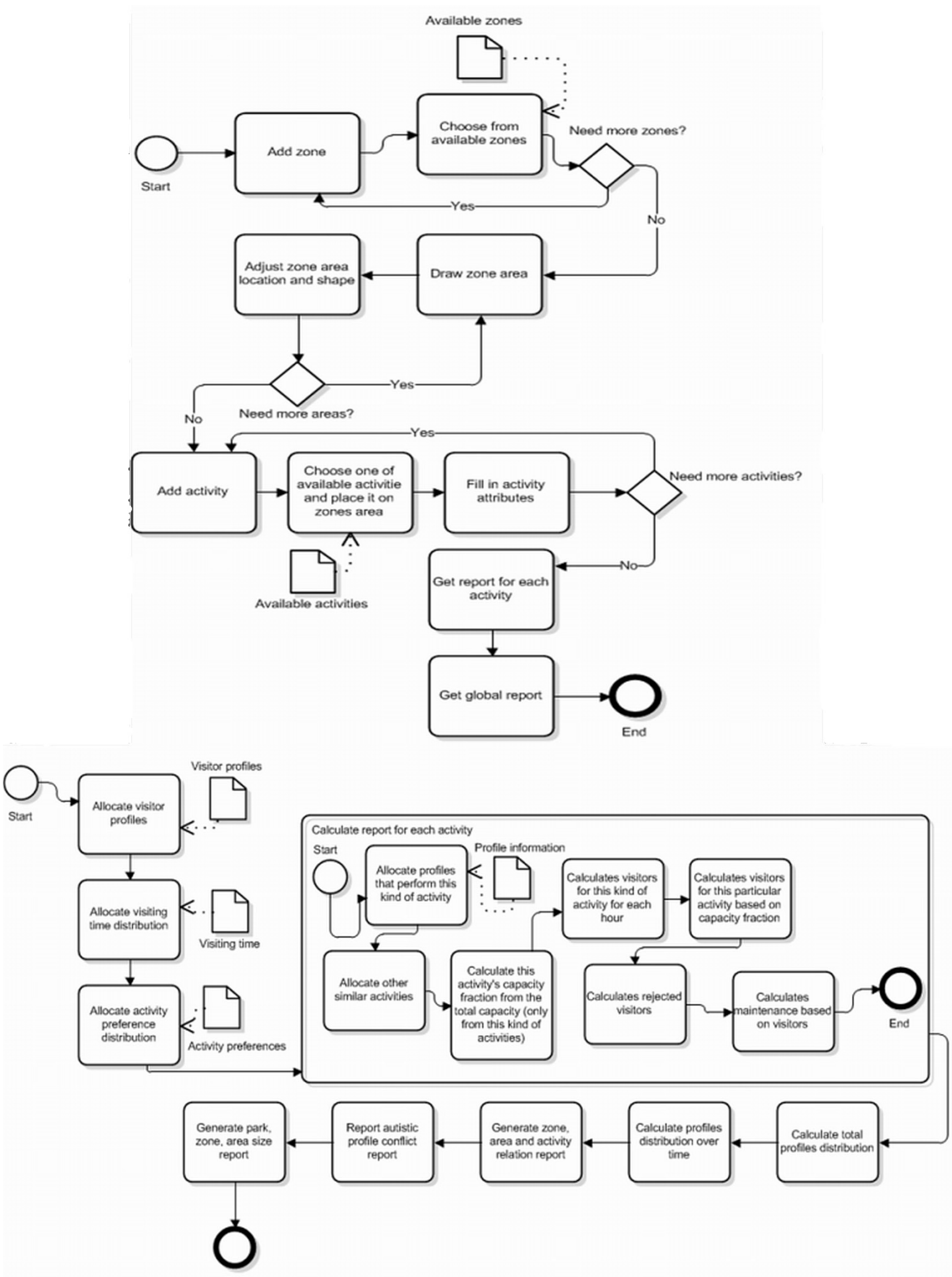
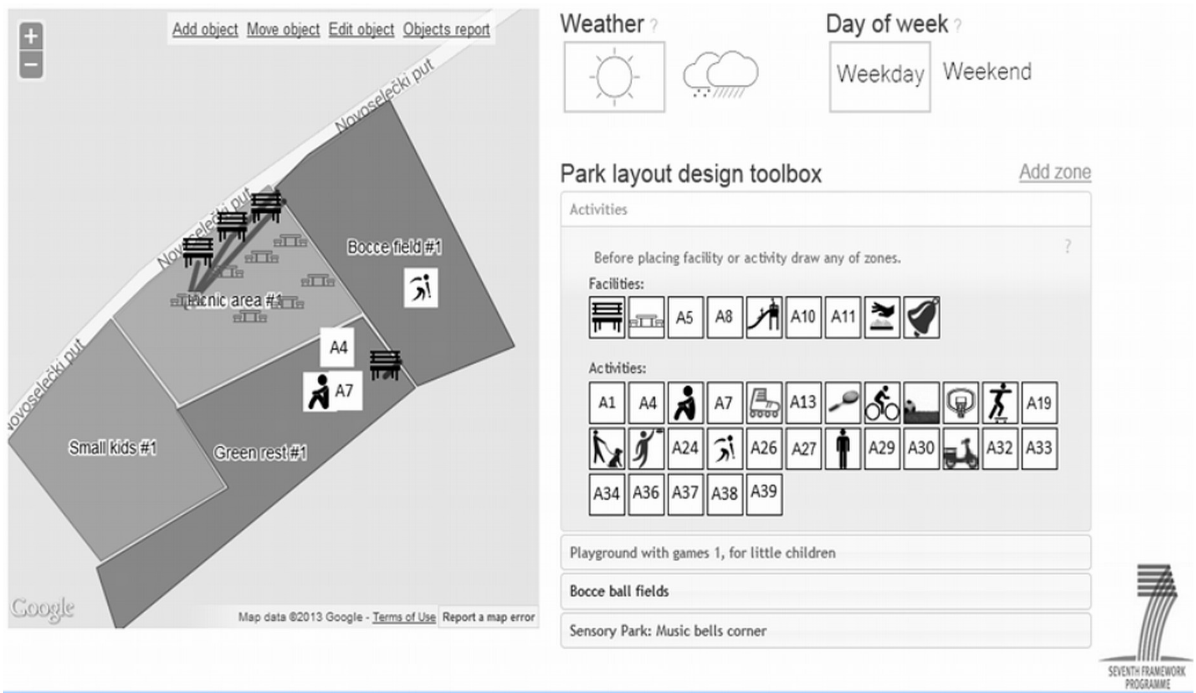


Figure 8. Zagreb Open Green Park interactive layout design



It is proposed to use a modified version of the software design waterfall life-cycle model in which simulation is used to design a conceptual model and validate its functionality. This can significantly improve project transparency for policy decision makers. Simulation ensures visualisation of the conceptual model and can predict the thresholds of non-functional parameters and possible bottlenecks in various policy decision-making scenarios.

However, it must be mentioned that the design of simulation models requires practical experience and in case of complex systems, the model will be distributed and heterogeneous, which will comprise different simulation technologies. Conversely, simulation models have to be created ensuring a sufficiently high layer of abstraction, which would be understandable to policy decision makers and other stakeholders.

Zagreb Open Green Park simulator was designed to assess the possible breakdown of park zones while respecting the comfort area of each visitor. The use of simulation allowed evaluating potential visitor interests to avoid mistakes in the overall planning of the park as well as served as a source of input information for Zagreb Open Green Park Layout Design, which ensures precise design of the park area using spatial data for determining activity locations. Maintenance of the Zagreb Open Green Park simulator will continue by the end of the FUPOL project.

The perfection of conceptual model visualisation is a question of further improving the quality of software development projects. It is expected that simulation will be further combined with the possibilities of virtual and augmented reality, providing the user with an immersive validation environment.

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KEY TERMS AND DEFINITIONS

Face Validation: Visual assessment of simulation model running results to ensure that model conform to real-world process imitated.

Heterogeneity: Different simulation methods use in joint simulation task.

Simulation: "Simulation is the imitation of the operation of a real-world process or system over time" (Banks, 1998).

Sociotechnical System: Integrated system, where "made by hand" part an i.e. technical system is combined with social part that is not "handmade". In this case, "social" describes environmental, human as well as other systems.

Software Life-Cycle: Period of time when the software designing started by the end when nobody no more interested in the software use.

Statistical Validation: Statistical assessment of simulation model running results respecting data confidence and credibility.

Verification: Simulation model software debugging to ensure that simulation model fit with conceptual model.

Chapter 8
A Review of the Application of Fuzzy Cognitive Maps in the Policy Decision-Making Life Cycle

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ABSTRACT

Fuzzy cognitive maps are a qualitative modeling technique that uses expert knowledge to attempt to represent the interactions between problem-specific factors aiming to simulate how these interactions alter the factors and drive the current state of a problem to a different state. Recent years have seen an increase in the number of research attempts that propose the adoption of Fuzzy cognitive maps (FCMs) as a means to forecast the effect of a policy in a number of interesting domains, including land use, urban (re)development, and other social, political, or economic issues or to simulate the current state of affairs to pinpoint possible hotspots for creating a policy. This chapter presents an overview of these research attempts where fuzzy cognitive maps have been employed as a simulation tool in order to support decision makers in their assessment of the impact of policies and help them adopt the most suitable policy to implement.

INTRODUCTION

Modern-day policy decision-making has become more complicated and involves greater risks compared to past decades. This is largely down to the increase in the number of variables that need to be taken into account when making decisions concerning the adoption of a new policy or modifying the content of an existing policy. For instance, recent social issues and environmental laws have influenced both the subject matter of policies as well as the process of policy decision-

DOI: 10.4018/978-1-4666-6236-0.ch008

making. Additionally, the availability of more experts, the increase in the accessibility of data, as well as the establishment of social media as part of our everyday lives has required the policy decision-making process to be altered to accommodate these new aspects. Furthermore, citizens are now given greater opportunities to have their opinions heard, as well as means to marshal support or rally opposition towards various policy decisions, especially with the increasing use of Internet and mobile/smartphone applications and social media sites.

Part of the agenda setting stage of the policy-making life-cycle (discussed in detail in Chapter 5) involves defining the problem to be addressed and establishing the need for a new policy or a change in an existing policy. Once these activities are completed, the analysis stage begins – challenges and opportunities that are associated with an agenda item are defined in detail and recorded in a draft policy document. In order to specify exactly what a policy is supposed to accomplish, it is important to specify its goals and objectives, including the ways to measure its impact on economic, socio-cultural, environmental or any other relevant concerns defined in specific criteria and indicators. Additionally, it is equally important to gather as much knowledge and expertise as possible from different sources, such as research-based or scientific knowledge from previous projects and policy implementations, as well as statistical information, to help in upcoming simulations and forecasts performed later on in the analysis stage. After these activities have been carried out, policy-makers will be left with a number of approaches or strategies from which they will need to decide which one will make the better policy to implement in the next stage of the life-cycle. To evaluate all these options, policy-makers have to model and simulate the impact of each policy and match the results against the criteria and indicators defined previously. Analysing the characteristics of the options will then help determine the final strategy to implement as a policy.

Constant changes in transportation, economics, family life, medical practices, and many other aspects can heavily influence the way a policy is perceived by citizens in terms of quality factors. Added to the fact that the process of drafting and implementing policies is inherently very challenging and highly complex, this has left policy decision-makers struggling to successfully exploit the knowledge and expertise of specialists, and to adequately predict the impact of a policy and how citizens will perceive it. This is also the main reason why very few specific modeling and simulation methods have been developed and adopted to help with policy decision-making in the past. Recently, however, policy decision-makers have shifted towards using intelligent techniques to help them overcome these challenges. One of the most popular techniques used is fuzzy cognitive maps – an expert-based qualitative modeling technique. Generally speaking, fuzzy cognitive maps (FCMs) are used to depict a mental representation of the factors existing within a given problem. These factors can be states, notions, events or any concepts that possess certain characteristics and qualities. Causality is then incorporated by connecting these factors together based on the influence each factor exerts on another, resulting in a directed graph of concepts and relationships known as a cognitive map. Once the map is formed, fuzziness is introduced in the connections so that causality (i.e., each edge/relationship) is denoted as matter of degree to signify the strength of the influence between two factors. To help decide the factors to be included, the causality relationships and the degree of strength of each influence, domain experts are consulted providing their knowledge and expertise. As a modeling technique, FCMs can help assess the current situation of a problem, but their main advantage lies with their ability to predict the future state of a problem by simulating the interactions of the factors in the form of a fuzzy feedback model of causality. Hence, FCMs are an ideal inference tool to perform what-if scenario analysis (Glykas, 2010).

Because FCMs make use of expert knowledge, they are regularly used as prediction models in intelligent decision-support tools and in the past have been used successfully to model social, economic, political and environmental problems. In policy decision-making with FCMs, decision-makers consult experts relative to a particular policy domain (such as economists for banking and finance policy-making, medical practitioners for health and welfare policy-making, etc.). Examples of their usage include community facilities, sustainable tourism, urban segregation, urban development and environmental effects. Their ease of use allows non-technical decision-makers to gather and incorporate existing expertise and simulate the potential impact of a decision. Furthermore, the fact that the vagueness and ambiguity, which is often present in decision-making processes, is handled through the fuzzification of values allows for more realistic simulations.

The remainder of the chapter is organized as follows: To begin with, an overview of the way FCMs work is given and presents the main background theory and notions required to construct FCM models and simulate the interaction between factors. The next section provides the literature review, which is the primary aim of the chapter. Specifically, the section explores the ways FCMs have been applied in various policy domains and shows how policy-makers have made use of the knowledge of experts, stakeholders and citizens to model the current state of specific problems and perform what-if scenario analyses to assess the impact of candidate policies. Also, the section describes how FCMs have been (or planned to be) used in the policy decision-making life-cycle in several pilot cities participating in FUPOL – an EU-funded FP7-ICT project promoting a new governance model to support the policy design and implementation life-cycle (Future Policy Modeling, 2011). Several limitations are, in addition, discussed in this section and possible solutions to these limitations. Following this, a section is dedicated on examining future research directions in the area of policy decision-making using FCMs. Finally, the chapter closes with some concluding remarks.

BACKGROUND

As mentioned previously, FCM modeling is a qualitative modeling technique and belongs to the field of Computational Intelligence. It brings together various elements of fuzzy logic theory (Zadeh, 1965) and artificial neural networks (McCulloch and Pitts, 1943). In particular, this modeling technique was introduced by Kosko (1986) and builds upon the theory of cognitive maps (Axelrod, 1976) by combining high-level reasoning in a linguistic (fuzzy) form with the learning and classification abilities of artificial neural networks with the goal of dynamically providing support in management, decision-making and planning activities in the context of a problem being solved. Due to the simplicity of both the representation and execution of a FCM model, the technique is widely used in crisis management and policy-making in economic and socio-political systems, where quantitative models are often too expensive, complex and unreliable to be applied.

Concepts and Causal Relationships

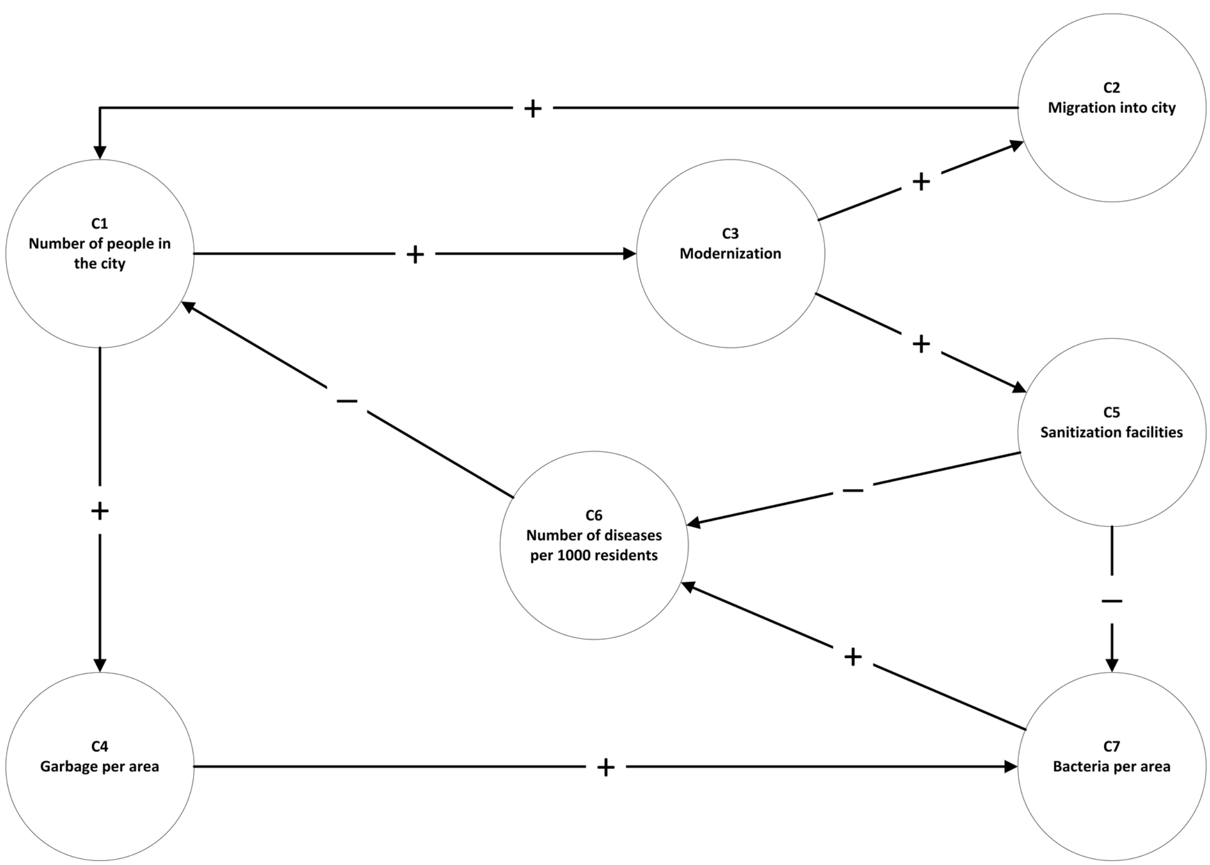
Specifically, a FCM model is an acyclic directed graph that is constructed with the aid of domain experts to graphically represent the knowledge of a specific problem. When a policy decision needs to be taken (as determined in the agenda setting stage) the policy decision-maker consults experts and writes down all the factors influencing the policy – problem, characteristics, states, variables, or entities. These factors are called “concepts” and are represented by nodes in the graph. Next, with the help of experts again, the “causal relationships” between the concepts are also recorded to understand how the different factors positively or negatively influence each other.

On the graph, these causal relationships are denoted as edges linking two nodes. Figure 1 shows a well-known example of a cognitive map constructed with the help of experts to model the concepts and their causal relationships in the domain of public health in a city (Maruyama, 1963). A positive edge links concept C1 to concept C4, meaning that an increase in the number of people in the city will increase the garbage per area. Contrarily, a negative causal relationship exists between concept C5 and concept C7 since an increase in sanitization facilities will decrease the bacteria per area. The nodes and edges on the graph simply form a cognitive map; there is no “fuzziness” incorporated yet. However, since the goal is to model the current state of a problem, in this case the state of a city’s public health, values must be assigned to concepts and causal relationships in order to reflect the current state of the problem quantitatively. Only then can a policy decision-maker assess how the effect of a change in one concept drives the problem to a different state, by allowing the different interactions that exist between the concepts to occur algorithmically/mathematically.

Fuzzification Analysis of Concepts

Once all concepts have been agreed upon, the fuzzification procedure is carried out. Fuzzifica-

Figure 1. Example of a cognitive map for public health (Maruyama, 1963)



tion essentially involves employing a membership function to break down each concept into a number of fuzzy (overlapping) sets in the range [-1, 1] and assigning a linguistic description that corresponds best to the state of a concept within the boundaries of each fuzzy set. The goal here is to allow neighbouring intervals to overlap so that there are varying degrees of confidence for each linguistic description, rather than crisp-valued intervals. Linguistic descriptions usually take the form of a single word, a short phrase or a sentence.

Activation Levels and Weight Values

Next, each node is initialized with a numeric value (known as its "activation level") in the range of [-1, 1] to qualitatively signify its current presence or state in the problem. In general, a value closer to -1 indicates that the concept has a strong negative presence, leading to inhibiting effects in the problem, while a value closer to 1 indicates a strong positive presence, leading to promoting effects in the problem. The decision-maker and domain experts must then together designate the strength of each causal relationship. Values, again in the range [-1, 1], are placed on the edges of the graph to indicate the strength of the causal relationship between two concepts, known as "weight values". If a concept positively influences another concept, then the edge will be assigned a positive weight value. The degree of influence will determine whether this weight value will be closer to 0 (a slight influence) or 1 (a strong influence). Conversely, if a concept negatively affects another concept, then the weighted arrow will take a negative value, again, based on how severe the effect is. Concepts that are independent of each other will have no edge linking them. Figure 2 shows how the cognitive map in Figure 1 develops into a FCM by incorporating the activation levels of concepts and weight values of causal relationships.

Domain Experts

Both node values and edge values are provided by a domain expert. However, it is more common to consult more than one domain expert, meaning that average values for concept activation levels and causal relationship weight values can be assigned. Furthermore, by rating the level of expertise of each expert, weighted average values can be assigned instead, thus giving greater significance to the values provided by experts with more knowledge in the domain.

Execution

Once the initial activation level and weight values have been determined, the problem's concepts are free to interact. Interaction is simulated by iteratively adjusting the activation levels of concepts using an updating function (Eq. 1).

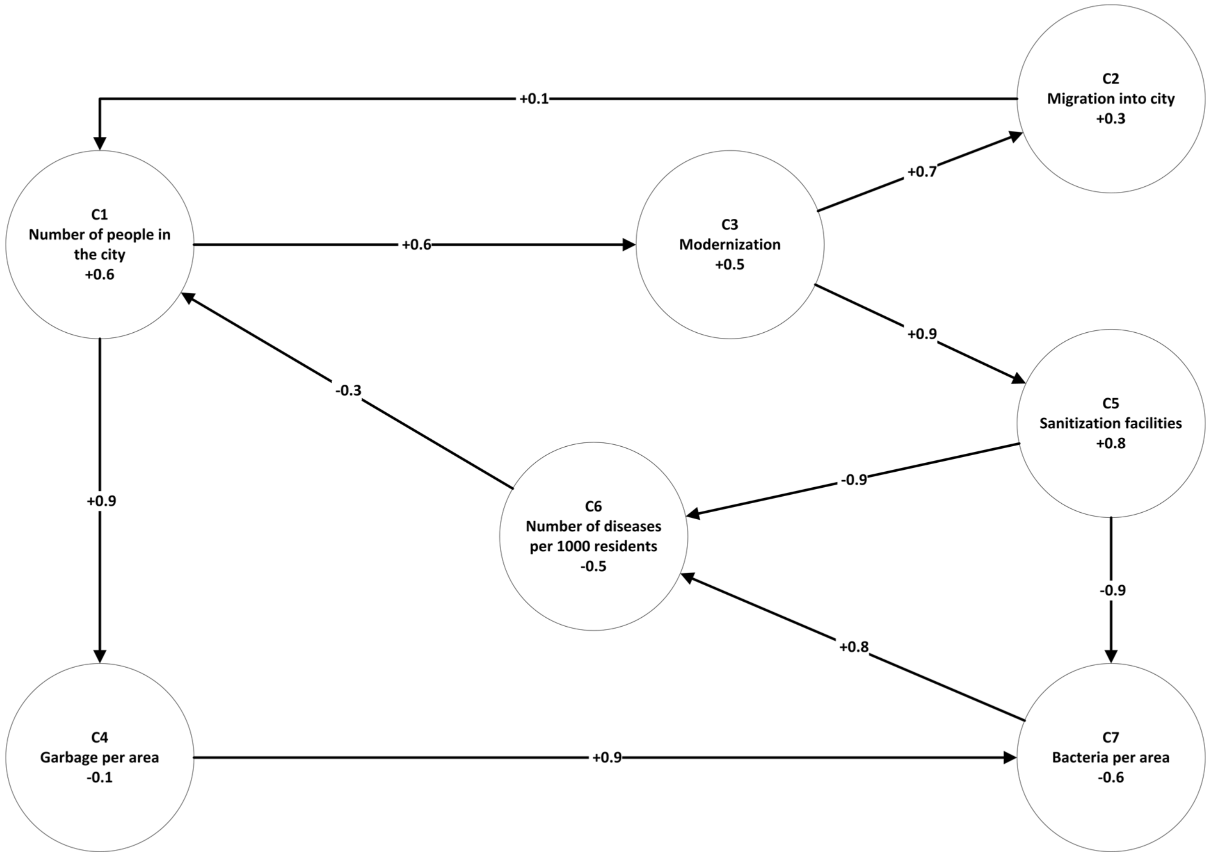
$$A_i^{(t)} = f\left(A_i^{(t-1)} + S_i^{(t-1)}\right), \tag{1}$$

where and $A_i^{(t-1)}$ is the previous activation level of concept i at time $t-1$, and $S_i^{(t-1)}$ is the summation of the weighted influences exerted on concept i from all other concepts at time $t-1$, denoted by

$$S_i^{(t-1)} = \sum_{\substack{j=1 \\ j \neq i}}^{N} A_j^{(t-1)} w_{ji}. \tag{2}$$

The resulting value is passed through a transformation function f to contain the value between a specific range, usually [0, 1]. A common transformation function used is the Sigmoid threshold

Figure 2. Resulting FCM after activation levels and weight values are added to the graph modeling the public health cognitive map in Figure 1



$$f\left(x\right)=\frac{1}{1+e^{-cx}} \tag{3}$$

where c is a positive real number. The simulation continues until the model either reaches equilibrium at a fixed point for each concept, or exhibits limit-cycle behaviour, or exhibits a chaotic behaviour. Equilibrium signifies that all activation levels have stabilized at a specific value with no change being observed – this is the desired outcome. Limit-cycle behaviour indicates that activation levels repeatedly loop in a confined range of values (oscillate) under a specific time-period. Chaotic behaviour, the least desired outcome, denotes that activation levels arrive at a variety of values in a non-deterministic, random way.

Defuzzification Analysis of Concepts

If an FCM model reaches equilibrium, the resulting activation levels need to be defuzzified. Specifically, each activation level is interpreted based on the fuzzy sets constructed in the fuzzification process. The value of each concept's final activation level is applied to its membership function to obtain the fuzzy sets in which the activation level falls in and is interpreted accordingly. There are two possible cases: firstly, that an activation level falls completely in only one fuzzy set, meaning that the interpretation is given at 100% confidence; secondly, an activation level may fall in-between two adjoining fuzzy sets, meaning that each interpretation is given at a lower confidence.

LITERATURE REVIEW

FCMs have been adopted in a number of research attempts as a way to assess the suitability of policies and to forecast their impact in many different application domains. This section presents an overview of several such research attempts, aiming to illustrate the capabilities and advantages of this qualitative modeling technique for effective decision-making.

Defense

Several attempts have used FCMs as a tool for military planning. For instance, Yaman and Polat (2009) proposed FCMs as a mechanism for effects-based operations planning, where the objective is to determine and select the most suitable course of action to succeed in a specific operation involving both military and non-military methods. The scenario examined dealt with a military operation using NATO to stabilize a country and the goal was to create a model capable of assessing how the interaction of various sub-effects managed to contribute to the achievement of several main effects in order to satisfy the operation's objectives. Their FCM model consisted of 12 concepts corresponding to 12 sub-effects, linked together with a total of 64 causal relationships. Six experts were consulted to provide the necessary activation levels and weight values for simulating the model. In order to take into account the dynamic conditions affecting the operation's objectives, the experts were also asked to provide values denoting a possibility of influence (probability of a concept altering the value of another concept), degree of influence (the amount of change that a concept causes another concept), duration of influence (length of time required for a concept to alter the value of another concept by a certain amount of change) and permanence of influence (the length of time required for the change to expire). These values were incorporated in order to extend the classic FCM algorithm. Essentially, they allow decision-makers to first configure several "initial conditions" of an operation, and then observe the impact of these configurations through the interaction of the sub-effects with respect to how successful each configuration is in achieving the main effects and, subsequently, reaching the operation's objectives. Similarly, Rashaad et al. (2011) use FCMs to emulate the decision processes followed by army infantry platoon leaders in order to offer help in actual infantry operations and missions. Their model focuses on how situation awareness plays a part in the decisions taken by leaders and represents the relationship between the requirements of situation awareness, goals and decisions. Goal-Directed Task Analysis (GDTA) was performed to extract the model's concepts and then a subject-matter expert helped determine the causal relationships, assess the weight values and extend the model with additional nodes. A total of 7 concepts (goals) were identified together with 15 causal relationships. In addition, each goal was broken down into a set of sub-goals and each set was modelled into a sub-FCM. The map was simulated under a scenario where the mission consisted of getting a troop to enter a building, given the number of soldiers and their capabilities, the number of enemy soldiers and their capabilities, and the presence of civilians. The goal was to identify the best strategic position of forces to avoid civilian injuries.

Business and Finance

With the global financial crisis currently in full force, many policy decision-makers in the banking and finance sectors have turned to more sophisticated and intelligent techniques for support in many aspects. FCMs have been employed for both forecasting future states of a current problem as well as assessing the effect of various policy decisions. Papaioannou et al. (2013) investigated the consequences of the Greek private sector involvement (PSI) on Cypriot bank branches operating in Greece using an FCM model as the prediction mechanism. The model consisted of 15 concepts with 111 causal relationships, which were initialized after consultation with two experts. A total of 10 scenarios were constructed in order to carry out simulations and allow the decision-maker to observe how the probability that Cypriot banks were to shut down their Greece-based branches was affected by different changes to the percentage of Greece's PSI.

The privatization of businesses has also been investigated, as shown by Çoban and Seçme (2005), who specifically focus on the impacts of policies and practices regarding privatization on employees of public enterprises. The authors' aim was to improve the efficiency of such practices by considering the opinions of employees during the creation of regulations. Two groups of stakeholders, civil servants and workers, were individually surveyed to form a social map of what each group perceives the effects of privatisation on the enterprise, themselves and the environment to be. The civil servants social map comprised 48 concepts and 174 causal effects, whereas the workers social map contained 46 concepts and 128 causal relationships. Examples of the factors identified by both groups include unemployment, social unrest and uncertainty, production quantity and quality. Once the maps were constructed, simulation and analysis was carried out on each map to see the various effects of privatization (considered an independent variable) on the factors (considered as dependent variables). For civil servants, it was observed that privatization would lead to a reduction in costs, overemployment, prices of raw materials, disparity of wages and contribution to the economy, while quality, wages and labour productivity would improve. For workers, similar effects were observed together with a decrease in the standard of living and increase in salaries, productivity and new investments among others. It was also observed that a synergetic effect occurs due to the interaction of the factors among themselves, in addition to the interaction between privatization and the identified factors.

Environment

Perhaps one of the most significant areas of policy decision-making for any government involves different aspects concerning the environment, including pollution and waste planning, protecting and monitoring ecosystems, and land development. In addition, one of the most popular uses of FCMs in this area is to support the inclusion of stakeholders' opinions and participation in environmental management. For example, Özesmi and Özesmi (2003) explored the use of FCMs for the conservation and sustainable development of Uluabat Lake. The authors took into consideration the fact that the participation of local stakeholders is as important for the safeguard of biodiversity as government and local authorities. Therefore, they surveyed 35 stakeholders (including hunters, municipal officials, locals and NGO members) in order to construct 23 FCMs that were later condensed into one consisting of 17 concepts. Several objectives were then assessed by letting the concepts interact during simulations. Specifically, the policy options concerned decreasing lake pollution and increasing villagers' income, and those results were then analysed and recorded into an ecosystem management plan.

Conservation is also the focus of Murungweni et al. (2011), who explore the application of FCMs for analysis of the vulnerabilities of livelihoods to exogenous changes. They used the technique to help solve the current conflict of interest between stakeholders with regards to the conservation of natural resources and land use of a region of southwest Gonarezhou National Park, Zimbabwe. The goal was to extract the variables distinguishing different livelihood types and then simulate for each livelihood type how vulnerable it is (i.e., how the population is affected by hazards and how it reacts to the consequences brought on by these hazards). Local citizens, informants, focus groups and stakeholders were interviewed resulting in the identification of three livelihood types: cattle-based, crop/cattle-based and nonfarming-based. An FCM was constructed for each livelihood type using factors, variables and drivers that were significant for the people associated with each individual livelihood and the connections between them. Four scenarios were selected for simulation, in which concepts were initialized according to varying expectations of climate change and the region's policy options, so that after the interaction of the concepts the policy decision-maker is able to understand and analyse the magnitude of vulnerability of different types of livelihoods.

Climate was also the focus of the work by Giordano and Vurro (2010), whose objective was to adopt FCMs to help in the extraction and investigation of stakeholders' perceptions of drought, and analyse potential conflicts for the Trasimeno Lake area in the Umbria, Italy. Papageorgiou and Kontogianni (2012) deal with stakeholders' analysis for ecological modeling and environmental management using FCMs for the Northern Black Sea in Ukraine. Specifically, 29 lay people were interviewed to extract citizens' perceptions on future prospects and risks regarding the Black Sea's marine environment. This led to a collective FCM model containing 26 concepts and 145 causal relationships. Simulations were then carried out in order to observe the perceived tendency of the Black Sea's ecosystem using different scenarios that randomly initialized the model's initial states. In one of the scenarios presented, the authors deactivated the most central concepts (municipal solid wastes, human activities, urban sewage, industrial activities and harmful algal blooms) and activated strongly or with uncertainty the remaining non-central concepts. At the end of the simulation it was observed that concepts regarding biodiversity and the ecological state of marine environment were able to terminate with high values, demonstrating that conservation policies regulating the risks factors of the most central concepts can play a significant role in the Black Sea's marine ecosystem and biodiversity.

Land cover was the focus of the work presented by Soler et al. (2012), who attempt to study different types of land use and causes of their change in the Brazilian Amazon. Stakeholders and experts were consulted to create the FCM model, in addition to innovatively employing spatial data to identify causes of land use change. The model contained a total of 15 concepts and 32 causal relationships. Two land cover change scenarios were explored through map simulation and analysis was performed on the values of concepts at the final state. For the land reform and conservation scenario, the final state of the model showed an increase in the degree of agro-pasture expansion if a policy to increase official settlements and spontaneous colonization was implemented. For the climate mitigation scenario, it was observed that if a reduction in subsidies and an increase in forest conservation services rewards were enforced, then in the case of an intense dry season, deforestation would decrease but also modify agro-pasture activities.

Ramsey et al. (2012) aim to assess the effects of deer control policies on forest ecosystems in New Zealand with the help of FCM model simulations. The authors created a map with 8 concepts and 16 causal relationships after collecting data from sampling estimates and consulting 3 forest ecology experts. Additionally, each concept was assigned variable-length fuzzy sets during analysis and from the data collected, the map was initialized accordingly. The goal of the approach was to examine how foliar biomass and the rate of growth of seedlings under different environmental conditions might respond to different deer abundance. Four different configurations initialized with varying seedling heights were used in the simulations to assess the objectives.

Ortolani et al. (2010) focused on agri-environmental measures in Belgium concerning farmer types. Concepts and causal relationships were identified using questionnaires and interviews conducted with 20 farmers. The FCMs were built individually for each farmer, and hence the number of concepts varied from 17 to 37 for each map while the number of connections ranged from 19 to 51. The goal was to help address several questions to support policy decision-makers. Specifically, the questions related to the drivers of behaviour that are influenced by pulling policy levers, the outcomes that farmers consider significant and the policy that success can be measured against.

There are many factors influencing the design of urban spaces, such as legislation, nature, functionality, and accessibility. Xirogiannis et al. (2004) concentrate on the aesthetic aspect of urban spaces and attempt to model experts' knowledge within a FCM and simulate the model as a decision support for aesthetic analysis of urban spaces. Specifically, two scenarios were created concerning the development of a strategic plan for the preservation of historic settlements and the restoration of substantial pathways and narrow streets. The 13-levelled hierarchical FCM consisted of more than 250 aesthetic-related principles, such as "road face", "urban furnishing", "historical value", etc., with several concepts expanding into lower-level maps. The experts consisted of a team of architects and urban designers, who were involved in providing the values to initialize the model. The interaction of the concepts through the defined causal relationships helped assess in each scenario the degree to which a particular road was worth preserving in Hermoupolis, the capital city of the island of Siros in Greece. Özesmi, & Özesmi (2004) provide a thorough overview of several other real-world instances of environmental management where FCMs have been adopted.

Energy and Natural Resources

Many governments of both developed and developing countries are putting into action energy-related policies to try to effectively plan for, generate and use energy. There are many aspects to energy and resources that need to be considered, such as trading, transporting and storing energy as well as standards regarding emissions and efficiency. In addition, policies relating to technologies for alternative and renewable energy sources as well as usage and quality of natural resources are investigated. For instance, Jetter and Schweinfort (2011) used FCMs in two studies regarding solar photovoltaic panels for residential customers in order to handle the uncertainties faced by the industry. The first study involved two experts providing information regarding the attractiveness of photovoltaic systems consolidated into a FCM with 26 concepts and 35 causal relationships. The goal was to assess how the performance of solar photovoltaic panels improves in order for the technology to become attractive. Two separate simulations were executed, one where economic growth is continual and another where economic growth is stagnant. The second study involved 7 experts (a grid expert, a customer, a forecaster, a new market specialist, two energy consultants and a photovoltaic panel user). All experts' maps were integrated into a single map consisting of 51 concepts. Such was the complexity of the relationships between the concepts that more than 130 edges were required to model their interactions. The goal of the second study was to examine how the attractiveness and profitability of photovoltaic technologies changes as a result of various economic growth and government support (incentives) levels. Different scenarios at both ends of the spectrum were executed in order to perform this evaluation.

Another application of FCMs in the energy sector involves wind energy deployment (Amer, 2011). Here, the authors attempt to create scenarios for analysing factors that are capable of triggering the large-scale deployment of wind energy in Pakistan. With the help of two experts, a total of 15 concepts were included in the model having 23 causal relationships between them. Three scenarios were developed and the map was initialized to reflect different situations regarding economic growth, the demand for electricity and the level at which the government has policies in place regarding wind energy. After simulating the model for all three scenarios, the authors interpreted the outcomes with respect to the deployment of increased wind energy, local manufacturing of turbines and equipment costs. The outcomes were then used to suggest a technology roadmap for the development of wind energy.

With respect to natural resources, Kafetzis et al. (2010) focus their attention on the domain of water use and water quality. Specifically, the authors tackle the issue of social scarcity, which is considered a significant factor in water resource management, and explore the ability of FCMs to capture both feedback and conflicting opinions of participants. Two case studies were examined in the authors' work leading to the creation of two FCM models. Their first model involved the elicitation and recording of stakeholders' opinions concerning the development of water use policies for management of the Pinios River basin in Greece. The authors interviewed 30 stakeholders (residents, farmers, experts, government officials and researchers) providing them with 17 concepts to choose from to create individual FCMs. The individual FCMs where then consolidated into a "social" FCM model which was later reconfigured into the final desired social FCM comprising 27 concepts, such as water deficiency, agriculture and irrigation, and 71 causal relationships. After performing simulations and analysis, the authors concluded that given the current state of the problem, stakeholders would be willing to pay for water resources only after the government or the EU provide water storage infrastructure. If the government or the EU does not provide infrastructure and investment, then there is unwillingness to pay and poor quality management. Their second model involved extracting the perceptions of stakeholders regarding the transboundary river of Maritza that forms a border between Bulgaria, Greece and Turkey. Eight experts from all three countries were interviewed to form individual FCMs, having, on average, 50 concepts and 65 causal relationships. Using the FCM models to carry out analysis, the authors deduced that no regulation for delivering socially optimal resource use leads to stakeholders having the perception of inequality, increased congestion at the river basin and higher costs for consumers. Conversely, regulation would reduce the effects of positional competition for the resource.

Transport

Planning for transport combines the assessment and evaluation of the different modes, infrastructures, vehicles and purposes for the movement of people or goods. Transport also affects various other factors such as tourism and the environment, and so it is important for policy decision-makers to be able to analyse different proposed strategies concerning this topic. Mkrtchyan et al. (2012) and León et al. (2013) investigate how people use their knowledge of different modes of transport to make travel decisions. The goal is to support policy decision-makers in their understanding of people's travel needs by attempting to model people's travel behaviours. Hence, this will help them formulate and implement more effective transport policies. Specifically, FCMs were used as a travel demand forecasting technique in conjunction with cluster analysis in order to group users exhibiting similar tendencies for the city of Hasselt in Belgium. The authors supplied questionnaires to 221 transport users of the city of Hasselt to extract events, actions, goals, values and trends when travelling, which were later modelled in individual FCMs. After simulating individual behaviour, the results were then grouped to provide policy decision-makers analysed information to help solve city infrastructure and demographic planning. Ugurlu and Topcu (2012) focus on increasing transit satisfaction and transit ridership in urban transportation and adopt FCMs as a means to investigate the relationships between influencing factors and to analyse the impact of alternative options. Using existing literature, the authors constructed a model with 13 concepts relating to satisfaction of public transport (such as service quality of public transport, reliability and income) and then surveyed 4 experts to extract the causal relationships among the concepts. After the model was built, it was simulated for several what-if analysis scenarios, wherein the initial state of concepts were altered each time in order to observe the final state that the model reached under different service levels. The first scenario involved exploring what would happen if the cost of travel for commuters was lowered (e.g., through incentives, discounts and subsidies). The results showed that this would lead to a large increase in the transit ridership level, a higher level of service quality, as well as a decrease in private car ownership. The second scenario investigated the impact of decreased travel times. Again, the transit ridership level and satisfaction would both increase significantly, and the number of private car owners would fall. The third scenario assumed an increase in car ownership and projected an increase in travel times due to the fact that cars and public transport vehicles share right of way. Finally, the last scenario examined what the effects of improving the image of a transit agency would be. Here, the outcomes suggest that by investing in improving its image, a transit agency will see an increase in transit ridership together with improved service quality, leading to much higher public transport usage.

Kang et al. (2004) explore relationship management for airline services using a FCM consisting of factors related to the effectiveness of relationships between personnel, for instance conflict, communication, shared values and trust. A questionnaire was handed out to cockpit crews and cabin crews working for a Korean airline and a total of 365 responses were taken into account that led to the identification of 11 causal relationships between the 7 factors affecting the effectiveness. Then, a linear structural relationships method was employed to ascertain the weight values on the causal effects. What-if analysis was carried out by modifying the activation levels of various concepts to examine the final state of the model and how the effectiveness changes. For instance, by promoting a high level of communication and shared values, the effectiveness of the airline services also reaches a high level. This approach, therefore, provides indication that motivating personnel by investing in certain factors of relationship management could lead to increased effectiveness and, consequently, revenues.

Tourism

A large percentage of revenue for many countries comes from the tourism sector, and for some countries it makes up the majority of revenue. Therefore, governments aim to put into place effective tourism-related policies as part of their country's planning strategies. Information technology plays an important role for the tourism sector since it provides solutions for many aspects of the industry, such as flight tracking, reservation systems, virtual tours and many more. Kardaras et al. (2013) focus on e-tourism and, specifically, personalizing the presentation of content and adapting media in hospitality (hotel) websites. The goal is to ascertain the level to which each media type (text, icon, photo and video) is suitable to each service feature offered by hotels. Twelve experts were consulted who had knowledge regarding the significance of each service feature, as well as the suitability of the media displaying them. In order to incorporate the views of each expert in a single FCM, the authors adopted a fuzzy Delphi method and recorded the concepts and causal relationships accordingly. In the end, thirty-two hotel services were taken into account, for which a customer express their priorities on some or all of the services. Then, according to the customer's preferences, the FCM retrieves how suitable each media type is for the customer and selects the one which is best. Finally, the website windows and presentation is configured after defuzzification in order to show the information in a personalized manner.

Health and Welfare

FCMs are well-suited for modeling complex systems, especially for solving social problems, such as provision and planning of social services and disease prevention and monitoring. Mago et al. (2013) recently adopted the technique to identify policies for reducing the level of homelessness by simulating a model consisting of 24 concepts and 32 causal relationships. The various factors, such as family breakdown, unemployment, crime, etc., were derived from the authors' personal and historical knowledge in the field, essentially deeming them as the domain experts. Three cases were constructed, in which different concepts were activated and initialized at varying levels. After simulating the three cases, the final activation levels were analysed to determine which problem states were either most likely to result in homelessness, least likely to result in homelessness or unable to ascertain the outcome of homelessness.

Future Policy Modeling (FUPOL) and FCMs

Chapter 5 presented a detailed description of FUPOL (Future Policy Modeling), which proposes a new comprehensive policy-making life-cycle model backed up by several innovative ICT technologies that are associated with each life-cycle phase. As part of the demonstration of the potential of FUPOL's services, several pilot cities are participating by applying the phases of the life-cycle in specific policy contexts in order to help evaluate the corresponding technologies within the framework. The policy areas investigated consist of urban economy (Barnsley and Yantai), community facilities (Zagreb, Skopje and Yantai), urban segregation (Skopje) and sustainable tourism (Pegeia). During the analysis phase of the proposed policy-making life-cycle, FCMs have so far been applied for the cities of Zagreb and Skopje.

One of the pilot tests for the city of Zagreb involved the design and implementation of policies concerning the construction of activities and facilities in a centre for autism currently under development in a green park in Oporovec South. A detailed description of the case study concerning the city of Zagreb can be found in Chapter 15. FCMs were used during the analysis phase of FUPOL to help policy decision-makers assess which activities and facilities are most suitable based on their usage by autistic and non-autistic infants, children and adolescents, as well as adults in an attempt to improve their integration. To begin with, experts identified 40 candidate activities and facilities that could be constructed in the centre for autism, such as roundabouts and swings, benches, parks and gardens. Next, the activities and facilities were grouped together into 16 candidate zones, and for each zone an FCM was constructed. Specifically, each FCM consisted of a number different concepts relating to the attributes and requirements of the activities and facilities of the zone and, in addition, several concepts regarding the sensory profile of the targeted users. Experts then helped to identify the relationship between the activities and the aspects of the users' sensory profile so that each FCM could be simulated to assess which combination of activities and facilities will yield the greatest usability/efficiency of each zone, so that the centre of autism can be constructed with facilities that will be highly-utilized and that will satisfy the needs of both autistic and non-autistic people based on the profile of the zone's users

For the city of Skopje, one of the pilot tests included the policy design and implementation regarding the selection and scheduling of recreational activities on Vodno Mountain. Chapter 16 presents this case study in more detail. Similarly to the approach used for the centre for autism in Zagreb, FCMs were adopted during the analysis phase of FUPOL. The recreational activities were grouped into clusters based on their characteristics with the help of local domain experts. The clusters of activities include:

1. On-foot activities such as hiking, bird watching and mountain safariing;
2. Sport activities on facilities such as paragliding rock climbing and skiing;
3. Stationary activities such as picnicking and dining at restaurants;
4. Transport activities such as driving with a car or public transport;
5. Biking activities such as mountain biking and cycling;
6. Extreme sport activities such as extreme biking and freestyle skiing;
7. Racing activities such as car racing and motorbike racing.

The clusters of activities allowed at each specific type of resource (mountain locations, transport roads, parking lots, hiking trails and services) was also determined with the help of experts and using this information, a FCM was constructed to model the relationship between the scheduling of activity clusters allowed at each resource and the satisfaction of several user groups visiting the mountain (regular hikers, regular bikers, weekenders, weekend families, weekend sportists, car racers and spectators, and bike racers and spectators). A total of 33 concepts were identified pertaining to the schedule of activity clusters at resources, satisfaction of user groups and the number of visitors. In addition, 95 causal relationships linking these elements were also established. The main goal of the model was to help stakeholders (local authorities, event organizers, mountain administrators, etc.) assess how the scheduling of various activity clusters at resources will affect a targeted user group through simulation of different scenarios. For example, administrators may want to assess how the number of weekend families visiting the mountain will be impacted if an increase in the scheduling of on-foot activities at hiking trails increases. Alternatively, they may want to evaluate the change in the level of satisfaction of regular bikers given that an influx of weekend sportists is expected. Thus, simulations will help identify an optimal schedule of recreational activities at different resources to accommodate the needs of as many visitors as possible.

Solutions and Recommendations (Limitations)

One of the most important aspects of FCMs is their ability to provide policy decision-makers a means to predict outcomes through executing or simulating various different scenarios. Therefore, it is important for researchers who attempt to model problems with FCMs to take full advantage of this and go a step beyond using the technique as a means to simply consolidate expert knowledge into one unified map. Instead, they should also be used to forecast possible future states to provide solutions for effective decision-making.

In certain circumstances information provided by experts may be conflicting with respect, for instance, to the existence of particular concepts or to the sign of a causal relationship. Therefore, it is vital that adequate mechanisms are introduced in order to handle such conflicts. One way is to normalize the values provided by experts using a weighted average approach, so that experts with a higher level of trust are given more credence. Another way is to use a “majority rules” method where the decision to include a concept or causal relationship depends on the number of experts who share the same belief.

Finally, one of the drawbacks relating to the actual use of FCMs concerns the lack of commercial tools. Currently, policy decision-makers who are willing to adopt this technique must do so in collaboration with an expert who can provide them with an implementation of the algorithm in order to carry out simulations and scenario analysis. A number of research efforts presented in the literature review have relied on the authors' own implementations because of the limited number of available tools. Therefore, it is important that a user-friendly application is developed, which integrates all the theory and algorithmic aspects of FCMs with a decision support mechanism into a unified working environment.

FUTURE RESEARCH DIRECTIONS

The majority of problems require knowledge from domain experts and that is why most of the FCM models are constructed with consultation from specialists and authorities. However, in some cases concepts and causal relationships can be initialized with the use of (historical) data. Hence, one interesting area of research could involve exploring ways to initialize a model with information extracted from various sources in real time in order to avoid the time it takes to process expert knowledge, as well as to dynamically update the information and avoid the static nature of past data.

Today's policy decision-makers are often faced with the challenge of solving large-scale problems. However, these types of problem involve many variables, parameters and uncertainties, leading to the need for many concepts and causal relationships in corresponding models. A new approach proposed by Mateou et al. (2005) suggests the use of hierarchical FCMs, in which one or more concepts on the map are decomposed into smaller FCMs forming a multi-layered structure. In this way, the large-scale problem becomes a set of smaller and more manageable problems, which are then modelled and executed individually to provide feedback to higher levels. This allows for a more methodological approach imitating human decision-making processes.

Finally, FCMs are now gradually being used as a qualitative method of extracting opinions and perceptions of stakeholders, who are directly involved and affected by policies, decisions and practices. Since the implications of any policy must be thoroughly examined, based on how the involved parties believe they are to be affected, FCMs can provided a unique way of collecting and consolidating the data, which is not historical or expert-based, into one integrated model, from which different what-if scenarios can be simulated and analysed.

CONCLUSION

The literature review presented in this chapter shows the benefits of using FCM theory for policy decision-making and their effective contribution in the analysis phase of FUPOL's policy-making life-cycle. The application of the technique has proven valuable in many domains, both as a means of identifying potential policies and assessing the possible impacts of a candidate policy to see if it meets the desired targets. Furthermore, the increase in the number of these applications in recent years shows the potential advantages, especially due to their flexibility and ease of understanding. By simulating policy options with FCMs, it is possible to determine which policies and combination of policies would be most accepted by citizens. Local people and other stakeholders could understand what the meaning of each policy scenario is and could relate it to the outputs that are generated by the FCMs.

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KEY TERMS AND DEFINITIONS

Activation Level: The fuzzy numeric value of a concept indicating the strength of its presence in the model.

Adjacency Matrix: An $m \times m$ matrix representing the causal relationships between m concepts in a cognitive map. Values can be either 0 (no causality), 1 (positive causality) or -1 (negative causality).

Analysis Life-Cycle Stage: Second stage in the policy-making life-cycle involving activities to identify challenges and opportunities, in addition to determining solution approaches and strategies.

Causal Relationship: A causal connection between two concepts. A postive causal connection means that one concept increases (positively influences) another concept. A negative causal connection denotes that a concept decreases (negatively influences) another concept.

Cognitive Map: A signed digraph consisting of nodes and edges used to represent experts' knowledge in a particulare domain, with the nodes acting as the concepts of the problem, and the edges acting as the causal relationships connecting concepts.

Concept: A causal object, variable, entity or state present in a problem.

Fuzzy Cognitive Map: A special instance of a cognitve map where the strength of the presence of a concept and the causality between two concepts are fuzzified, that is, denoted by a degree.

Weight Value: The fuzzy numeric value of a causal relationship indicating the strength of influence from one concept to another.

Chapter 9
Visual Process Support to Assist Users in Policy Making

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ABSTRACT

The policy making process requires the involvement of various stakeholders, who bring in very heterogeneous experiences and skills concerning the policymaking domain, as well as experiences of ICT solutions. Current solutions are primarily designed to provide "one-solution-fits-all" answers, which in most cases fail the needs of all stakeholders. In this chapter, the authors introduce a new approach to assist users based on their tasks. Therefore, the system observes the interaction of the user and recognizes the current phase of the policymaking process and the profile of the user to assist him more sufficiently in solving his task. For this purpose, the system automatically enables or disables supporting features such as visualization, tools, and supporting techniques.

INTRODUCTION

Stakeholders often have to consider big data-sources during policy making, be it statistic data, social media data or something else. In most cases the stakeholder has to deal with complex systems, which allow on the one hand extensive analysis, but on the other hand require some amount of expert knowledge to use them correctly and effectively. Therefore, most visual information processing systems are balanced between little functionality but simple use, majorly focusing on experienced, but not expert users, and a high amount of functionality with high complexity which are therefore mostly designed for experts.

The major challenge between these two options, simple systems for ordinary users and complex systems for experts, is that especially if systems

DOI: 10.4018/978-1-4666-6236-0.ch009

are designed for a larger target user group, not all users are represented adequately. One alternative is to provide different systems (or different views and tools within the system for the different stereotypes of users) depending on the users' expertise. However these systems are mostly not very efficient for all users. Usually the user group in the center of the spectrum between expert and novice users is in the uncomfortable situation of having to select one of the non-optimal two solutions. Additionally, this user group has to deal with the context change, if they switch between these two stereotype views, which come along with a hard break in the provided visual and interaction metaphors. Such stereotype programs are known also from daily use, e.g. some CD burning programs provide users a simple burning mode and, an advanced one. Both modes do look different and provide a different feature list.

Based on many of these kinds of experiences the user can be identified as the main actor, whose behavior should be the top priority during the concept and design phase. Considering the user-based aspects more sufficiently in computer systems, the development of user-centered systems or user-centered information visualization became more and more important. In contrast to other approaches the development is not only driven by the possibilities (e.g. what can be done with the data?), but also and even more important is that the user will be able to handle the system and solve his tasks. In order to better address the behaviors of the user, various strategies were developed to support him in solving the tasks. The solutions vary in their strictness, solutions like the implementation of shortcuts are useful features that might be used, but they can also be ignored. Other supporting solutions such as wizards are very strict, so the user has to follow without any option to break out of this routine. On the one hand such a strict user limitation can be annoying, if the user knows what to do and how to do it. That can result in situations where experts have to solve a task in a way that is not very efficient. On the other hand, such a strict user limitation often leads to a successful task solving, whereas additional useable features can be ineffective and therefore they imply the risk of failing.

In this chapter we describe a novel adaptive approach to support and assist the user during his task mainly based on the actual phase in the process, but even more based on the user's behavior. For certain tasks and interactions of the user, different technical features that support and assist the user can be enabled or disabled. Such technical features can be, for example, visualization, which shows a specific issue more precisely. Furthermore, technical features can be tools, such as an editor or supporting techniques, e.g. recommender techniques or hint techniques. In fact, the user gets no stereotypic changing views, instead he gets additional features enabled or disabled in dependence of his work and his personal needs, so that the user does not lose track of his goal, just because of a clear understandable user-interface. In consequence, experts will get less restrictive features and tools that allow solving tasks more effective, whereas novices will mostly get restrictive features where they are more strictly guided through the task solving routine and get features and visualization recommended that i.e. other novices used to solve the task.

CLASSIFICATION OF USER-ASSISTANT TECHNIQUES

To avoid the risk that a user explores passing the aimed goal, approaches for supporting users through the interaction process within an application do exist. To allow a better overview we categorize the approaches into different groups, as a kind of survey. They all have as goal to support the user in solving a given task more efficiently, effectively, and in a user-satisfying way.

In general, we can classify the general approaches into seven distinct categories (see Figure 1). The difference can more precisely differ how static or dynamic they are. Static features are approaches that are almost always available to the user in the same form. The simplest example for such a static approach is key strokes, e.g. Ctrl+C or Ctrl+V for copying and pasting data, whereas dynamic features are just available under certain conditions, e.g. adaptations of the user-interface based on probabilistic model.

Adaptation

Adaptation is mostly implemented by considering context variables, like the interaction history of the user or the different ranking of data entities. Based on that, the graphical interface is automatically changed to improve the representation adapted to the user's behavior. The way of adaption can vary, so it is possible to change just some visual parameters, e.g. the size, color or the position on the screen, or perhaps the entire visualization through changing the layout or replacing the coupled visualizations.

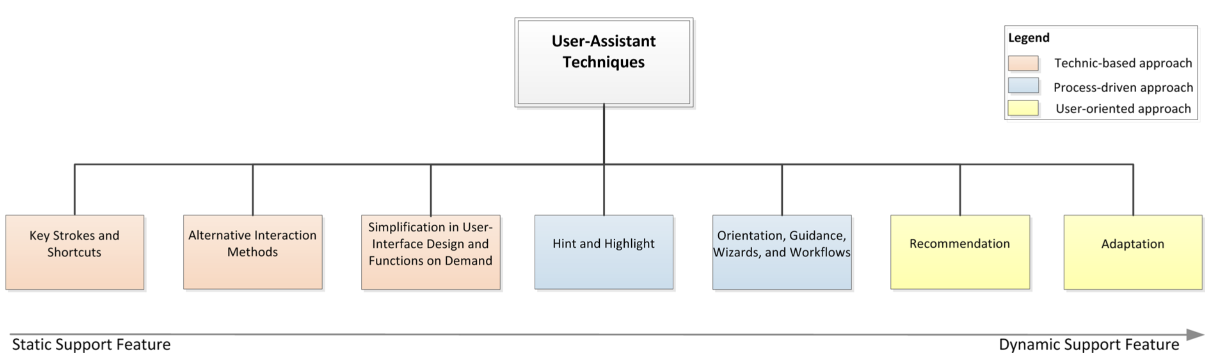
Another possibility for supporting users in relation to the processes is using personalization and adaptation approaches. Focusing on semantic technologies, these approaches can be subdivided into three types (Torre, 2009):

1. The first is adaptation of content and recommendation. It aims at highlighting entities which fit best to the user, e.g. based on the deviation of the entity names with respect to the user's performed search query.
2. The second option is adaptation of structure and presentation, which encompasses the customization of the data structure in a user menu. Therefore the hierarchy of the structure can be changed by sorting, hiding, visualizing, enabling and disabling the existing concepts.
3. The third approach is about adaptation to support annotation, which is often realized by tagging. The user also gets the possibility to get content tagged by other users and based on his own, often used tags.

Recommendation

Another aspect is recommendation. Recommendation can also be included in adaptive systems. But

Figure 1. The classification taxonomy of user assistent techniques. The position from left to right represents its level of dynamics. A static feature ignores the personal needs of user and is available all the time, whereas dynamic features strongly orienting on the user needs, and providing individualized support based on these needs.



in general recommendation is the ability to advice the user for a possible improvement of the visualized data or toolset. Recommendation is mostly based on interaction data of a group of users, or on the underlying content. Normally people provide recommendations as inputs, which the system then aggregates and directs to appropriate recipients (Resnick & Varian, 1997).

In the first developed recommender system from Tapestry, this approach was named "collaborative filtering", which is also the name in some recent publications (Goldberg et al., 1992). However, this term is confusing, because some approaches do not explicitly collaborate with recipients (Resnick & Varian, 1997).

To differentiate the existing recommendation systems, Gaul et al. defined a three-dimensional classification regarding the input-data (Gaul et al., 2002; Neumann, 2008):

1. Explicit versus implicit input data. The explicit approach based on direct user feedback, which comes directly from asking the user about their opinion on different subjects. In contrast, implicit recommendation is based on behavioral usage data.
2. Degree of personalization. To allow for the presentation of recommendation to appropriate users, it is necessary to first identify these users. The identification can be performed on different levels, beginning from low, e.g. transaction or session, up to the highest level, e.g. full user identification and search context.
3. User-centered versus item-centered. The user-centered approach focusses on the interests of the users. Users are grouped based on the interests. Later, the recommendation is performed on these interests for the existing different groups. This method is less anonymous. In contrast, the item-centered approach neglects the user and his interests. The recommendation is just performed on the items and its character, e.g. on shopping websites only similar products will be shown.

Simplification in User-Interface Design and Functions on Demand

The simplest way to support users is to provide an easy-to-understand user-interface, which offers just the main required functionality. Such approaches can be grouped into "simplification and functions on demand". The main idea is to reduce the functions to the most significant and requested ones - this also counts for the conceptual model (Johnson, 2010). Next to the visualization and general application design, a simple and retraceable interaction design is helping the user to deal with a system (Wigdor & Wixon, 2011). The main challenge for these approaches is to determine those functions that fit well to the users' goals and tasks. Therefore, the applications need to be efficient, effective, and needs a high level of user satisfaction. To measure the usability of user-interfaces, the characteristics efficiency, effectiveness and user's satisfaction are the main observed values (Nielsen, 1994).

An advanced approach of simplification lies in limiting only the visible functions. Therefore, the simplification takes just place on the visible user-interface, where just those function can be selected, that are useful for the current display. In consequence, the list of functions depends on the displayed situation e.g. if a performed search has no data, then also no data-editing function should be displayed. It is also possible to create stereo-type user-interfaces. Common types are easy and advanced modes. The easy mode is designed for application novices, only fundamental functions are provided. The advanced mode is mostly designed for experts. A bigger set of functions is provided. This simplification approach is summarized as functions-on-demand.

Orientation, Guidance, Wizards, and Workflows

Mostly, recently published software becomes larger and more complex. It can be seen as a trend to provide as much functionality to users as possible. This results in difficult to understand applications and user-interfaces where most users do not understand how to use them. To solve this issue, the incorporation of explicit user guidance into toolsets is an effective opportunity, which can be named as user guidance environment (Sliski et al., 2001). An often used approach for guiding the user is a hidden defined workflow in an application, on which the communication of a user can be allocated to a specific step within the workflow. The advantage of such an implemented workflow is that the process is mainly regarded as a whole (Günther, Schönig & Jablonski, 2012). The workflow can contain a single path to do one task. In some cases it can also contain alternative ways or perhaps ways of applying functionality to solve this task (Pohl et al., 1999; Günther, Schönig & Jablonski, 2012). In contrast to such general workflows, the guidance can also be implemented with Wizards. Wizards are beneficial if users should be guided through a fixed process e.g. installation routine (as presented in Figure 1). Within the different steps the users get informed or have to enter required information (Silingas et al., 2009).

A continuous approach of implementing a workflow in applications is the visualization of such a workflow. The main idea is to provide orientation for the user so that he sees in which phase of a process he is currently acting. The visualization can vary between just a numerical value e.g. "you are on page 5 of 10" or in graphical form like they are used on some web shops.

Hint and Highlight

To support users during the work with an application, the system can help users by showing hints e.g. tool tips or emergency warnings. These approaches do present information in the user's view to help him to solve his task faster. As an advantage the user does not need to search a special function, instead the system advices the user to the special function (Hjert-Bernardi, Melero & Hern'ndez-Leo, 2012). The view of the user is directed to the information that might be important for him. The existing hints can be statically designed or they can be automatically generated (Charrada & Glinz, 2010).

A similar approach is the highlighting of information. Here, the goal is to guide the user's attention to the visualized information that might be interesting for a user. Thus, the user sees all the information, but expected information with a higher importance is indicated, e.g. with a different background color (Ostkamp, Bauer & Kray, 2012; Lin et al., 2011).

Both approaches are primary designed to set the focus of the user on specific information. There are no processes needed, but such functions are often used in process-driven scenarios.

Key Strokes and Shortcuts

Under this approach we summarize all alternative interaction forms with the keyboard to allow the interaction in graphical applications that normally have to be performed using the mouse. In general, we can distinguish two types of keyboard interactions: keyboard shortcuts (or hotkeys) and stroke shortcuts (or stroke gestures) (Appert & Zhai, 2009). The benefit is the high efficiency, because instead of clicking with the mouse through a context menu and searching for a specific command, only a simple shortcut on the keyboard has to be pressed to execute the same command. This allows a quick and easy interaction.

This kind of support is predominantly used by advanced users, because it is necessary to know about that feature in general. Moreover, the existing keyboard shortcuts and stroke shortcuts of the operating system and within the application have to be remembered. Another problem is the missing support in modern devices, for instance on tablets and smartphones, which do not provide a keyboard as common interaction interface.

Alternative Interaction Methods

The interaction-process for users can be designed easier if alternative interaction devices will be used with more natural interaction strategies. Especially interaction forms which are close to natural human interaction, e.g. with the performance of gestures (Schlömer et al., 2008), can make the communication with technical systems easier. Therefore, the application has to support such devices, or a system that takes on the organization of such devices is needed (Burkhardt, Stab, Steiger, Breyer & Nazemi, 2012; Burkhardt et al., 2011). The communication by speech also counts to alternative interaction forms.

DESIGN OF A PROCESS-BASED USER SUPPORTING SYSTEM

In the previous chapter we introduced the current state of the art approaches to support users. In this chapter we outline our novel process-adaption system to support and assist users. The major idea is to observe all internal system events, as well as user interactions with the system. Based on these events, a generalized process model will be generated in the first phase. In the second phase, this process model supports the user through enabling and disabling of various features.

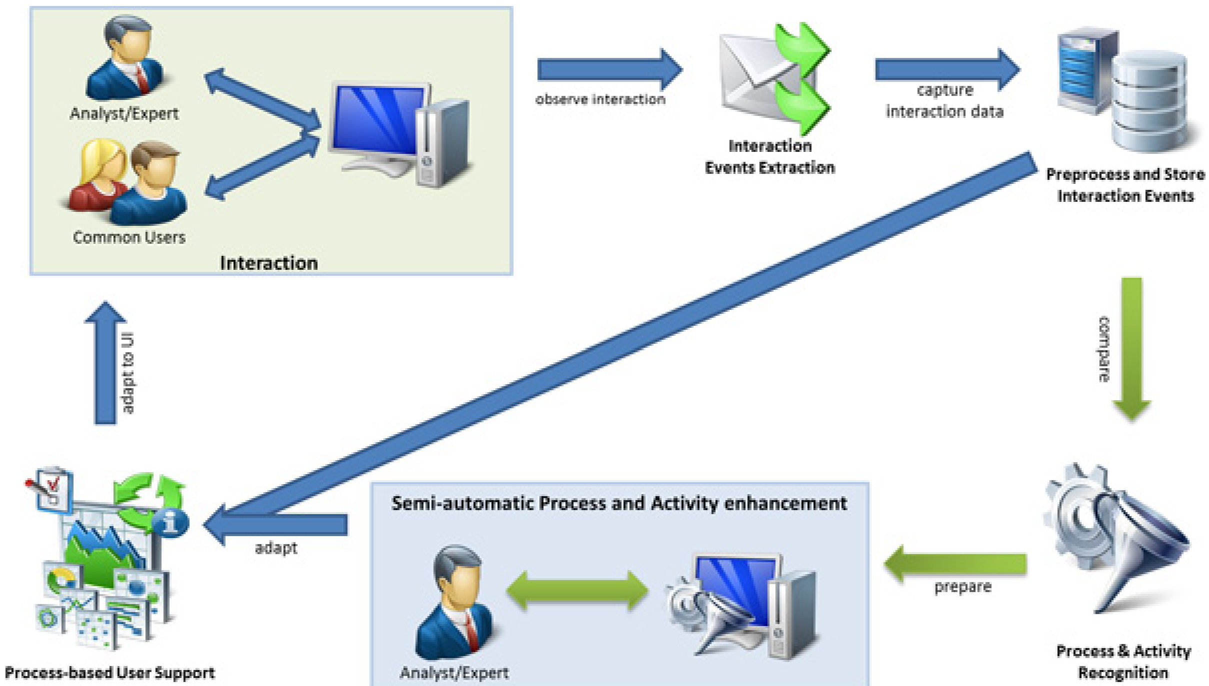
General Model

The six-step model we defined contains two different phases. The first phase addresses the process generation and the second phase addresses the later following adaption of the user-interface. In general we have to distinguish between these two main phases, consisting of the data acquisition for the generation of the process model at the first phase, and the user-interface adaption based on the process model in the second phase.

The general process adaption model describes an iterative process that consists of six phases:

1. Interaction phase: During the interaction phase the users work with the system. At the very beginning no process adaption is being considered. Therefore, the major target user group should consist of experts/experienced users, who know the system and the workflow to solve their tasks. Later – after the process model has been generated – also non-experts can work with the system, because of the active supporting features.
2. Interaction events extraction phase: During the regular interaction, beginning by launching the application, the visualization system generates several events. These events can be subdivided into different types: (i) system events that inform about some technical system states, e.g. a configuration was read, (ii) status events, which inform about changes due to the user's interaction, e.g. a click on a graphical node or a menu entry, (iii) abstracted (high-level) events with a basic semantic meaning, e.g. selection of an entity as logical consequence of a mouse click on a graphical node. All of these events will be generated during the runtime of the system, and they are extracted for further probabilistic analysis.
3. Preprocessing and storing interaction events phase: In the phase of preprocessing and storing of the extracted events the retrace-ability is in focus, so that performed interactions with regards to the correct order can be followed. This means that the events are stored with respect to the session, the correct order, and the involved user. This is necessary to mine a valuable process. Moreover some

Figure 2. Generalized interaction and activity processing model to support the user during his task. The blue arrows indicate the regular interaction cycle, whereas the green arrows indicating the process mining and editing phase of the system. The regular interaction cycle is used for every user interaction, whereas the process mining and editing phase runs only in longer time intervals.



continuing preprocessing can be done to reduce the mining complexity. But such pre-calculations depend on the used algorithms.

4. Process and activity recognition: The process and activity recognition phase is the main processing step. In this phase, the system automatically mines and computes the process based on the collected events. The resulting process model works fully autonomously, but it describes the process and contained steps only in a very technical manner, e.g. input text or press button. The reason for this circumstance is the limited semantic information from the events. Here, only basic information entities are available, but not their precise meaning – however in a limited way a meaning can be determined, e.g. selection of an entity. Because of this fact, the mined process definition needs to be refined from an expert to specify and label the contained steps more specifically.
5. Semi-automatic process and activity enhancement: After the automatic process and activity recognition, an expert has to refine the generated process. The minimal effort an expert has to do is to rename the activities with human-readable labels. In the worst case, the expert has to restructure or enhance the process cycle. The required enhancement effort of the expert depends on the used process mining algorithm. Overall, the expert has all possibilities to make changes on the process. Furthermore, he has to take care about defining a valid and functional process, because based on the applied process the user will be guided through the tasks later. The better the process is defined, the better the usability und use

for the users. But also the adaption abilities provide a better support and joy of use, if the process is as well specified as possible.

6. Process-based user support: In the last phase, the user is supported in his interaction. Therefore the generated process including the adaption functionalities are used to support the user in solving the tasks. The support is based on the current phase in the process. The support of the user can be enhanced, if the role of the user or a kind of personalization is also considered.

The presented overall process introduces all relevant steps. For the common use, it is not always necessary to generate a new process. The semi-automatic process mining steps 4 and 5 are only performed between longer time intervals. We can split the described approach into two major parts: (1) the process mining phase, including the initial learning phase, and (2) the practical use phase with the adaption based on the mined process.

The Process Mining Phase

The most analytical part is the process mining phase, in which the event data is transformed to mine/model a process. In general, it does not matter what kind of process model is targeted. So, among others, it can be, for example, a Petri net or a BPMN model (Van der Aalst, 2011) – we focus on the latter, because it allows a better representation for visualization purposes. In general, we can describe the mining in very simple representation.

The simple event Log L, with a set of traces over a set of activities A for which $L \in B(A^*)$ holds, and a function (or its implementation an algorithm) Y that maps the log L onto a BPMN model:

$$\mathrm{Y}\left(\mathrm{L}\right) = (\mathrm{N}, \mathrm{M})$$

Furthermore, we see the recorded events not only as local independent states. Instead, we understand them as frequently and sequentially generated entities during the interaction process. To respect this fact sufficiently, we focus on heuristic mining methods (Weijters & Ribeiro,2010; Weijters & van der Aalst, 2003; Van der Aalst, 2011, pp.193). In contrast to the simple approaches, such as the $\acute{a}$-algorithm (Van der Aalst, Weijters & Maruster, 2004;Van der Aalst, 2011, pp.129) is that rarely used paths should not be incorporated into the model. This representation bias provided by the causal nets and the usage of frequencies makes the approach more robust than most other approaches (Van der Aalst, 2011, pp.163).

All of the existing approaches aim at generating a process model that is based only on the event logs. Through the consideration of heuristic mining methods, also the sequence and the frequency of their incidence will be considered and supports the generation of an improved process model. In the current version we are using a common heuristic mining method, with just some minor changes which were necessary to integrate it into our system and based on the features of the events. In future work, we expect to make some sophisticated changes to improve the mining process and the generated process model.

Assistance and Recommendations

In the second phase, we use the process model to assist the user in his work on the visualization system. Therefore, the process model acts as an orientation on what the user can do in each phase of the process. Because of the fact that the process model is based on events, each activity can be recognized based on the sequence of events. This automatically allows recognizing the current task and activity of a user.

The most basic support feature is to support the user by provisioning a view in which phase of the process he is currently working. Beyond that, approaches can also be aligned to a single task. For instance, if a user interacts in an analysis task, statistical visualization can be recommended. In fact, the user gets those visualizations that are most appropriate to solve tasks, but he can always choose other visualizations, which are more appropriate or a personal preference. The general architecture is sketched in *Figure 3*. The core of this process adaption model is the process control, which observes all system events and compares it with the process model. In this manner, the system knows about the current task and activity and can assist the user through enabling of supporting features. Supporting features are in the most basic version visualizations, but we also understand features such as guidance or hint functions, as well as other recommender or adaption functionalities.

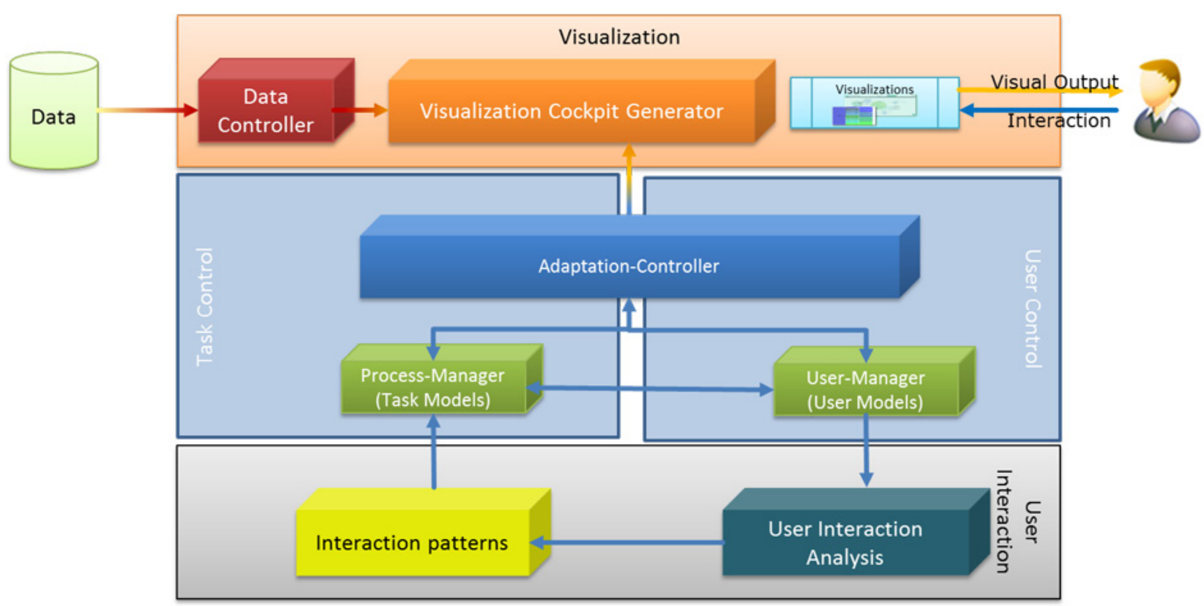
Aside from the process model, also a user model can be used to consider the user's behaviors too. As a result, visualizations can be parameterized to improve the presentation of the data in perspective to the user needs.

A special characteristic of our approach is that, on the one hand it uses all kinds of internal events to recognize the current task of a process, but even more important is the weighted consideration of interaction events. The reason for this weighting of the user interaction is that the user being the main actor in the visualization system can choose how and what task he wants to accomplish. Only for improved, active task recognition the internal events (such as information of the current use a specific data-model or that certain visualization was enabled) will be used next to the interaction events.

IMPLEMENTATION

The implementation follows the described concept. As technical foundation we use the SemaVis

Figure 3. General concept for a dynamic process-supporting system based on user's behavior. Therefore, it allows integrating process supporting features to adapt the user-interface based on the current task and activity. Furthermore it enables the inclusion of a user analysis module to consider the user's behavior in the context of the current task and activity.



framework[1], which is an information visualization system that shows information from heterogeneous data-sources in a graphical manner. This client technology is compatible to the Flash player, builds the basement of our implementation of dynamic user-supporting adaptation concept.

From the technical perspective, the presented concept bases on two parts. The first part is the process analysis web-service, which is majorly responsible for the process-mining and therefore the calculation of the process model. The visualization client sends all events to the web-service, which stores the events in a database. Afterwards a (Process-) Analyst/Expert runs the semi-automatic process mining and enhances the process model. The result is a very detailed process model, which is used by the second part, the visualization client (in our environment we use SemaVis). The process model supports the user during the interaction with the visualization client through enabling of supporting features. In a simple version the user gets shown process visualization for his current task, so that he has an orientation about the outstanding steps to finalize the task. In an advanced mode the visualization can guide the user, e.g. through automatic enabling of visualizations or other tools.

In addition to the process support, it can also be combined with user-adaption techniques, such as the user-based adaption by Nazemi, Stab & Kuijper (2011). This allows for adapting the user-interface also on the user's behavior. The described approach of Nazemi et al. aims to change the visual primitives to highlight the relevant entities of the user based on the user's interaction history. Therefore, the user gets an optimized user-interface based on the current task on the one hand, and based on the personal behaviors on the other hand.

The first prototype is shown in Figure 5. In the top (1) the user can perform a search query and choose the data-source. On the right side (2) the user can choose a visualization, which will be placed and can individually arrange on the visualization desk (3). The process support module is running hidden in background. Currently only the status is shown by workflow visualization (4), and some visualization will automatically be opened in dependence of the current process step. This prototype will be enhanced with a couple of further policy making features, which also requires extending the process model.

Figure 4. An overview of the entire Process Analysis Architecture. In general, multiple instantiations of the visualization client are used at the same time. All events on the system are sent to the process analysis web-service, which generates a process model semi-automatically. Based on the process model the user gets actively supported during his further system use.

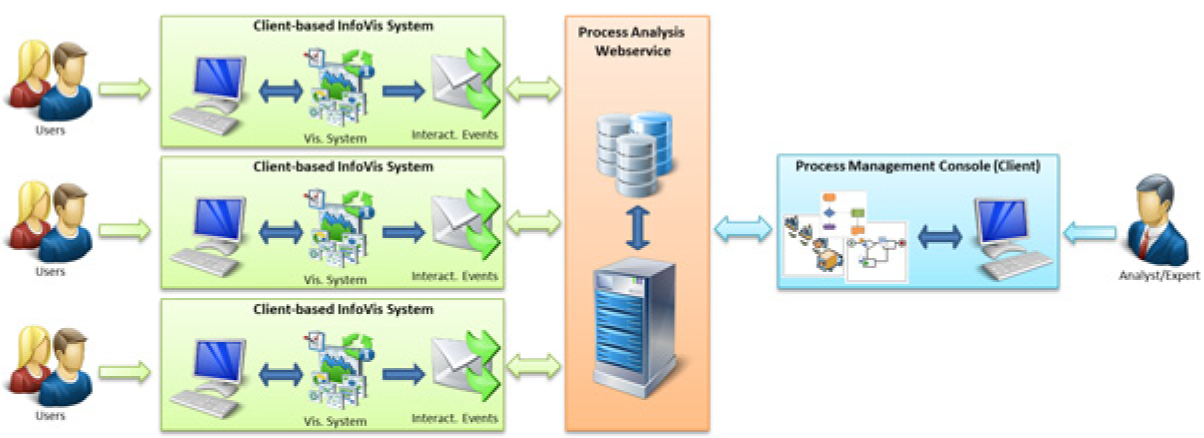
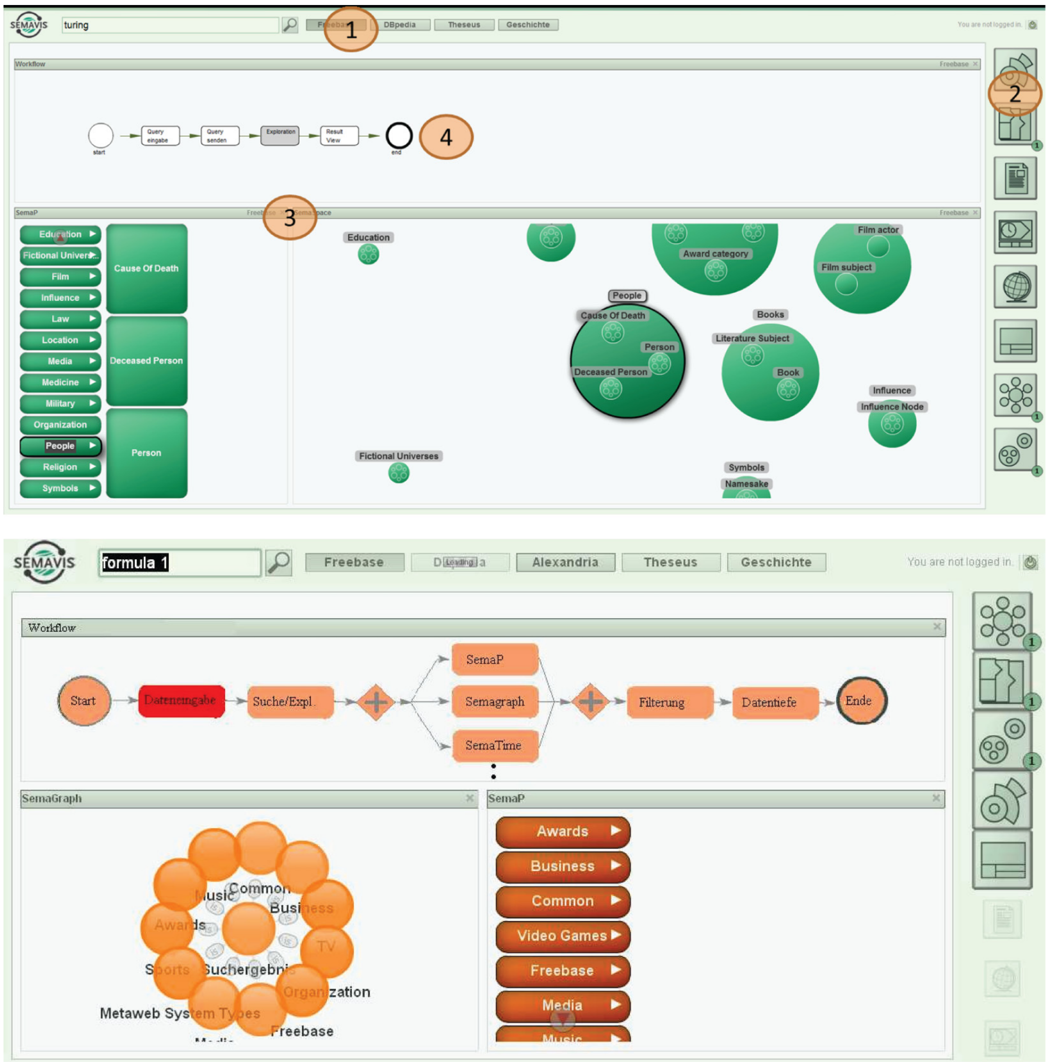


Figure 5. Two screenshots of our first prototype of the process supporting visualization system. The process visualization shows the current active step within the process of semantic data exploration. In the screenshot on the bottom a more extensive, but with less details defined, process is used.



CONCLUSION

In this chapter we introduced into different supporting techniques, which we grouped into seven categories. We introduced into their dynamics, their strictness and in consequence how the interaction of the user gets more or less limited. These features build the basement of our concept, where we introduced a dynamic supporting approach to assist users through complex processes. The goal is to guide or support users through complex processes by enabling or disabling various features depending on the current process phase and the user needs. This ensures a more effective guidance of users' through the task solving routine in dependence of their experiences and knowledge. So on the one hand, the experts are not limited in the way of how they use and interact with the system, but on the other hand, novices guided rather strictly through the task solving routing, so that they will not fail in solving their tasks.

In contrast to the introduced features, our approach considers them as technological feature to assist the user in his work. But next to the mentioned supporting techniques, we also use common techniques, such as specifically designed visualizations which consider the requirements on the user (e.g. multi-dimensional visualization for experts and common visualizations for novices), or editors to make changes on data. The main benefit of the resulting system is an intelligent system that enables stakeholders of the policy modeling process to do their tasks more efficiently and effectively.

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KEY TERMS AND DEFINITIONS

Adaptation: Adaptation in human-computer interfaces is the automatic and system-driven changes on content, structure, and presentation of system-behavior that involve some form of learning, inference, or decision making based on one or many influencing factors to support users.

Adaptive Visualizations: Adaptive visualizations are interactive systems that adapt autonomously the visual variables, visual structure, visualization method, or the composition of them by involving some form of learning, inference, or decision making based on one or many influencing factors like users' behavior or data characteristics to amplify cognition and enable a more efficient information acquisition.

Information and Communication Technologies (ICT): Under Information and Communication Technology technologies for information provision, sharing, using and visualizations are summarized. A major benefit lays in the exchange of data for the use with other technologies and therefore the use in a number of different use cases.

Policy Modeling: The term policy modeling deals with the making of (political) policies, which can result in the creation of new laws. Policy modeling covers all necessary steps beginning at the identification of a problem, analysis, decision making, implementation, end evaluation of a policy.

Policy: Under the policy a theoretical or practical instrument can be understood that aims to solve a specific problem. In the political domain, a policy can represent a new law.

Process: A process is logical aggregation of activities. A process is defined by an initial state and an (to achieve) end state. Through the processing of the activities, the transformation from the initial state to the end state will be realized.

SemaVis: SemaVis[i] is an adaptive semantics visualization technology developed by Fraunhofer Institute for Computer Graphics Research.

ENDNOTES

1 More information about SemaVis on: http://www.semavis.com.

Section 3

Technologies for Active Involvement of Citizen in the Policy Process

Chapter 10
E-Participation with Stakeholders' Feedback Platforms

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ABSTRACT

Natural language summarization and other social media analytics tools enable a communication manager to rapidly browse through a large number of text documents authored by citizens and get a sense of their interests and opinions. However, this approach is rather passive and unidirectional because it does not allow proposing to the citizen to express their opinions on specific topics. Similarly, social media platforms allow a crowd of individuals to answer questions but not support a "one-to-many" dialogue, where the communication manager, acting on behalf of the public authorities, can interact with the crowd. In this chapter, the authors describe a software platform that aims to address this gap and describe the system envisioned in the FUPOL project.

INTRODUCTION

A Community Feedback Platform (CFP) enables efficient bi-directional communication between policy makers and citizens. It is designed to manage ideas, opinions, and arguments for or against a future or ongoing project. Depending on the state and maturity of the political objective that we are targeting, in order to gather innovative ideas from citizens one could consider using Idea Management Systems (IMS), Question-Answer websites (Q&A), or online forums. However, since these tools have not been designed specifically for public consultation, they exhibit some limitations:

DOI: 10.4018/978-1-4666-6236-0.ch010

- *Lack of a centralized repository.* There is no single centralized repository of comments that decision-makers can easily access. Political discussions occur on a variety of social media websites (Facebook, Twitter), online forums, tools for commenting news articles, and sometimes on the official town website itself.
- It is hard to reach *critical mass*. Dedicated CFP may lack enough critical mass of participation because the citizens' contributions are dispersed across several disparate and unconnected social media or communication channels.
- *Balance in contributions*. The comments from the citizens often vastly outnumber the comments or propositions from the policy makers, who have less time to participate.
- *Polarization and balkanization*. Social media channels such as political blogs and discussion forums often suffer from biases due to polarization and balkanization (Klein, 2012). That is, some cater to the right-leaning audience whereas others cater to the left-leaning audience. This results in stale debates within balkanized forums where people discuss only with others that think alike and thus fail to examine the broader set of alternatives being examined globally.

Due to these limitations, traditional CFPs require several improvements to become more effective decision-making spaces. Citizens need to be able to directly express their opinions in the system, answer to policy makers, and report problems in a city. Policy makers need to be able to timely analyse and browse citizen's ideas. They should also be able to easily relate citizen's opinions and issues to areas of the city map. The system presented in the next section addresses these requirements.

In addition, a new challenge for collective intelligence tools is to enable ideation and deliberation at the meso-scale level of organizations such as local geographic communities (e.g., cities). Prior technologies, in part, supported idea generation and collaborative deliberation at the level of small groups (i.e., groupware) and, in part, enabled large-scale sharing of knowledge and opinions (e.g., wikis, blogs, and forums). However, when an entire local community participates in a decision making process, a much larger number of ideas are generated. Thus the selection and judgment can become prohibitively time consuming for selecting and implementing the best ideas.

Customer Feedback Systems

Systems for managing customer feedback are used by organizations to obtain knowledge from communities. These technologies are based on three traditional methodologies for managing feedback, each with existing problems:

- **Traditional Surveys and Polls:** Survey campaigns with random on-site interviews of citizen are the most common solution to extract opinions. Large European cities (i.e., with more than a million inhabitants) invest a significant portion of their budget on household surveys to understand the needs and opinions about their inhabitants. Household surveys are typically run every decade. Their main limitation is the high cost of distribution and data collection and the long turnaround time. Since many cities are trying to reduce their debts and become more efficient, information technologies represent a better alternative to paper-based surveys. That is, citizen can obtain feedback from their public authorities more frequently than every ten years! Moreover, traditional surveys are often limited in their ability to collect information because the respondents are bounded by closed sets of answers (i.e., multiple-choice questionnaires). Open-ended questions are often not included (or, when included, not answered by the respondent) since they would require more time and effort to collect and analyse the feedback and, moreover, the respondents cannot receive direct feedback from the inquiring authorities.

- **Online Surveys:** Many websites or polling companies are today offering online survey services. These services, however, are often criticized for their intrusiveness or for being less in-depth than other methods. First, they are often administered in the context of city-related websites (e.g., as pop-up windows) with the assumption that the citizens will voluntarily devote time to answer a few questions. Second, their ability to collect information is limited by the setting in which they appear: for example, they may appear while the user is busy with another task. They also suffer from the same biases of the traditional surveys and polls, such as self-selection of those willing to participate (e.g., the most compliant citizens, the activists, etc.).
- **Feedback Analytics Services:** Online media monitoring systems such as the ones described in the *Hot Topic Sensing* chapter provide services that are useful to gather and summarize a lot of information from the citizens on specific topics (e.g. specified by keywords). However, they are *passive* or reactive to the user since they are invoked after a problem is encountered or when the user has a request. Therefore they are better suited as support for improvement processes.
- **Idea Management Systems:** These services are similar to live forums for bounded communities but introduce additional structure for collecting and managing the citizens' feedback. They are often used to help organizations with their grassroots innovation processes. In these systems the members can report problems, suggest solutions, and select among the solutions with the support of, for example, categories or topics, a workflow, and voting or rating mechanisms.

The common aims of these different services include colleting problem reports, solutions, or opinions, prioritizing these contributions, and measuring the satisfaction of the community. When coupled with monitoring and analytics of social media, these services can help organizations understand their customers or city administrators understand their citizens.

Toward a New Approach

Collaborative ideation and deliberation processes are a possibility, but traditionally they have been possible only at a small scale (i.e., groups and teams). When one tries to scale them up to larger scales such as cities, various problems arise. Within the complex social structures of large cities, simply having thousands or millions of people brainstorm or debate is nearly impossible. However, thanks to the emerging technologies and social trends that we describe in this document (e.g., political blogs and discussion forums, Facebook and Twitter discussions centered on city politics, etc.), the CFP can be a valuable tool for such large-scale ideation and deliberation processes.

In the proposed approach, the Hot Topic Sensing (HTS) module addresses the identification of needs and monitors the impact of the related solutions. In addition, the CFP supports the crowd-based process of creating solutions in response to existing problems: crowdsourcing, brainstorming, analysis, and pre-selection of the most promising ideas. Taking into account the objectives of the CFP, the idea management methodology seems to be the most relevant. Nevertheless, reviews of prior work on Idea Management Systems show that current solutions are still lacking features that can enable and facilitate large-scale ideation and deliberation (e.g., when dealing with very large datasets) (e.g., Klein and Convertino (2014)).

Scenario

We envision the scenario where the board of a local community must address a very controversial issue that requires a collective decision as soon as possible. The entire community will be impacted by the decision. A traditional approach to resolve controversial issues would be to hire a polling or market research agency. The agency would gauge the views and expectations of the citizens and then a number of possible solutions would be proposed. Since this is a long and expensive process, the board has decided to use a grassroots approach: the crowd of citizens will act as a "free" market research agency. That is, via the CFP the problem is described to the citizens and then they are asked to propose potential solutions. The board expects high participation because the current issue, as publicly known, will affect a very large number of citizens. Via the system, the citizens will directly propose their solutions and opinions, answer to policy makers, and report on additional problems. On the other hand, for policy makers, the CFP facilitates access to (and analysis of) citizens' ideas and opinions through fine-grained text analysis algorithms.

BACKGROUND

We review here some early examples of feedback community platforms. In particular, we focus on idea management systems (IMS) to identify some useful features that we reused and extended within the FUPOL project. First, IMS are defined as *computer software that supports the practice of gathering and evaluating ideas in a structured fashion, with a goal of selecting the best ideas with the greatest bottom-line potential for implementation*. The design of current IMS typically assumes the following process for the users and the administrators:

1. Create a campaign that is focused on a desired topic;
2. Engage a community of users by disseminating the campaign via to social media or e-mail;
3. Start the idea generation process: the community contributes ideas and comments or votes on ideas;
4. At some point start the idea selection process and allow users to rank ideas from different point of views;
5. Deliberation process: the best promising ideas are developed into detailed solutions and are implemented.

We can distinguish two general classes of IMSs. The first includes the systems that are deployed in the context of organizations. Some of them are targeted at communities of customers, such as the *My Idea* system by Salesforce deployed at Starbucks or the *Idea Storm* system developed and used by DELL. Others are deployed internally to the organization to let its employees propose innovative ideas for the company to invest in. Examples include *Spigit* (www.spigit.com), *IdeaScale* (www.ideascale.com), and *Imaginatik* (www.imaginatik.com). Bailey and Horwitz studied the practices around content, interaction, and participation in an IMS deployed at Microsoft and drew some early lessons on how to implement a grassroots innovation pipeline for an organization (Bailey & Horvitz, 2010). The basic functions supported in this first class of systems include: posting and sharing an idea; tagging or commenting an idea; voting an idea; search and browse ideas.

A second class of IMSs are the systems that support e-democracy or e-government in the context of a physical or online community (Bertot, Jaeger, Munson, & Glaisyer, 2010). Two examples are the *Deliberatorium* (Klein, 2012) and the *mIPS* system (Vivacqua, Expedito, Galuzzo, Borges, & da Silva, 2010), both of which support collaborative deliberation through an argumentation map (a map of issues or questions, related positions or answers, and related arguments or pros/cons). In the *Deliberatorium*, the users tackle complex problems such as climate change by contributing to the argument map. The *mIPS* system is a prototype built to allow the citizens of a city to deliberate on issues such as the transportation problem that afflicts the city. It allows the citizens to submit ideas and express or visualize links between ideas (e.g., derived ideas, merged ideas). Less structured examples of this second class of systems are the suggestion boxes or public websites such as *Open for Questions* deployed at Whitehouse.gov or Google's *project10tothe100.com*, where the content is simply organized around questions.

The IMS, as crowdsourcing systems, have in common the general aim of allowing a large community of users to collectively *generate*, *discuss*, *select*, and *implement* ideas. However different system designs may be proposed, depending on the specific domain, purpose, and roles involved: e.g., tools for customer feedback, innovation pipelines for knowledge workers, e-democracy system for citizens, etc. This, translates into different data models, interaction and incentive models, and organization-specific deliberation workflows. More practically, the different designs affect user participation and the quality of the ideas generated and selected (Bailey & Horvitz, 2010). This suggests the need for future systematic analyses of the rationale and the actual impact of specific design decisions in IMS.

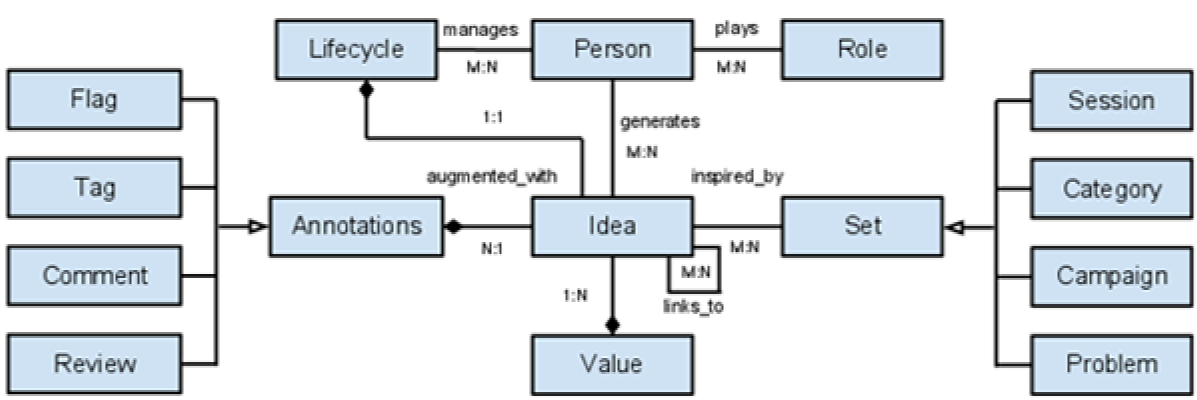
However, despite the multiple differences among these systems, they all share the same basic building blocks: a way of representing ideas (the data model), a process for generating, filtering and deciding on the ideas, a crowd participating on each phase playing a particular role, and a model of incentives to make them participate. We expand on these building blocks in this section.

Collective Ideation Model

Based on a review of a diverse set of existing IMS, we characterize here the model of collective ideation that these systems tend to assume (common concepts, processes, and roles). The conceptual model is illustrated in the simplified (data centric) diagram in Figure 1.

The most central concept in the model is the Idea. It is generated by a crowd (i.e., Person in Figure 1) in the context of a brainstorming session, campaign, thematic category, or problem (i.e., generalized by the notion of Set in Figure 1). Individuals, in the crowd, play specific Roles as contributors during different phases in the idea

Figure 1. Idea space conceptual model



Lifecycle. During these phases, additional data or metadata are generated around the ideas as Annotations, which include reviews, comments, tags, flags, or even extensions to the basic structure via user defined fields.

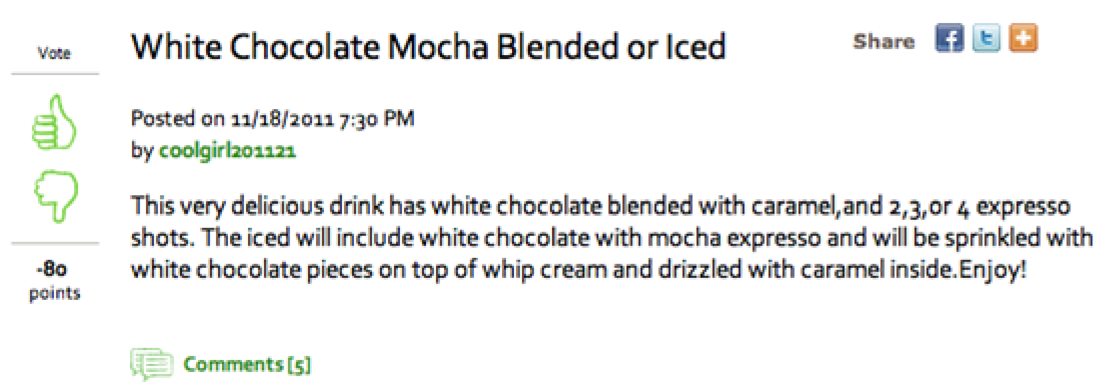
An example of idea in an IMS can be seen in Figure 2. During their evolution, ideas are transformed: they can evolve to be more specific, merged with others to convey a more general concept or inspire new ideas. This phenomena is usually traced using links between ideas, as proposed in (Fergus, Singh, Hertzmann, Roweis, & Freeman, 2006) and partly implemented in some commercial systems. Closely related to (but also distinct from) the information "content" of the idea, is its Value, which represents the value judgment that individuals give about that idea (e.g., votes, business impact). The value judgment usually comes explicitly in the form of "votes", implicitly as number of comments or views, or can be quantified through more sophisticated techniques such as prediction markets (e.g., www.spigit.com). Finally, more formal value judgments can be expressed through ratings, generally while the idea is under review.

Process and Roles

All the interactions that occur around the ideas, from their conception to their implementation, are managed following a structured process. This process is typically represented as a funnel through which ideas are iteratively filtered until the best ones become concrete products or services. How such process is implemented varies greatly from system to system but there are many similarities across existing IMS and there is some consensus in the literature (Westerski et al. 2011). Without losing generality we can aggregate those, as parts of an iterative process, in the following phases:

1. **Challenge:** Also known as inspiration or problem, it is the phase in which the crowd is motivated to contribute with ideas around the context defined by the challenge. Back to our examples these are finding the next summer product or what city service to provide.
2. **Ideation:** The phase in which the community puts its effort on generating ideas. The motivations and assumptions in this phase strongly depend on the target scenario addressed by the system.
3. **Filtering and Synthesis:**In this phase the most promising ideas are pushed forward, filtering out not relevant ideas. During the process ideas can also lead to new ideas, be merged, etc.
4. **Implementation:** The phase in which the most promising ideas are transformed into solutions and realized.

Figure 2. Sample of idea posted on an IMS



Note that growing an idea implies changing its content as well as in its value. The most contingent type of evolution is when the conditions that motivated the idea change or when new conditions that arise make an idea that was novel obsolete or one that was irrelevant relevant.

The level of participation of the individuals in the crowd and their responsibilities in each phase describes their role. The most general ones are:

1. **Contributors:** We refer to the crowd generating and contributing on the ideas as "community";
2. **Facilitators:** Members or administrators that help the best ideas to emerge and grow. Facilitators usually respond to the needs of an organization;
3. **Reviewers:** Individuals with some degree of expertise in specific areas assessing the idea against some criteria
4. **Decision-Makers:** The leaders in charge of taking the final decisions.

COMMUNITY FEEDBACK PLATFORM FOR E-DEMOCRACY

Existing Community Feedback Platforms (CFP)

We turn our attention to open sources tools and found two interesting candidates both in the field of Q&A. These share the same idea of crowdsourcing of IMS.

OSQA is an open source Q&A system. It is has a free software licensed under the GPL, and you can download the source code. OSQA is originally based on CNProg, an excellent Chinese Q&A web application written by Mike Chen and Sailing Cai. OSQA is written in Python and powered by the Django application framework.

AskBot is an open source Question and Answer (Q&A) forum project inspired by StackOverflow and YahooAnswers. Askbot is based on OSQA. Then, we compared AskBot, OSQA and an existing IMS (IdeaScale) along key features of such systems.

Nevertheless, both IMS and Q&A systems *have limited support for facilitators*. Many additional functions are required to support the whole decision process. When an entire organization or community participates in the ideation process, a large number of ideas is usually generated, thus the selection and judgment are likely to become prohibitively lengthy and time consuming, requiring a lot of effort from the facilitators. The large scale in combination with some limitations of current IMS can ultimately lead to lower quality of the ideas generated, selected, refined, and finally implemented. More precisely, the design limitations that can reduce the *efficiency* and *effectiveness* of the entire process are the following:

- **Information Overload:** Current systems provide limited content management tools to address the cognitive overload in situations where a large number of ideas is generated during the ideation process. The overload is due to the redundancy in the ideas generated, such as duplicates or similar ideas, noise due to irrelevant ideas, and lack of organization (Klein, 2012). Content management functions that can help include support for removing duplicates, identifications of related ideas, and functions for semantic organization that make the browsing more efficient.
- **Value Judgment:** With the constraints of time and budget and the large scale of the ideation process, the attention of the facilitator becomes a precious resource. Current system designs orient their limited attention towards the "best ideas" but based on decision criteria that do not properly reflect those of the organization. Indeed, the criteria that govern the promotion of ideas should vary depending on the value system that applies, and yet, current systems use

standard measures such as "popularity" as attention driver. Therefore, it becomes very difficult for the facilitator to help with the selection and judgment of good ideas because the system provides no support for balancing the judgments of the crowd with those of the organization. In finding the next summer product, for example, the facilitator will need to consider not only the votes the different ideas have received (popularity) but also the decisions criteria that the management uses based on the business plan of the organization. Similarly, in the city scenario, the community leaders will need to analyse amongst the most desirable projects the ones that are aligned with the current political agenda of the city. Moreover, regular users lack insight and feedback about the decision process once these external criteria, currently unrepresented in the system, are ultimately applied to their contributions.

- **Sub-Optimal Use of Human Resources:** Finding the right people to contribute to certain tasks around ideas, e.g., to generate, contribute, review or moderate ideas, taking into account their expertise and time constraints, it is not effectively supported by current systems and approaches. In order to successfully exploit the crowd, it is important to make an efficient and effective use of their knowledge and skills while also considering their limitations. Another important tactic is to provide targeted incentives and feedback to encourage and sustain the participation of desired contributors (e.g., reviewers).

FUPOL Dashboard for Facilitators

The *Dashboard for Facilitators* builds on existing IMSs to offer services for innovation facilitators. We aim at providing tools for innovation facilitators that are not present in existing idea management systems. We do not aim at re-implementing IMS functionality but rather at complementing and augmenting them (Baez and Convertino, 2012). This implies a clear separation between the functionality of the IMS and those for the facilitators. Moreover, a successful solution requires the intelligence and services of a platform to be reused and integrated with the tools and culture of the organization. It also should allow organizations to build their own solutions on the specialized services provided by the platform. Therefore, one of the concepts we propose is *facilitation as a service*, by looking at the facilitation tasks as services that can be integrated reused and mashed up.

Geographical Information in Public Participation

An important function for local communities that remains unsupported in the current systems is the lack of integration with geo-spatial information: e.g., easy geo-tagging of the ideas or the contributors, easy-to-add geo-references to locations within ideas. For example, this integration would allow citizens to contribute their opinions as they browse the city map. Currently, some social media monitoring platforms allow city administrators to analyse and interpret these data; however we are still lacking suitable platforms that feedback this type of information from the city to the citizen. In order to create and support a bi-directional dialogue between citizen and the public authorities, a few innovative platforms have been developed at Xerox Research Centre Europe. They are based on a combination of forums, geographic information systems (GIS) and text understanding techniques based on machine learning approaches.

We have worked on integrating standard text forums with geographic information systems in a project called *GeoTopics*. Below we show a screenshot of tweets and post on the French City Rouen. Each text is geolocalized and represents a discussion thread. Red markers represent post by a city official related to a specific ongoing action or

Figure 3. Visualization of public messages in Geotopics

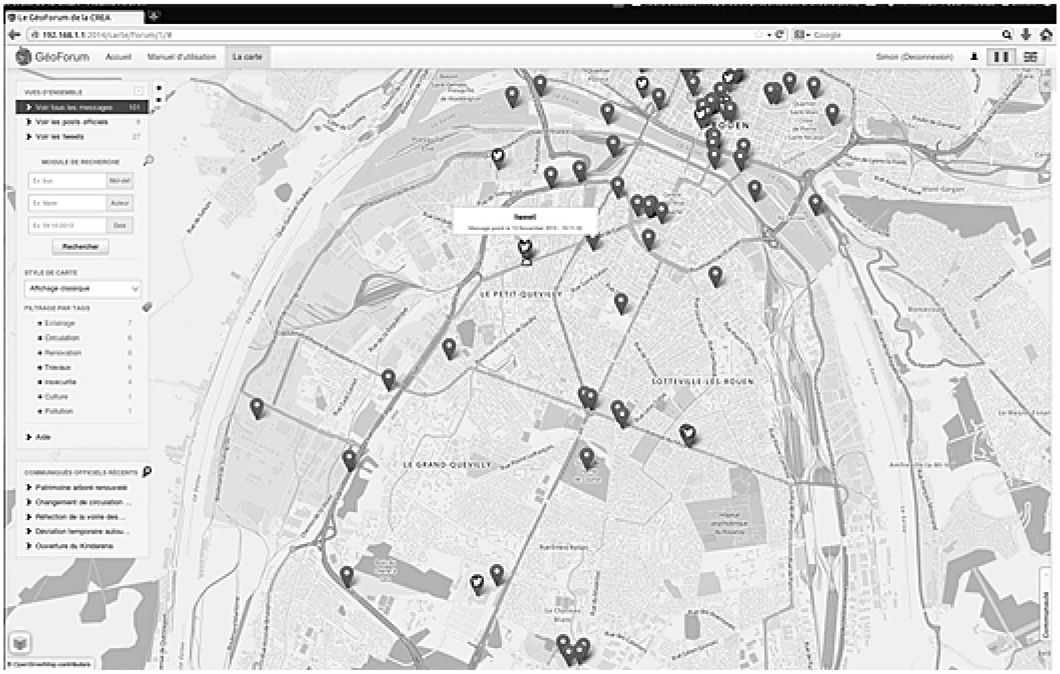


Figure 4. Density representation of the messages in Geotopics

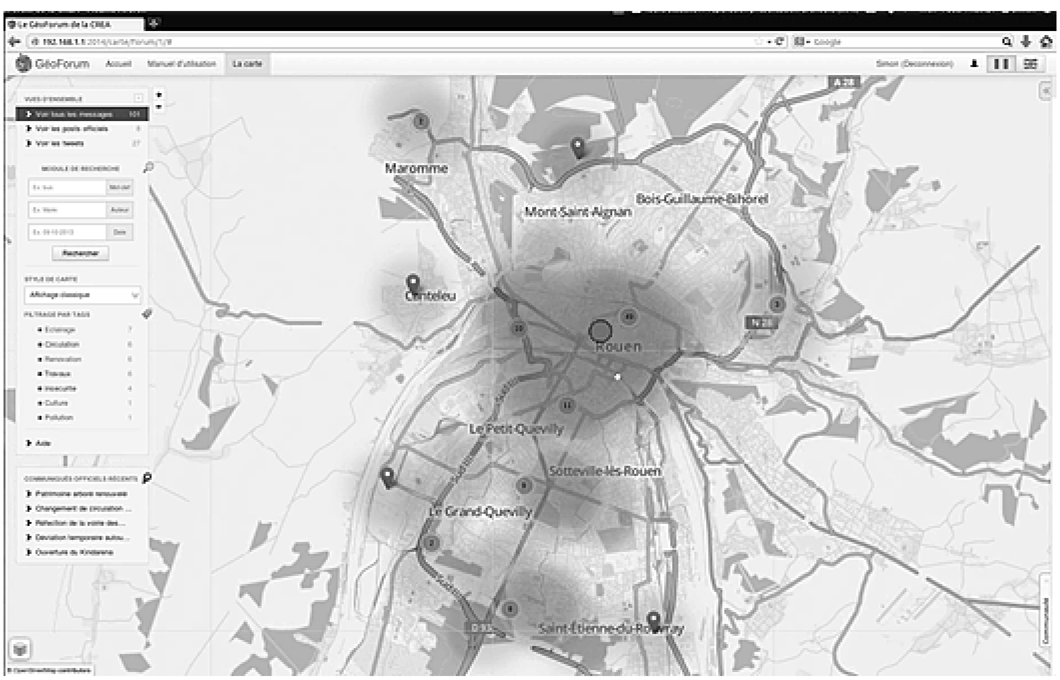
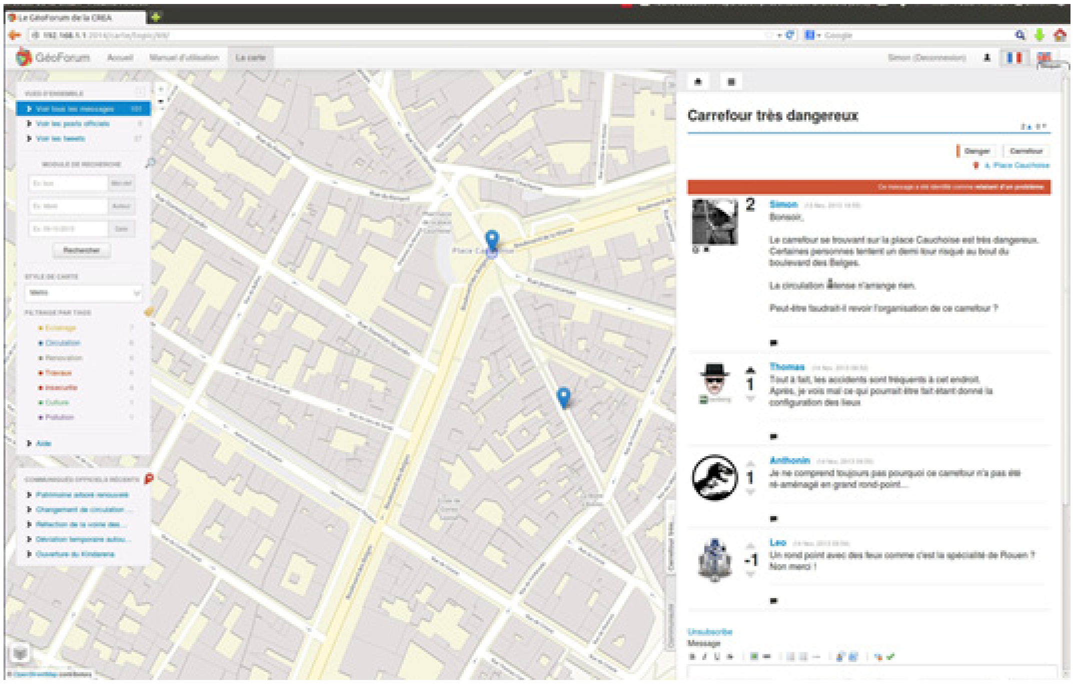


Figure 5. Public forum synchronized with the map



campaign. Blue markers represent e-citizens posts. Citizens can more easily communicate on certain regions of a city and find related discussions.

It is also possible to look at a heat map of the posts in order to find the region with the highest density of posts (Figure 4).

Finally, in the last screenshot we show an example of a given thread where people can comments on other's post, vote etc.

In all the screenshots illustrated above the left panel enables one to search and filter on appropriate metadata. The system also integrates text classifiers where an analyst/moderator can create categories, filters such as transport, culture, education etc. These classifiers will be learnt automatically when users tags posts for instance.

CONCLUSION

In this chapter, we reviewed existing systems and pointed to their limitations. We motivated the need for supporting a bi-directional dialogue between citizen and the public authorities. We pointed also to the need of better support for facilitators to help them organize the content. We discussed how facilitator could be supported by automatic text analysis techniques such as the one shown in the dashboard. Finally, we proposed a community feedback platform that integrates a classical text-based forum with a city map, the aim of the design is to make the user interactions more intuitive and appealing.

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KEY TERMS AND DEFINITIONS

Collective Ideation: Process of creating innovative ideas and inventions involving multiple persons. These participants in the process are not necessarily colleagues in the same organization, but can be independent, self-interested persons, for example in the collective customer consultation of Starbuck.

Community Feedback Platform: Software platform that manages a community of users providing feedback about some targeted topics.

Facilitator: Person that supports a community of users of a software platform in their access to the information and guide them to reach the platform objective. In a idea management system, the facilitator classify, sort and modify the ideas generated by the users to identify the best ideas more efficiently.

Geographical Information System: Associated in the manuscript with Geographical Information System. A GIS is a software platform that enables efficient visualization and management of geographical data.

Idea Management System: A system that enables the management of comments written by a community (employees, customers, experts) to propose innovative ideas improving the current processes.

Question-Answer Website: Online interface where users ask questions and experts (often users themselves) respond to questions.

Chapter 11
Information Visualization and Policy Modeling

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ABSTRACT

Policy design requires the investigation of various data in several design steps for making the right decisions, validating, or monitoring the political environment. The increasing amount of data is challenging for the stakeholders in this domain. One promising way to access the "big data" is by abstracted visual patterns and pictures, as proposed by information visualization. This chapter introduces the main idea of information visualization in policy modeling. First abstracted steps of policy design are introduced that enable the identification of information visualization in the entire policy life-cycle. Thereafter, the foundations of information visualization are introduced based on an established reference model. The authors aim to amplify the incorporation of information visualization in the entire policy design process. Therefore, the aspects of data and human interaction are introduced, too. The foundation leads to description of a conceptual design for social data visualization, and the aspect of semantics plays an important role.

INTRODUCTION

The policy modeling process and lifecycle respectively is characterized by making decisions. The decision making process involves various stakeholders, that may have diverse roles in the policy making process. The heterogeneity of the stakeholders and their "way of work" is a main challenge for providing technologies for supporting the decision making as well as technologies to involve various stakeholder in the process. Stakeholders in this context may be citizens too, whereas often the term "eParticipation" is used in this context. Information visualization techniques provide helpful instruments for the various stages of decision making. To elaborate the different

DOI: 10.4018/978-1-4666-6236-0.ch011

stages of policy making and the role of visualization in each stage, we have developed three-stepped design process for the roles of visualizations in the policy modeling lifecycle (Kohlhammer et al. 2012). The model propagates the steps of information foraging, policy design and impact analysis, where various visualization techniques can be applied to. These steps are investigated in particular for the FUPOL project, where the information foraging stage covers the visual representation of various data and data formats to get a comprehensible and understandable view on the given masses of information without losing the context and targeted task. The impact analysis step will use and cover both, the outcomes of the simulation activities of FUPOL. The outcomes of the statistical data mining methods will be covered to support both, the active and passive involvement of the citizens and to provide a kind of "public mood" about a certain topic.

For decision making in the policy life cycle, Data, information, and knowledge are crucial and important resources. Beside storing, managing and retrieving data, one important factor is the access to the increasing amount of data. A promising discipline facing the information-access challenge by investigating the areas of human perception, human-computer interaction, data-mining, computer vision, etc. is information visualization. One main goal of information visualization is the transformation of data to visual representations that provides insights (Keim et al. 2010) to users and enable the acquisition of knowledge. The access to data is provided by interactive "pictures" of knowledge domains and enables solving various knowledge and information related policy tasks. These "pictures" are generated through transformation and mapping of data (Card et al. 1999) to visual variables (Bertin 1983) that are perceived by human to solve tasks (Shneiderman 1996). Different approaches on creating this "picture" of data provide various ways of perceiving visual representation of data and interacting with them. The most popular way is to get first an overview of the entire domain knowledge in an abstracted way, followed by zooming and getting more detailed information about the knowledge-of-interest (Shneiderman 1996). This top-down approach (*Information Seeking Mantra*), proposed by Shneiderman (Shneiderman 1996) makes use of our natural interaction with real world. Getting into a new situation forces us to build association of known or similar situations and create an overview of the context. Further interactions in this situation are more goal-directed and detailed. The complementary bottom-up approach, premises that we are able to verbalize a problem or direction. The visual representation is then generated by the results of a search query. Based on the amount and complexity of the results various visualizations may provide abstracted views or detailed visual knowledge representations.

The process of information search can be further optimized by the technologies and methods of formalized semantics and ontologies, in particular in context of the Semantic Web.

Semantic Web targets on a machine-readable annotation of data to provide a "meaning" by defined and formalized relationships between resources on web. (Kohlhammer 2005) While Semantic We focuses on the machine-readability, Information visualization focuses on the maximization of our perceptual and cognitive abilities (Chen 2004).

In context of Information Visualization the aspects of data, user and tasks are of great importance. For designing Information Visualization tools the question: which data to what kind of users and for solving which tasks may provide an adequate design process. In this context the recent research investigates in particular the feedback loop to the data in Visual Analytics, the model-based visual knowledge representation in Semantics Visualization and the cognitive-complexity reduction of users in Adaptive Information Visualizations (AIV).

This chapter introduces information visualization as a solution for enabling the human information access to the heterogeneous data that are necessary during the policy modeling process. Therefore we first identify the steps of policy design, where information visualizations are required based on an established policy life-cycle model. Thereafter a foundational overview of information visualization will be given, investigating beside visualization techniques, the entire spectrum of data to visualization. In this context data and interaction methods will be introduced. We will conclude this chapter with a conceptual example of visualizing social data in the domain of policy modeling.

ABSTRACT POLICY MODELING STEPS

Policies are usually defined as principles, rules, and statements that assist in decision-making and that guide the definition and adaptation of procedures and processes. Typically, government entities or their representatives create public policies, which help to guide governmental decision-making, legislative acts, and judicial decisions.

Some policy-modeling researches emphasize theoretical respectively formal modeling techniques for decision-making, whereas applied research focuses on process-driven approaches. These approaches determine effective workflows through clearly defined processes whose performance is then monitored (for example, as in business process modeling). This applied-research approach is widely seen as one way to effectively create, monitor, and optimize policies. One aspect of process-driven policy making is the clear definition of the sequence of steps in the process. This ensures the consideration of the most relevant issues that might affect a policy's quality, which is directly linked to its effectiveness.

Ann Macintosh published a widely used policy-making life cycles; it comprises these steps (Macintosh 2004):

1. Agenda setting defines the need for a policy or a change to an existing policy and clarifies the problem that triggered the policy need or change.
2. Analysis clarifies the challenges and opportunities in relation to the agenda. This step's goals are examining the evidence, gathering knowledge, and a draft policy document.
3. Policy creation aims to create a good workable policy document, taking into consideration a variety of mechanisms such as risk analysis or pilot studies.
4. Policy implementation can involve the development of legislation, regulation, and so on.
5. Policy monitoring might involve evaluation and review of the policy in action.

The general process model of Macintosh was applied to identify the need and advances of information visualization in the entire process (Kohlhammer et al. 2012). Therefore the model was abstracted to a highest level for identifying general and abstract information visualization steps: The need for a policy, the policy design, and impacts of the designed policy are shown in Figure 1.

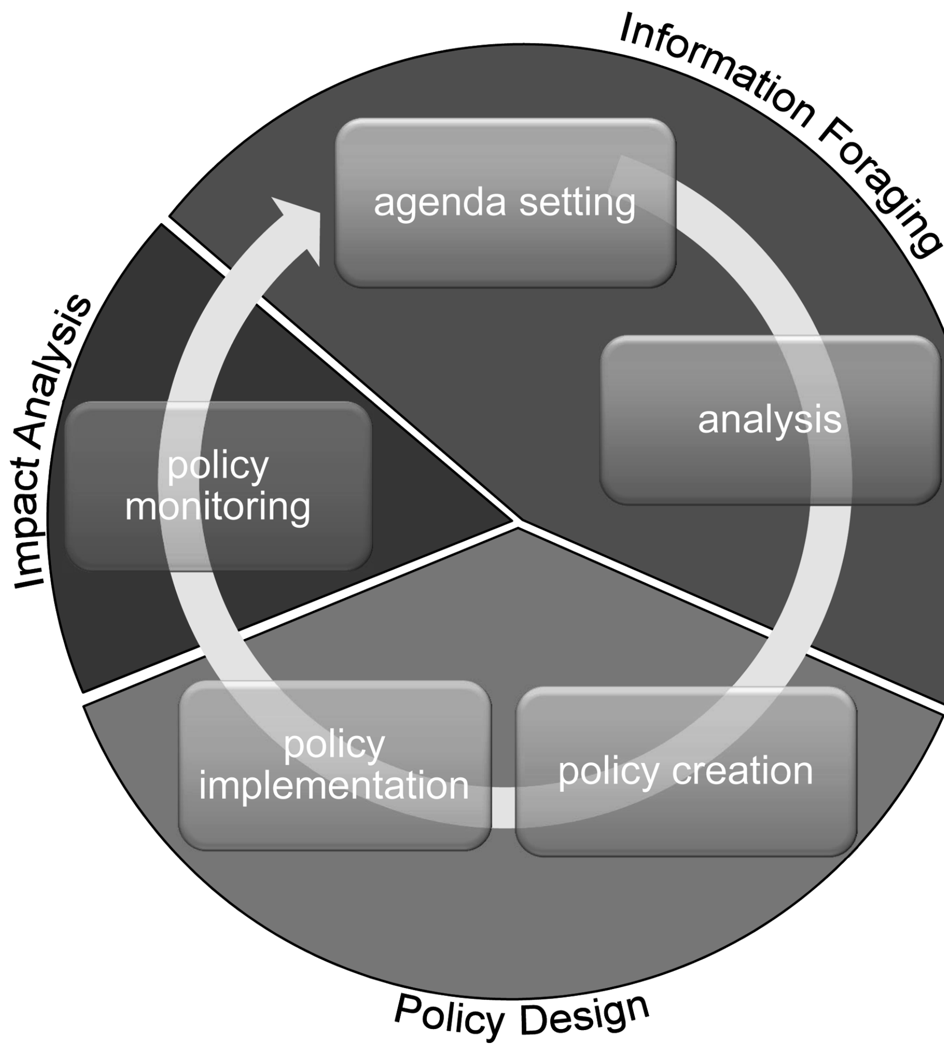
For adopting visualization in policy making, we simplified the general model and introduced three iterative stages (Kohlhammer et al 2012):

Figure 1. Abstract Policy steps

1. **Information Foraging:** Supports policy definition. This stage requires visualization techniques that obtain relations between aspects and circumstances, statistical information and policy-related issues. Such visualized information enables optimal analysis of the need for a policy.
2. **Policy Design:** Visualizes the correlating topics and policy requirements to ensure a new or a revised functional interoperability of a policy.
3. **Impact Analysis:** Evaluates the potential or actual impact and performance of a designed policy, which must be adequately visualized to support the further policy improvement.

All phases involve heterogeneous data sources to allow the analysis of various viewpoints, opinions, and possibilities. Without visualization and interactive interfaces, handling of and access to such data is usually complex and overwhelming. The key is to provide information in a topic-related,

Figure 2. Mapping of the five policy steps to the simplified model of information visualization in the policy making process (adapted from Macintosh 2004 and Kohlhammer et al. 2012). (Own drawing).



problem-specific way that lets policy makers better understand the problem and alternative solutions.

Today, many data sources support policy modeling. For example, linked open government data explicitly connects various policy-related data sources[1]. Linked data provides type-specific linking of information, which facilitates information exploration and guided search to get an overview and a deeper understanding of a specific topic. Further data sources may be the massive and growing statistical data provided by various institutions, including the EC[2].

Current policy modeling approaches do not use visualizations intensively neither for the general process nor for the entire identified stages.

The gap between information need and information access can be efficiently closed via information visualization techniques. The next sections will introduce some main aspects of information visualization independently from policy making and design. This should amplify actors in policy design to investigate information visualization as an instrument for the information provision process.

FOUNDATIONS OF INFORMATION VISUALIZATION

Model of Information Visualization

One of the most influential model in information visualization is the model of Card, Mackinlay and Shneiderman. It is a data flow diagram that models the data processing from its raw form into a visual representation. The visualization is described as a series of partly independent transformations. Its main contribution is that the complexity of the visualization process is split into smaller sub-processes. This is why it still serves as a basis for many visualization system architectures today. Usually, scientific contributions in the information visualization domain can be mapped precisely onto particular parts of the pipeline. Another important aspect of their work is the idea of user interaction in the pipeline. A visualization technique is not static process. Every component along the data processing pipeline serves as a basis for process control mechanisms.

The pipeline starts off with the transformation of the raw input data into data formats that are suitable for the visualization. This standardization is necessary if more than one data source should be attached to the process or if a single data source is used for different visualization techniques. This transformation aims at a data representation that is normalized in terms of content and structure so that the visualization can be decoupled from the input data. This is an important strategy that permits to adapt techniques to different scenarios and data sets. It might involve trivial operations like converting one data format into another, but in many cases it is also necessary to identify and deal with incomplete, imprecise or erroneous data. Depending on the application the outcome of this step is well-defined data for the visualization.

The second step in Card's visualization pipeline is the mapping of standardized, but raw data into the visual space. This mapping can be considered as the core transformation that forms the actual visualization. That is why the different visualization techniques can be differentiated in thispart of the pipeline. The visual space is described by a series of visual attributes which inherently represent the basic tools of the visualization techniques. Ware identified several groups of these attributes: form, color, animation and space (Ware 2013). While the second part of the pipeline describes the transformation into the visual space, the third block is about transformations within the visual space, the view transformation. In almost any case the transformation also takes place within the value set of a single visual attribute. This includes, for example, rotation, zoom and other camera settings as well as modifications of the color map for an attribute.

Card's model of the visualization pipeline is a also a model for a technical realization of visualization techniques and processes. Together with Mackinlay and Shneiderman he also develops a model for what he calls “Knowledge Crystallization Process”. Instead of describing the data flow through the technical components they model the path from input data to application-dependent, domain-specific knowledge. This crystallization resembles the classification of analytic artifacts as done by Thomas & Cook (Thomas and Cook 2005). It models a cyclic process that repeats of the following steps:

- Forage for data.
- Search for schema.
- Instantiate schema.
- Problem-solve.
- Author, decide or act.

The proposed sequential cycle can be altered by several feedback and feed-forward loops that are the main characteristics for this model. Whether or not these loops are executed depends strongly on the application scenario. In most cases, human-interaction is required whenever a decision has to be made. In order to do that the human must be able to judge the available results. This task can be performed through automatic analysis if the judging process can be explicitly formalized.

The model of Card and Thomas et al. complement one another in the sense that the model for the knowledge crystallization process is independent of the technical realization. The single steps solely describe the way knowledge is gained and the tasks that perform in each step. The model of Thomas et al. is still valid if the interactive visualization techniques are replaced by automatic analysis methods, as done, for example in data mining.

Thomas & Cook define as the principle of knowledge crystallization as analytic deduction but focus on different aspects. Analytic artifacts appear in knowledge crystallization only implicitly whereas the transformation process and their application is put in the foreground. In many cases, the approaches for the theory and the models in information visualization can be assigned to one of two groups. These are “data-centered” and “decision- or user-centered” tasks. They differ mainly by the information that is available in the design phase. Amar and Stasko (Amar and Stasko 2005) put those two principles in juxtaposition in the context of information visualization. Visualization in data-centered approaches aims at a realistic representation of data and its structure. In its most consequent form, this idea is completely independent of the human user and the tasks that should be solved using that visualization. Its main goal is to create an identical replication of the input data in the mental model of the user. Viewing the data is an elementary low-level process. It is supported through visualization, but it does not support the user in solving a high-level task. According to Amar, the static connection between analytic activities is based on the assumption that the aims of the user are also formulated in a static and explicit manner. They find it necessary to link the user tasks on different abstraction layers through information visualization, i.e. low-level and high-level tasks.

In the following sections we will present two parts of the Card pipeline: the visual mappings and the interaction techniques. Mappings can be partitioned in five different groups that map fundamentally different structures into the visual space. Interaction techniques can be roughly classified by the part of the visualization pipeline they control. In this manner, the differentiation is performed through technical criteria. However, it would also be possible to separate the visualizations by the task they support. Although many techniques are advertised through the tasks they claim to solve, comprehensive studies that compare many different techniques is not yet available in the literature. Wherever possible, we will present reviews as found in the literature and express our own opinion where appropriate.

DATA FOUNDATIONS

The information visualizations model that was described in the previous part always starts with the transformation of data in their raw form. Heterogeneous data types need to be investigated for the transformation process. Shneiderman (Shneiderman 1996) introduced a taxonomy of data types, which distinguishes data types in one-, two- and three-dimensional data, temporal and multidimensional data, and tree and network data. We will shine light on these categories in this section of the chapter. Together with an independent taxonomy of analysis tasks, Shneiderman also presented a matrix of visualization techniques, which provides solutions for specific tasks and data. It has to be stated, however, that it is quite common that a given dataset falls into more than one of these categories of the taxonomy. The term "dimensionality" may either refer to the dimension of the actual data, or to the dimension of the display. In some cases, if the data set has a "native" dimensionality (as is the case with most geo-spatial datasets) the preferred visualization techniques map this data onto its native space. Also note that most of the visualization systems presented here employ one or more navigation and interaction concepts that were described in the previously, without being mentioned here. We make a clear distinction between publications introducing basic technology and visualization techniques of the "second generation", in which most of these technologies are implemented as a quasi-standard an in nearly all cases used in combination. The work of Keim (Keim 2002) gives a contemporary survey on the basis of Shneiderman's taxonomy.

One-Dimensional/Temporal Data

Tables with two columns are a typical example for one-dimensional datasets. If they contain at least one temporal component in their structure, they are referred to as temporal dataset and form a special subclass of 1-dimensional data. Shneiderman also includes textual documents, program source-code, lists and all other kind of sequentially arranged data to the category of one-dimensional data. Whether text documents actually belong to this category depends on the perspective and task. If the central focus lies on the individual items in the sequence (as for searching words in a document), the corresponding space is one-dimensional. If the focus lies on the sequence as a whole (as in document analysis and classification), the data space actually is multidimensional. Given the usual complexity of input data sets, they do not fall in the category of one-dimensional data alone. In this paragraph we present a number of visualization approaches which emphasize the temporal / one-dimensional components of the datasets.

Havre presents a visualization technique called ThemeRiver as part of a document analysis of news reports (Havre et al. 2000). It maps the change of headline stories in the news onto a time scale. The basis of this technique is the appearance of a specific keyword appearing in a number of articles and shows how specific themes may appear at the same time (though not on a granularity level of a single article). Card et al. describe a type of visualization (Card et al., 2006) that maps the temporal data is also onto a single axis, a time-line. This visualization couples temporal and hierarchical data. For the problem of mapping temporal data to a visual aspect, which is neither a time-line nor an animation, no convenient solution exists. In most cases, one of these variants is chosen, because they can be intuitively understood.

The work of Hochheiser and Shneiderman (Hochheiser and Shneiderman 2004) lies in the tradition of a number of tools which refine the dynamic queries technique. As in the other visualization techniques, the temporal information is mapped onto the timeline. The use of so-called TimeBoxes covers a spatial and temporal interval to intuitively define a number of data filters to identify time-series, which share a common behavior. Timebox queries are combined to form conjunctive queries of arbitrary complexity. These techniques are conceptually not restricted to temporal data. Every temporal dataset that is used in these techniques can be replaced with one-dimensional data of any other (ordinal) type. Lin et al. give a survey on the different techniques for the analysis of the same kind of data, including Timebox-Queries, calendar based visualization techniques. The authors also contribute VizTree, which interactively visualizes a similarity analysis in a number of data graphs, producing similarity trees (Lin et al., 2005).

Hao et al. (Hao et al. 2005) propose another combination of clustered / hierarchical data together with a large time-series data set. In their application scenario, the time-series entities show intrinsic hierarchical relationships. This technique combines tree-map properties with the ability to show temporal development of stock-market prices. The hierarchical properties of the underlying data are used to match the level of interest and importance in the layout.

The approach proposed by Voinea at el. (Voinea et al. 2005) in the field of collaborative document creation management deals with a completely different kind of data. The authors focus on software development source code files which require significantly different processing than plain text documents. The creation process of the software is clearly separated in a one-dimensional aspect (the position of lines added to the source-code), and the temporal aspect (the development of the source over time), both of which are combined in a two-dimensional overview. Different parts of the code can be identified by their author(s), such as stability and other aspects.

Two- and Three-Dimensional Data

The mapping of abstract two and three-dimensional data has by far the longest tradition. All kinds of geospatial information visualization can be identified as a mapping from data in a two-dimensional space (geographical maps) or three-dimensional space (a virtual model of our physical world). Every atlas can be considered a collection of physical data and geographic metadata which accounts for most of the earliest efforts in actual information visualization. Embedding abstract data into a representation of our physical world is one of the most powerful metaphors, because humans are attuned to organize and arrange mental mappings while copying our physical world. Hence, many visualization techniques for this embedding have been developed. Over the years, this concept evolved from plain satellite image visualization to a collaborative platform for which the (virtual) world serves as a common frame of reference to contribute, search and analyze large amounts of additional geographic metadata. Not surprisingly, many visualization techniques have been developed that use this platform as a basis for their data (Chen and Zhu 2007). With a special focus to the spread of avian flu, Proulx et al. combine the embedding of spatial, temporal and other metadata to actually formulate and test hypothesis on the basis of "events" (Proulx et al. 2006). Events serve as metadata containers which are used to bind the information to a place, time, etc.

One of the most prominent mappings of abstract data into two-dimensional space is the scatterplot technique, which appears in a large number of variants (North 2000). Despite the fact, that the native display space is only two-dimensional (although three-dimensional scatterplots exist), they are often used in combination as scatterplot matrices or with other techniques to be used in multidimensional data analysis. Scatterplots work best for numerical data (which can be mapped on the x and y coordinates respectively), and is of limited usage to convey purely semantic information. Because of their simple metaphors (points in n-dimensional space become points in 2-dimensional space), they are most conveniently used to visualize projections between n-dimensional data-space and display-space, which usually are supported by numerical methods just as factor analysis, matrix decomposition and similar methods.

One field of two- and three-dimensional mappings has been left out on purpose: Scientific visualization as is separated from information visualization by the data that is displayed. By definition, it deals with physical data which inherently lies in physical space rather than abstract information and metadata. Consequently, the techniques of scientific visualization are out of scope.

Multidimensional Data

Most of the techniques presented here involve data which covers more than three independent dimensions. Visualization techniques for multidimensional (or multivariate) data explicitly address the problem to visualize and identify inherent dependencies in the datasets, which cannot be expressed by simple correlations. Hidden relations may incorporate ten or more dimensions of data, and one of the major goals in all of these techniques is to display a sufficiently large number of dimensions in (2-dimensional) screen space to make these correlations visible. Defining "Visual Data Mining" as a concept the work of Keim gives a survey on a number of visualization techniques for multi-dimensional databases (Keim 1996). Aside from graph-based visualizations for networks and hierarchies, two classes of techniques evolved over the years to become prominent representatives for the visualization of multi-dimensional data: The first one is the so-called parallel coordinates technique, the other one falls into the category of pixel-oriented layouts. It has to be noted, that all of these techniques virtually never appear in their "pure" (i.e. conceptual) form. Most of the recent frameworks and techniques derive their improvements from an adequate combination of different basic techniques – in some cases in the same display. This holds true especially for glyphs, which also constitute a group of multidimensional visualization techniques, but does not refer to the layout (i.e. the positioning of visual objects in screen space) but on the appearance of objects. Basically every single visual object that conveys more information than its position can be considered as a glyph.

The parallel coordinate technique, as the name suggests, has all axis in the display arranged in a row of parallel lines. Basically this technique can be used for nominal, ordinal or numerical axis, but it works best for ordinal and numerical data. A "point" in the n-dimensional space is drawn as a poly-line connecting the (coordinate-) values on every axis. While the basic idea is relatively old, contemporary studies on parallel coordinates emphasize their use for the analysis of datasets (Siirtola 2000). In many cases, this technique is tightly coupled with the generation of dynamic queries. Both of these techniques illustrate the identification of data clusters by visual/manual methods (Siirtola 2000) and a method the display the data at different structural levels (Fua et al. 1999).

Complementary to that, the general idea of pixel based methods is to use the screen space in the most efficient way possible: Every pixel in the display area is used to convey different information: The use of "non-data-ink" is reduced to a minimum. Pixel-based techniques must cope with the layout problem of an adequate mapping of the (multidimensional) data-space onto the screen space. In many cases there is no strict correspondence between the similarity of the data items and their distance. (Keim 1995, Keim 1996 and Keim 2000) provide a good overview over the general idea of these techniques.

Tree and Network Data

Graph visualization has become an important topic in information visualization area over the past years. The display of networks helps to analyze of relationships between entities rather than the entities themselves. Graph visualization is used in many different application areas. For example, the site maps of web sites as well as the browsing history of a web browser can be displayed in a directed graph. In biology and chemistry, graphs are applied to evolutionary trees, molecule structures, chemical reactions or biochemical pathways. In computing, data flow diagrams, subroutine-call graphs, entity relationship diagrams (e.g., UML and database structures) and semantic networks and knowledge-representation diagrams are the main application fields. Furthermore, document management systems profit from document structure and relationship visualization. Social networks visualization has also become a popular application of graph visualization methods.

The key issues in graph visualization are the graph structure (directed vs. undirected graphs, trees vs. cyclic graphs) and their size. A survey of graph visualization techniques for different graph types can be found, for example, in the work of Herman (Herman et al. 2000). The graph display is driven by its layout. There are different graph layout techniques suited for different graph types.

For trees (graph in which any two vertices are connected by exactly one path) the classic layouts will position children nodes "below" their common ancestor (Reingold and Tilford 1981), in 3D a cone layout is used (Robertson et al. 1991). For large graphs the high node and link overplotting requires new visualization and clustering techniques, For example, 3D hyperbolic space layouts (Munzner 1997) or *treemaps* (van Wijk et al. 1999).

VISUALIZATION TECHNIQUES

As described in the previous section, a visual mapping is a transformation of the data flow performed by visual techniques and will be used for their classification. It is important to note here that visualization techniques contain almost never a visual mapping in pure form. Especially newer techniques are often combinations of older approaches. Some of them are explicitly mentioned in a separate sub-chapter at the end of this chapter.

Each of the following sub-chapters presents a category of visualization- and interaction techniques with a focus put on newer approaches. The classification we performed is similar to the multi-dimensional visualization technique classification done by Keim (Keim 2000) which we extend with a class that deals with projection methods. Whenever possible, the techniques are presented independently of their application domain. Where ratings of a technology are provided, then these are typically related to the technique's ability to solve a particular task rather than the type of data they display.

Instead of describing iconic data like Keim does, we focus on projection methods, because they are tightly coupled with methods from data-mining. Moreover, the class of pure iconic techniques has lost importance during the past couple of years. Today, the results of this domain are reused particularly in glyph-based designs. Glyphs are singular symbols for data objects that represent one or more attributes.

Keim provides a classification survey of visualization techniques combined with a comparison regarding different characteristics of the data, the tasks and inherent properties of the visualization itself.

The survey can be separated into three independent task groups: task-related, data-related and visualization-related characteristics. The associated questions are: Which tasks can be solved? What kind of data is suitable? What are the inherent properties of the technique?

Keim starts his evaluation by testing task-related capabilities of the techniques. The first task is the support for cluster identification in a dataset ("clustering") and describing the distribution/cumulation of points in high-dimensional space ("multivariate hotspots"). Data-related capabilities comprise the number of attributes, the number of data objects and the possibility to faithfully map nominal scales ("categorical data"). Among others, the inherent properties of the technique comprise effective use of available space measured through the overlapping area of the visual items ("visual overlap"). The last criterion is the experienced difficulty learning a technique ("learning curve").

Geometric Methods

Every visualization technique that maps a data element directly on a visual attribute that is more complex that a single pixel (e.g. lines, glyphs, etc.) belongs to the group of geometric methods. It is highly heterogeneous and contains many hybrids that also belong to class of projection methods. Most of the classical diagrams like starplots, pie charts, bar charts, line charts, histograms, etc. as well as geographic maps, parallel coordinates, scatterplots and scatterplot matrices. As an example, scatterplots can also be considered as a projection method.

One of the most important visualization techniques are line charts. They display one-dimensional functions like time-series in many application areas. Hochheiser and Shneiderman. (Hochheiser and Shneiderman 2004) present a Timebox-Widget that allows for interactive selection and dynamic filtering of the displays data sets. It is based on the older technique "Dynamic Queries" combined with a new visualization approach. The user defines a box selection implicitly through one or more intervals of attribute values that are mapped to the x- or y-axis in the display. These intervals define the data sets that lie completely within these data sets.

Equally important are geo-related data mappings. Every atlas can be seen as a collection of geo-data and geographic metadata. Embedding this abstract information in a geographic representation is one of the most abundant metaphors possible, because the reference to a location is one of the most important relations people use to organize information. Proulx et al. (Proulx 2007) display geo-data together with a time-based mapping in order to combine the two natural reference frames (space and time).

An example for an interesting combination of techniques is presented by Bendix et al. (Bendix et al. 2005). It has been chosen, because it combines two of the most popular techniques – parallel coordinates and dynamic queries. Compared to most other techniques, the parallel coordinates approach excels in that as the number of attributes is only limited through the amount of available screen space. Every attribute is mapped on its own axis which is parallel to every other axis. One element of a data set is thus represented as a polyline that intersects with all axes at that point that represents the value of the respective attribute. Data clusters and correlations can be easily identified if the attributes are adjacent. Bendix et al. put their focus on the search of describing expressions rather than the data set itself. This search of expressions is, apart from the search of patterns, a major aspect in visual data analysis. Technically spoken, they deal with the mapping of nominal data types. As they do not have a natural ordering, they display the relations between different classes instead of the data set itself. (Bendix et al. 2005)

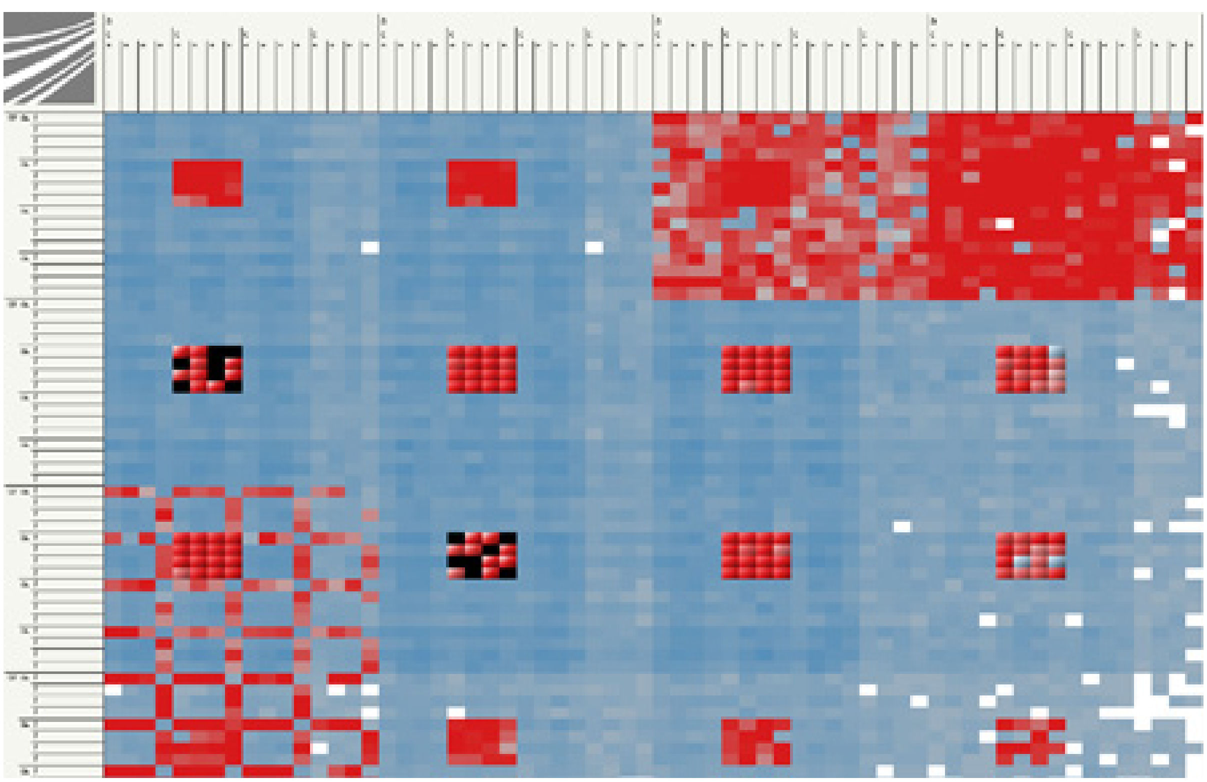
Pixel-Based Techniques

A visualization technique belongs to the group of pixel-based methods if the number of used visual attributes comprises only the position and color of a single pixel. Consequently, every pixel represents a data element which permits to display a maximum number of data elements at the same time. Pixel-based methods impose two design-problems. The value set of an attribute must be mapped to the range of available colors, but this is a problem that persists in most visualization techniques (Wijffel 2008).The second problem is about arranging the pixels related to the data set. The visualization can be seen as a function that values from high-dimensional space on the 2D screen.

A definition of pixel-based methods and a more formal description and can be found in the work of Keim (Keim 2000). The function that maps data elements in the visual space can be seen as the result of an optimization process. Assuming that the data set is ordered, this optimization must ensure that the one-dimensional ordering is kept also in the two-dimensional display. Equally important is the selection of the display area that ensures that the average distance between pixels that belong to the same dataset is minimal. The purpose of that is to aid the user in finding relations between different attributes in a data set.

May et al. present a visualization technique that maps multiple attributes on the same display. Every single pixel stands for a range of values that covers several data objects at the same time. The aggregation of the data values defines the final pixel color (May et al. 2008). In contrast to many other techniques the interesting information is hereby contained in frequencies. Pixels that relate to similar value sets can be, but do not need to be contiguous. Repetitions in well-defined horizontal

Figure 3. Pixel-based visualization from May et al. 2008 (with permission)



or vertical distances also indicate correlations. The human recognition is able to detect patterns in complex structures even if the data is distorted by noise. While pattern detection is easy, interpreting their meaning is often challenging.

Pixel-based techniques are often suitable for explorative analysis of patterns and distinctive features. Displaying previously found relations is a different task that is usually performed by different visualizations. More formally, the data model that describes the input data structure is linked but not equal to the analytic model that describes relations in the data set. Accordingly, different tasks often require different perspectives.

Hierarchies and Trees

Trees describe binary relations between differentiable elements can be described in a finite set. Most approaches in terms of visualization expose the hierarchy as dominant structure although several other attributes of the elements are present in the visualization. As the hierarchy does not impose a particular spatial structure, visualization techniques can be separated in two distinct parts. The first group deals with the design of visual mappings, i.e. the selection of attributes and metaphors for the display of elements and their connections. The element position in the 2D space does not play a major role for them. The second group is dedicated to different layout algorithms that map the elements according to one or more properties into the visual space.

Keim et al. present two space-filling methods that display hierarchies in different manners (Hao et al. 2005) and Mansmann 2007). The first one displays child nodes in their own separate space whereas the latter uses – similar to a treemap – the space of the parent node. Among others, the importance of leaves compared to inner nodes has influence on which one of the two methods makes more sense. The treemap puts the focus on the leaves of the tree. In contrast, the hierarchical layout highlights nodes that are close to the root node and less dominant in the treemap.

The nodes are displayed as simple rectangles in both cases which leaves room to show additional information. They can be used as a basis for a visualization of its own. The only restriction is that the amount of available screen space is defined by the tree layout. However, practically all visualizations for trees and graphs have in common that their ability to query and to display details is rather limited and often insufficient. This is why they are often combined with other methods, e.g. graph visualizations. Holten (Holten 2006) gives an example of such a combination. A node-link diagram is shown on top of a hierarchy with different aspects of the data. The edges between nodes are gathered in bundles in order to reduce the overdrawing and thus increase the readability of the graph.

A simple variation of node-link diagrams is the traditional Dendrogram. It is characterized by the fact that all nodes of a hierarchy level are in the same line. This significantly improves the visual arrangement of the tree. The simplicity of the structure and the display allows more complex information presentation. Up to a certain point it is possible to create abstractions of the components and use more or less independent techniques to display nodes, edges and the structure itself. The arising number of combinations is thus a source of new designs even without fundamental novelties.

Facing aesthetic, scientific and task-related aspects, designs tend to become overly complex which is conflicting with the user's need for easy-to-understand interfaces. A good visualization provides the relevant information on first sight without need for the user to actively search for it. This conflict has been actively discussed in the scientific community in the past years (Lorensen04) and (van Wijk 2005). The task defines, which data should be displayed, but it inherently defines as well which data should be hidden from the user as well. The data types impose a natural limitation on the repertoire of visual mappings. Today, scientists debate about the basic properties of visual mappings that are required support specific tasks with specific data sets in an adequate manner.

Graphs and Networks

Even if trees are only a specific subgroup of graphs they are typically depicted by very different techniques. Visualizations for trees exploit their simple structure, especially the fact they typically describe orderings. Compared to that, the placement of nodes in an arbitrary graph layout that fulfills certain optimality constraints is more complex, or mathematically spoken: NP-hard (Brandes et al. 2003).

Most graph visualizations are variations of node-link-diagrams. Some examples have already been given in the previous sub-chapter. As with trees and hierarchies the publications can be split in two categories: the graph layout on one side and the visualization of nodes and edges on the other side. The quality of a layout is measured in different criteria which often impose conflicting constraints. It is, for example, desirable to be able to see the most significant structures and clusters. But it is also desirable to minimize the spatial distance of related partitions. This makes it per se difficult to find a layout that is optimal for all demands.

Technically, the layout is often computed by mass-spring-simulations, so called “spring-embedders”. They model the optimality criteria as an energy function. The simulation then tries to find a global minimum for that function. In a mathematical sense, layout algorithms are related to non-linear or local-linear projection methods.

One fundamental problem in graph visualization is the sheer amount of nodes many datasets contain. The number of nodes that can be displayed on the screen is rather limited. Considering that the focus of the user is either on the global structure or on a particular group of nodes it often makes sense to hide a large part of the data set. Balzer and Deussen (Balzer and Deussen 2007) create a visual abstraction on the basis of existing node hierarchies. It can be, for example, generated by hierarchical clustering algorithms. The nodes and the edges of a cluster are then combined into one single graphical element. A variation of this has been presented by Henry et al. (Henry 2007) who model this graphical element as an adjacency matrix. Their main contribution, however, is to provide interaction tools for the user.

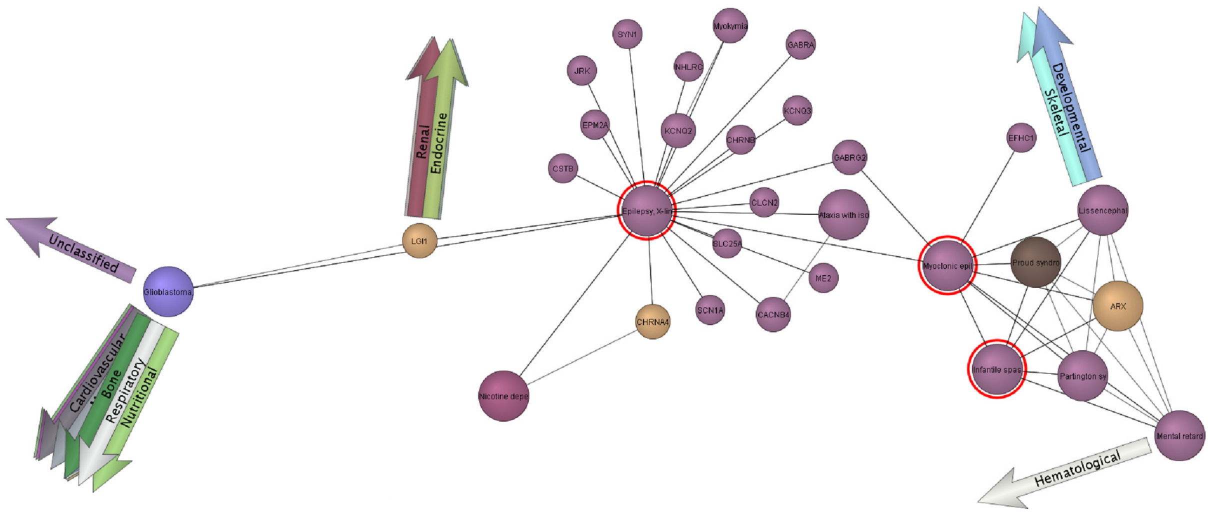
A system that is dedicated to navigate in large graphs has been developed by Abello et al. (Abello et al. 2006). The basis for that is again a given node hierarchy. It is used to display an overview on the graph that is used for navigation. At the same time, it acts as filter for the nodes that are displayed in a detailed view. Depending on the level of detail, sub-trees are expanded or collapsed.

Van Ham (van Ham 2009) faced the same problem from the opposite side. Based on an initial node pick, only a small region around a focus node is displayed. This idea has been picked up by May et al. (May et al. 12) whose system allows for more than just one focus node. It also add landmarks as graphical cues to give information on the context of the visible sub-graph. The arrows point along the shortest-path to regions in the graph that might be worth exploring.

Many combinations of techniques for the graph structure and the detail view are possible. Displaying details in the graph makes sense only if the information can be classified and processed on first sight, for example a mapping on a color scale.

The number of currently available visualization indicates already that there is no single best visualization, neither for the graph layout nor for displaying nodes and edges. The complexity of network graphs is often distributed on many structural levels. Many techniques assume that it has an inherent hierarchy. They exploit that

Figure 4. Signposts for navigation in large graphs (from May et al., 12, with permission)



by computing and using hierarchical structures for the display. Even if a visualization technique is able to switch between different levels in the hierarchy, it is probably not able to display all levels of the structure this at the same time. This does not work, because the user's visual ability to focus is limited to one or two levels. The essential task of graph visualization is thus to display one structural level as good as possible and to support user-controlled switches between different levels if necessary.

Projection Methods

This part of the book deals with projection methods. They project the data space onto the 2D visual space. This transformation is performed prior to the visual mapping. Originally, projection methods can be compared to methods from data mining domain even if the projections are of higher degree. The data space describes the set of all possible combinations of different data set attributes. Every element is represented by one point in this space. The projection tries to map the information that is inherent in this high-dimensional space into 2D. As with graphs, the focus is on the distribution rather than on accurate representation of single data elements.

Scatterplots are projection methods that are rather easy to understand. Basically, two attributes, typically numeric scales, are mapped onto the vertical and horizontal axes of a diagram. The main advantage compared to other techniques is their simplicity and the fact that most users know the concept already from math courses in school. The drawback is that only two attributes can be compared at the same time as the projection is linear along with the axes of the coordinate system. Elmquist et al. overcome this limiting with a Scatterplot-Matrix. It displays all possible scatterplots with a given number of attributes of a dataset in a matrix. (Elmquist et al. 2008) Every entry in that matrix is a miniaturized scatterplot. These small scatterplots give a first idea if and how two attributes are linked. The matrix display provides an overview and helps the user to find interesting attribute combinations, but it also solves the coherence problem for the scatterplot: modifying parameters (in this case the selected axes) modifies the user perspective in a way that the user cannot comprehend. The display before and after the modification differ so much that the user is not able to recognize the influence of the modified parameter. Animated transitions between those settings are an often used strategy to fight that problem.

A linear projection can be described as an optimization process that tries to find an optimal direction. As most optimizations do, the Principal Component Analysis (PCA) (Müller 2006) tries to minimize an objective function. For PCA, it describes the variance of points along an arbitrary axis in space. Linear projections screen all information along one projection axis, but highlight structures that are orthogonal to that axis. In case, a dataset contains structures that become manifest along several (in the worst case perpendicular) axes, linear projections fail to display the dataset properly.

Schreck at el. present a projection method that is based on self-organizing maps (sometimes also referred as Kohonen maps, named after Teuvo Kohonen) (Schreck at el. 2008). As the name already inclines, the maps are self-organizing neuronal networks that map high-dimensional attribute space in the two-dimensional display space. In contrast to other methods, the display space is discrete rather than continuous. Every discrete element corresponds to a set of classes and every data element is represented by an element that belongs to exactly one of the classes. Every class contains one element that represents the class as a whole. The classes can then be put in relation with each other in terms of similarity, or simply spoken, similar classes lie close to each other in the map.

With the exception of scatterplots, all linear projection methods work with numerical data only. Non-linear projection methods are able to work with other data types if the spatial distance between two data elements is metrically defined.

Above all, projections describe the data distribution in a multi-dimensional space. As a result, the points are mapped so that elements that are close in the data space are also close in the 2D space. Thus, these methods are particularly useful for clustering, similarity detection and outlier detection.

VISUAL INTERACTION

Many different information visualization techniques for interaction and navigation within the abstract data space exist. Hearst considers the following as the most important ones: brushing and linking, panning and zooming, focus and context, magic lenses, animation and as an additional combination overview plus detail (Hearst 1999). These techniques can be seen as the fundamentals (together with the visualization metaphors) for the design and implementation for visualization techniques.

Brushing and Linking

The interaction technique "brushing and linking" describes a connection between two or more views of the same data, based on a user-defined selection. Selecting a certain representation in one view affects the representation in other views as well. This requires that the raw data is mapped not only to one view at a time, but to several views. More specifically, brushing refers to the idea that the user picks a subset of the original data whereas linking refers to the visual highlighting in different complementary views. This Highlighting can occur in a number of forms. They all have in common that the selected item(s) can be distinguished in an intuitive way from the unselected items. This naturally limits the number of scalar dimensions which can be used in the same display. The work of Ware gives an overview on visualization features and presents how different visualization can be used to judge whether groups of objects belong together or not (Ware 2013). The basic feature classes presented are form, color, motion and spatial position. His work on preattentive perception gives important information which types of features can be used which each other, and which types of features should not be used for different information. Examples include using a different color, font, background or symbol, and adding additional labels for highlighted items (Eick and Karr 2000; Wills 1995). Depending on the sources, the brushing and linking technique is either considered as a change of the visual mapping (Hearst 1999) or as a technique which modifies the data transformation (Card et al. 1999). Most importantly, every visual mapping is required to provide an inverse mapping, by which visual structures can be remapped to a common data reference.

An example for a system implementing brushing and linking for the visualization of search results is the INQUERY-based 3D-visualization by Allan (Allan 1997).

Panning and Zooming

The view transformation from visual structure to views is often controlled by panning and zooming operations. Changing the viewpoint of the user alters the portion of the displayed part of the visual structures. Hearst uses the metaphor of a movie camera (Hearst 1999). Card et al. use the term "panning and zooming" in their listing of interaction techniques (Card et al. 1999). Their equivalent is camera movement and zooms. In contrast to simple panning, camera movement includes the third dimension, when dealing with three-dimensional visualizations. In both cases, zooming includes possible changes of the level of details displayed, when changing the zoom-factor – the virtual distance to an object of interest. An interesting contribution on zooming is the "single-axis-at-a-time-zooming", discussed by (Jog and Shneiderman 1995). While normal zooming can be explained by using a camera metaphor, this fails to work, when only the scale of one of the axes is changed.

The camera metaphor for movement in virtual (3D-)space is better-known from virtual world and games. However, a classical example for a system implementing panning and zooming for the visualization of browsing and searching is Pad++ (Bederson et al. 1996). One of the central characteristics of this system is the fact that scale is added as a first class parameter to all items displayed. In addition to implementing simple panning and zooming, Pad++ goes far beyond this interface technique. It also offers focus-plus-context views as well as overview plus detail, which are described later. In general, at least simple forms of panning and zooming are today one of the general techniques implemented in many of the available visualization systems.

Focus-Plus-Context

An inherent problem of zooming is that the higher the zooming factor is, the more details can be shown about particular items or the better the separation between close up items, but less can be perceived from the surroundings or the overall structure of the information. Focus-plus-Context techniques mitigate this problem by presenting more details about the items in focus, and less about the context while trying to avoid that the context of the information in the focus is completely hidden. Card et al. list three points as premises for focus plus context (Card et al. 1999):

- The user needs both overview and detailed information simultaneously.
- Information needed in the overview may be different that that needed in detail.
- These two types of information can be combined in a single (dynamic) display.

Overview-plus-Detail (Furnas 1981; Furnas 1986) methods can be used to cope with the mentioned problem of zooming and at least the first two of the premises, but overview plus detail does not combine both types of information in a single display. Hearst describes a fisheye camera lens as a metaphor for focus-plus-context (Hearst

1999). The trailblazers for fisheye views were two publications of Furnas (Furnas 1981; Furnas 1986) on "Degree of Interest" (DOI) functions and Sarkar (Sarkar 1992) with their extensions for graphical fisheye views. Card et al. list the following techniques for selective reduction of information for the contextual area: Filtering, selective aggregation, micro-macro readings, highlighting and last but not least distortion (Card et al. 1999). They interpret focus-plus-context as a data transformation, whereas for zooming, where a sort of filtering can also occur, they categorized the complete technique as working on the view transformation.

Examples for systems using focus-plus-context for the visualization of search results or browsing are the document lens, the table lens or the Pad++ system. The document lens (Robertson and Mackinlay 1993) is a component of the Information Visualizer system. It is a 3D tool for large rectangular presentations of documents or web page collections, like the web-book. The pages of the document of a collection are exploded out, so that all pages are available simultaneously and can be viewed using a rectangular lens magnifying the page in focus, and therefore distorting all the other pages. Another component, also using a lens metaphor, is the table lens (Rao et al. 1994). The table lens can be used for viewing of result lists or other lists in tabular form, and includes functions for magnifying lines or groups of lines whilst keeping the rest of the table viewable in compressed form. An entirely different method for a focus-plus-context, which uses semantic information technique, is presented in (Kosara 2001). Blurring is used for highlighting relevant information, without compromising the ability to show an overview of the situation.

Semantic Zooming

In contrast to ordinary zooming techniques, semantic zoom does not only change the parameters of a graphical representation, but modifies the selection and structure of the data that is displayed. Graphical zooming usually affects the displayed size of an object and – if applicable – also affects the graphical level of detail of a given object representation (i.e. the number and complexity of graphical primitives shown), based upon some distance measure. Semantic zooming, on the other hand, changes or enhances the actual type of information conferred in the graphical object(s). Usually additional graphical objects, just as annotations, flags or similar metaphors appear in the display while zooming. For every type of entity and every level of detail the structural information has to be defined. Semantic zooming is a technique for details-on-demand to avoid display cluttering in the panoramic view, while retaining all information for a more local field of interest.

Boulos presents a survey about the use of graphical map for browsing metadata resources (Boulos 2003). Map-based visualization techniques provide a natural frame of reference, by which an intuitive search strategy can be imposed to the user: The mapping defines the spatial topology – especially the "similarity in the abstract space" between points, mapped into their mutual distance. Modjeska gives an extensive survey about the navigation in virtual information worlds (Modjeska 1997). Semantic zooming can be developed for hypermedia and spatial worlds with a variety of information structures. It uses semantic information to change the physical representation of objects according to viewing scale. In their early work, Ahlberg et al. present a coupling of the semantic zooming technique and dynamic query technique in a starfield display. (Ahlberg et al. 1994)

The Magic Lens is a special form of a semantic zoom which connects the interaction method with a lens metaphor. Magic lenses allow to select an area of the view port (of either fixed or arbitrary size), and to manipulate this area with specific operators. They can be overlapped on items, and change their applied to the underlying data (Hearst 1999).

Animation

While the other techniques described so far affect data transformations, visual mappings, and/or view transformations, animation does not influence these conversions, but is affected by them. For a discussion about animation in the larger context of motion and the general usage of motion see the work of Bartram (Bartram 1997). Animation is used more and more in information visualization systems to help users keeping their orientation when transformations or changes of mappings occur. In the transition between images of the same data objects, animation is used to keep the path of an individual object coherent to human perception. The cognitive load on the user is reduced by providing object constancy and exploiting the human perceptual system (Robertson et al. 1993). Animation is used in a number of information-seeking systems like the Information Visualizer*, the Navigational View Builder*, Pad++*, or SPIRE. In the Information Visualizer*, animation is used in several ways, like for example animation rotations of Cone Trees to track substructure relationships without thinking about it (Robertson et al. 1991). In addition to animate changes (Bryan and Gershman 2000) used movement in their "aquarium" interface for a large online store to reinforce the absence of structure in the displayed items.

Especially in the context of semantic information, is has to be noted that animation is also used in the Prefuse toolkit (Heer et al. 2005) for the animation of graphs and networks. Depending on the field of interest, a different part of the structure must be centered in the viewport. This usually requires the movement of the different nodes in the network for the new arrangement. In most cases, this motion is animated to keep the mental image of the network structure consistent (Abello 2006). Animation can also be used to display actual – usually time-dependent – data (Tekusova and Kohlhammer 2007), which can also be used to add a new data-dimension to the display. This can be exploited to spot significant transition patterns over time.

Overview Plus Detail

For Overview-Plus-Detail, two or more levels of linked visualizations with different zoom factors are used. In contrast to semantic zooming, where different zooming levels are used in the same display, two or more separated displays are used. The technique helps users, while looking at a portion of the data at a detailed level, keeping an overview of the whole structure. Card et al. differentiate between time multiplexed overview plus detail displays, and space multiplexed ones (Card et al. 1999). Time multiplexing means, that overview and details are shown one at a time. Spatial multiplexing means, that overview and details are shown both at the same time at different locations on the screen. Time multiplexed overview plus detail views are conceptually not far away from simple zooming. Overview plus detail is sometimes also called map view concept (Beard and Walker 1990). Card et al. report that typical zoom factors (that is the relation between the size of the shown area in the two displays) range from 5 to 15, and that there is a limit for effective zoom factors of about 3 to 30.

Examples for systems using overview plus detail for the visualization of search results or browsing are the Harmony VRWeb 3D scene viewer, or the pre-VIR prototype by (Bekavac 1999). The Harmony VRWeb 3D scene viewer (Andrews 1995) uses a 2D-map for navigation in an information landscape. pre-VIR uses Overview plus detail in a horizontal tree view of the graph of the search results to ease navigation through the graph.

Dynamic Queries

The dynamic query technique has been presented in some foundational work on information visualization (Shneiderman 1994; Ahlberg 1994). Accessing information in databases is a major activity of knowledge workers. Unfortunately, traditional database query languages trade off ease of use for power and flexibility. The dynamic query technique is a convenient visualization of local database queries, with a simple, intuitive, interactive query refinement method. The basic idea of this technique is to generate moderate to complex queries on a database by purely visual means and to ensure that there is an instant feedback in the display showing the search results. One or more selectors control the value range of one or more attributes. Viewing a graphical database representation, users manipulate the selectors to explore data subsets rapidly and easily. In a navigational environment, dynamic queries may offer a useful way to reveal attributive information, which can facilitate way finding.

Direct Manipulation

Direct Manipulation basically manifests in two slightly different ways, depending on the relation of the manipulated object to the data displayed in the display. The graphical user interface provides elements and metaphors (buttons, sliders, etc.) which can be manipulated. In many techniques, including the dynamic query techniques presented above, the manipulation of the GUI elements may control the actual visualization, as is the case with most dynamic query techniques. This is some sort of direct manipulation regarding the GUI elements, but it is indirect with regards to the actual visualization. The means of manipulation do not necessarily correspond to the effect they cause. SHNEIDERMAN presents techniques by which this mental gap can be bridged to design intuitive interfaces (Shneiderman 2004).

SEMANTICS VISUALIZATION

Knowledge as Semantics Data

Since the announcement of the idea of Semantic Web (Berners-Lee 2010) the interest for semantic technologies and semantic data management increased. Berners-Lee et al. describe this idea as a new form of web content that provides meaning for computers systems and unleashes a reformation of new possibilities in the "web of data" (Berners-Lee et al. 2001). In this description two scientific developments joined and formed the understanding of semantic data: the developments of the World Wide Web and the semantics formalisms. These formalisms where predominantly subject in the field of artificial intelligence. (Berners-Lee et al. 2001)

In artificial intelligence formalisms for formal semantics where elaborated as knowledge base. Typically this knowledge base was designed for a specific application scenario. Hence the possibilities of reuse were limited. To overcome this limitation web-based semantic markup languages emerged in the Semantic Web. In the first step this markup language had been an extension inside HTML code to assign metadata, as semantic, to data fragments, like e.g. a telephone number. These machines enable to the interpretation the data fragments, e.g. as a base for calculating the relevance of a data fragment for solving an information need of the user. But here the interpretation logic is nested within the machines. Therefore, shortly afterwards the first semantic extension of websites, the trend moved to formalize also the interpretation logic within the data representation. Thus the web-based semantic markup languages provide the representation of semantics metadata, formal implications, restrictions etc.

The semiotic triangle describes an interpretation of semantic markup languages. In the semiotic triangle a sign invokes a concept. The concept in turn identifies an abstract or concrete thing in the world (Guarino et al. 2009). The formalized semantics is designed to be used for representing a data fragment's potential usage. The metadata captures part of the meaning of data (Antoniou et al. 2008). This formalization enables data reusability, machine-readability, inference mechanisms and semantic interoperability (Gómez-Pérez 2010).

Formalisms for Representing Semantics

Semantics formalisms describe the metadata as machine-readable formal semantics (knowledge representation paradigm). Semantic networks, frame-based logics, and description logics can be mentioned as most common existing formalisms. (Hitzler et al. 2008)

Semantic Networks describe data entities as nodes, which are connected among each other if a semantic relation exists (Fensel et al. 2003). Each of these connections is labeled to express the pragmatic idea behind this link. But in semantic networks the labeled link has to be interpreted if the underlying semantic is important. A well-known example for semantic networks is the *Resource Description Framework* (RDF). (Hitzler et al. 2008)

In addition frame-based logics may be used, which represent each named object as a frame. Frames have data slots in which a property or attribute of the object is represented. Slots can have one or more values and furthermore these values may be pointers to other frames (Fensel et al. 2003). The extension of RDF, the RDF Schema (RDFS), is a frame-based layer extending the expressiveness of RDF.

Another semantic formalism is the so called *Description Logics*. These allow constructing more expressive semantics, in terms of quantitative (numeric) and qualitative (structural) limitations, formal implications and restrictions. Substantially description logics constitute fragments of first-order logic, restricted to a certain complexity class to allow the construction of a high expressive language (Hitzler et al. 2008). Using description logics the semantics is represented as a terminological box (TBox) and an assertional box (ABox). In the TBox abstract information for concepts are specified. Information assigned to a concepts hold for all individuals (ABox) of this concept, thus this knowledge describes general properties of concepts. In the ABox the described real world objects are represented as individuals (Gómez-Pérez et al. 2010). Description logics based semantics formalisms are e.g. the Web Ontology Language (OWL) and OWL2.

Semantics data representations consist of concepts, concept taxonomies, relationships or roles between concepts, and properties describing the concepts. Thus on the concept level mainly concept taxonomies are described. Therefore semantics data representations consisting of these components are called lightweight formal semantics.

On the other hand heavyweight formal semantics allow representing more formal implications. This enables to model restrictions on domain semantics by adding formal axioms, functions, rules, procedures and constraints to lightweight formal semantics (Gómez-Pérez et al. 2010).

There are important relations and implications between the knowledge components (concepts, roles, etc.) used to build the formal semantics, the formal semantics formalism, used to represent the components, and the language, used to implement the semantics data (Gómez-Pérez et al. 2010).

Semantics Visualizations

Semantics Visualization plays a key-role in enlightening various relationships between data entities. Furthermore the relationships enable to gather information and adopt knowledge. Semantically annotated data can be visualized with semantics visualization, commonly known as "Ontology visualizations”. The following section gives an overview about existing visualization techniques for representing semantically enriched data.

TGVizTab (TouchGraph Visualizaiton Tab) is the *TouchGraph* (Alani 2003) visualization Technique in the Protégé (Noy e al. 2000) ontology management tool. It provides different level of details by choosing variable radius of visibility. The user can navigate through graph by visualizing the parts of the graph gradually. The users can also rotate the graph to see the graph from different perspectives. Furthermore, She can also switch the graph to hyperbolic tree. It offers the also personalization features, which allows the user to choose focal point, color for the nodes, fonts and visibility of nodes. The ontology is also presented as tree structure on the left (Class Browser). It is a desktop solution, which the favorite ontology management tool for the experts. It is does not allow the aspects like brows and editing in “one-single-view”, role based editing and collaboration. The GUI and UE design is suitable for the experts and does not meet the needs of the average user.

OntoTrack (Liebig and Noppens 2004) is a browsing and editing “in-one-view” ontology authoring tool for OWL lite ontologies. It offers a user friendly Graphical User Interface (GUI), which allows the users navigation and manipulation of large ontologies. It offers also intuitive User Experience Design concepts e.g. miniature branches or selective detail views to handle and manipulate ontologies in one-view. The system is based on *SpaceTree* (Plaisant et al. 2002). It is desktop application and it is not available as a web-based solution. It supports the scalability issues but does not provide features like personalization, role based view and collaboration.

TM-Viewer (Topicmap Viewer) (Godehardt and Bhatti 2008) is topic map based ontology visualization tool. TM-Viewer offers fields or sectors, which can be extracted from the ontology. The concepts in each field are represented with specific icons, lines between the knowledge concepts represent the associations and the levels represent the abstraction level of the concepts (inner level show generic concepts). Furthermore, the graphical metaphor with special icons for each sector supports the user to recognize the concept and navigate through the map easily. *TM-Viewer* allows to user to personalize the GUI with the help of configuration file completely. The user can choose not only the color for sectors or association, but also change the icons. It is web-based solution, but it does not allow role based and collaborative ontology visualization.

The visualization of huge number of knowledge items e.g. more than 100 topics can overstress the user. That is why, TM-Viewer uses cluster concept to keep the visualization manageable for the users. According to the cluster concept all the topics, which have same sibling will be clustered as it is shown in fig. The History component helps the user to keep the track of their navigation through the Topicmap. (Godehardt and Bhatti 2008)

COE (Hayes et al. 2003) is an RDF/OWL ontology viewing, composing and editing tool built on top of the IHMC *CmapTools* concept mapping software suite. Concept maps provide a human-centered interface to display the structure, content, and scope of *an ontology*. Concept mapping software solutions are used in educational settings, training, and knowledge capturing.

COE uses concept maps to display, edit and compose OWL, in an integrated GUI combining Cmap display with concept search and cluster analysis. COE imports OWL/RDFS/RDF ontologies from XML files (or URIs using http) and displays them as a new concept map. Layout is automatic. Stored ontology Cmaps can be modified and archived using Cmap Tools.

CropCircles (Parsia et al. 2005 and Wang and Parsia 2006)is an ontology visualization which represents the class hierarchy tree as a set of concentric circles. *CropCirces* aims to provide users intuitions on the complexity of a given class hierarchy at glance. Nodes are given the appropriate space in order to guarantee enclosure of all the sub trees. If there is only one child, it is placed as a concentric circle to its parents, otherwise the child - circles are placed inside the parent node from the largest to the smallest.

In order to navigate the ontology structure, the user may click on a circle to highlight it and see a list of its immediate children on a selection pane. The selection pane can let the user drill down the class hierarchy level-by-level and it also support user browsing history. The user may also select which top level nodes to show in the visualization.

Jambalaya (Storey et al. 2001) is a visualization plug-in for the Protégé ontology tool (Noy et al-2000) that uses the *SHriMP* (Simple Hierarchical Multi-Perspective) 2D visualization technique to visualize regular Protégé and OWL knowledge-bases. *SHriMP* is a domain-independent visualization technique designed to enhance how people browse and explore complex information spaces.

SHriMP uses a nested graph view and the concept of nested interchangeable views. It provides a set of tools including several node presentation styles, configuration of display properties and different overview styles.

OntoRama (Eklund 2002 and Eklund et al. 2002) is a RDF browser used for browsing the structure of an ontology with a hyperbolic – type visualization.

The hyperbolic visualization is motivated mainly by two arguments. Firstly an order of magnitude more nodes of a tree can be rendered in the same display space and secondly the focus of attention is maintained on the central vertex and its neighborhood. This means that the hyperbolic view is particularly useful for hierarchical diagrams with large numbers of leaves and branches and where neighborhood relationships are meaningful.

Unfortunately, *Ontorama* currently does not support "forest structures", which are sub-hierarchies neither directly nor indirectly connected to the root. It uses cloning of nodes that are related to more than one node, in order to avoid cases where the links become cluttered. It can support different relation types. Apart from the hyperbolic view, it also offers a windows explorer – like tree view.

OntoSpere3D (Bosca et al. 2005) is a *Protégé plug-in* for ontologies navigation and inspection using a 3-dimensional hyper-space where information is presented on a 3D view-port enriched by several visual cues (as the color or the size of visualized entities).

OntoSphere proposes a node – link tree type visualization that uses three different ontology views in order to provide overview and details according to the user needs. The OntoSphere3D user interface is quite simple; mouse centered, and supports scene manipulation through rotation, panning and zoom. It is strongly bound to the "one hand" interaction paradigm, allowing to browse the ontology as well as to update it, or to add new concepts and relations. Ontology elements are represented as follows: concepts are shown as spheres, instances are depicted as cubes, literals are rendered as cylinders and the relationships between entities are symbolized by arrowed lines where the arrow itself is constituted by a cone.

User interface features direct manipulation operations such as zooming, rotating, and translating objects in order to provide an efficient and intuitive interaction with the ontology model being designed. Since the tool aims at tackling space allocation issues the visualization strategy exploits dynamic collapsing mechanisms and different views, at different granularities, for granting a constant navigability of the rendered model.

Concepts and instances within scenes are click-able with the following outcomes: (1) Left clicks perform a focusing operation, shifting the currently visualized scene to a more detailed view, i.e. clicking on a concept in the tree view leads to a detailed view of such a concept. (2) Central clicks are used to expand collapsed elements. The actual behavior of the central click is slightly different from scene to scene: in the Main Scene it simply expands a concept replacing it with his children; in the Tree View expands a collapsed sub tree and collapses the others; in the Concept Focus Scene when clicking the central concept it shows/hides its children. (3) Right clicks, instead, open a contextual menu offering a set of alternatives dependent on the current scenes and the element properties.

When between 2 concepts in a scene occurs more than a single relation and a single line represents them all, no relation label is explicitly reported and arrow-head cones can be clickable as well. In that case the cone is depicted in white and left clicking onto it lists such relations.

A certain degree of scene personalization in terms of sizes of graphical components, distances between them and colors is supported through a proper option panel that is evocable by a button localized in the sx panel of the plugin.

Furthermore logical views can be defined on this hyper-space in order to easily manage interface complexity when the represented data gets huge, and thousands of concepts and/or relations must be effectively visualized.

The *3D Hyperbolic Tree* visualization was created for web site visualization but has been used as a file browser as well (Munzner 1997 and Munzner 1998).

It presents a tree in the 3D hyperbolic space in order to achieve greater information density. The nodes of the tree are placed at a hemisphere of a sphere. The graph structure in 3D hyperbolic space shows a large neighborhood around a node of interest. This also allows for quick, fluid changes of the focus point. Additionally, it offers animated transitions when changing the node on-focus.

IsaViz (Pietriga 2001) is a visual environment for browsing and authoring RDF ontologies represented as directed graphs.

It presents a 2D user interface allowing smooth zooming and navigation in the graph. Graphs are visualized using ellipses, boxes and arcs between them. The nodes are class and instance nodes and property values (ellipses and rectangles respectively), with properties represented as the edges linking these nodes.

IsaViz enables user import ontologies of RDF/XML, Notation 3 and N-Triple formats and export of RDF/XML, Notation 3 and N-Triple export, but also SVG and PNG formats.

OntoViz (Sintek 2003) is a Protégé (Noy 2000) visualization plug-in using the GraphViz library to create a very simple 2D graph visualization method.

The ontology structure is presented as a 2D graph with the capability for each class to present, apart from the name, its properties and inheritance and role relations. The user can pick a set of classes or instances to visualize part of an ontology. The instances are displayed in different color.

It is possible for the user to choose which ontology features will be displayed (for example slot and slot edges), as well as prune parts of the ontology from the “config” Panel on the left. Right-clicking on the graph allows the user to zoom – in or zoom – out

Grokker is a system to display the knowledge maps. It offers graphical representation for the search results or a file search. It uses a graphical metaphor for documents, clusters and category circles. The size of cluster and category circle shows the number of contained documents i.e. larger category circles contain more documents or results. The right panel offers further details about search results and allows the users to create own working list or tag to del.icio.us. The left panel offers filtering mechanism by date or domain and search within shown map. It is web-based solution and offers a user friendly and easy to GUI and UE design concept. It does not support role based, aspect oriented and collaboration aspects.

Kartoo is a search engine, which displays the search results with topographical interface. It displays the results closer to each other, if they have close relationship. The keywords show the relationship between the search results. The users can also click the keywords to navigate through the map. *Kartoo* uses different icons as graphical metaphor for different type of results e.g. documents, website etc. On the left side, all the topics are listed and serve as additional view of all displayed results. Furthermore, the description and thumbnail of the results are shown by roll over on the left side. It offers a user friendly and easy to GUI and UE design concept and it is a web-base solution. It does not support role based, aspect oriented and collaboration aspects.

Webbrain allows the visualization of the search results and organization of information. The organization in the *Webbrain* is associative instead of hierarchical. The users can organize the information by defining the association between the information items. The information in *Webbrain* is thoughts and they can be all type of documents like website, word or pdf-files. When the user chooses one thought, then it moves to the center and related thoughts to the selected thought branching out around it. The Company "The brain" offers different versions "Personal Brain (Desktop)", "*Webbrain* (Web)" and "Enterprise Knowledge Platform". The enterprise solution allows the collaboration as well. It offers a very easy and intuitive GUI and UE concept. It can also be used as *Mindmap*.

A more recent approach for visualizing complex semantics and ontologies is the *SemaVis* visualization technology. (Nazemi et al. 2011) *SemaVis* provide a more comprehensive view on heterogeneous semantics structures and uses several visualization techniques as described in previous chapters for graphically presenting semantic data. The main goal of *SemaVis* is to provide a core-technology for heterogeneous semantic data, different users and user groups and support heterogeneous tasks. Therefore a three layered model was developed, based on the model of Card et al. (Card et al. 1999), to provide a fine granular adaptation at different levels of abstractions. *SemaVis* subdivides the visualization layer into the layers *Semantics*, *Layout* and *Presentation*. With its modular characteristics several visualization techniques can be chosen while working with the visualization to present different views on the same data.

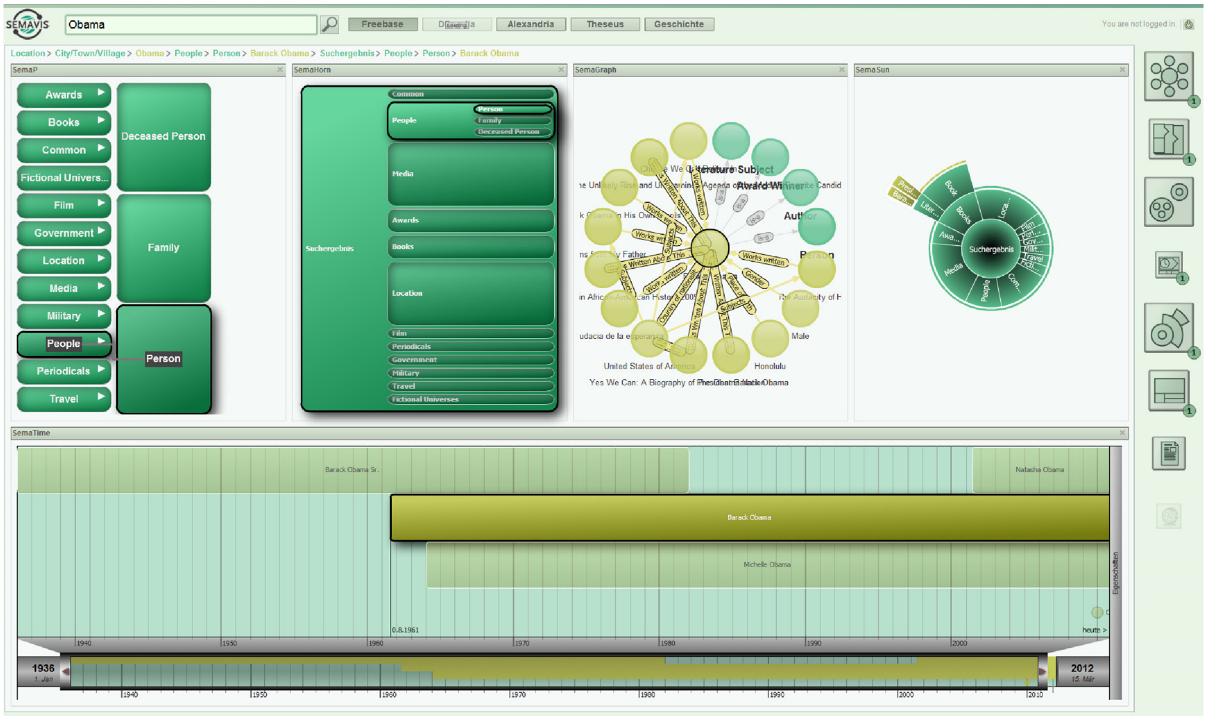
With an integrated *Visualization Cockpit* (Nazemi et al. 2010) the vies can be combined to solve different visualization tasks, e.g. exploring knowledge, comparing data structures etc. (Nazemi et al. 2011)

VISUALIZATION OF SOCIAL DATA AS SEMANTIC INFORMATION

The involvement of citizens, their opinions, discussions etc. in the policy modeling domain plays an increasing role. The web provides mass amounts of social data, which can be used to identify problems and involve the citizens' opinions in the policy creation process. The masses of information are very difficult to handle. Everyday new opinions, discussions etc. and there with new data are available. In FUPOL various technologies faces this challenge from different point of views. The crawling of data, the extraction of topics-of-relevance (hot-topics) and their causal relationships are investigated in FUPOL. From the users' point of view, the visualization of that data would provide an efficient way to acquire knowledge, e.g. for identifying problems and impacts of policies.

FUPOL provides therefore a visualization model that applies a top-down explorative metaphor for gathering knowledge in problem identification, impact analysis on social (subjective) level etc. The top-down approach integrates various overview visualizations, which first give an overview of topics in categorical, temporal and geographical aspects and provide further a faceting to reduce the information amount on relevant aspects. On the visualization level "details-on-demand" and graph-based visualizations provide a comprehensible view on the information relationships. With various visualization techniques the level of detail may prove fine granular or textual information. A

Figure 5. Visualization Cockpit of SemaVis (Nazemi et al. 2011)



model of data analysis for (data-based) adaptation provides an adaptable and adaptive multi-visualization view on the data. This approach enables the detection of policy related issues easier (more time efficient).

The benefit is to apply quantitative data analysis and visual mapping mechanisms in the domain of policy modeling to bridge the gap between masses of information entities (instances) and users' task. Therefore the quantity and attributes of the underlying data are analyzed and visualized in combined multi-visualization user interfaces. The analysis provides further a data adaptive visual representations, which may be integrated with further adaptation rules. The here proposed top-down (overview to detail) visualization cockpit provides another scientific value that is not investigated so far in context of social data for policy modeling.

This section describes an exemplary conceptual design for social data visualization based on semantics. In order to get the most suitable solution when analyzing social network data the appropriate visualization needs to fulfill some informational requirements. This means the visualization needs the capability to communicate available information as the result of the analysis process to the user interacting with the system. Depending on the available context information of the interaction (e.g. the actual task of the user, the political question to be solved) the visualization may also support the visual highlight of the relevant information artifacts. In this step of the conceptualization of the social web visualization predominantly the fulfillment of the identified informational requirements will be addressed. Further an overview-to-detail approach with combined semantics and quantitative visualizations will be introduced by investigating the FUPOL social data ontology. We propose in this chapter a solution to gather the semantic information in different levels of visual abstraction and provide therewith a new integrated approach of user experience with social data. In particular, the domain of policy modeling and the requirements on the policy process act as foundation.

Informational Requirements

The first and most obvious requirement is the illustration of the structural information or social groups, which predominantly is given by the relations between the nodes. Structures of the social network can depict interesting direct or indirect relations leading or promising to a specific result. Furthermore the nature of the connection structure provides informative bases where groups of people or topic-related documents occur and illustrate their impact to the neighbored nodes. Thus this structural requirement also represents social groups and social relations. To name some, these structures may be cliques, clustered cliques per clustering index, paths and different graph patterns.

In contrast to the structural information concerning multiple nodes and their intermediate relations, the second informational requirement corresponds to the position of a single node within the network. The social position describes for example the influence of a single user to other community members.

The third informational requirement describes the nodes itself. A user interacting with the social web visualization has always to be aware of the type of node which is connected with other entities. The most common node type may be a single person or a group of persons, which interacts in a social community. But also the type of posting or way of participating may be the information of interest.

To ensure the user may interpret the information type, glyphs are used to represent the nodes content type. In social web the nodes' content may be e.g. a single person, a group of persons, text, files, configuration files, audio, video or statements/messages. This can be indicated by icons or visual variables e.g. color or shape.

Due to the fact that the informational requirement information referee may vary in general (variable), but for a concrete situation or view of interest is a defined fix subset, the visualization concept needs to be designed appropriately. There are two types of information referee: the node references a concrete thing which can be pointed to (e.g. a person, a group of persons, a street, a building) and a non-physical object (e.g. an opinion, a topic) which can only be described textually but holds for multiple nodes (in terms of persons/actors).

The first type of information referee will be depicted in an information panel metaphor which displays the associated information like name, textual information and location. Users are able to interact and interpret this type of presentation, and the detailed information does not disturb the general interaction and navigation process within the visualization. Thus this visual metaphor corresponds to Shneidermans visual information seeking mantra: (1) overview first, then (2) zoom and (3) filter and present (4) details on demand. To ensure this mantra, details on demand will be displayed the information panel only if a user hovers over the visual element with the mouse; or if the user does an active interaction like a click on it.

Thus the second type of information referee will be visualized as a statistical distribution using a well-known visualization type, the pie chart. This pie chart is positioned directly behind the person, group of person or document discussing about the topics, like depicted in the subsequent picture. Due to their closeness this statistical information is directly associated to the node (law of closure, Gestalt psychology).

The social position represents the influence of a person or a group of persons to others. In addition here the social position will also be interpreted as the influence of a document, a statement, etc. with regard to the readers or the opinion generation process. Therefore this measure can be visually represented so that users are able to interpret the relations in a correct manner.

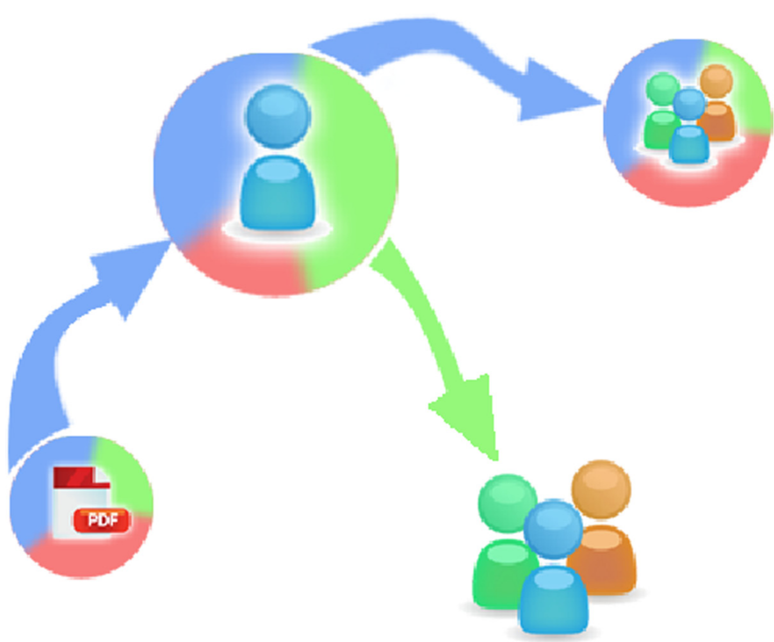
Social positions or social influences can be measured with two different measures. The first is a kind of measurement concerning only one element, which means this node has the power of x which is higher/lower than the power of y of another node. The second type is the resulting effect of the social position to other nodes, for example statements of a person influence others behavior/opinion with an intensity of value z. Due to the fact that the effect of social positions or social influence always relates to two or more nodes, usually in a directed way with a specific intensity this informational requirement will be visually represented using the edges between the entities. In contrast, social position or influence measures concerning only one node will be represented per size of the visual element itself.

Information attributes are important for the meaningful interpretation of the social data. The requirement information attributes summarize time stamps and trends (evolution/progress) and the consequential actuality of the information. In addition, geographic data, e.g. in which country a person lives, is addressed by this requirement. In order to visually meet the powerfulness of these information attributes, different visual layouts will be presented in this section.

The standard view on a social network is a graph view or linked network between the nodes. The nodes differ in their information type, so documents, movies, and persons build up the whole network structure.

To investigate the time stamps and time trends of the social data a timeline-based visualization is used. Here a stacked graph is appropriate for

Figure 6. Example of visualizing influencing relations



trend visualizations (e.g. topic evolutions) or a timeline-based bar chart if the data entries have the attributes of start and end times. In the subsequent picture an example is given for a stacked graph visualization presenting topic evolutions. The same concept can be applied to topics discussed by groups or single persons, like depicted in the subsequent picture.

Visualization of Social Data as Semantic Information

The work of the visualizations in context of social data is to provide a sufficient tool for identifying:

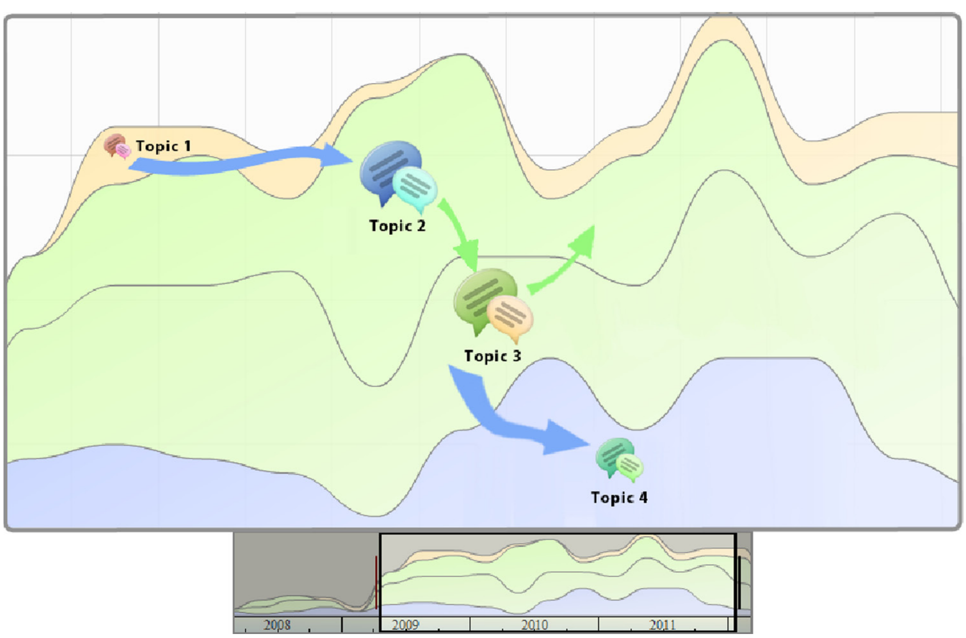
- Opinion-makers, opinion-leaders and influencing persons.
- Topics-of-interest (hot topics) in context of political discussions.
- Geographical influenced areas in context of identified topics.
- Temporal spread of hot topics.
- Relevance of hot topics after a policy implementation (impact).
- Further relevant aspects of social data analysis in context of policy modeling.

Formal Semantic Description of Social Data

The formalization of the crawled social web data is provided in FUPOL as a light-weight ontological representation. The technologies provide feature extractions based on statistical models. The extracted features are then formalized in a semantic relationship model, based on SIOC and FOAF, whereas FUPOL-specific classes are enhancing the ontology (see FUPOL Ontology).

Although the ontology provides a formalized and accessible way of the masses of social data, the problem still remains that only a low hierarchy is provided with masses on instances in each concept, e.g. the class "Topic" may contain a large number of topics. This is in particular a challenge

Figure 7. Topic evolution in a social web visualization



for web-based visualizations and a transparent and comprehensible on the data. To face this problem following approaches will be developed:

- Overview visualization of the ontology as a temporal, geographical or/and categorical spread.
- Details-on-Demand visualization on graph-based structures.
- Combined visualization of the Overview+Detail in a multi-visualization user interface.
- Use of the described visualization primitives in the various levels of visual representation.

Overview Visualization

The main challenge of visualizing the social data is the masses of instances in the described semantic representation. We have elaborated two ideas of partner technologies to face this problem on the data level, but beside a solution reducing the amount of instances per class/concept, the challenge of visualizing a mass amount of data still remains. An adequate way of facing this challenge on the visualization-level is the appliance of Shneiderman's Information Seeking Mantra (Shneiderman 1996). Shneiderman proposed a three-level seeking mantra containing the following steps: overview first, zoom and filter then details-on-demand. In the context of visualizing the social information the overview aspect plays a key role. In particular, we identify in context of social data visualization three main views on this information-level:

- Overview on categorical level,
- Overview on temporal level,
- Overview on geographical level.

The levels of overview visualizations are not distinct and can be combined to view on different information aspects.

Overview on Categorical-Level

The thematic arrangement enables a visual overview definition of "categories-of-interest", whereas all are some part of information are visualized interactively. We apply in this context two main visualization types to visualize the computed relevance and the result of a quantitative analysis on the user request. The different informational requirements are then visualized on the presentation level by using the visual variables. The size of a graphical entity will provide quantitative information whereas the relevance is visualized by their color.

We provide as the first categorical visualization an hierarchical treemap that uses the thematic hierarchy of the ontology as one visual indicator, the relevance of the topics as another visual indicator and the size as a third indicator for providing an overview of a topic on categorical level.

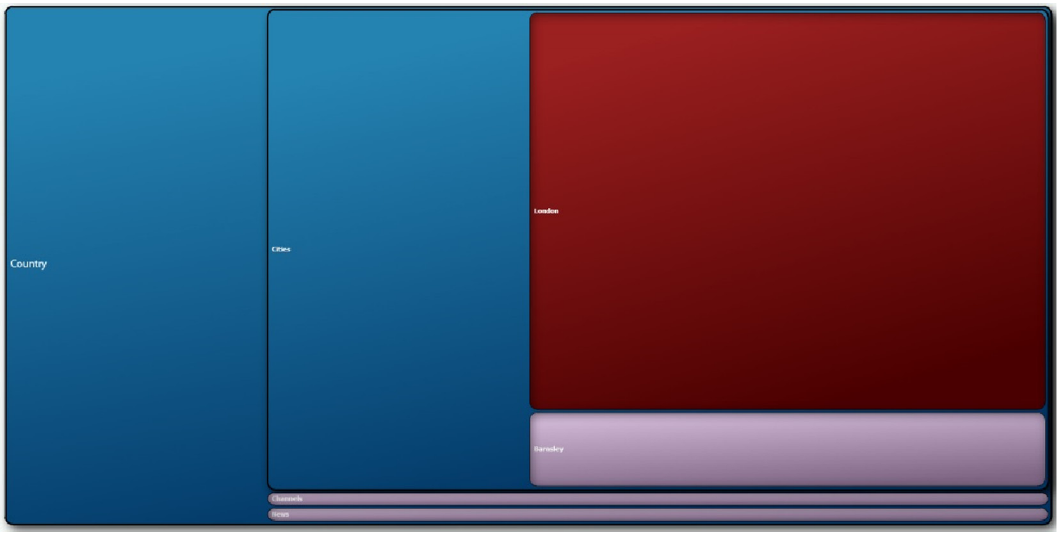
The following figure illustrates a very simple example of the described view. The parameters are abstracted to highest level. The hierarchy is simplified visualized as an overlapping (superimposing) and integrating spatial spaces. The size is illustrating the quantity and the color the relevance, as shown in Figure 8.

In contrast to that very simple visual view, a graph-based layout will be integrated that targets on the same information values. Therefore the size of circle will be used as the indicator for the quantity of information in one category, the hierarchy will be displayed as smaller integrated circles, and the color will be used for the computed relevance. We are dismissing any semantic relationships in this view, to not confuse the user with too many information.

Overview on Temporal Level

Another way of visualizing an overview of the whole spectrum of information is the consideration of the temporal attributes. With visualizing the temporal overview and providing a faceting in

Figure 8. Simplified abstract illustration of the hierarchical treemap (own development)



time another dimension of the data is investigated. We propose that the temporal view is the most beneficial way to:

- View the trend of upcoming social opinions.
- Interacting with and filtering semantic data for topic-of-relevance based on time.

Here we propose the use of a stacked graph with the using the following informational requirements on the information dimensions:

- **Size:** Quantity of topics, terms or extracted features.
- **Color:** Relevance based on the computed relevance.
- **X-Axis:** Temporal spread.

Overview on Geographical Level

The overview aspect can be investigated from the geographical point of view too. This visual representation here investigates the geographical spread. This visualization is beneficial when the data can be assigned to geographical attributes and the temporal space is set to a specific value, e.g. today's topics-of-relevance in Barnsley. The quantitative value cannot be considered in this view. It visualizes the geographical spread of topics on a map. The color indicates the topic related to a hot-area and this area can be named by the identified topics.

Details-on-Demand Visualization on Graph-Based Structures

The next step after the overview is a more detailed view with relational information. Therefore the existing graph-based visualizations will be extended to visualize the dependencies between actors and topics, between actors themselves and between topics themselves. This step can be done after a refinement on the overview visualization or based on a specific search that contains a comprehensible number of entities.

We propose to use a force-directed visual graph algorithm with quantitative analysis for this issue. In this case the size of a circle indicates the number of entities, the color the relevance, the size of entities the number and/or relevance of a topic or actor himself and the relations the semantic relationship design in the FUPOL social data ontology.

The detailed visualizations can further provide more information by requesting more details on demand. For example in the figure, we see one actor with a greater size than the others. With this information we can assume that this actor is an opinion maker, because either he has many postings or the postings are read by many people (regarding to the underlying data and goal). By clicking on this actor the visual representation will first give more information about him and further provide detailed information (as far as available) about the person.

In all the steps we have defined different visualization types that are appropriate to meet the informational requirements from the social data part of view. One of the main contributions in this task is that the visual change of the steps from overview to details and vice versa is recognized and appropriate visualizations are provided in combined user interfaces.

The categorical, temporal, and geographical view can be combined in various ways to provide a sufficient view on the social data. One promising way to provide a fruitful way for visualizing the different informational requirements of social data and statistical data respectively is the juxtaposed orchestration of visualizations (Nazemi et al. 2010) as illustrated exemplary in Figure 10.

Figure 9. Graph-based detail visualization (own development)

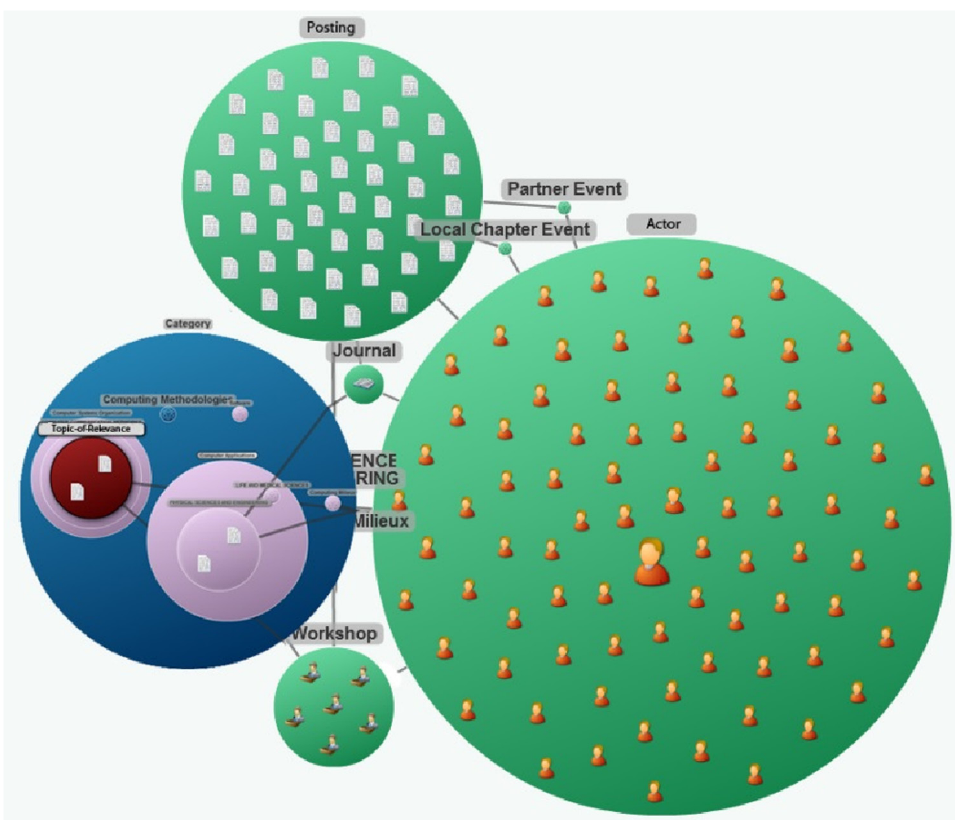


Figure 10. Visualization orchestration

FUTURE RESEARCH DIRECTIONS

Social media, linked-data and data on web provide masses of information that may help to find out the intentions of citizens and ease the decision making process in the entire policy creation process. The access to the information on web is getting more and more difficult, due to the growing amount of data. One promising way to illustrate the data and interact with them are information visualization tools, whereas commonly information visualization is either too simple (pie and bar charts) or too complex (analyst tools from visual analytics). This aspect is a great challenge in particular for the policy and eGovernment community. Thus, although the visualization techniques provide promising ways to interact with knowledge, they are not really accepted in that domain. Future research topics should cover more the human factor and the human-centered design of visualization systems. In particular adaptive and intelligent visualizations, incorporating machine learning algorithms for recognizing and modeling users' behavior, tasks to be solved, and the underlying data will play an essential role for the acceptance of complex visual systems.

CONCLUSION

The policy creation and modeling cycle is characterized by the need of information in particular to have a valid foundation for making decisions. In this context various kinds of information plays a key-role: social-data enable mining opinions and identify opinion leaders, while ground truth statistical data helps to identify policy indicators and therewith enables monitoring, validating or identifying policy needs and changes. The main problem in this context is the mass amount of data, especially on web. One promising way to face the challenge of "big data" is the use of interactive visual representations. Information visualization provides here various techniques for visualization.

But not only the visualizations themselves play an important role, the way how human interacts with the visualizations and the way how data are modeled, transformed and enriched gains more and more intention.

We introduced in this chapter information visualization as a solution for enabling the human information access to the heterogeneous data that are necessary during the policy modeling process. Therefore we first started to identify the steps of policy design, where information visualizations are required based on an established policy life-cycle model. Thereafter a foundational overview of information visualization was given, investigating beside visualization techniques, the entire spectrum of data to visualization. In this context data and interaction methods were introduced too. We concluded the chapter with an conceptual example of visualizing social data in the domain of policy modeling.

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KEY TERMS AND DEFINITIONS

Adaptation: Adaptation in human-computer interfaces is the automatic and system-driven changes on content, structure, and presentation of system-behavior that involve some form of learning, inference, or decision making based on one or many influencing factors to support users.

Adaptive Visualizations: Adaptive visualizations are interactive systems that adapt autonomously the visual variables, visual structure, visualization method, or the composition of them by involving some form of learning, inference, or decision making based on one or many influencing factors like users' behavior or data characteristics to amplify cognition and enable a more efficient information acquisition.

Information Visualization: It is the interactive visual representation of data to amplify cognition and support information and knowledge acquisition.

Semantics Visualization: Semantics visualizations are computer-aided interactive visualizations for effective exploratory search, knowledge domain understanding, and decision making based on semantics.

Semantics: Semantic can be defined as data with meaningful relations of at least two information or data entities, to provide in best case a disambiguated meaning.

SemaVis: SemaVis is an adaptive semantics visualization technology developed by Fraunhofer Institute for Computer Graphics Research.

Visual Analytics: Visual Analytics is the interactive coupling of data analysis and information visualization to provide insights and knowledge.

ENDNOTES

1 http://data.gov.uk/linked-data

2 http://epp.eurostat.ec.europa.eu

Chapter 12
Hot Topic Sensing, Text Analysis, and Summarization

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ABSTRACT

Social monitoring platforms are software services that enable the rapid analysis of massive amounts of information (mostly text messages) expressed in social networks. Their usage today mostly focuses on marketing industries that need to reach their customers in a proper way. In the e-government domain, however, such tools have mostly been used by political parties as a support to election campaigns, but few have been actually used to provide a comprehensive understanding of the citizens' needs in everyday life. In this chapter, the authors present a set of data analytics tools that can help public authorities to extract and summarize textual content from Internet forums and social media feeds. There are many potential applications of these tools, such as the visualization of the main political discussion in the city, early detection of disagreement with the local politics, and city services connected to social media.

BACKGROUND

Computational parsing and understanding of natural language by machines is the goal of Natural Language Processing (NLP). To achieve this goal, a preliminary step is determining the computational representation of the data. Unfortunately, natural language exists in a very high dimensional space and is highly structured. Working in this space is therefore computationally expensive and dimensionality reduction – while preserving relevant information – is consequently an important issue in NLP. One of the o is by ignoring word order. This simplification, known as the bag-of-words (BOW) model (Salton & McGill, 1983), represents documents as attribute-value tables where each word in a fixed vocabulary is an attribute and its related value is the number of times that word ap-

DOI: 10.4018/978-1-4666-6236-0.ch012

pears in the given document. This representation is also known as the Vector Space Model (VSM) and is by far the most popular method to represent the content of a document in NLP.

The motivation underlying the VSM representation is that a vector of word counts corresponds to a lower-dimensional version of a document that clearly evocates – at least in an indirect manner – the theme of a document. Further, this allows us to quantitatively determine the similarity between two documents by, for example, determining the angle between their vector representations using cosine similarity. However, while intuition suggests that word dimensions with high value will help describe the theme of a document and help differentiate it from others, document vectors are often overwhelmed with low-content "stop"-words such as "the", "of", "and", "to", "a", etc. that appear with high frequency but do not add any information to the thematic make-up of a document. This makes the representation less informative and pushes differentiating words to the background rendering comparison methods such as cosine similarity much less effective.

One solution to this problem is to re-weight the frequency terms to put more emphasis on differentiating – and therefore content-heavy – words. The most popular of these approaches is referred to as *tf-idf* weighting. Here, instead of containing the frequency of each word in a document vector, each word is represented by a value that is proportional to both its frequency in the document and its *inverse*-document frequency. This has the effect of minimizing the value of words that appear in many documents and are therefore not very differentiating. In addition to tf-idf weighting, a number of other term re-weighting schemes have been proposed in the literature.

While VSM succeeds in many respects at dimensionality reduction, further reduction is possible and often of great value. We naturally imagine documents to be about one or many discrete topics and representing a document in "topic"-space can be the most efficient depending on our ultimate goal. For example, document classification often seeks to classify documents into groups of texts that address similar topics. If this is the task, then a representation of a corpus of documents directly in this space would indeed be appropriate. A highly influential work is known as Latent Semantic Indexing (LSI) and consists of computing the Singular Value Decomposition (SVD) of a term document matrix to help uncover words that commonly co-occur. Following the decomposition, word co-occurrence patterns are projected along a singular vector (Deerwester, Dumais, Landauer, Furnas, & Harshman, 1990). Documents are then represented in a low-dimensional semantic space where the components can be seen as "concepts". LSI is in many ways the "ideological" precursor to modern probabilistic topic models.

While not a direct descendent of LSI, probabilistic topic models build from the LSI idea that documents can be represented in a low-dimensional semantic space corresponding to concepts or topics. Probabilistic Latent Semantic Analysis (pLSA) is a generative probabilistic model that describes the document creation process as an admixture model where documents are represented as mixtures of topics and topics are represented as mixtures of words (Hofmann, 1999). In pLSA, each topic is a multinomial distribution over a fixed vocabulary and a document is generated by drawing a topic for each word and then drawing a word from a distribution specific to that topic. The distributions over topics are learned from a training set and therefore pLSA can have major problems with over-fitting (D. Blei, Ng, & Jordan, 2003). Further, it is not a properly defined generative model because the parameters are tied to an arbitrary training set. pLSA can be thought of as a constrained matrix factorization problem equivalent to NMF (Lee & Seung, 1999).

A topic model defined as a generative probabilistic model is Latent Dirichlet Allocation (LDA) (D. Blei et al., 2003). LDA is an admixture model that extends pLSA to a fully probabilistic generative model by placing a Dirichlet prior on the document-specific topic mixtures. Each document is described by a probability vector Θ_d over *K* topics which describe the extent to which the document touches upon each topic. Each topic generates words from a discrete probability distribution $\varphi^{(k)} = p(w \mid k)$. The generative process of documents in a corpus *D* under LDA as follows:

1. For each topic *k=1,...,K*,
   a. Draw topic-word distribution *p(w|z=k)~Dirichlet(b).*
2. For each document *d=1,...,D,*
   a. Draw document-topic portion *p(z|d)~Dirichlet(a).*
   b. For each word in *d*:
      i. Draw topic $z_i \sim p(z|d)$.
      ii. Draw word $w_i \sim p(w| z_i)$.

The central computational problem in LDA is posterior inference. Here, we are interested in *reversing* the generative process such that we can determine, conditioned on observed data, the distributions that describe a corpus. Unfortunately, however, posterior inference in the LDA model is intractable. Nevertheless, there are a number of approximate inference techniques that are able to estimate the posteriors of interest to a close approximation. These include variational inference, and Gibbs sampling, and expectation propagation. A comparison of several approximate inference methods is presented in (Asuncion, Welling, Smyth, & Teh, 2009).

Following posterior inference, the revealed latent topics can be inspected to reveal patterns in the datasets. It is current practice to look at the most likely words in each topic and to represent documents by their topic signature, Θ_d. In addition to understanding a corpus through its common topics and the frequent words in those topics, there is also a great deal of work in visualizing the latent information that LDA can uncover.

From Figure 1, we can see that LDA can uncover interpretable topics that help to understand the thematic make-up of a document in a reduced dimensional space. Due to its usefulness and modular nature, a number of extensions to the original LDA model have been proposed in the literature. We will mention only a subset of them here.

One of the major problems with the representation is that "stop-words" (such as "the", "have", "like") with little semantic information often overwhelm the document vectors and therefore make it difficult to perform meaningful comparisons. This is also a problem in LDA and results in word distributions that are overcome with stop-words and therefore do not contain meaningful differentiating semantic information. The standard *ad hoc* approach of dealing with this problem is to pre-process the data by filtering out syntactic-only words with a compiled list of common stop-words. This technique works well in practice but lacks a formal grounding and has problems both with undercoverage (some stop-words that should have been filtered out are not on the list) and overcoverage (some words that should have been included were filtered out). These problems are especially prevalent in non-generic domains, but even in "standard" writing they show up due to the fact that different words have different functions given context. A principled approach to dealing with the stop-word problem is proposed in (Griffiths, Steyvers, Blei, & Tenenbaum, 2005) where a Hidden Markov Model (HMM) is combined with LDA to learn topic models that consider only words deemed by the HMM to be "semantic". This has the effect of filtering out syntactic-only words and results in more interpretable topics with less noise. Another approach proposes a topic model where words can be generated from one of either a background word distribution, a document-specific word distribution, or a semantic topic model (Chemudugunta, Smyth, & Steyvers,

Figure 1. Most relevant words for few topics found in media in the region of Barnsley (UK)

Topic Coherence	1	2	3	4	5
Top Word 1	Road	Pain	costs	immigration	health
	traffic	Chronic	discharge	book	company
	junction	Patients	conditional	jonathan	healthcare
	updated	appropriate	fine	british	private
	agoshow	techniques	disqualification	response	received
	minutes	Efficacy	community	review	labour
	yorkshire	management	road	people	registered
	ways	Side	suspended	david	director
	moving	Effects	order	davids	care
Top Word 10	street	Patient	prison	evidence	shares
	busy	Tramadol	unpaid	debate	conservative
	roundabout	Drugs	compensation	fact	parliamentary
	Lane	Analgesic	sentence	labour	cumberlege
	southbound	significant	supervision	portes	payment
	west	Effect	jail	merton	secretary
	leeds	Effective	curfew	white	cinven
	directions	Analgesia	avenue	ethnic	executive
	westbound	Distress	drive	britain	pharmaceutical
	heavy	Codeine	hours	economic	paid
Top Word 20	south	Appears	close	half	companies

2007). Here, words that do not add to the content of documents are generally pushed to the background word distribution, while words that are not simply document specific – and therefore contribute to shared semantic topics – are pushed to the LDA-like topics. Other topic models that aim to better model natural language include the Spherical Topic Model (Reisinger, Waters, Silverthorn, & Mooney, 2009) which is based on a mixture of von Mises-Fisher distributions and normalized data. It also includes the NMF model that was extended to orthogonal nonnegative matrix tri-factorizations in (Lee & Seung, 1999). Finally, a sparse additive topic model approach views topics as deviations from a constant background language model that more normatively includes the sparse nature of natural language into a topic model (Eisenstein, Ahmed, & Xing, 2011).

Despite the recorded successes of topic modeling techniques, topic models have suffered from scalability issues in their canonical form (Bai et al., 2009). Nevertheless, recent work has been proposed that aids in skirting this issue and that ultimately speeds up posterior inference in LDA and its counterparts. First, when there is a large amount of data to process, linear (in time) approximate inference algorithms can be too slow. (D. Newman, Asuncion, Smyth, & Welling, 2009) presents a distributed (parallel) version of the Gibbs sampling algorithm for LDA, resulting in a nearly linear speed-up in appoximate inference with the number of processors. Separately, when there is a large amount of data that continues to grow, re-training a model (even if it is done in parallel) is inefficient. To deal with this problem, an online version of variational inference for LDA has been proposed that is based on stochastic learning (Hoffman, Blei, & Bach, 2010).

One final issue with probabilistic topic models is the approaches that are taken to evaluate their performance and, indeed, relevance. When topic models are used simply as a pipeline for a further extraneous technique such as document clustering, we can simply use existing objective evaluation metrics from the extraneous field or task. However, when we are interested in evaluating a topic model in and of itself, it is often less clear which approach should be employed. One of the standard methodologies that has emerged for this task in the literature is to treat topic models as language models and consider their performance in prediction on a held-out dataset. The accepted approach for this – standard in the field of IR – is the perplexity metric (D. Blei et al., 2003; Teh, Jordan, Beal, & Blei, 2006). The perplexity is a monotonically decreasing function of the log-likelihood and can be thought of as the average number of "confusion" in possible words to predict on a test set. While LDA and its nonparametric counterpart the HDP topic model (Teh et al., 2006) have been shown to achieve lower (better) perplexity than mixtures of unigrams and pLSA (Hofmann, 1999), recent studies have shown that the perplexity measure correlates only weakly with human preferences (Boyd-Graber, Chang, Gerrish, Wang, & Blei, 2009).

While LDA has been shown to be both popular and important in numerous tasks, several studies also report that it does not generally outperform LSA in IR or sentiment analysis tasks (Maas et al., 2011; Q. Wang, Xu, Li, & Craswell, 2011). Because of this, there has been a resurging interest in LSI that has concentrated on extending its canonical form to deal with some of the deficiencies with the original model. For example, Supervised Semantic Indexing (SSI) (Bai et al., 2009) proposes to learn low-rank projection matrices on query-document pairs so as to minimize a ranking loss. In addition, SSI projects queries and documents differently from each other – making it potentially ideal for IR and query-focused summarization – and is able to automatically learn the tradeoff between the latent and the original VSM representations of data. Other work in this realm includes (Q. Wang et al., 2011), where the influence of ℓ_1 and ℓ_2 regularization on the projection matrices is studied and it is shown how to distribute the SSI algorithm in a parallel manner using the MapReduce framework. An interesting alternative to LSI is Random Indexing, which finds low-dimensional subspaces of the term-document matrix through random projections (M. Sahlgren, 2005).

Time Varying Topic Models

Topic models have also been extended to take time information into account so as to evolve topic distributions. The paper on 'Dynamic topic models' (D. M. Blei & Lafferty, 2006) was one of such first attempts. The essential idea (depicted in the following graphical model) is that the topic model's parameters evolve at each time stamp. (C. Wang, Blei, & Heckerman, 2008) refine the previous work by allowing a continuous evolution of time rather than the discretization required for the original dynamic topic model.

In the same vein, (Kasiviswanathan, Melville, Banerjee, & Sindhwani, 2011) address the problem of identifying emerging topics through the use of dictionary learning (a.k.a Sparse Coding). The method works in two stages: (1) identification of novel documents; and (2) clustering of novel documents. One advantage of evolving topic models is their natural capacity to monitor trends in the data.

Social Media Analysis

We outline here several studies that analye textual content in social media. These related works highlight potential problems and interesting extensions of statistical models for hot-topic sensing. For instance, several studies have underlined the noise and sparsity of texts, a recurring and significant problem, when it comes to analyzing social media.

- **Data Sparsity:** For instance, Phan, Nguyen, and Horiguchi (2008) explain the following: "Many classification tasks working with short segments of Web text, such as search snippets, forum chat messages, blogs, news feeds, product reviews, and book and movie summaries, fail to achieve high accuracy due to data sparseness."
- **Noise:** Similarly, Magnus, Sahlgren and Karlgren (2009) discuss the noise problem: Any method that relies on non-trivial preprocessing (such as part-of-speech tagging, syntactic chunking, named entity recognition, language identification) or external resources (such as thesauri or ontologies) will be brittle in the face of real world data.
- **Spatio-Temporal Information:** Space and Time play an important role as they can capture the contexts of textual documents. This is why several studies have proposed extensions of topic models to account for spatiotemporal information. Furthermore, an additional constraint is that algorithms should incrementally be updateable and able to cope with a constantly dynamic environment.

Topic Models in Social Media

Phan et al. (2008) state that short texts such as comments do not provide enough word co-occurrence or shared context in order to learn a good similarity measure with topic models. To overcome this problem, they propose to rely on a *universal dataset*. For instance, Wikipedia could be seen as a universal dataset as it covers many words, concepts, and topics. Then, they proceed by learning topic models on the universal dataset and represent the initial short text collections with the topic decompositions. Finally, they use discriminative classifiers to categorize the initial shorts texts. In a nutshell, this paper proposes to inject prior knowledge by learning topic models on an external but related corpus.

Hong & Davison (2010) address the problem of using topic models in Twitter. They highlight that one of the main problems is the message length which renders model estimation difficult. They suggest aggregating multiple short messages on an author basis into a single document. In addition, they show that simple tf-idf weighting outperforms topic models in user classification tasks when there is enough textual content (long documents or aggregaton of messages). Moreover, they show that the author topic model, which accounts for different users, leads to worse performance than LDA. In addition, this study claims that topic modeling can yield beneficial features to describe short texts, which can be used as raw features or complementary features in classification tasks.

Jin, Liu, Zhao, Yu, & Yang (2011) study two corpora of short texts: an advertisements and a tweets dataset. First, they augment the initial dataset with additional text from the Web (this is done by crawling URLs given in tweets for example). Then, they propose to learn *jointly* the topic models for the short text collections and the long text ones. Topics are shared during the learning stage which helps differentiate topics in the original collection and in the external one. Of course, this learning is constrained so that the auxiliary collection is primarily modeled by dedicated topics. This strategy is shown to be better than only learning topic models on an external collection.

The following papers aim at combining the geographical information to the textual contents: First, Pozdnoukhov & Kaiser (2011) employs the online LDA algorithm to find topics for tweets in Ireland. Second, they smooth the topic representation of tweets to include spatial dependencies which is done using a kernel density estimate. Third, they analyze the temporal evolution of numbers of tweets within a topic with a Markov-modulated time varying Poisson process in order to distinguish emergent topics or events. In a nutshell, this paper proposes a method to analyze the space and time structure of topics. Lastly, the authors claim that "the identified prevailing topics are often found to be spatially contiguous."

The tags assigned to images in Flickr can also be analyzed in detail (Sizov, 2010). The paper proposes to also model the geographical locations (here latitudes and longitudes) in an extension to Latent Dirichlet Allocation. The idea is that topics have a geographical location and that the topic that generates a word in a document also generates the geographical coordinates. Doing this, textual topics are constrained to have geographical regularities. Finally, the paper shows that their model outperforms LDA which indicates that using geographical data in topic models can be beneficial.

Sakaki, Okazaki, & Matsuo (2010) aims at having a Real-time Event Detection system thanks to Twitter and applies it to detect earthquakes. It starts with a classifier for filtering relevant tweets for earthquakes in Japan. The classifier is based on features such as the keywords in a tweet, the number of words, and their context. Then, relevant tweets are aggregated over time in order to trigger an earthquake alarm. Finally, they show how to estimate the locations of earthquakes' epicenters by integrating a spatial model (a Kalman filter) for the diffusion of tweets. Overall, their framework can accurately detect earthquakes in real time and illustrates the benefit of using spatiotemporal information with Twitter.

The paper (X. Wang, Zhai, Hu, & Sproat, 2007) proposes to mine coordinated text streams. For example, when a major event occurs, many newspapers from different countries and therefore in different languages are likely to cover this particular event. Thus, a coordinated text stream is a set of text streams that shares common timestamps. The authors propose an extension of PLSA to learn coordinated topic models across multiple sources of documents which also account for the document time.

The paper (Mei, Liu, Su, & Zhai, 2006) proposes an extension of PLSA to account for spatiotemporal dependencies. The idea of the probabilistic model is as follows: the choice of a topic to generate a word in a document is governed by the topical content of the document but also by the time and location of the document. The model allows one to then monitor the evolution of topics within a location and for a fixed topic across locations. Three datasets extracted from the web were used to asses the model. One of them dealt with the hurricane Katrina, one for hurricane Rita and a last one about the iPod Nano. The authors claim that their model is generic and efficient in discovering spatiotemporal topics.

Event Detection

Another line of work that is possibly relevant to FUPOL is the one on Event Detection techniques. These methods do not apply topic models, nor document clustering techniques, but look at the dynamics of word frequencies as time series in order to find "bursty" or buzz words. In other words, it is assumed that a burst in word frequency can reveal a particular event occurring in the real word. A seminal paper in this field is the one by Kleinberg (Kleinberg, 2002), which has been discussed and evaluated in many studies.

Searching Microblogs

The following papers discuss search functionality in micro blogs. As micro blogs are short texts, several modifications to state of the art models enable one to improve search performance.

(Naveed, Gottron, Kunegis, & Alhadi, 2011) study search in the TREC Twitter dataset. It shows that the classical document length normalization used in IR actually penalizes the performance when searching in micro-blogs. Second, they use a probability of re-tweet as a quality measure to re-rank tweets and can be thought as an analog of PageRank in Web search.

Search in micro-blogs often amounts to computing similarities between two very short segments of text. The study "Similarity Measures for Short Segments of Text" in (Metzler, Dumais, & Meek, 2007) shows that standard text similarity measures perform poorly on such tasks because of data sparseness and the lack of context. They evaluate lexical similarities, probabilistic methods and study the influence of stemming and query expansion. Their conclusion indicates that lexical matching is good for finding semantically identical matches and that the probabilistic methods are better at finding interesting topically related matches. Hybrid methods that combine lexical, stemmed, and probabilistic matches outperform all the other methods alone. The authors of (W.-T. Yih & Meek, 2007) refine this study with a Web-relevance similarity measure and show how to combine them in a supervised way.

Available Data and Corpus Creation

(Sarmento, Carvalho, Silva, & de Oliveira, 2009) discuss a methodology for automatically creating a reference corpus for mining political opinions in user-generated content. They first start with hand-crafted rules relying on large sentiment lexicon to identify sentences expressing political opinions. Their results show that most of the rules can identify negative opinions with very high precision whereas the detection of positive opinion is only correct in 77% of the cases.

- **ICWSM Datasets:** The AAAI Conference on Weblogs and Social (ICWSM) has interesting social media datasets. Two datasets are available: ICWSM 2009 Spinn3r Dataset and ICWSM 2011 Spinn3r Dataset. The latter dataset, provided by Spinn3r.com, is a continuation of the 2009 Spinn3r Dataset and consists of over 386 million blog posts, news articles, classified ads, forum posts, and social media content from between January 13th and February 14th. The content includes the syndicated text, its original HTML as found on the web, annotations and metadata (e.g., author information, time of publication and source URL), and boilerplate/chrome extracted content.
- **TREC Micro-Blog Search Task:** The TREC challenge organized micro-blog search tasks using a corpus coming from Twitter. The corpus is comprised of 2 weeks of tweets sampled courtesy of Twitter and is designed to be a reusable, representative sample of the twitter sphere - i.e. both important and spam tweets are included. As the reusability of a test collection is paramount in a TREC track, the

sample can be obtained at any point in time. The size of the corpus is approximately 16 million tweets over a period of 2 weeks (24th January 2011 until 8th February, inclusive), which covers both the time period of the Egyptian revolution and the US Superbowl. Different types of tweets are present, including replies and re-tweets.

- **Hot Topic Sensing:** There are many different approaches to address the problem that we refere as *Hot Topic Sensing (HTS),* i.e. the ability to detect recurrent discussion topics in a stream of texts. Most of them rely on probabilistic topic models. We list here several elements from from the literature:
- **External Knowledge:** Injecting external knowledge while learning topic models for social media datasets is beneficial. This is confirmed by the experiments in (Phan et al., 2008) and (Jin et al., 2011). These related works give us some insight on how to best apply topic models, namely that it might be necessary to inject prior or external knowledge in the statistical models. Such data could come from Wikipedia or online newspapers with focused crawling.
- **Evaluation Metric:** It is not clear yet which spatiotemporal extension of topic models is clearly better than any other. In fact, many papers have proposed different extensions, often with different application scenarios and without comparing to recent methods. Therefore, it is difficult to draw conclusions on these works as they do not have common evaluation metrics. Similarly, it is unclear how event detection techniques such as finding "bursty" words compares to time varying topic models.

This literature search shows the need of evaluation metrics for Hot Topic Sensing. For instance, it could be IR-oriented metrics such as Precision and Recall, which would capture the number of times when there is indeed a "hot topic" happening and when the proposed method would miss it. The Hot Topic Evaluation metric would allow one to measure the progress being made with novel methods.

- **Visualization:** The result of the HTS module has to be presented to a policy maker and its team. Therefore, there is a need for an appropriate visualization of Hot Topics.

There are several interesting research directions to pursue for HTS. One would be to account from the different sources of information coming from the Web instead of considering them as a single stream of documents. For instance, the textual style of tweets is very different from the user comments in a blog or news article. Similarly, the number of tweets may be much larger than the number of comments whereas the quality of comments might be better. One may want to understand the topical difference between Tweets and comments coming from Facebook for instance.

Another research direction is to examine how to best use the metadata, such as spatio-temporal information or user context to find topics. There are still several uncertainties on the availability, relevance of such metadata and impact on performances. However, this is a direction that WP6 will track within the scope of the project.

Relevant techniques for the FCP system include Natural Language Processing and Machine Learning methods. Many of the functions required for the Feedback Community Platform will be similar to the HTS ones. Searching, clustering ideas and comments are examples of such functions. Related Works for HTS are also relevant for the FCP system and we focus here on additional aspects required for the FCP. Perhaps the most important aspects in the FCP deal with sentiment analysis and summarization.

Computational Political Science

Before moving to the summarization section, we want to mention relevant works coming from the field of Computational Political Science. According to Zhu (n.d.), Computational Political Science encompasses both the analysis of computer-generated data from the web, sensors, communications, electronic media or digital databases and the use of computational formalisms and languages to describe and analyze political phenomena. Some approaches focus on text analysis techniques such as classification, clustering and sentiment analysis can be applied to political data. It is worth mentioning that there are several interesting sources of information in political datasets that are not textual content but various metadata such as citations between texts, links between blogs or social networks of politicians.

Roll call dataset is defined in (Clinton, Jackman, & Rivers, 2004) as the recorded votes of deliberative bodies such as legislatures and courts. These data can be used by political scientists to estimate for instance ideal points of legislators. An ideal point is a point in Euclidean space associated with each legislator and that is supposed to capture his or her political orientations. For instance, political parties can be fairly recovered from plots. These ideal points are then the basis of further analysis for political scientists, such as understanding evolution over time of legislators, or roll calls that cut across ideological dimensions. We refer the reader to (Clinton et al., 2004), a seminal paper, on a Bayesian treatment for roll call data. In a nutshell, roll call data – votes -- is modeled as a logistic regression problem. Interested readers can refer to (Bafumi, Gelman, Park, & Kaplan, 2005) and (Kellernamn, 2010) for further discussion and analysis with ideal points.

Another popular concept in computational political science is known as Fighting Words. The expression Fighting words refers to lists of words, or figures placing words on a map. These fighting words convey key insights from statistical analyses of text, such as how word usage differs across political parties or salient words in a text or debate. According to (Monroe, Colaresi, & Quinn, 2008), these word lists and graphics are one of the most intuitive ways to convey key insights from texts, establish a link between semantic concepts to political parties and can be used as features for other analysis.

Topic Modeling

We have found two papers applying topic models to computational political science. (Grimmer, 2010) developed a Bayesian Hierarchical Topic Model in order to analyze expressed agendas in senate press releases. In the US, senators publish their agendas in public press releases. The method was applied to a collection of over 64,000 press releases from senators from 2005-2007, which gave insights on how senators explain their agenda to citizens.

Gerrish & Blei (2011) develop probabilistic models for roll call data on a set of issues and integrate textual information such as bill texts into the models. They show how the votes can be explained by topics and political party. Their idea is to combine Latent Dirichlet Allocation with classical models of roll call data. They link the latent topics of bill texts to some bill sentiment variables as shown in the following graphical model:

The concepts of ideal points and fighting words are relevant to FUPOL. For instance, fighting words could be used to better understand the motivations of supporters and detractors of a policy. A priori, citizen's ideal points may have limited applications in FUPOL. It may be difficult to track citizens and issues over time. Further, citizens' votes may not be available directly as their feedback may be limited to comments. Generally, votes will never be available directly or indirectly because the principles of democracy include a secret ballot. However – though it would be difficult to measure – if a citizen identifies with a certain group or political party we can often assume which vote they would take in an election or referendum. Nevertheless, these works contain very interesting ideas that link textual data to votes. Even if the data collected in FUPOL is likely to be different from political data (votes and (clean) texts), this paper can be a great source of inspiration for analyzing opinions in the case where citizens can vote on policies or ideas.

Text Summarization

Automatic text summarization is the task of generating a summary text *s* that is based on one or more input texts *t* where the length of *s* is less than the length of *t*, and *s* contains the most *salient* information prevalent in *t*. In *generic* summarization, where the task is essentially to produce an abstract representation of the input, the salient information will include the most important information conveyed throughout the original text(s). In a *query-focused* summarization task, the salient content will be the most important information in the input that is related to a user's query *q*. For example, if the input text is a newspaper such as *The New York Times*, a generic summary would likely include information on the top stories (typically found on the front page), whereas a query-focused summary with *q*="*football*" would focus specifically on the most important news related to football. The principal problems in summarization research are (1) to determine the most important and non-redundant pieces of information in an input (Radev, Hovy, & McKeown, 2002); and (2) to present this information in a coherent output.

In addition to differentiating between generic and query-focused summarization, there are a number of other dichotomous features that contrast automatic summarization techniques and goals. Two of the most important relate to how the summary language is generated, and the type or character of the input. The canonical division in summary language generation is that of extractive vs. abstractive summarization. In the former approach, sentences or phrases are typically ranked with a scoring function such that the most important sentences receive the highest scores (Nenkova & McKeown, n.d.). The highest-scoring sentences are then extracted and strung together to form a hopefully-coherent output summary. The latter method resembles the approach that a human would take in summarizing a document where the important information is re-written – or "abstracted" – in the summarizer's own words. While abstractive summarization is in most cases ultimately more desirable,[1] most existing systems rely on extractive summarization due to the myriad number of complexities and difficulties associated with generating coherent natural language (Nenkova & McKeown, n.d.).

The character of the input is the other major differentiating factor in summarization systems. It is typically portrayed as single- vs. multi-document summarization (Radev et al., 2002). With the former, the goal is simply to summarize the contents of a single input document. The latter, of course, calls for the summarization – into a single summary – of multiple input documents. A unique challenge in multi-document summarization is in determining content that is important *across* the input document set rather than simply important in just one document (depending on the task, of course). For this project we will want to consider even more nuanced models than these. If we were to summarize the viewpoints related to a certain government project then this might be considered similar to multi-document summarization as we are interested in summarizing the viewpoints of all citizens (where several documents in a multi-document summarization task roughly correspond to the several forum posts by citizens on an e-governance website). However, unlike the traditional task definition for multi-document summarization where only the most important viewpoints across the input document set would be considered as salient, here we might want to consider all *contrasting* viewpoints, or all that have been considered by a certain number or type of users.

In the following subsubsection, early (or "traditional") text summarization methods will be covered beginning with the pioneering work done at IBM in the 1950's. Most of these methods are based on simple term frequency statistics of the input and this core method remains at the heart of many summarization systems today. Following that, more modern methods that employ sentence clustering, graphs, probabilistic topic models, and complex NLP-based pre-processing will be presented. We will then cover opinion summarization which is a novel sub-area of text summarization research and that is directly relevant to the FUPOL project. Finally, we will briefly remark separately on sentiment analysis as it can play an important role in opinion summarization.

Traditional Methods

The first known work in automatic text summarization is that by Luhn at IBM in the 1950's (Luhn, 1958). Like most existing summarization systems today, Luhn uses a scoring function to rank each sentence's importance ("significance") and then selects sentences for summary inclusion based on this score. Sentence significance is determined by both word frequency and the sentence's position within its containing document. The word frequency-based score is computed by considering a subset of the words in the input to be "important" words. These are the words whose frequencies are above some threshold so that they may be deemed important, but below another cut-off so as to ignore very common words that do not contribute content. These latter words are stop-words such as "the", "of", "to", "and", etc. Each sentence's score is proportional to the number of "important" words that it contains. Despite the method's simplicity, many of its core ideas continue to be used in modern summarization systems today.

The next major contribution to automatic text summarization following Luhn came in the 1960's with additional features that improve the sentence scoring function. While Luhn principally considered the number of "important" words in a sentence, Edmondson's work presented three additional features: "cue", "title", and "location" (Edmundson, 1969). A training step determines cue words that can be considered either to be *bonus* or *stigma* words. The former increases the sentence score while the latter lowers it. Bonus words could include "important" and "greatest" while stigma words could include "hardly" and "impossible".[2] The title feature assigns additional weight to words that appear in the document's title under the theory that these sentences will be important by virtue of addressing the main topic – as determined by the author – of the given document. Finally, the location feature adjusts the sentence score based on its relative location in the input document. Typically, sentences near the beginning or end (introduction and conclusion) of a document should score higher than sentences found in between these areas.

More recently, Luhn's basic idea of extractive summarization by means of term frequency statistics has been refined into a more principled probabilistic approach. While Luhn's method of scoring sentences based on their prevalence of high frequency words is explained by the fact that the most important ideas will have to be elaborated upon extensively and thus words related to these ideas will have high frequencies in the resulting document, Nenkova, et al. empirically show that extracting sentences following the theme of highly frequent words is a good strategy to model human summarization (Nenkova, Vanderwende, & McKeown, 2006). In their study, a number of human generated summaries are examined and it is demonstrated that words that appear more frequently in the input also appear more frequently in the summaries. Following this determination, the summarization system *SumBasic* is presented (Nenkova et al., 2006).

SumBasic scores sentences based on their average word probability under the stop-word filtered unigram distribution of the input. Note that the input could be either a single text or a collection of related texts collected in a document set. The probability of a word w_i is given as $p(w_i) = \frac{n_i}{N}$ where n_i is the number of occurrences of w_i in the input and *N* is the total number of word tokens. A sentence is then assigned a score as follows:

$$Score(S) = \frac{1}{|S|} \sum_{w_i \in S} p(w_i) \quad (3)$$

Sentences are selected in a greedy manner such that the highest scoring sentence that contains the word with the highest probability and that has not yet been selected is chosen for extraction. An approach that globally optimizes the sentence selection task so as to include the most probable words at each step (rather than greedy selection) improves *SumBasic*'s performance (W. Yih, Goodman, Vanderwende, & Suzuki, 2007).

To discourage redundancy in a summary, the input distribution *p*(w) is continually updated as sentences are selected for extraction. At each step, after the highest scoring sentence is selected, the probabilities of the words contained in the selected sentence *S* are lowered to a number close to 0:

$$\{w \in S : p(w) = 10^{-6}\} \quad (4)$$

This has the effect of discounting (or nearly erasing) the contribution of words that have already appeared in the summary by virtue of being in sentences that have already been selected. A later formulation of the *SumBasic* method alters the redundancy avoidance step to temper the selected words' probabilities more gently. Haghighi and Vanderwende update the probabilities of selected words as $p(w) = p(w)^2$ (Haghighi & Vanderwende, 2009). This allows words to continue to contribute to the scoring function even if they have been selected before, but also further discourages words from contribution when they have been selected many times.

While simple, *SumBasic* performs surprisingly well particularly on the canonical summarization problem of generating summaries of news stories (Nenkova et al., 2006). Despite its successes, however, using raw word probabilities introduces problems with stop-words and other very common domain-specific words that should be ignored in determining importance. While stop-word lists are common, they often have problems with over- and under-coverage and to perform best should generally reflect the given domain. An alternative to using a stop-word list, however, is to use tf-idf term weighting, a technique developed in the information retrieval literature (Salton & McGill, 1983).

Tf-idf stands for term frequency-inverse document frequency and weights the term frequency of a word inversely proportional to the number of documents that it appears in. This has the effect of discounting the contribution from words with low information that appear in all documents such as the stop-words. To be able to exploit tf-idf, however, the system needs access to a large "background" corpus for typical term usage in a number of generic documents. Instead of considering the simple unigram probability of words *p*(w) in sentence scoring, the tf-idf value of a word can instead be considered:

$$\text{tf-idf}_w = n_w \log(D/d(w))$$

where n_w is the number of times the word appears in the input, *D* is the number of documents in the background corpus, and *d*(*w*) is the number of documents in the background corpus that contain the word *w*. This re-weighting can be very helpful when there is access to a large collection of background documents in the same domain as the summary target. For that reason it is extensively employed (Fung & Ngai, 2006)

Another simple term-frequency based approach that makes use of a background corpus involves determining "topic signature" words by means of a log-likelihood ratio test (Dunning, 1993).[3] The test determines, in a probabilistically principled manner, which words are indicative of the input (topic signatures) and which are not. Two hypotheses are considered: in the first, the probability of word w under the unigram distribution of the input, $p(w|t)$, is equal to its probability under the unigram distribution of the background corpus, $p(w|b)$; the second hypothesis postulates that the probability of w under the input distribution is greater than under the background distribution and that the word is therefore demonstrative of the input's theme. The likelihoods can be computed with a binomial distribution and the ratios of the hypotheses are then used to determine which words are considered to be topic signatures. Finally, sentences are then typically selected based on the number of topic signature words that they contain (Lin & Hovy, 2000).

Sentence Selection

The methods described previously lay out a number of data-driven unsupervised approaches for determining sentence salience.[4] However, once sentence importance has been determined with a scoring function, the process of selecting sentences for summary inclusion is not entirely trivial. First, there are two types of sentence scoring: static and dynamic. With the former, sentence scores do not change as sentences are selected for extraction. With the latter, however, sentence scores may be updated during the selection process to help avoid redundancy as in *SumBasic*. Dynamic scoring can be helpful for avoiding summaries that include many sentences discussing the same thing and that are therefore overly redundant.

A more principled approach to selecting sentences while avoiding redundancy is the method Maximal Marginal Relevance (MMR) (Carbonell & Goldstein, 1998). MMR aims to balance the importance of a sentence with its distinction from other sentences that have already been selected. In other words, a high sentence score is based both on importance and novelty of information. The marginal relevance of a sentence is understood to be a linear combination of its relevancy to a query or the document as a whole and its dissimilarity to sentences that have already been selected. The sentence selecting function under MMR is shown in Box 1.

In the original MMR formulation, Carbonell and Goldstein use cosine similarity for both similarity measures. Note that in the original formulation of the importance measure, $sim_1(s,Q)$, the similarity of the given sentence s is measured against a user query Q rendering MMR a query-focused summarization approach. Nevertheless, the query can simply be replaced by the entire input to adapt MMR to generic summarization.

While MMR helps to formally define how one favors importance over novelty, its practical implementation – like *SumBasic* and other similar methods – follows a greedy sentence selection approach where rather than globally optimizing the resulting summary following some objective, an

Box 1.

$$MMR = \arg\max_{s\in S}[\lambda sim_1(s,Q) - (1-\lambda)\max_{s_i\in C} sim_2(s,s_i)] \quad (6)$$

where S is the set of remaining candidate sentences, C is the set of sentences that have already been selected, and $\lambda\in[0,1]$ is a parameter that determines the contribution from the relevancy measure and the redundancy avoidance measure.

iterative approach is followed where at each step the best choice is made. This method has seen good results but they do not normally reach what the optimal solution might. An example helps to highlight this problem: at an early stage in the MMR selection process, a very long sentence touching on several areas may be selected for inclusion. Then, later sentences that better address the topic may not be selected due to their similarity to the already selected sentence. A globally optimal solution might prefer several shorter sentences. Exact solutions to this optimization problem are generally intractable, but solutions that appeal to an approximation have been shown to produce good results (McDonald, 2007).

While early work by Edmundson proposed the use of multiple features for determining sentence salience, the method employed does not exactly qualify as "machine learning". For example, the "cue" feature – which helps determine the saliency of a sentence by its number of *bonus* and *stigma* words – was implemented by creating a cue dictionary compiled with statistical data from human summarizers and that was then refined by certain linguistic criteria. The four considered features were linearly combined with feature-specific weights but the weights were not learned directly. Instead, different permutations of weights were tried to determine the best distribution. Later work, however, included many more features for supervised summarization and thus turned to machine learning methods.

One example system uses Edmundson's and some other novel features and trains a Naïve Bayes classifier to determine sentence salience in technical articles (Kupiec, Pedersen, & Chen, 1995). Numerous other approaches centered around machine learning but that make use of different learning methods and additional features have been presented in the literature. However, in domain independent summarization tasks simpler unsupervised methods based on term frequency generally continue to outperform supervised machine learning approaches. While supervised approaches do very well in specialized domains where the writing is often very specific and structured, their data-driven counterparts are often more amenable to unstructured writing. There are notable exceptions, however. One is a "hybrid" model of fused unsupervised and supervised approaches that performs very well on traditional news data (Celikyilmaz & Hakkani-Tur, 2010). Here, Celikyilmaz and Hakkani-Tur first learn a hierarchical topic model of the input and then train a regression model – where they make use of "meta"-features – to determine sentence salience. Unsupervised topic modeling approaches that leverage the recent interest in this area of machine learning for text summarization will be discussed in the next subsubsection. Finally, despite their successes in domain-dependent summarization and "hybrid" approaches combining both techniques that have been shown to do well in traditional news summarization, supervised approaches suffer from one other major problem. Obtaining training data is often difficult or expensive (usually both) and most supervised methods require large amounts of it.

Topic Modeling Approaches

Some of the perhaps most interesting novel work happening in summarization builds upon the recent interest in research into probabilistic topic models such as Latent Dirichlet Allocation. Topic models can help solve a number of problems that are left open in the simpler methods based directly on unigram probability distributions of the input. Three major problems with using non-augmented flat probability distributions for text summarization are: (1) words often have several meanings (polysemy); (2) ideas can be expressed using different words that means the same thing (synonymy); and (3) unigram distributions lack structure in that a great deal of co-occurrence information is lost when we simply look at the frequency with which each term appeared. Topic modeling approaches to summarization are able to address all of these problems.

Haghighi and Vanderwende present a study of news summarization where sentences are selected to minimize the Kullback-Leibler (KL) divergence between the summary unigram distribution and some representative distribution of the input (Haghighi & Vanderwende, 2009). They begin with a stop-word filtered unigram distribution where the objective function for the generated summary is:

$$Summary = \arg\min_{S \in S^*} KL(P_u \mid P_S)$$

where S^* is all the possible combinations of sentences in the input, P_U is a smoothed unigram distribution of the input, and P_S is the unigram distribution of the currently considered summary S. Optimizing this objective function is intractable so a greedy approach is taken where the sentence that decreases the KL divergence between the two distributions is chosen for inclusion at each step. Other approximations to the global optimum such as considering an insertion or deletion of a sentence to or from the summary at each step have been shown to improve results. In the pure greedy initial formulation, however, this method outperforms *SumBasic* with statistical significance in news-based summarization.

Haghighi and Vanderwende then look to augment the unigram distribution with additional structure for the multi-document summarization task. In the first structured formulation, a topic model is trained on a collection of document sets where each word can be generated by one of three distinct latent distributions: (1) content; (2) document-specific; and (3) background. The background distribution is shared amongst all document sets and should reflect "general language filler" including stop-words. The document-specific distributions are distinctly document-specific and only generate words within their given documents. The remaining words are generated by the content distribution and the motivation is that these words are more representative of the given document set. This is nearly identical to an approach taken by Daumé and Marcu but their method is presented as being specifically tailored for query-focused summarization as the "content" distribution is seen as a distribution that puts high probability mass on words related to a query (Daumé,III & Marcu, 2006). After learning the latent distributions, the smoothed unigram probability distribution P_U is replaced in the objective function with the learned *content* distribution φ_C. This change improves summarization performance on news data.

Haghighi and Vanderwende explore one more set of structural additions to their model. Rather than simply having three flat latent word distributions, the content distribution is augmented to contain semantic topics. This way, if an input text contains various themes, each of the themes can specifically be included in the summary. Additionally, theme-specific summaries can more easily be generated if only one specific aspect of a text is of interest to a user. Mason and Charniak later improved performance with this model by altering the objective function to explicitly discount sentences that contain document-specific words (Mason & Charniak, 2011). Finally, the *PathSum* model takes a similar approach to dimensionality reduction through topic modeling to better ensure that summaries will contain the nuanced sub-themes that are prevalent in natural language documents (Darling & Song, 2011).

Semantics and Discourse

The early summarization systems that rely only on raw term frequency distributions have been successful but generally have problems in keeping track of content and importance when diverse words are used to refer to the same idea (synonymy) and when sentences employ coreference. For example, one sentence may introduce important concepts and a subsequent sentence may deduce important relations between them but only by indirectly referencing those ideas: "*Bali* is typically a peaceful and tranquil vacation spot. However, this past week a bomb exploded *there*." In this example, the second sentence explains the significant event, but simply extracting that sentence is ambiguous because the word "there" means nothing without the previous sentence to provide context. The problem with synonymy is that with simple term frequency, two words "phone" and "mobile" may not have high probability by themselves, but if they are synonyms for each other, then the idea of "mobile phones" may be very important. Systems that aim to bridge this gap use semantics and discourse methods for aiding the summarization task.

The previous section discussed some methods based on topic models which can help with the problem of lexical ambiguity, but there are several others. One is based on lexical chains (Silber & McCoy, 2000). A lexical chain is a span of related content within a document. The principal computational problem is in finding the lexical chains that exist in an input. Most methods make use of WordNet, a manually compiled thesaurus that groups words into synonym and antonym sets. Barzilay and Elhadad present a summarization method based on lexical chains where the most representative sentence for each lexical chain found in an input is used to create an extractive summary (Barzilay & Elhadad, 1997). Unfortunately, one of the main problems with techniques that make use of WordNet is that we have to rely on its content and the content is not very good for languages other than English (even in an English-only system there are problems with undercoverage as it is a static resource). Also, the problems that lexical chains are meant to solve – namely determining latent discourse topics in an input – are able to be tackled quite well without the need of a manually compiled resource with the more modern approach of probabilistic topic models as discussed in the previous section.

Sentence Clustering and Graph Methods

One of the issues that automatic summarizers – particularly those that tackle multi-document summarization – have to grapple with is redundancy in the output. One approach that is both useful for determining the important areas in an input and avoiding redundancy is sentence clustering. Sentences that address similar points are clustered together and the resulting clusters' sizes (the number of sentences assigned to each) can help determine the most salient areas that are addressed in the input. Further, if only a single sentence is extracted from each cluster, redundancy can be avoided. McKeown, et al. use a number of features to cluster sentences together and then form an extractive summary based on the resulting clusters (McKeown, Klavans, Hatzivassiloglou, Barzilay, & Eskin, 1999). Their features include word co-occurrence, noun phrase matching, synonyms determined with WordNet, and the sharing of common semantic classes for verbs.

If we were interested in particular areas covered in an online forum, sentence clustering could be considered as a first-step in the summarization process for determining and presenting opinions expressed on the forum. This is directly applicable to the FUPOL project's goals of processing the large amounts of varying input that might be found on an e-policy or citizen-augmented governance forum.

One of the problems with sentence clustering, however, is that sentences can only be placed in a single cluster. This is at odds with most real-world sentences that often might fit equally well into more than one distinct cluster. One solution to this problem is summarization based on graph methods. Here, the input is represented as a graph where the vertices represent the sentences, and edges are typically assigned weights proportional to the similarity between the two sentences that the edge connects. Once the graph has been constructed, an algorithm such as PageRank can then be used to determine the most important sentences (Langville & Meyer, 2006). By assigning similarities for all pairs of sentences – rather than enforcing a hard clustering – graph based methods provide a less strict approach to determining sentence saliency and therefore offer an often improved method for summarization.

Opinion Summarization

While a number of diverse summarization methods representing the state-of-the-art in the area have been presented, most are often proposed to tackle the canonical task in text summarization: providing abstracts of news stories. For many tasks, a more nuanced approach is often required. One example of a more specific area that will be important for the FUPOL project is opinion summarization, and even more specifically, opinion summarization from online forum communities. Opinion summarization is a relatively novel field (Paul, Zhai, & Girju, 2010; Ren, Ma, Wang, & Liu, 2011; D. Wang & Liu, 2011), and opinion summarization in "spontaneous conversations" – which is similar to the unstructured text found in social media and forums – has rarely been studied. Nevertheless, there is a growing body of work in this area and it will be covered in this section.

Mining and summarizing customer reviews is a sub-domain of opinion summarization that has been studied due to the prevalence of online shopping ("e-commerce") (Minqing Hu & Liu, 2004). This task can be divided into three sub-tasks: (1) determining the product features that customers have expressed an opinion about; (2) identifying the sentences that highlight the negative and positive opinions that customers have for each product feature; and (3) generating a coherent summary of these opinions. Adapting this approach from product features to government projects or political decisions is a natural progression.

In work by Hu and Liu, a customer review summary details a product p's features f. Each feature f_i includes the number of positive and negative comments that the feature received and individual review sentences elaborating on the positive or negative opinions that were held. This latter step is similar to document classification but entails classification at the sentence level rather than document. Tying it to other work presented here, while extractive summarization typically seeks to identify and extract *representative* sentences from an input, Hu and Liu look to identify product features and the opinions related to those features.

In this work, Hu and Liu first identify the important product features that many reviewers have expressed opinions on. A POS tagger is run over the sentences in the review to determine nouns, noun phrases, and adjectives. Association mining (Agrawal & Srikant, 1994) is then performed on the nouns and noun phrases to determine the frequent features that are addressed. The "opinion" words are then determined from sentences featuring the important product features. The opinion words are chosen as the adjectives closest to the feature words in the feature sentences. The semantic orientations (positive or negative) of the opinion words are then identified using synonym and antonym sets from WordNet. Finally, the orientation of each opinion sentence is determined from its opinion words and the final summary is generated.

Many of the existing methods concentrate on binary-contrastive opinion summarization such as determining the views of those who are for or against government-provided health care in the United States ("Obama care") . An interesting research avenue might be to generalize this approach to summarize multiple viewpoints (multinomial vs. binomial choices). Nonparametric Bayesian methods might be used to determine the number of different viewpoints. One could also consider where different viewpoints overlap to help determine where we can find consensus.

Conversation Summarization

For summarizing viewpoints from users on an e-governance policy website forum, the views that will be expressed will often come across as a conversation amongst users as ideas are debated and refined. This genre of text has connections to research in conversation summarization and e-mail thread summarization. One potential task is that described by Wang and Liu: given a speaker *s*, a conversation *c*, and a topic *t*, summarize the speaker's opinion *o* towards the topic *t*. This could be a simple binary opinion such as $o \in \{yes, no\}$ or $o \in \{for, against\}$, a "binned" mult-ary opinion such as $o \in \{$ strongly agree, agree somewhat, neutral, disagree somewhat, strongly disagree $\}$, or it could also be more nuanced where *o* has an open domain that cannot necessarily be ordered.

To tackle this task, Wang and Liu propose a sentence extraction approach and provide two distinct approaches to selecting the sentences for extraction. The first ranks sentences using a linear combination of features and the second is based on graph methods. For the former, the features include classic summarization features such as the number of topic words, the sentence length, and the sentence words' frequency in the input, but also the probability that the given sentence contains opinion. This is determined by training a maximum entropy classifier on a large collection of background documents such as movie reviews. For the graph-based approach, similar features are considered, but discourse cues are also incorporated. The discourse cues are incorporated using directed edges and can reinforce connections when utterances are from the same speaker in the same turn (or message) or if two sentences form a question-answer pair (determined using a simple heuristic where if sentence 1 contains a question mark or a "wh-word" then the immediately following DA sentence 2 is its answer pair).

Another closely related task to summarizing opinions in an online forum is e-mail thread summarization. Here, the motivation is presenting a short summary of an ongoing e-mail discussion thread that is supporting a group decision-making process so that a user may quickly catch up on the main issue that is being discussed (Wan & McKeown, 2004). Wan and McKeown present an approach for addressing this task where representative sentences are extracted and used to generate an e-mail thread overview summary. They assume that the central matter of the thread is laid out in the first e-mail, that the thread only discusses one issue, and that the original issue does not drift to a new issue as the discussion in the thread progresses.

First, the e-mail thread is segmented into an initial e-mail laying out the discussion topic (the first e-mail) and subsequent replies (all other e-mails). Each sentence in the first e-mail will then be considered as a candidate for the sentence that outlines the discussion issue in the summary. A comparison vector is created that represents the replies to which the candidate sentences will be compared. The candidate sentences are then compared to the comparison vector of reply sentences using cosine similarity and the highest ranked candidate sentence is deemed to be the sentence that exemplifies the e-mail thread discussion topic. The comparison vector of reply sentences is constructed either using a centroid method (average vector of reply sentences), a centroid method based on a singular value decomposition (SVD), a key sentence method based on SVD, or a combination of the methods. To extract the responses to the issue, the first sentence of each reply e-mail is used. To evaluate their method, Wan and McKeown use a portion of the Columbia

ACM Student Chapter corpus of e-mails with manually annotated gold standards. The only portion that was tested was the determination of the initial discussion topic sentence.

Another method for e-mail thread or newsgroup discussion summarization approaches the problem by first clustering messages into topical groups and then applying a sentence selection procedure (P. S. Newman & Blitzer, 2003). To cluster messages into related groups, the candidate groupings are first filtered by only considering parent-child and sibling messages pairs in the thread tree. An iterative clustering approach is used where messages are first placed in individual clusters and then at each step the two most similar clusters are combined until some size threshold is met. To build a summary for each cluster, each assigned sentence receives a score based on its ordinal position in the cluster which includes the lexical similarity of the sentence to the cluster centroid.

Online Discussions and Blogs

More specifically related to the FUPOL project, there has been some work on summarizing "dynamically" created information in online discussions and blogs (Zhou & Hovy, 2006). Zhou and Hovy outline their approaches of creating "sub-summaries" for each sub-topic that is found in an online discussion forum. Each message is first segmented using TextTiling to determine the different topics referred to in each message. Then, each discussion is also segmented hierarchically using hierarchical clustering. Similar to e-mail thread summarization, a single message is always deemed to initiate a discussion (chosen as the first in time from each cluster) and then the responding segments are found using machine learning methods such as maximum entropy modeling and support vector machines.

In other work, Hu et al. propose an approach to comments-oriented blog summarization where the most important comments from a blog post inform the created blog summary (Meishan Hu, Sun, & Lim, 2007). More formally, the task is to extract a subset of sentences from the blog's sentences *P* where the extracted sentences best represent the discussion observed in the set of comments *C* associated with the blog post. To solve this problem, the authors propose the ReQuT model which attempts to score sentences based on being associated with comments that are written by authoritative readers, appear in widely quoted comments, and represent topics that were highly discussed in the comments.

Perhaps the most closely related research to our proposed work is that by Ren, et al. in which they propose summarization of online forum threads based on latent topic propagation (Ren et al., 2011). Unfortunately, however, the methods that they employ are not expressed very clearly. In any case, the motivation is as follows. Three principal characteristics that differentiate summarizing online forum discussions from more traditional multi-document summarization tasks are: (1) topic dependencies arise when a user replies to a specific message; (2) topic drifting occurs as the conversation takes on additional sub-topics over time; and (3) text sparseness is a real issue as most posts are composed of short messages that do not provide enough information to use traditional term frequency-based approaches. A novel topic model is proposed that aims to take these three issues into account: the Posts Propagation Model (PPM).

Like previous work, the strong – yet reasonable – assumption underlying the model is that there is one post that initiates each conversation thread with either a question or comment and that this post is the earliest one in the thread. All other posts in the thread are considered to be replies to the original question or comment. Further, the approach outlined here – again, following previous work – aims to find representative sentences and extract them to form a coherent summary of the discussion.

Summary Generation

Following some discussion on more precise summarization tasks and methods, we return to a general goal in summarization – that of actually generating the summary text. The most common approach in most summarization methods – and indeed, in every one covered here – is sentence extraction followed by pasting the extracted sentences together into an output summary. While this is the common approach, generating the summary like this is not always trivial. The principal problem is sentence ordering, particularly when multiple input documents or sources are involved.

For single-document summarization, the sentences are traditionally simply displayed in their original order. While problems can crop up if some sentence is displayed that is nonsensical because it requires another sentence to be shown for it to be made sense of, this is not an ordering problem and is instead more closely related to selection and choosing sentences that lead to coherent extractive summaries. In multi-document summarization, things become more complicated. A common approach is simply to assign a relative location value to each sentence $\ell \in [0,1]$ where 0 corresponds to the sentence being the first sentence in its document and 1 corresponds to the last (a sentence from the very middle would have $\ell = 0.5$, etc.). The summary is then prepared by ordering the extracted sentences according to their respective ℓ values. This is clearly a naïve heuristic that fails in many situations due to the different writing styles and themes prevalent in the input documents. It does seem to do better than a random ordering, however.

One domain-specific approach to handling the ordering problem is using probabilistic content models of common discourse patterns in the input. Barzilay and Lee study disaster articles specifically and show that the information in these documents is typically presented in a common order that can be learned with an HMM: disaster description, casualties, next steps, previous disasters, for example (Barzilay, Elhadad, & McKeown, 2002). The best summary sentences can then be chosen based on their matching the model and these extracted sentences are presented in the order that the model has learned from training data.

In summarizing opinions gathered from online forums, one straightforward approach could be simply ordering information units by the time they were created. Unlike traditional multi-document summarization tasks – where the creation date is unknown, ambiguous, or highly coarse – forum posts typically (a) have a hierarchical organization that topologically includes the response-purpose of each post, and (b) contain a fine-grained time stamp that makes the creation date clear to a high precision. Chronological ordering was used in the multi-document summarization context in (Barzilay et al., 2002)] using an available publication time, but this makes less sense in the canonical task of news summarization because news stories will often contain background information that does not adhere to the chronological publication date. The approach should be of more use when opinions and response to opinions are to be summarized as will likely be the case with FUPOL.

Finally, while extractive – rather than *abstractive* – summarization is still the dominant approach in the field, we mention here that a first step towards *abstractive* summarization may be sentence *compression*. Here, the summary is still made up of sentences extracted from the input that are deemed to reflect the important content, but extraneous or redundant information is first removed so as to compress the sentence to a shorter length. It turns out that this approach is in fact very popular amongst human summarizers(Jing & McKeown, 1999). Many of the approaches used for sentence compression are based on heuristics. Some use rules based on syntax and discourse knowledge such that the syntax parse tree of a sentence is used to determine what portions of the sentence may be cut (Jing & McKeown, 1999). Other approaches are based on statistical techniques including the noisy channel model and decision trees (Knight & Marcu, 2002).

As an example of the summary of political opinions that could be provided to the user of the FUPOL system, we consider the citizen consultation that took place for the United States Department of Agriculture's (USDA) proposed National Organic Program (NOP). The NOP is a set of administrative regulations that require the establishment of national standards to govern the marketing of organic-labeled products. The purpose of the regulations is ostensibly to ensure consistent standards in what is considered "organic", but the specific proposed implementation was widely condemned by concerned citizens. 20,936 comments were submitted by citizens where the vast majority was against the NOP as it was proposed. Clearly, reading through more than 20,000 comments represents a prohibitive investment of time for already swamped law-makers. Therefore, automatically distilling the prevailing sentiment of the populace in an easy-to-digest format would be of interest to government decision makers. A proposed summarized report of the citizens' comments on NOP is shown in Box 2.

In this summary, the percentages correspond to the proportion of sentences in the corpus that we allocated to the corresponding topic. The underlined titles were manually written based on the extracted sentences. It gives a quick overview of the large text corpus and directly shows that people participating in the public consultation were against the legislation project, with main concerns around organic food and genetic manipulation. We see that the sentences selected by the algorithm favor diversity and do not contain much word repeat between sentences from the same cluster.

Summarization Evaluation

One of the most important considerations in performing research in this area is evaluation. For an often highly subjective field such as summary generation, some quantitative methods must be used to ensure that purported improvements lead to better results at a given task. To make things more difficult, even with an arguably straightforward objective definition of a summarization task, there is often little agreement amongst human judges on what is the most important content in a document (Goldstein, Mittal, Carbonell, & Callan, 2000). Nevertheless, when several evaluators are used an "average consensus" tends to emerge. We begin by detailing the most common automatic summary evaluation system, ROUGE.

ROUGE – Recall Oriented Understudy for Gisting Evaluation – computes statistics of overlapping *n*-grams between sets of model summaries and candidate summaries (Lin, 2004). It is the most commonly used metric for evaluating automatic text summarization work. ROUGE works by comparing the words (and more generally, *n*-grams) that are found in a candidate summary with a collection of model summaries and gives a score that represents the overlap. ROUGE is a strong "baseline" evaluation system because it is quick and provides results that are roughly commensurate with human judges when extractive summarization is considered. With abstractive summarization, ROUGE becomes less useful because it has no notion of "ideas", polysemy, synonymy, etc.

A more powerful method – but that requires human annotators – is the Pyramid method for summarization evaluation (Nenkova & Passonneau, 2004). This method quantifies and formalizes the manual evaluation process and is therefore much more stringent and objective than experiments that simply ask a collection of human judges to determine "the best summary". Here, a discourse unit known as a summarization content unit (SCU) is considered. An SCU is a clause containing one "piece" of semantic content. To evaluate summaries using this method, each model and candidate summary must be marked

Box 2.

FOR (~3%):

General (~ 100%)

• The standards, in general, appear to be well thought out.

• Having a strictly defined definition of the term "Organic" when used on food labeling is, in my opinion, a very good idea.

• I am very much in favor of the assurance such a standard would give to the consumer.

AGAINST (~97%):

General (~30%)

• It goes against everything that the "organic" label stands for.

• The national organic foods act is too weak.

• The American consumer should be able to depend on the label "organic" meaning natural from start to finish.

Genetic engineering / Irradiation (~60%)

• Any Federal definition of "organic" must preclude use of radiation in processing, sludge as fertilizer, animal by-products as feed and genetic engineering for stock production.

• Under NO circumstance do I want to have genetically engineered livestock or any irradiated products considered acceptable for the "organic" foods labeling.

• Labelling foods that have been irradiated or genetically engineered as ORGANIC is MISLEADING to the public!

Animal Treatment (~5%)

• Living conditions for livestock should also be addressed in any proposal that is made to deem foods "organic".

• I also think that livestock feed should be regulated to prevent the livestock from being fed "recycled" animal by-products.

Other (~5%)

• I urge you to extend the time allowed for public feedback.

• If the proposed National Organic Standard passes in its current form, I feel that I would not know what I am buying, nor be able to trust in its safety.

up with its contained SCUs. Each SCU is assigned a weight that corresponds to the number of model summaries that contain it. A candidate summary should not contain any SCU that has a lower weight until all possible SCUs with higher weights have been included. The pyramid score is then a number between 0 and 1 that represents the ratio of the sum of the weights of the considered summary's SCUs to the sum of the weights of a reference summary.

For creating summary-like reports in FUPOL, evaluating our methods will be a challenge (as with all novel areas in summarization research). The key will be to formally define what constitutes a "good" summary report. With this formalism in place, gold standards can be established and human raters can be used to determine improvements in systems. These raters can be recruited traditionally (perhaps asking the participating cities to help) or online task micro-payment sites like Amazon

Mechanical Turk could be investigated. Some approaches to organizing this kind of evaluation are outlined below.

In one study on opinion summarization in conversations, Wang and Liu had three annotators listen to speakers giving their opinions on certain topics. The annotators then had three tasks: (1) write a 100-word summary of the speaker's opinions towards the given topic; (2) select up to 15 phrases (or "dialogue acts", DA) from the input that best represent the speaker's opinions towards the given topic; and (3) select an overall opinion for the speaker's opinion towards the given topic that is one of strongly support, somewhat support, neutral, somewhat against, strongly against (D. Wang & Liu, 2011). These three human-created outputs were then used to compare the automatic systems' performance against model summaries. This approach is nice because it provides answers to compare with at an increasing level of granularity and subjectivity. A candidate summary may be very close to an abstractive summary but score poorly against the extractive version, for example.

In Lerman, Blair-Goldensohn, & McDonald (2009), the authors present a large scale evaluation of sentiment summarization for the purpose of determining what model properties are correlated with human preference. In other words, the research seeks to determine the scoring function for selecting sentences in sentiment/opinion summarization that results in the best summaries as determined by human judges. To simplify their investigation, each document to be summarized is defined as being about a single topic where the author has an interpretable opinion about that topic. For this study, three distinct approaches to opinion summarization were considered. Four experiments were run with nearly 2,000 rater judgments considered. The raters were shown two summaries of an identical product review side by side along with the "correct" rating (i.e. 4 of 5 stars). The raters were then asked to choose their preferred summary where the choices could be one of: no preference, strongly prefer A/B, prefer A/B, or slightly prefer A/B. In A vs. B comparisons, the raters agreed at least 64% of the time and at most 74%. Some of the interesting observations that were made include the fact that raters tend to prefer summaries with lists; they did not like text that did not include sentiment; they strongly disliked when the overall sentiment of the summary was inconsistent with its "correct" sentiment (or star rating); and raters disliked very general comments such as "the product was good". While the latter two may be obvious, this study does shed some light on what human judges prefer in opinion summaries and how they agree on their ratings.

Finally, to be able to evaluate a summarization system we also of course need data. Data may be found directly related to our task, but some data that may also be of interest is data that includes model summaries to compare our generated summaries against. While we may be interested in a particular custom-designed summary, input/output pairs for determining the important areas in an online discussion forum would be useful. In (Zhou & Hovy, 2006), Zhou and Hovy use the Open Source Software (OSS) development discussion forum as it has matching participant-written summary digests. This may be something to consider.

Sentiment Analysis

Sentiment analysis is the task of automatically determining the sentiment of an author of a piece of text. This could include a binary response variable such as the text being *for* or *against* an idea, or it could infer a numerical ranking from a text-based product review. While a number of the approaches described above – particularly with respect to opinion summarization – touch upon sentiment analysis (and there are indeed multiple overlaps between sentiment analysis and opinion summarization), we present sentiment analysis specific research in this subsubsection where generally the goal is classification of a text due to its sentiment.

Sentiment classification is a much more difficult problem than document classification by topic because it generally requires a greater level of understanding. Sentiment is often expressed more subtly – and often ironically or sarcastically – and simply finding topic indicator words therefore often fails. Another issue that makes this task difficult is that negating words can easily change the entire meaning of an apparently simple sentence or a word that is normally considered to be good can be used as an adjective to make a bad word even worse ("I absolutely did *not* love this movie", "This movie was *amazingly* bad"). One of the original approaches to sentiment classification is that by Pang, et al. who treat it as a machine learning problem (Pang, Lee, & Vaithyanathan, 2002), but some promizing work has been recently proposed to handle negations using a tree that follows negation (Socher et al., 2013)

CONCLUSION

We presented an overview of the rich domain of topic modeling for online opinion summarization. These models are essentially decomposed into supervised techniques, which are based on classifications techniques using annotated text corpora, while unsupervised techniques are seen today as more promising since they do not assume that we know a priori the names of the categories that are present in the set of available textual documents. This is particularly relevant in the e-government domain, where new topics frequently appear, depending on the main events present in the news. In addition, a single clustering of text is not often fully satisfactory since more advanced analytical are requires by the stakeholders. We presented some of these extensions to the basic topic models, focusing on political polarization, time-varying topics and summarization techniques.

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KEY TERMS AND DEFINITIONS

Hidden Markov Model: Also known as *HMM*, similar to *State-space model.* It is a well known probabilistic model for discrete time series based on the assumption that there is an unobserved Markovian sequence of discrete states.

Hot Topic Sensing: Also known as *HTS*, similar to *Topic detection and tracking*, and *Social Media Analysis.* It is the name of a software module that automatically analyzes textual data from citizen messages and return them clustered and organized into semantic categories.

Latent Dirichlet Allocation: Also known as *LDA*, similar to *Non-negative matrix factorization (NMF)*, and *Topic model.* One of the most popular topic models, it assumes that document words have been generated according to a two-step process: first, the latent representation (topics frequency) is randomly generated according to a Dirichlet distribution, and then the words are generated according to the topic proportion and the frequency of words in these topics.

Natural Language Processing: Also known as *NLP*, similar to *Natural Language Understanding.* It is the scientific domain related to the analysis of texts in natural language.

Social Media Analysis: Also known as *SMA*, similar to *Data analytics*, *Text analytics*, and *NLP*. It is the scientific domain focusing on the analysis of data generated by the users of a social network. This includes mostly textual information that is exchanged in the network.

Topic Model: Similar to *Clustering method.* A topic model is a method that allocate semantic categories to documents, and where each document can have multiple categories (called topics).

Vector Space Model: Also known as *VSM*, similar to *Bag-of-Words (BoW).* It is a mathematical representation of concepts as a vector of fixed length. Typically, for textual documents, the Vector Space Model implies that documents are represented by the weighted frequency of every possible word or phrase.

ENDNOTES

1 However, in domains such as law where precise wording is highly important extractive summarization is often preferred to abstractive.

2 Note that this feature is clearly highly domain dependent.

3 These are simply words that are demonstrative of the theme of the input but in text summarization they have typically been termed "topic signatures".

4 The terms "salient", "important", "representative", and "significant" with respect to sentences are often co-mingled and interchangeable in the summarization literature.

Chapter 13
Real-Time Multimedia Policy Analysis of Using Video and Audio Recognition from Radio, TV, and User-Generated Content

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ABSTRACT

Real-Time Multimedia Content Analysis opens up exciting possibilities for accessing opinion-oriented arguments about regulations and dynamic policy changes. In this chapter, the authors present common methodologies and core technologies to analyse multimedia content from a practitioner's viewpoint, highlighting their primary impact, best practices, current limitations, and future trends. They illustrate the impact of multimedia content analysis within a governance-oriented applied context based on two use cases: one use case addresses the task regarding the improvement of certain KPIs (Key Performance Indicators) for the quality of living in a city by performing real-time analytics of TV news in order to assess public opinion and how it changes over time with respect to certain events or incidents; the second use case addresses search and data exploration within multimedia data to reveal certain correlations across space and time in order to retrieve meaningful information from unstructured sources of data, information which can effectively contribute to meeting the concrete needs of citizens.

DOI: 10.4018/978-1-4666-6236-0.ch013

INTRODUCTION

Multimedia and user-generated content are powerful means of conveying information between different stakeholders in a society. From a governance and policy modeling perspective, analysing information between government organizations and the civil society can provide novel ways to promote the democratic role of media, to gauge public perceptions and influences; to provide more effective citizen-centric services and policies; and to close the loop from policy proposal over implementation to assessment of the impact. Real-time Multimedia Content Analysis as a part of Information and Communication Technologies opens up exciting possibilities for accessing opinion-oriented arguments about regulations and dynamic policy changes, and allows a quick reaction to citizen opinions. However, there are several challenges. Multimedia content encompasses vast amounts of data, which are typically unorganized or only weakly structured in terms of space, time and topics. Information needs to be extracted from different sources and formats (text, video, images, sound) and a meaningful interpretation of the content must be accomplished resulting in extracted concepts, entities, relations and emotions. The analysis process and the extracted data – as the technology layer within the communication process between citizen and government – must be presented in a transparent and easy to understand manner for all participants and actors, and must meet legal and ethical requirements. In this chapter we first present common methodologies, core technologies to analyse multimedia content from a practitioner's viewpoint, highlighting their primary impact, best practices, current limitations and future trends. Given the heterogeneity of information sources from traditional (TV, radio) and new media forms (social media, blogs), the information extraction process involves multiple, often interdisciplinary technology components. We will describe these components (audio segmentation, speaker segmentation, speech-to-text, key-frame and shot cut detection, coverage, text detection, face recognition and identification, video transcoding, semantic processing, video search and visualization) and their relations within an information processing system in a transparent way. In order to emphasize the relevance of multimedia content analysis within a governance-oriented applied context, we will illustrate this on two use cases.

BACKGROUND

Real-time multimedia content analysis, video and audio recognition for radio, TV and user-generated content for governance and policy applications have very important multidisciplinary implications in terms of technological and governmental aspects. In order to develop successful applications, we have to take into consideration the requirements, limitations, current developments and trends from both fields. Due to different viewpoints, research initiatives may not match stakeholders' interests in every case. On the one side it is a political question, and on the other side mature applications or ideas are missing as to how people/governance can process large amounts of data (multimedia and user content). The question is how to integrate technology and governmental requirements. According to Mohanty & Nayak (2008), Information and Communication Technologies are necessary to improve the efficiency of government organisations; and there is a clear and evolving need for monitoring and analysis for policy life-cycle. Information Technology and governmental processes have a bi-directional influence on each other. On the one hand, technology is capable of shaping electoral mechanisms or political situations: "The Internet and social media in Kenya, which played a central role in this year's elections by allowing Kenyans to question candidates, took on a new function" (Abshir, 2013). On the other hand, as (Kim, 2011) showed in a Korean use case, policies and regulations have an impact on how broadcasting and telecommunications operate, as well as the convergence of electronic media changes the regulations.

When targeting the extraction of information relevant for the policy generation process, important issues of quality and quantity arise. Getting qualitative feedback on various actions, and preparing for structural, political changes (which occurred in the last years the user-generated data, and citizen involvement) is a key issue in policy modeling and governments. Analysts in governance and policy modeling need feedback to close the loop from generating policy proposals over the implementation to the impact assessment, and Information Technologies can support effective and faster policy making processes by extracting data.

Data quantity and diversity poses another challenge. Government needs to handle an increasing amount of multimedia data due to the rapid growth of publically available information; activities need to be measured, processed and analysed; citizen participation and their empowerment in political dialogues must be assessed. With the integration of traditional media (TV, radio) and new media (social media, blogs), new needs arise to deal with the complexity of data analysis: real-time analysis (speed/access, variety of sources, validation), integration of heterogeneous multimedia sources, and meaningful interpretation of the content of structured and unstructured data.

This chapter will present two use cases and provide an insight into best practices and future challenges. In the use cases we will present best practices around TV and radio broadcast media monitoring: speech/text, video processing, media and multimedia content analysis for applications of governance and policy modeling. First, we would like to introduce which requirements and needs appear from the governmental side (general requirements, implemented use cases, areas of interest, costs) during dealing with multimedia data and content (new and traditional media, future challenges, perspectives, requirements in terms of real-time processing and analysis, and key performance indicators). Secondly, we must examine how this can be matched with current technologies (video, audio processing, content and semantic analysis, user generated content). At this point we have to distinguish that in literature there is a big difference between: (1) monitoring policies with ICT technologies, and (2) the need for new – as yet implemented, or missing – policies regarding the new ICT technologies and ways of data processing. According to (Bertot et al., 2012) in many cases in social media there is no clear policy regulation. However, the two fields are extremely close together, and go hand-in-hand (e. g.: applying multimedia data monitoring would also require new policies). We would like to focus on the (1) case: how to use ICT in e-governance - the possibilities, limitations, and future directions. (Misuraca et al., 2012)´s paper about future governance in Europe 2030 investigated the question regarding emerging technologies in IT governance, and analysed possible scenarios and ICT tools needed in governance and policy making. ICT and governance will have a bidirectional influence on each other, meaning that new applications and emerging technologies will also change the way of policy modeling and policy making.

Government regulations still often encompass some ambiguity. For example, in the field of broadcasting many countries have separate agencies dealing with broadcasting. Telecommunication regulations are often formulated in a diverse manner(Kim, 2011), information about policies is often unstructured or semi-structured given that they originate from multiple sources and change frequently. These factors call for tools supporting policy modeling and policy making by objective measures (Rao & Dey, 2011). As (Rao & Dey, 2011) also note: Governments "*Need to know the act related to the same topic, that have been established before, and whether the content of the new act conflicts with or has already been included in previous acts*". Such a validation step can be well supported by multimedia data monitoring and content analysis. In addition, governance-based medias are evolving in their coverage (or lack of it) of different areas of the world, and this can also influence whether and how governmental action in such areas is communicated outside the circle of those directly involved. Multimedia information (from global TV channels and press agencies to local journals or radio stations, to social media and video) can play a crucial role in political questions and actions. While the significant role of the media in spreading information and in influencing political perceptions and societal behaviour is widely acknowledged, the specific and complex role of different media types in a policy life-cycle deserves deeper analysis. Such analysis with the help of ICT (and the corresponding Key Performance Indicators) can help to provide a better understanding of both the roots and impacts of policies. Research should address the role of the different types of media – including global and local media (TV, press, radio, video) and social media – within the context of the policy life-cycle. For example: the relation between media and political elites, between media and business, and between media and the society are also crucial questions. The role of traditional and new forms of media is to be assessed when it comes to implementing new policies. E-government is typically defined as the use of innovative ICTs such as text mining, information retrieval, machine learning, natural language processing and modern data analysis techniques (probabilistic Latent Semantic Analysis, Non-Negative Matrix Factorisation) capable of discovering underlying trends and clusters in vast quantities of data; as defined by (Evangelopoulos & Visinesun, 2010).

We cannot forget the general requirements for technology, data protection and other aspects (such as ethics). The field is very broad, often dominated by challenges of a technical nature and these aspects might receive less attention. Examples include data-protection, dealing with personalised data, and the behaviour of open-legal markets. Both new technologies and new media create challenges with respect to security and privacy questions (Bertot et al., 2012), as well as introducing a need for information transparency, and legal regulations for information sharing (Wenjing, 2011). The general requirements must also include the human aspect in form of the social acceptance. (Finn, 2011) examined information sharing with respect to politics and policies, and he found out that both individual and community-focused analysis are important to understanding the interaction of participants within the policy cycle. Openness is a key issue, since for a functioning democracy a wide availability of information is essential. Humans adapt their behaviour to technology, but technology behaviour is also connected to IT literacy (Fedorowicz & Dias, 2012). These are important because often governance is especially connected to societal challenges, such as healthcare, and problems with ageing, or negative feedback. Finally, the question of cost efficiency arises. Manual labour and human-operated solutions have become very expensive, and are not affordable for most applications, which direct stakeholders towards automated solutions. In the long term, automated solutions are more cost-effective than human based manual solutions (Martienne et al., 2012), while accomplishing the same quality of work.

E-governance sets the goal to deal effectively with multimedia data and to extract relevant information. Multimedia is important, because beside text based analysis, visual information has become more and more important. (Chen et al., 2007) shows an example of an already implemented monitoring use case of water quality management in Maryland, USA where technology and governance were merged. This example is interesting because they collect user feedback for information discovery, and derive integrated data flows across numerous organisations and individuals, taking the normative models for e-government into account. (Chen et al., 2007) speak about the complications of integrating the various forms of data because of the missing common format; a criticism which is also valid for multimedia content. Apart from the need for integrating data from various sources of information, there is also a representational diversity of data given the multitude of proprietary formats. Standardized data formats and protocols are a requirement when data across different groups of the society must remain understandable, easy to access and process according to the source of interest.

Specifically in our use case 1 the multimedia data originates from two sources: new and traditional media. Comparing key features of social and traditional media we can conclude that new and traditional media require different processes of content analysis. social media may have the problem of validation due to biased personal views or imprecise information. However, (Rao & Dey, 2011) argue the opposite, that capturing citizen opinions can be more reliable than traditional media, but traditional media expresses the opinion of the most important stakeholders. There is a difference in the content of information we can get from the retrieval process. For example, in social media active opinions prevail, in traditional media the international feedback, a view of a country can be measured in a more global sense. Both types of inputs can be effectively used to prevent bad policy impacts (Bertot et al., 2012). However, there is a tendency towards traditional and social media merging more (see e. g.: Social TV as mentioned by Dan et al., 2012). Social media and the traditional media open different questions and need different technological requirements, different policy and government regulations and monitoring: who generates the content (citizens and stakeholders), who is watching it (one-way, many-ways), type of interaction (social media creates dialogue (Hansen, Scheiderman & Smith, 2011) and measurement of different aspects (user generated content, using television content one can assess a broader impact). These factors have to be taken into consideration during the development of the integrated data monitoring system.

- **Need for Real-Time in E-Governance:** One of the most important requirements in e-governance is real-time feedback and dealing successfully with vast amounts of data (or, using the popular word: big-data). (Misuraca et al., 2012) express the urgent need for real-time monitoring and prior assessment on local, regional, national and pan-European scales: *"Policy makers cannot afford to wait until situations are clarified and until the effects are evident before they take decisions." … "Information management and analysis to monitor and simulate in real-time the behaviour of real and virtual entities (people, things, information, data): as future ICT network will link data from any object to person, or the operating environment they are placed in they will generate better information and analysis which can enhance decision making significantly."* Although real-time analysis and use cases are underrepresented in both the technological and governmental parts, these topics are highly important. According to (Martienne et al., 2012) the numbers of radio and TV channels have drastically increased, which has opened up the need for development of new services and products, such as TV-monitoring systems. The need for monitoring social networks, micro blogs and their effects on society has increased within the last 10 years. Growing social networks on the internet and the success of new media created the demand to monitor and analyse user-generated context. This has a critical impact on government and policy. The rising use of these technologies in real-time increases the amount, and in the ideal scenario, the quality and variety of freely accessible information. User generated information contains messages in real-time, which are usually not yet available in the official media, but all this information is available to the public. Typically users inform each other of events and share opinions (Knight et al., 2011.). Thus, even news of extracted data at a given time, event, issue, and given place can be shared. Social media is not just one specific way of communication, but has also proven to be an important factor in increasing resilience and "preparedness" e. g. in the case of USHAIDI (Poblet, 2010). Given these characteristics, measuring citizen participation provides an excellent opportunity for the measurement of policy life-cycles.

- **Measurements and KPIs:** Interpreting the large amount of data, from a governmental side, the need for measurement and key-performance indicators arises: (In Hellang et al., 2012) articulated the missing measurement and Key Performance Indicators for management and the evaluation of e-government initiatives. They focused more on organizational intervention, and later in this chapter we will focus on the technology-based design of the key performance indicators. In the first place, a policy network is a collection of existing resources (Janouski et al., 2012). The information flow between policy and policy network actors (such as government agencies and interest groups) should be processed in real-time, as the outcome of a policy network is influenced by time, context, location and social factors such as culture, conventions, sentiments and users. Therefore measurement is not only meaningful but essential. Measuring impact, monitoring and analysing target audience is also highly relevant to various topics; it involves standardisation of key performance indicators and media analytics. Measurement should be conducted at various scales: globally and at country level; the process should involve periodical reports. Content analysis is recommended to be supported through quantitative assessment and analysis integrated into a scoring system; to track and measure traditional and social media, we need to support the use of multiple languages. Identifying objectives, target audience and setting goals are essential parts of KPIs. That opens the need for global media measurement systems on a governance policy measurement scale, integrating all possible media. (Macnamara et al., 2011) conducted an extensive study about social media usage in governance. Their results have shown that almost half of organisations do not monitor social media regularly. However, we cannot confuse the need for creating policies for different types of media with the need of governance to use and monitor media. In the survey "European Communication Monitor 2011" (Zerfass et al., 2011) refined and confirmed their description of social media governance as comprising of following factors: social media guidelines for communicating in blogs, Twitter; tools for monitoring stakeholder communication on the social web; training programs for social media; and key performance indicators for measuring social web activities (Zerfass et al., 2011).

REAL-TIME MULTIMEDIA CONTENT ANALYSIS FOR RADIO, TV, AND VIDEO

Content can be extracted from both textual (audio) and visual sources. Therefore, in TV content, analysis combining images, sound and text plays a significant role in processing. Audio information can be measured across event statistics: participation, music, words (statistic of nouns), speech overlap, speech turn (Abduraman et al., 2012). At the same time videos contain many levels of information: colour, texture, shape, actors, textual information (e. g. subtitles). Visual processing often involves algorithmic concepts of spatio-temporal interest points, motion patterns, motion histogram, analysis in the frequency domain and principle component analysis (Kompatsiaris et al., 2012) It is important to mention that with the current state of technology it is more easy to analyse audio than video, but undeniably stake-holders show a strong interest in video content analysis, preferably without significant time delay. In the field of content analysis there are main challenges like high-level semantics cannot be so easily processed by machines, as by humans, usually data-learning phases need heavily time consuming manual labelling. At the same time, according to (Willems et al., 2012), there is also the well-known problem of redundancy, which means that the same content is distributed several times over several channels, and we have to face the challenge of carrying out the analysis in real-time. The large amount of information causes a limited control over the received content; therefore content analysis is a core requirement.

Another important aspect for stakeholders is to find an effective way to cope with negative publicity surrounding given topics in incidents and events (e. g.: Reputation damage (ISACA, 2011). As by (Coombs & Holladay, 2012), the challenge for mobile media governance is to increase overall resilience and preparedness, with the help of information sharing and processing. Certainly, the questions are the indicators in a government to measure "policy awareness", being most characteristic of an event or incident. However, impact is the most important factor to establish measurable entities. The following metrics can be defined, for example: (1) reach: how many people see the content, or how often and how much content? It is possible to track the reach of tweets, pins, videos, posts on Facebook and brand hashtags?, (2) mentioning, and (3) Other interactions such as clicks, re-tweet, share and comment. Measurability is a necessary requirement of such indicators. According to (AMEC,2010) some required key performance indicators are: impact (there is currently no scalable facility to ascertain or infer who or what caused someone to change their mind or behaviour), influence (analysing how much visual presence and 'wow factor' a piece of content contains), reach (number of people that have been exposed to a specific content), frequency (the amount of times that an event occurs), reach and frequency (average number of times that each person has been reached, or exposed to the content), media literacy (see above), semantic and social analytic aspects (the application of search, indexing, semantic analysis and business intelligence technologies).

Generally, for speech and audio recognition, text analysis and text-based applications are more common. For example, text based technological applications are, according to (Rao & Dey, 2011): information extraction, information retrieval, topic tracking summarization, categorization, concept linkage, information visualization and question answering (Bertot et al., 2012). E-governance processes both written and spoken information (speech-to-text), e. g. with the help of Natural Language Processing as mentioned by (Mohanty & Nayak, 2008). (Rao & Dey, 2011) suggest capturing citizen's opinions in Print and Digital Media via textual processing and state that knowledge insights extracted from these databases can be used in forming new regulations/policies understanding citizen opinions and answering their concerns. (Evangelopoulos & Visinesun, 2010) showed how statistical techniques can help governance to analyse the unstructured citizen feedback with help of Latent semantic analysis (LSA), and how text mining can contribute to the dialogue between citizen and their government using concept extraction to "close the loop in government decision support" and to extract the meaning. However, text mining can process unstructured/semi structured data (Rao & Dey, 2011), and print/digital media. Both types of media contain data in the form of public and stake-holders' opinions, containing large amounts of visual data. (Bekkes & Moody, 2011), state that visual information plays a significant role in governmental context. Also in data processing understanding, as parts of visual culture, since "in electronic government, images play in increasing role in the digital interactions between governments and citizen". (Bekkes & Moody, 2011) define this as e-governance. They demonstrate that the attention towards visual dimensions is missing; therefore they define the following primary requirements: improvement of the quality of service delivery, stimulating participation.

Use Case 1: Monitoring and Analysis from Radio, TV, and User-Generated Content

Let us assume your city has applied successfully to host a sports event to improve certain KPIs (Key Performance Indicators) for the quality of living. This can include improving the health of people by promoting sports, improving the social climate by providing the values of sport to young people and finally improving the infrastructure of your city by having an event where infrastructure improvements will pay off immediately. During the preparation of the event, during the event and after the event you need to get feedback about the impact. While social media is ubiquitous, professional journalism provides a defined quality and a defined region of impact by using TV news (high-quality live pictures) to illustrate the perception by the main mass media. To perform TV monitoring successfully, you need an analysis system which provides you with real-time analytics, a world-wide and integrated coverage in multiple languages, alerts, information segmented into stories, the ability to define your areas of interest concisely and precisely based on textual representations of both audio and video content. We give an overview on the building blocks of such a system, discussing the technology behind each of the blocks subsequently: audio segmentation, speaker segmentation, speech-to-text, key-frame and shot cut detection, text detection, face recognition and identification, video transcoding, semantic processing, video search. The capturing of local content via local capturing stations will be also presented (coverage). With examples, we will present the possible benefits of the technology for policy monitoring, media analyse, for specific scenarios such as: media/policy measurements, as impacts, peace-building, decision supporting systems etc. The following challenges arise: how to realise real-time analysis; how to provide the necessary large-scale coverage (we are speaking about 300 channels, more than 30 countries), which is more extended, and bigger as usually in research tests; and how to conduct a search, so that the user gets the required information. As already presented in the previous section, an extensive overall multimedia coverage is a tangible requirement for governmental questions. The strong advantage of this system is to find events with a meaningful clustering and analysis, to create a situational overview (from unstructured data towards structured data) and to provide expertise on a given topic (in our case: policy cycle process) by analysing vast amounts of data in real-time. Broadcast TV characteristics according to (Anguera et al., 2010): (1) produced in a studio or in the field, (2) the signal-to-noise ratio is generally good, or better compared to other scenes (e. g. meetings), (3) speech is often read or at least prepared in advance, (4) speech can be overlapped with music, laughter or applause, (5) the number of speakers is usually larger, but speaker turns occur less frequently, and (6) the detection of acoustic events and speakers are challenging but not that hard compared to other audio sources (e. g. meetings). Signals are captured using either satellite or terrestrial antennas. Those signals which are captured in analogue are converted to digital signals and stored using dedicated storage servers.

With key performance indicators many possibilities open up for various levels of measurement as for each and every actor, social dynamics during policy making or statistical analysis (e. g.: vocabulary used, repeating rate, speaker, interviewed person characteristics, policy specific thesaurus of vocabularies used in media assessment) over historical and actual media coverage. Historical analysis opens the possibility of comparing various items over time, and gives a clearer picture of the policy cycle representations in all the media analysed. This could be combined with a special analysis of: geographical and time-wise distribution of all reactions upon a specific message; the actor (citizen, stakeholder, etc.) creates more or less impact during the policy life cycle. From an aggregated data set it can be also possible to provide some drill-down analysis into several statistical sub-segments and aspects of media analysis such as: the role of international and national media, the role of mainstream: classical media versus web-based, social, new media, reactions upon actions in the policy cycle, duration, wording and vocabulary used.

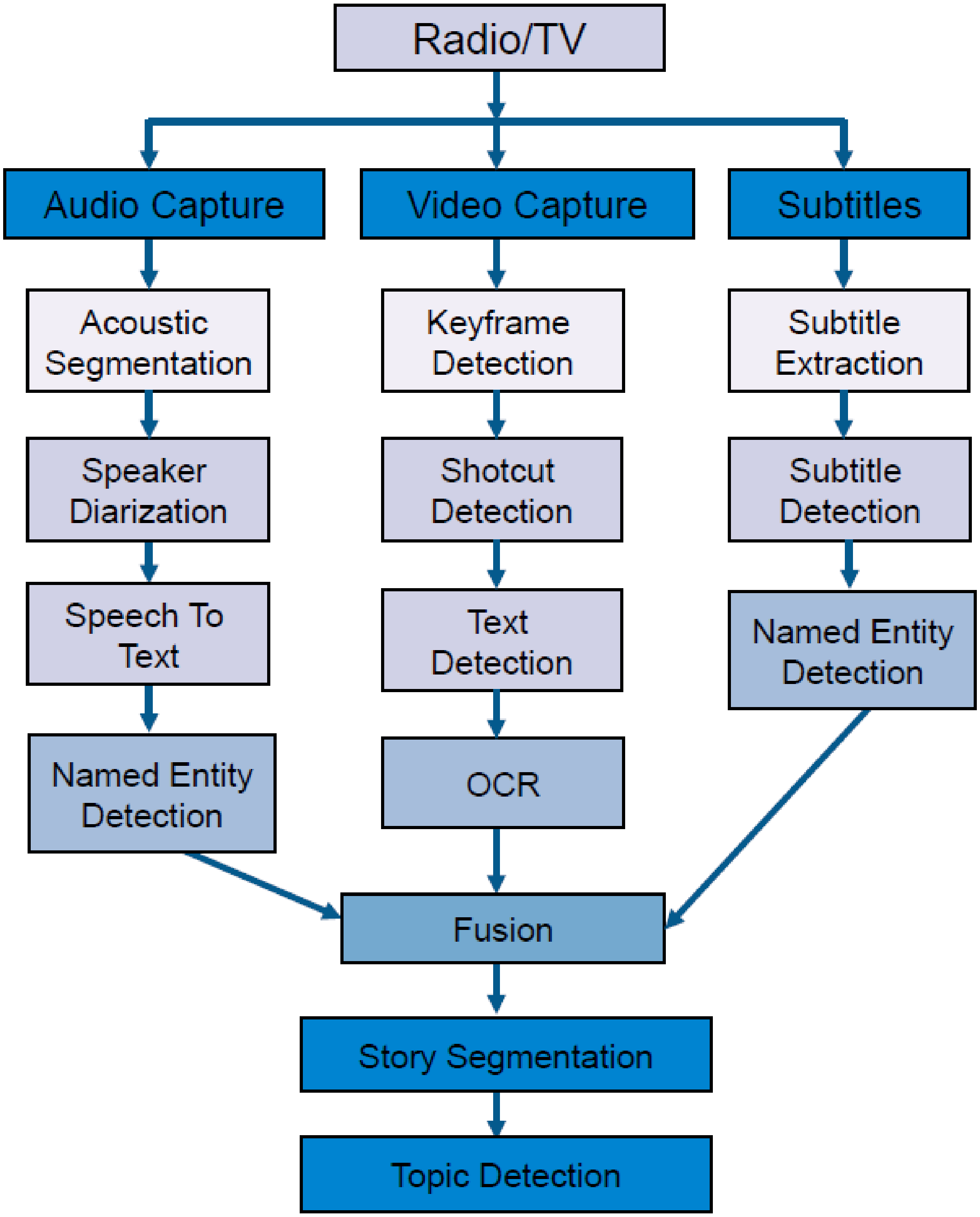
In audio-visual speaker analysis we also have to take the question of cost and resource issues into consideration. The question is, whether somebody would afford to have a small quality improvement, and significantly higher costs. Dealing with errors is also a very interesting question. According to studies, even if there are manually set errors in the text, it does not significantly influence the results. A threshold is about 50% of error rate, which is high. (Allan, 2020) hypothesized that "*robust behaviour is the result of repetition of important words in the text meaning that losing one or two occurrences is not crippling and the result of additional related words providing a greater context meaning that those words will match even if the seemingly critical word is misrecognized*." He argues based on empirical experiments (with longer, and with shorter queries) carried out by *(Barnett et al., 1997)*. This is also supported by (Hauptmann & Wactlar et al., 1997) who state that: *"In our experiments, word error rates up to 25% did not significantly impact information retrieval and error rates of 50% still provided 85 to 95% of the recall and precision relative to fully accurate transcripts in the same retrieval system"*.

Integrated IT systems for policy modeling and policy life-cycles induce several requirements, which furthermore also define the current limitations. Such requirements derive also from the above described section, and contain for example: (1) real-time with low latency, (2) wide coverage, (3) multilanguage approach, (4) good quality, (5) continuous system check, and (5) feedback for the users. In this first use case we present a system, which is using know-how from real-time systems research and is capable of delivering information within less than 30 seconds from the time a keyword was aired until the alert is sent to a user/participant of the policy cycle. Real-time is indirectly connected to the requirement of low latency, describing the time difference between when information is aired/recorded and when it is processed. The delay is measured in seconds and can range from several seconds to days, depending on the system architecture and resources available. The easiest way to process information is in chunks, e. g. a 30 minute episode is recorded and segmented in smaller parts; and subsequently these are processed (e. g. converted to text using speech-to-text). This process has a system-inherent average minimum delay of half the duration of the episode. The mentioned system and the subsystems are specifically engineered to process incoming information in real-time (steam-based processing). This poses specific problems, since the algorithms need to take decisions before the complete information is available, but allows releasing information in small pieces and much sooner. Real-time systems also need to possess a wide coverage (e. g.: traditional, new media). Under coverage we understand the amount or extent to which something is covered. In connection to media, speaking about "Media Coverage" means media from across countries – and around the world. Coverage reflects the ability to view, not the actual viewing. Furthermore we can speak about vertical and horizontal coverage, the first one meaning the regional coverage (states, regions, provinces etc.). The second includes the national coverage: the 10/20 most important channels. For example, a TV or radio channel is a physical or virtual channel over which a TV or radio station or TV or radio network is distributed. A channel is used to convey an information signal, for example a digital bit stream, from one or several senders (or transmitters) to one or several receivers. In order to support both national and horizontal coverage, algorithms which work in English-only are not sufficient, rather, a worldwide and multi-language approach is essential. Spoken language differs considerably from other information sources, which are connected with quality issues (in TV often there is music, noise and other sounds to make analysis more difficult). Metrics like signal-to-noise ratio, bandwidth, audio encoding, language, dialect, speaking styles, gender, pitch to name just a few each pose a challenge. There is also the fact that redundancy of speech makes spoken language processing, with a focus towards information retrieval, a more promising field than simple transcription tasks. Managing in real-time, low latency systems also put the bar a level higher on system monitoring. If a system wants to provide real-time alerts, it cannot tolerate slow-downs; the health check system needs to perform at the same speed as the operational system itself. Traditionally, system management checks servers for failure every couple of minutes or even hours, which is clearly not sufficient for checking a real-time system. Too many scientists have to rely on artificially created, year-old test beds to prove their results and do not have the expertise and resources available to validate their results on live data.

New technologies have facilitated automating the process of capturing radio and TV broadcasts: real-time processing, 24/7 monitoring and automated keyword alerting just to name a few improvements. Compared to traditional monitoring, where trained professionals review and deliver results usually overnight, automated media monitoring detects and delivers all the relevant news as they break, either via e-mail, RSS, API, etc. Delivery components of automated monitoring are: streaming a clip (a short segment cut from video or audio. A clip is usually a shorter part of a longer recording, notification, clipping, reporting and editing. Processing data contains four main parts: (1) key-frame detection, (2) shot-cut detection, (3) text detection, and (4) OCR. However these four parts are a rather simplified version of the data processing: in *Figure 1* we describe the whole process including audio, video capture and subtitles. When monitoring a TV or radio station, the first step in analysing the data is to segment it according to acoustic characteristics. Keep in mind that one of the characteristics of spoken language is that we need to wait for a sentence to complete until we can analyse it. Spoken language processing includes technologies like Speech Recognition, Speech Understanding, Speaker Recognition and Language Recognition. Audio analysis segments the incoming audio into the categories speech/music/silence and detects changes of acoustic conditions. This information is valuable for determining the possible changes of clips and scenes. All audio segments where humans speak run through speech recognition software to deliver the transcript of what has been said. With the help of speech-to-text processing it is possible to convert incoming speech into a textual and time-stamped representation. We look at different levels of spoken language processing, with acoustic, lexical, syntactic and semantic as well as the communication process. When listening to a stream of audio, for example, from a TV or radio station, the first step in analysing the data is to segment it according to acoustic characteristics. Is it a person speaking or a song? Is it a person speaking for a long time (e. g. reading a novel), or is it a dialogue between two or more speakers? Audio segmentation gives us these answers. On all audio segments where human speak, we can run Speech Recognition to give us a rough transcription of what has been said. The presented systems are based on Hidden Markov Models (HMMs) which generate best-of-breed results on continuous speech as typically found in broadcast monitoring applications. This work is inherently multidisciplinary, requiring competence in signal processing, acoustics, phonetics, phonology, linguistics, computer science and combining technologies to extract the most of the incoming media. Audio and video are captured from a variety of sources and put on an incoming processing bus. Attached to this bus are processing components, such as: Format Converter: encodes and compresses information to make media stream-able, splices segments to provide for user-defined downloads in different qualities. Subtitle reader: extracts the subtitles (closed captions) from broadcasts and converts them into a textual and time-stamped form. Meta-data is used (e. g.: electronic program guide) to gather further information. Shotcut detector: identifies abrupt changes in the video stream to identify where a camera shot starts and where different shots are glued together. Text Insert Reader: some channels transmit information purely by inserting a text block underneath the speakers, e. g. during an interview. The text insert reader identifies these text blocks and uses optical character recognition (OCR = to transform images into time-stamped text).

- **Advanced Analytical Methods of Text Streams:** In governmental content there is a high expectation of advanced analytical methods in order to create relevant analysis and to understand the content over a large amount of data. Advanced analytical methods, topic detection, story segmentation and speaker recognition/clustering are categorized as high level analysis in the presented use case. However, nowadays the focus is strongly on social media, though government cannot afford to exclude the TV-view.
- **Speaker Recognition and Speaker Clustering:** According to Anguera et al., 2010 from early work with telephony data, broadcast news became the main focus of research towards the late 1990s and early 2000s. The use of speaker diarization (segmenting an input audio stream according to the speaker identity) was aimed at automatically annotating TV and radio transmission which are broadcast daily all over the word. Annotation contains automatic speech transcription and metadata labelling, including also the above-mentioned speaker diarization. The key questions in every governmental situation are: what is said, how it is said, and who said it. As an example, we can see the FUPOL policy model (Sonntagbauer et al., 2012). Since analysis also depends on the participants in a conversation. The above mentioned audio segments (results of the processing) can be clustered according to the audio fingerprints of the persons speaking. This allows us to analyse and identify which of the persons is speaking what segment. If you have a voice fingerprint of a person, you can use speaker recognition to label audio segments with person names (top-down approach). The process uses female and male speaker models. Taking quality and reliability questions into consideration it is challenging to recognise (1) English words across different channels and languages, independent of origin, and (2) to recognise also non-native speakers. As part of the segmentation process of audio streams we can also investigate when the

Figure 1. System overview



speaker is changing, male/female, etc. It is not only who is speaking, but also the content that is highly relevant in policy modeling, and in measuring reactions. Future strongly emerging fields are: topic segmentation, story-segmentation as part of content analysis and speech research; and it will take much expertise and experience until a mature technology gets established.

- **Story Segmentation and Topic Detection:** As in Audio Segmentation, a continuous stream becomes more manageable, once we have the ability to cut it into segments. With textual data we can use a semantic analysis tool to find boundaries between stories in the text. (See *Figure 1*). "Stories" is defined as a region of text which is about a particular topic. Topic detection and story segmentation work hand-in-hand to define stories and give those stories a semantic label called a topic. There is no static collection of stories, and when a new item is appearing in the broadcast, it will be identified on a stream in real-time. Subjects of new stories are usually persons, locations and organisations. Identifying the names of the entities (Named Entity Detection) in the text stream allows us to do a first-level semantic analysis and gives us a powerful means of focussing our search results.

In the first use case we have presented the information processing from TV and radio content. This is important for Governmental questions about urban settings. Collecting as much information for stake-holders as possible, and also involving citizen opinions, is crucial in the decision making process of policy life cycle. Not only the spoken language, but also the visual information contains highly relevant information we cannot leave out of consideration. The second use case focuses on the information we can gain from the video images. If we compare the two methods of information processing (speech-to-text and visual analysis), the image contains more information (colours, textures), but is harder to process and requires more computational sources. On the other hand, with real-time media monitoring it is possible to measure reactions on various topics; with videos it is possible to analyse and gain information from a real situation. Both use cases (1) connect to each other, and support the information collection phase in an e-governmental process, referring for example to the policy making model of (Sonntagbauer, Boscolo & Prister, 2012), and (2) for both of them we have to take into serious consideration the possibility of drawing the wrong conclusion, ethical questions, copyright issues, and also validation.

Use Case 2: Video Visual Analytics for Informed Decision Making and Planning in a City

Existing urban visual surveillance infrastructures, such as CCTV camera networks provide vast amounts of visual information which can be used to assess relevant factors affecting the quality of urban life. Recent developments in automated visual analysis such as recognizing, segmenting and tracking various video objects (pedestrians, cars, scene objects) enable novel information processing systems. Such a novel information analysis might encompass the characterization of the daily city-wide distribution of the population, the discovery of different types of mobility patterns and the assessment of their relation to a given spatio-temporal context. The urban living environment is permanently changing and these changes cannot be continuously monitored and assessed by human observers. Therefore, a fully or semi-automated analysis of the observed urban environment can substantially contribute to a successful localization of existing issues and in the long run to improve the quality of urban life as perceived by its inhabitants.

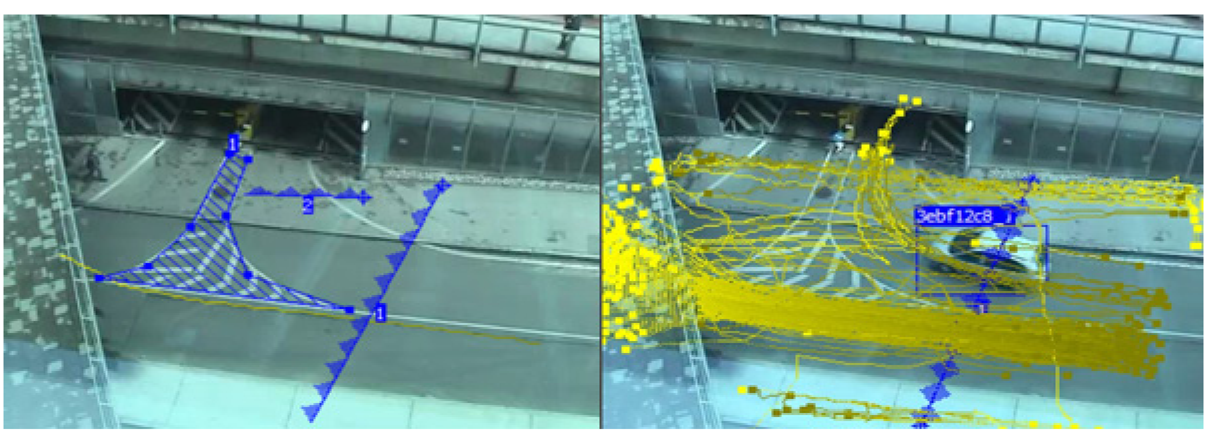
Protecting privacy is also an important issue here and must be taken into consideration. It must be emphasized that such a visual data analysis does not focus on observing individuals and their specific actions, but targets the derivation of statistical measures characterizing the ensemble of inhabitants. Inhabitants are considered as "actors" without an identity, thus no visual information about their faces, license plates or any other specific features linked to their identity is captured, analysed, or retained. At the technology level this becomes possible by constraining analysis methods to low-resolution visual analysis where identity-revealing features are not present.

In the following we describe two examples in more detail where informed decision making can be derived from video-based aggregated statistical evidence. The first example illustrates the case of quantitative assessment of the number, average speed and driving behaviour of specific vehicle types and the number of pedestrians at an arbitrary urban road section. Such local measurements provide an easy-to-interpret analysis of local traffic patterns by objective criteria which can be further used to deduce quality-of-life factors such as noise nuisance, air pollution and high-traffic injury risks. The second example demonstrates the use case of estimating pedestrian travel times between two distinct geographic locations in a city by matching pedestrians' visual appearances (clothing patterns) and performing a statistical analysis on large amounts of travel time estimates. Such travel time estimates can enhance passenger satisfaction and operational efficiency in urban infrastructures.

Quantitative Assessment of Local Urban Traffic Patterns

The quality of life of all citizens significantly depends on the level of traffic safety. Automated visual observation of urban scenes such as certain road sections can be used to collect and analyse large quantities of data which can be used to infer specific urban mobility patterns. By finding correlations in the large pool of raw data, relevant information can be distilled into a more concise form and presented to stakeholders and authorities for supporting them in decision and policy making processes. An example scenario is depicted in *Figure 2*. Automated detection and tracking of traffic participants over an extended period of time can reveal driving behaviours such as the path and speed of individual vehicles, the amount of pedestrians and whether traffic participants exhibit a responsible behaviour. A closer look at the time-aggregated data sample in *Figure 2* (left) reveals for example, that substantially more vehicles have travelled from left to right, than from right to left. It also becomes observable that most

Figure 2. Left – Image of an urban road segment with overlaid lines ("tripwires") and areas capable of detecting specific video events such as cars passing or entering an area. Right – Time-aggregated motion patterns of traffic participants over a duration of 20 minutes. Objects and observed motion patterns contain information on the size, speed and motion path (shown), thus revealing relevant information on the local traffic pattern within the given urban context.



of the right-to-left traffic involves entry into the garage. It can also be seen that the garage might have some operational difficulties, since many cars reverse and leave without entering the garage. Furthermore, some pedestrians cross the road at this observed location, hinting that there might be no nearby crossing for pedestrians.

A structured representation of the data shown in *Figure 2* may reveal additional relevant insights. *Figure 3* displays the correlation between the size distribution of observed video objects and their speed. As can be seen from this two-dimensional map, small and slow objects represent pedestrians, larger and faster objects are cars, while the largest objects travelling at medium speed are trucks. This easy visual separability of object classes within the map allows for a rapid assessment of the main characteristic of the given pedestrian and vehicle traffic. A high occurrence rate of heavy vehicles implies that noise, air pollution and road damage might be of relevance. If frequent pedestrian presence within the same time period is observed, pedestrian safety arises as an important factor. If a metric calibration for the camera observing the scene is performed, object speed in metric units can be statistically analysed. Given this information the number of video objects exceeding a given speed limit can be quantified, thus inferred whether an increased risk of traffic accidents prevails.

Pedestrian Travel Time Estimation by Appearance Matching and Aggregated Statistics

Pedestrian mobility in an urban setting or within large infrastructures (subways, malls, airports) poses an increasingly important problem, since passenger satisfaction and operational efficiency are both important criteria affecting the quality of urban life. Vision sensors and associated image analysis provide new means to assess relevant indicators on the presence and flow of passengers and on the specific location they are situated in. Vital urban transport infrastructures such as subways and airports show a steady increase in the number of installed video cameras as a result of the critical need in society and the economy for higher safety and security. They have emerged as an important class of sensor-based distributed intelligent systems, with unique performance, complexity, and quality of service challenges. It can be clearly foreseen that this trend will amplify in the near future. In parallel, the wide use of mobile devices with integrated cameras, computing hardware and displays opens up new possibilities for location-based assistive services such as location-aware mobile information systems.

Estimating travel times between distinct locations is an important monitoring capability. Given the technical possibilities, automated visual analysis is capable of detecting pedestrians and generating a discriminative representation (metadata) for all detected pedestrians in individual camera views. These representations are based on the appearance of clothing and do not contain any detail which is linked to the identity of a given person. *Figure 4* explains the concept of travel time estimation based on a pedestrian's visual appearance. Given two video cameras observing pedestrians at distinct locations not too far away from each other, there will be a set of pedestrians who will be visible first in one camera, and after a time in the other one. The time delay Δt_i associated with a given pedestrian represents his/her travel time between the cameras.

However, finding or correctly matching pedestrians between different camera views is a challenging task, even for a human observer. To overcome this visual ambiguity, only that set of pedestrians is attempted to be matched which visually appears unique. Uniqueness is determined from a statistical point of view by deriving the most frequent colour and texture patterns observed during a long time period among the pedestrian population. Certain pedestrian appearances (such as vivid colors or unique color combinations are not typical clothing patterns for most Western cultures) exhibit a large difference to the population's average and

Figure 3. Time-aggregated data (the same dataset as shown in Figure 2) of travel participants in a two-dimensional map correlating the speed and the size of observed video objects. Individual objects are shown as image thumbnails. Small and low-speed objects correspond to pedestrians, while large-sized objects represent trucks. When cameras are calibrated, a speed limit in metric units can be derived as displayed (red zone in the right). Such a map can provide easy-to-interpret information on local traffic conditions with respect to risk of accidents and noise nuisance imposed by large or high-speed vehicles.

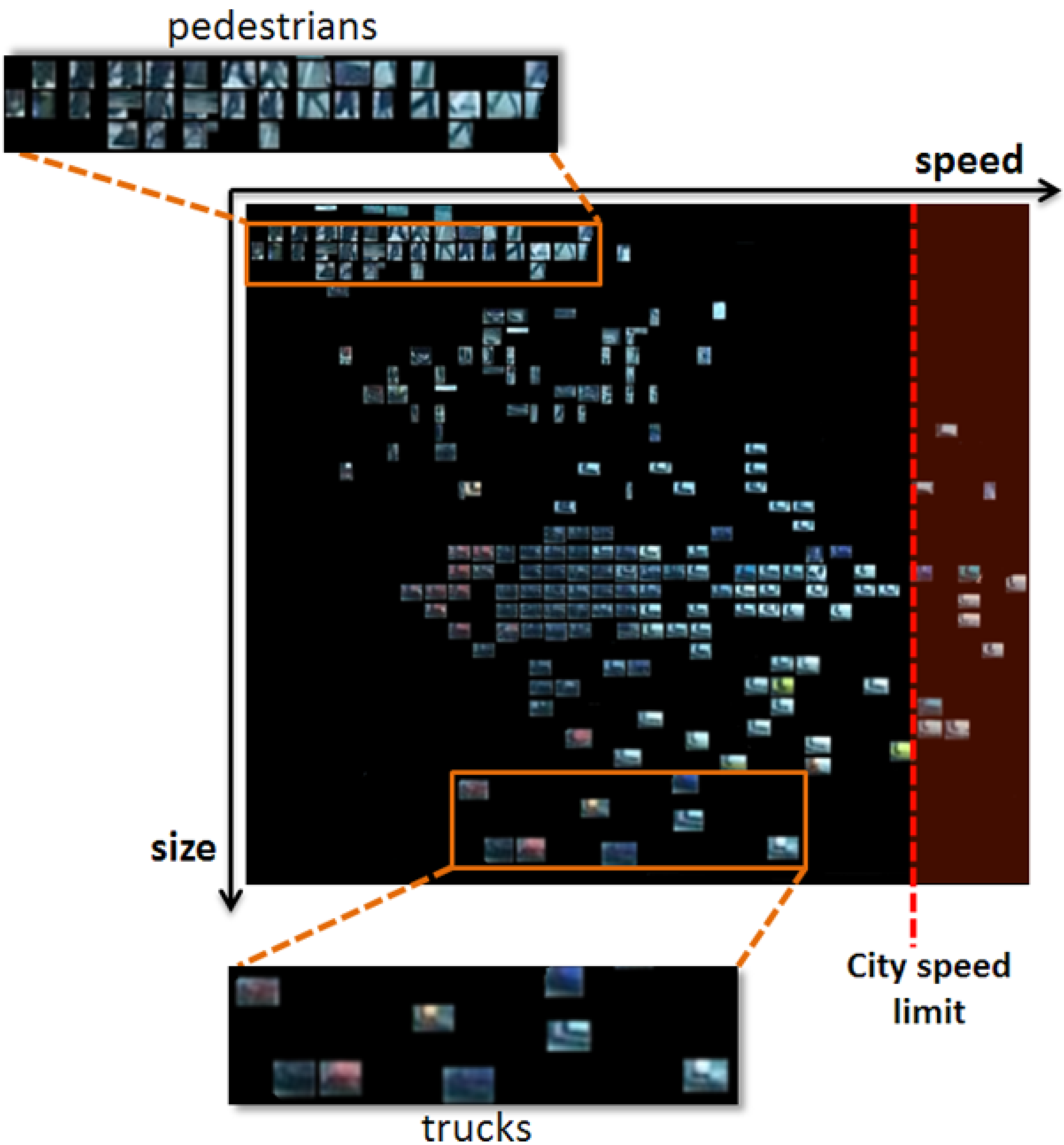
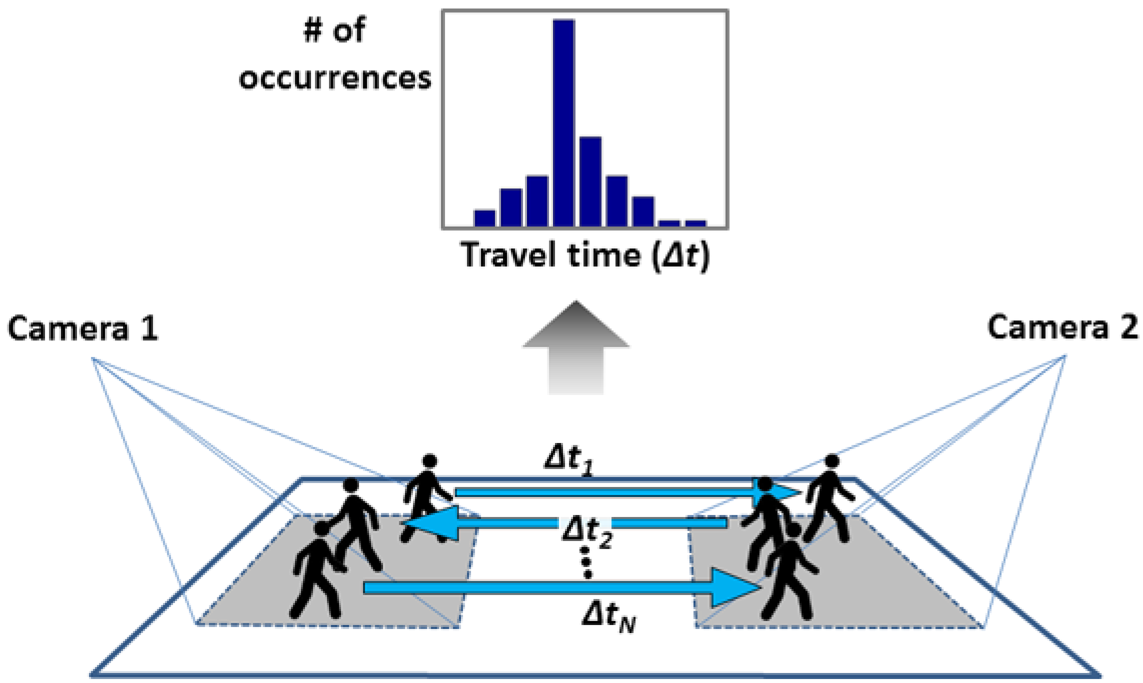


Figure 4. Illustration depicting the scheme of travel time estimation based on the observation and association of selected, easy-to-distinguish pedestrians across two or more cameras, located at different locations

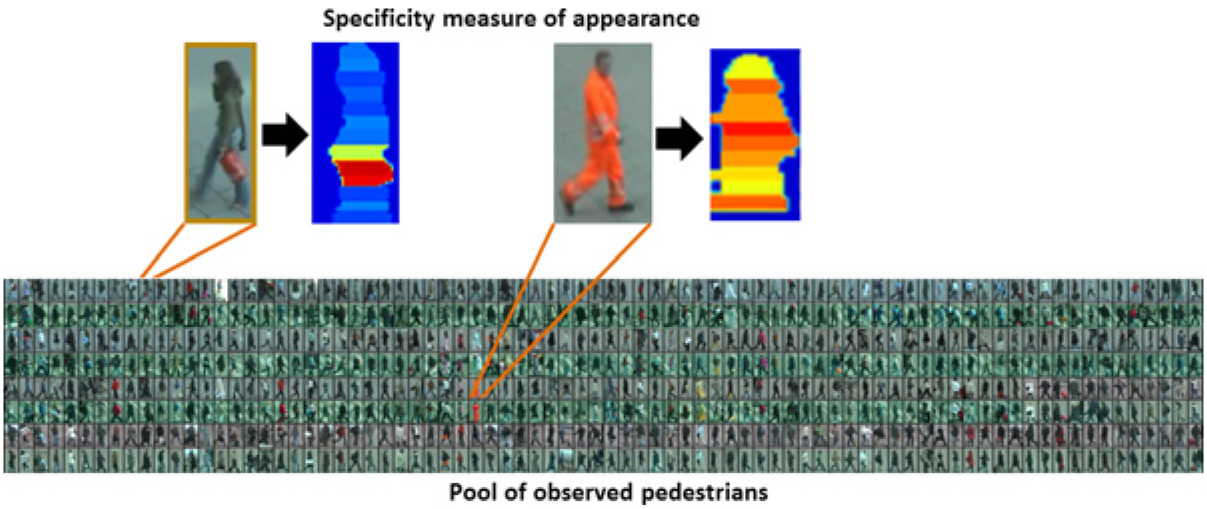


are likely to be found again by visual observations. The uniqueness of such clothing patterns is illustrated in Figure 5 for a small population (gathered during 15 minutes of observation). By temporally aggregating individual travel time estimates from tentative pedestrian matches (Figure 5), a most likely travel time estimate can be computed by taking the most frequently observed travel time estimate.

FUTURE RESEARCH DIRECTIONS

The amount of digitized information pursues a strongly non-linear growth rate. Along with the rapid increase of digital devices capable of accessing access digital content, these tendencies open up new possibilities for capturing public opinion or extracting specific information having an impact on stakeholders and the public. Nevertheless, the emerging possibilities come with great technical challenges. Interconnectivity, integration of technologies (e. g. Second screen), immediate feedback, and the amount of data are the most important examples representing such technical hurdles. Advanced analytical and new visualization methods, novel scalable analysis technologies, well established KPIs are required in the future to deal with the needs of e-governance. Hauptmann & Wactlar et al., 1997 argue for the importance of integration of technologies "from the fields of natural language understanding, image processing, speech recognition and video compression" to allow the users to explore multimedia data in depth as well as in breadth and also the *convergence between TV and Internet (and various devices) requires convergence of technologies*. TV Content Analysis and video-processing

Figure 5. Illustration showing a sample population of pedestrians (bottom) observed within 15 minutes at busy urban location. All images were captured at low resolution, thus only clothing patterns and no facial details are visible. Based on a statistical measure quantifying specificity (i.e. how different is a pedestrian's appearance from the average), it is possible to select such appearances which produce likely correspondences in distance cameras, as shown in Figure 4.



play a significant role along with speech-to-text (STT) application. Typical applications include, for example, duplicate findings, TV labelling, segmentation, structuring, content recommendation (Kompatsiaris et al., 2012), content extraction (semantic and concepts, and TV content), content structuring (structuring information in TV broadcasting into various categories), double detection, recommendation, content quality. At the same time we can observe emerging trends: web, social and interacted TV, content production, *indexing multimedia content, pairwise similarity, logo detection,* s*tory-segmentation (stories based on shots are merged into similarity between text keywords extracted from the teletex subtitle), or capturing long term user interest, speaker detection (Perperis et al., 2012)* etc. (Martienne et al., 2012) conduct for example automatic labelling (programs vs. commercial breaks) from the streams; they work both with manually and automatically segmented data. However, some of the above mentioned technologies are still in the early stages of their development, where challenges include semantic analysis, or how to define similarity.

Successfully integrating e-governance with information technology requires multidisciplinary approaches. Data comes from various sources, and there is a lack of mature tools. For large-scale data processing systems several challenging requirements must be met: input of data (monitoring), transformation of data, user generated content and computationally efficient and accurate semantics analysis (semantics analysis is typically associated with high computational costs, rendering real-time applications unfeasible). With the help of such tools citizen opinions can be captured via language processing and use TV broadcasting for various cases in e-governance. For all scenarios (Misuraca et al., 2010) proposed the following scenarios: "enhanced real-time situational awareness for tracking and policy modeling and visualisation, policy intelligence and ICT-driven decision analytic, automated mass collaboration platforms and real-time opinion visualisation, ICT enabled data and process optimisation and control, complex dynamic societal modeling system, semantic web applications".

CONCLUSION

Information Technology opens up the possibility for extracting opinion oriented arguments from digital data about regulations, the dynamical changes of policies and allows for quick reaction to the opinions of the citizens. There is a strong research need around monitoring content, trends, semantics and analysis of visual information within the context of policy cycle management. To meet the challenge of extracting new unknown information from different sources and formats (text, video, sound, pictures) Information Technology became of interest not only for governance and politicians, but for all citizens. Producing meaningful analysis and measuring impacts (e. g. for new policies and political measures) means also to process and present data in a transparent and easy to understand way for all participants/actors (citizens and government) in this bidirectional communication. We also provided an insight into a more general overview about technological requirements of e-governance, as well as summarised best practices and highlighted which technologies need to be improved in the field of content analysis. With our two use cases we provided a proposal for policy analysis in a specific urban environment (e. g.: city planning, concerts, pedestrian mobility); how to handle large amounts of data, in order to receive and analyse relevant information from audio, textual and visual formats. The use cases open up further research questions, such as how to perform advanced analytic (improved speaker recognition, topic detection) functionalities, and what the ethical requirements are. Defining clear measurement indicators, KPIs, for example to measure impact, reputation in all media (TV, radio, social media, blogs) is essential in the policy modeling cycle. We have also shown that integrating advanced technology components in government and citizen relation significantly aids in understanding the overall political environment. The need for real-time data analysis applications in a governmental setting is a clear trend to promote and to follow.

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KEY TERMS AND DEFINITIONS

Alert: An alert is an alarm or a warning, that notifies of approaching danger or action, like a flashing red light which prepares you for action as it notifies you of trouble ahead.

Automated Media Monitoring: Automated process of capturing radio and TV broadcasts 24/7 monitoring and automated keyword alerting.

Broadcast: A broadcast is a message that is transmitted by TV or radio. To broadcast means to transmit a TV or radio program electronically by TV or radio for public or general use.

Camera Network: Scalability of CCTV camera systems is an important issue, since large infrastructures require many connected cameras. Recent technology developments such as cameras with integrated network interfaces allow for a straightforward deployment of a great number of connected cameras, denoted as a camera network.

CCTV Cameras: Closed-circuit television cameras are either analogue or digital image capturing devices which are part of a network by being connected to recording and display devices. CCTV surveillance is commonly used in critical transportation infrastructures such as airports and subways.

Distributed Intelligent Systems: Distributed intelligence refers to systems of entities working together to reason, plan and solve problems. Nowadays, cameras in a network encompass more and more processing and analytic capabilities; therefore they can act as an interconnected set of intelligent sensor agents not only sensing but also jointly analysing the observed world.

Hit: Any time a piece of data matches the criteria one set. For example, each of the matches from a search is called a hit.

Location-Based Services: The role of location plays an important role since it typically defines spatial context in our digital life. Computer program-level services nowadays use location and time as specific contextual inputs to carry out an analysis and derive additional information.

Media Literacy: According to (AMEC, 2010), it is "the ability to filter and to recognize the political, economic, institutional, personal or otherwise substantiated motivation of information in print, audio/visual or online media and to classify the potential knowledge for themselves. Media literacy is a repertoire of competences that enable people to analyse, evaluate, and create messages in a wide variety of media modes, genres and forms."

Object Detection and Tracking: Automated visual analysis of digital images aims at interpreting their visual content and to distil this content into meaningful concepts such as objects (person, car), motion path and the nature of the scene.

Real-Time Multimedia Content Analysis: Information is automatically extracted in real-time using a combination of technologies, including digital audio and video recording, multimedia streaming, speech-to-text and text-recognition software. One receives audio or video clips for the topics of interest online or via an e-mail alert typically on average 25-30 seconds after broadcast.

Segmenting Audio Streams: Music, silence, speech with help of acoustic signals, and then cut out the music and silence, and work further with the text.

Visual Analytics: The term Visual Analytics represents novel algorithmic and analysis tools involving new visual representations and interactive schemes to allow for efficient information retrieval.

Chapter 14
Approaches to Integrate Various Technologies for Policy Modeling

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ABSTRACT

The purpose of this chapter is to outline various aspects of the technical design and architecture of an ICT system that is capable of handling the requirements that are typical for the policy-modeling domain. The authors provide an overview of the relevant technologies for each step of the FUPOL policy modeling lifecycle, the standards that they build upon, and how to integrate them into a coherent system. As FUPOL is currently the only existing system that is capable of covering the full policy modeling process, the authors illustrate the practical application of these architectural and technical concepts with examples taken from the FUPOL system.

INTRODUCTION

An ICT system support for the Policy Lifecycle Modeling is complex as the process itself, as we see it in most political organizations, is not a process at all, but more a sequence of ad hoc decisions that are not always grounded on research and data. While there are good models available that describe how it should be done in reality political decision making is heavily influenced by other organizations (parties, lobbies, pressure groups), media and other stakeholders. Thus a system that provides real value to decision makers must focus on flexibility and not try to impose a strict workflow that would limit the modus operandi. On the other hand changes in media technology (social networks, blogs, micro-blogging, mobile computing, …) and media use (public private

DOI: 10.4018/978-1-4666-6236-0.ch014

communication) provide opportunities for policy modeling that go far beyond the possibilities of the past if it is done well. Applying advanced ICT technology to as many stages of the policy modeling process as possible deliver an integrated view of the process and support decision making with data that is collected and analyzed in real time and with low latency. Using these techniques can add transparency to the process and lead to more informed decisions based on knowledge, data analysis and simulation results.

FUPOL is currently the only ICT system that supports the full policy making lifecycle and we'll refer to details of its implementation throughout the following chapters.

This chapter's objectives are as follows:

- Provide an overview of the system's scope – how is an ICT system for policy modeling embedded in the business domain and who are its users?
- Describe the core requirements for such a system – both on functional and non-functional level.
- Describe the building blocks of such a system with a focus on FUPOL's system design.
- Discuss various approaches to solve the integration challenge including technologies and architectural patterns.

BACKGROUND

Policy – according to Hewlett, Ramesh and Perl is "a course of action, authorized by the government, to achieve predefined specific goals" (Hewlett, Ramesh and Perl, 2009). Policy modeling is the process of defining an appropriate policy that is likely to achieve those goals.

Ann Macintosh defines the policy modeling process as a sequence of five stages, such as agenda setting, analysis, policy creation, implementation and monitoring (Macintosh, 2003). It's important to note that even as it's seen as a process it's not necessarily a linear sequence of actions. Feedback loops are built into the process to align the policy with the context in which it will be executed. These feedback loops should be based on objective data if possible.

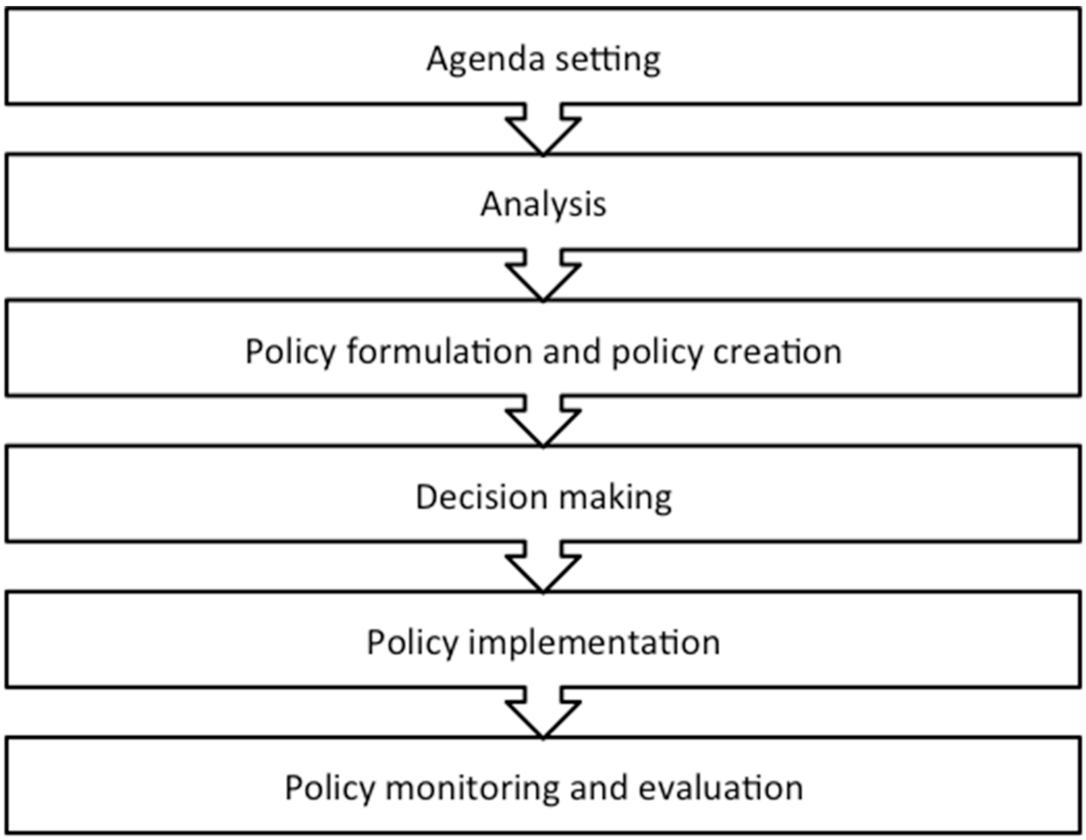
The FUPOL project uses the foundation that Macintosh provided in her model and extends it with an additional stage in order to put a stronger focus on decision making. The reason for that is that ICT systems are generally well-suited for collecting, processing and aggregating huge volumes of data, thus providing decision makers with statistics, summaries and other insights of real-world observations, including "what-if"-simulations that can add value to decision making, both for the politician who's accountable for his decisions, as well as for the citizens. This approach has been successfully applied to management information and decision support systems and FUPOL will bring it to policy modeling.

THE SCOPE OF THE ICT SYSTEM

The FUPOL policy modeling lifecycle adds an additional stage called 'decision making' between the Macintosh's "policy creation" and "policy implementation" stages:

1. **Agenda Setting:** Identify and validate the policy problem (set the political purpose - what needs to be solved).
2. **Analysis:** Identify the challenges, opportunities and solution approaches.
3. **Policy Formulation and Policy Creation:** Draft proposals for ratification based on policy options.
4. **Decision Making:** Select one of the viable alternatives and push it to acceptance.
5. **Policy Implementation:** Perform the necessary actions to turn the decision into results.
6. **Policy Monitoring and Evaluation:** Measure the policy's impact and assess the

Figure 1. The FUPOL policy modeling process



observable differences between what should be and what is (output target vs. changed reality).

Process Scope: Covering the Whole Policy Modeling Lifecycle

The ICT systems for supporting the policy modeling process must support all steps in order to be able to use their results for and objective decision and measure. If they, on the other hand, only support selected process stages then the number of possible feedback loops is reduced, adding a systemic bias to the result that the system might be able to represent and 'produce'.

For example a system that supports agenda setting, analysis and policy creation, but not implementation and monitoring would automatically be less sensitive to feedback from citizens and allow the policy maker to design a policy that is based on belief and less grounded in reality.

FUPOL uses various tools to support each of the above stages and provides functions for feeding the results of one stage as input data into another stage.

Users and Stakeholders: The ICT System's Social Context

Policy modeling happens in a 'user-rich' environment, full of stakeholders with different expectations and requirements.

The most important ones are:

- **Decision Makers:** Politicians who set the agenda and take the decisions.

- **Civil Servants:** Employees of those governmental organization that usually perform analysis and policy formulation, as well as large parts of the policy implementation, monitoring and evaluation.
- **Citizens and Organizations (further on called eCitizens):** People that get affected by the new policy. Their opinions are fed into the system as part of the feedback loops.

While the first two user groups can be seen as internal users to the organization that design and implement a policy the eCitizens are external and use the system with either intentional activity (active eParticipation) or just by providing opinions on some issue that are collected and analyzed by the system (passive eParticipation).

In order to collect substantial amounts of data it's important to keep the barrier low for eCitizens and to allow them to use the system without any technical or organizational obstacles. Thus it's important to:

- Support multiple channels for opinion collection (i.e. several social media sites, email, discussion forums, …) at the same time.
- Allow the eCitizens to use their existing accounts (i.e. using the Open Authentication standard (OAuth) for authentication instead of forcing them to create yet another personal account). While a trivial feature reusing existing accounts supports high repeat visitor rates.
- Honor the citizen's privacy expectations, i.e. by anonymizing content. Note that many countries have implemented data protection and privacy laws, but the citizens expectations might differ from the level of protection that these laws try to foster.

The Outside Entities that Provide Data and Information and Connect to the System

Policy Modeling with ICT support obviously needs input from entities that are outside the system's itself. Among these are:

- **Media Sites:** These entities provide either edited content (traditional media like newspapers) of above-than-average syntactic quality or social media content originating directly from the eCitizens. The syntactic quality of social media content is usually below average (grammar, punctuation, typos, emoticons and other particles, slang,…) which makes it difficult to analyze it with today's technologies, but it's very authentic content authored by the clients of the policy modeling process. (Traditional) media content can cover spoken language from tv and radio as well, as long as there's a way to transcribe it to text. Other media sources might be relevant too (i.e. video, photographs, …), but for those it might be harder to link the extracted information to the policy making process, especially as the analysis results from image recognition and other advanced technology are more focused on a specific use case and less usable for general trend analysis. Overall all content that seems to adress issues that are relevant to a policy can be used for analysis, as long as there's any tool available that is capable of extracting information from the data (topics, summaries, …). Media sites are connected using standardized protocols (i.e. RSS feeds) or proprietary APIs (i.e. Facebook's Graph API). For unstructured content it'll be necessary to integrate facilities for content extraction from generic web pages (boilerplate code removal).

- **Statistical Data Providers:** These entities aggregate objective information and represent them in statistics. Some of them are state-owned (i.e. Eurostat) and provide the data for free. Statistical data is important to parametrize the simulators (boundary conditions) and for visual analytics. Many data sets are georeferenced, which allows to correlate the objective statistical data with observations from social media. For example this can be used to find dependencies between the average household about on (georeferencing) social media (subjective data).
- **Knowledge and Best Practices:** While not mandatory for policy modeling per se document management systems that store best practises and content that relates to a political matter can help the decision makers and the civil servants to improve the quality of their policy modeling process. ICT systems allow to find relevant content and link it to political issues.

System Scope: What's Inside and What's Outside

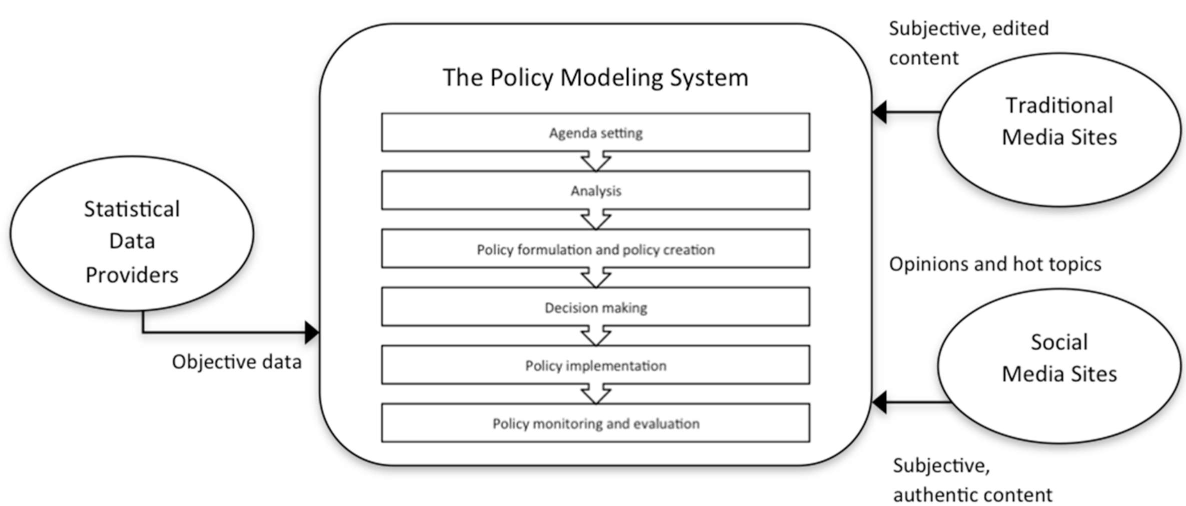
With the information already elaborated here we can draw a context diagram that represents what's inside the system's boundaries and what's outside of it (Figure 2).

Core Features

As already described ICT systems for policy modeling must support all steps of the process. Their anticipated business value is that they shall allow the policy maker to define, implement and improve a policy in a better way than without such system. This includes the effectiveness of the policy (does it achieve what's expected from it) and the efficiency to set it (implementation cost, timespan required from agenda setting to producing results).

Taking a look at the system from a very abstract business level allows us to describe the core features of such a system:

Figure 2. System context and most important data flows



- **Awareness of Policy Change Needs:** The system shall inform the decision maker that an existing policy's effectiveness has decreased below some acceptable threshold. This might be caused by changes in the environment in which it is executed (social changes, economic changes, political changes, …). Such features are most valuable in the phases of agenda setting and analysis.
- **Anticipating the Consequences of a Changed Policy:** The system shall provide hints to the decision maker that allow to decide between policy alternatives. Most of this will be used during analysis, policy formulation and decision making.
- **Promoting Civic Participation:** ICT systems for policy making require subjective data from eCitizens to extract opinions and topics that can be used as feedback to the policy maker. A high level of civic participation potentially increases the size of the available content that relates to the policy and it might increase the content's quality, as citizens get involved and learn about the problem.
- **Convenient Communication with Media:** Media content provides valuable feedback that helps the decision maker to improve the effectiveness of a policy (deeper understanding of the problem, increased acceptance of the policy by the citizens,…). As already mentioned such a system requires multichannel, simultaneous input from traditional media (newspapers, tv, radio, …) and from social media (blogs, microblogging sites, forums, social networking sites, …). In order to collect data from these sites the system needs sophisticated crawling capabilities (posts, answers to questionnaires, …) and facilities to distribute content over various channels (i.e. for policy dissemination).
- **Understanding Correlations and Trends in the Data:** The system shall integrate tools for analysing various data sets that are relevant to a policy (statistical data, semantic data, geographical data). This includes data browsing facilities and visualization tools. Statistical analysis programs and data mining software can create additional insights, too.
- **Tool Box Approach:** Although the policy modeling process is more or less a linear sequence of steps (with loops, though), its practical application requires flexibility in the selection of the tools that are most appropriate for the specific political issue and in the order of their execution. For example some problems might be suitable for a high level of civic participation, so questionnaires could be a valuable tool, while other issues might be too complex for that (thus requiring expert knowledge) and modeling an appropriate policy might involve heavy use of statistical analysis tools. As a consequence the system must not be implemented with a fixed workflow but instead as a toolbox that allows the selection of a set of tools and executing them in any order that seems to be appropriate. This requires the ability to feed output data from one tool as input into another tool.
- **Knowledge Management:** The overall result that the system shall produce is a 'good' policy, but there are other outputs of value as well. This might include lessons learned from working on the political issue, information collected from other sources that seems to be relevant to the problem etc. Knowledge can be represented in formal (well structured, ontologies,…) and informal form (documents, videos, reports, …).
- **Data Management:** The system must be capable to collect, process, analyze, visualize, import and export various kind of

data. This includes statistical data, semantic data (i.e. media data, micro-blog posts, knowledge, …), geographical data (maps, geo-referenced statistical or semantic data) and operational data (data that is required to run the system; most of it is relational data). The quantities that the system must be able to handle depend on the political issue and its scope (regional, national, international), but they're generally huge, while at the same time not considered to be 'big data' or difficult to handle with existing data processing technology. However the size of the collected data might challenge the analysis capabilities of the system.

- **Operational Support:** The system must support operational features like multiple clients, logging, journaling, authentication etc. Support for cloud computing to support the huge volumes of data might be required as well.

NON-FUNCTIONAL REQUIREMENTS: THE DRIVERS OF THE SYSTEM'S ARCHITECTURE

ICT systems for policy modeling are specialized toolboxes that combine requirements from various existing solutions, including decision support systems, management information systems (MIS), social media analysis tools, data analysis tools, geographical information systems (GIS) and others.

The functional requirements have already been described as seen from the business's perspective (which is the decision maker's point of view), but it's usually the non-functional requirements that drive a system's architecture. Thus they directly influence all integration aspects.

Scalability

Scalability is the ability of a system, network, or process to handle a growing amount of work in a capable manner or its ability to be enlarged to accommodate that growth (Bondi 2000, p195).

As already mentioned the data volumes that the system must be able to handle are huge like those parts of it that flow into the system from streaming media (social media content, transcription of spoken language (tv/radio), newsfeeds etc.). While not exactly 'big data' (dozens of terabytes to petabytes of data and difficult to handle with existing technology) and thus not requiring specialized hard- and software to capture, curate, manage and process it the numbers involved are a challenge for some technologies that are required in policy modeling (especially for generating in-time analysis results).

For example text analysis (topic extraction, summarization, sentiment analysis) depends on algorithms that might not be able to produce results within reasonable time with larger data sets. Other algorithms may be faster, but produce less accurate results.

Tools for visual analytics might have problems to visualize larger sets of (flat, unstructured) data, as it's often the case with social media data (i.e. millions of micro-blog posts). Even if they are able to handle such volumes it will be difficult for the user to interact with those big datasets. Anyway the visualization tools must be able to process the data and to support the user in extracting the 'big picture' that is hidden in the information. This might require techniques like information clustering, summarization and aggregated views as well as new kinds of visualizations.

Data storage and distribution inside the ICT system is usually not that much of a problem with today's technology. For example FUPOL uses a standard off-the-shelf relational database system for its internal data and an RDF store for media data.

In order to handle the scalability requirements there are several approaches available (Michael, Moreira, Shiloach, Wisniewski, 2007, p1):

- **Vertical Scaling (Scaling Up):** Increase a node's capabilities (i.e. by adding resources to it).
- **Horizontal Scaling (Scaling Out):** Add more nodes to the system (clustering, cloud computing, …).

Smaller systems (i.e. with a local or regional scope) might use vertical scaling and just increase the server's capabilities (RAM, CPU, storage) while larger systems will likely be hosted in the cloud.

Cloud computing service models are generally defined as:

- **Infrastructure as a Service (IaaS):** The vendor provides a virtualized infrastructure (server, storage, …); and/or
- **Platform as a Service (PaaS):** The vendor provides a virtualized execution environment (infrastructure, operating system, database, development environment,…); and/or
- **Software as a Service (SaaS):** The vendor provides an application that is hosted on a cloud based platform; and/or
- **Network as a Service (NaaS):** Not relevant for most policy modeling systems.

Depending on the commercial and political requirements most policy modeling solutions will choose IaaS/PaaS together with private cloud solutions or SaaS within public clouds. FUPOL uses an approach in between PaaS and IaaS for its own operation and will provide its functions following the SaaS paradigm to its clients.

Please note that cloud computing – while an elegant solution to solve many scalability issues in an efficient and economic way – might not be feasible due to political or legal restrictions, as the policy modeling organization loses strict control of their data. This leads to the creation of private clouds dedicated to the public sector.

Extensibility

Extensibility is the design principle that considers the future growth of an application with minimum effort.

In terms of a policy modeling system this means that the system's architecture must allow the build-up of additional features or system qualities based on the political (business) demand and on the available tools and technologies.

ICT support for all steps of policy modeling is quite new and those systems bundle existing tools and technologies to form a system that is well-suited to address the specific problems that this domain imposes. These systems can thus be decomposed again into modules that fulfill a very specialized purpose (text analysis, traffic simulation, …). An extensible system must be able to swap those modules with more advanced ones once they're available with minimum effort (for example without a major redesign; with minimum impact on the other modules).

Many of the system's features or qualities will benefit from future developments. Such improvements could be…

- **Better Analytics Tools:** Visual analytics (video analysis, face recognition, optical sentiment analysis), text analysis (advanced natural language processing, better support for multiple languages, higher accuracy in sentiment analysis…), advanced analysis tools from big data, analysis of social and communication patterns,…

- **Advanced Visualizations:** Future visualizations might provide better support for political decision making or for analyzing huge volumes of data.
- **Simulations:** Current technology for politically relevant simulations (social, economic, opinions, …) is still in its infancy. Using these tools requires specialized skills and the models are mostly 'single domain' and not well integrated. Additionally those simulations are very prone to changes in the boundary conditions. There are some aspects that can be simulated quite well (i.e. land use), but others (i.e. economic models) are still very inaccurate, at least for mid to long term simulations. Scientific advance might lead to more accurate or better integrated simulations.
- **Changes in Social Media Use:** Social media use is changing over time and once very popular sites have already become stunted (i.e. Myspace was the most popular web site in the USA in 2006; in April 2013 it was number 223). Additional services and sites (i.e. location based services like FourSquare) entered the market and became very successful. In order to collect relevant content from social media the ICT system must be extended to be able to integrate these sources. Note that social media usage is depending on several factors, some of which are rooted in culture and politics.
- **New Developments in Civic Participation:** New technologies might provide additional tools for supporting civic participation. Mobile devices allow immediate on-site feedback from citizens (i.e. to collect opinions that relate to a construction project) and sophisticated crowdsourcing approaches (i.e. distributed noise level measurements using smartphones). Wearable devices (i.e. smartwatches) could allow new applications as well.

The non-functional requirement of extensibility is usually addressed by modularization, separation of concerns, well-defined interfaces, standard protocols etc.

Note that extensibility and performance are often conflicting requirements.

As a consequence of the current state of the art an ICT system for supporting the full policy modeling process should not be seen as 'finished'. Instead of that it must be permanently extended with sophisticated technologies to increase its accuracy and its business value. Today's technologies don't allow always the production of an effective straightforward solution and there's still much room for improvement.

Adaptability

Adaptability is a system's ability that allows the change of its behaviour to the evolving user needs once the development of the system has finished.

Although the policy modeling process is well defined the reality of policy modeling often doesn't follow this process. Decisions are taken under political pressure, but without proper analysis or policies are decided that contradict the analysis results. An ICT system for policy modeling should support many different ways to use it, no matter to which extent the decision maker sticks to the predefined process.

As already mentioned such a system should not be designed with a strict workflow that doesn't allow the user to leave the predefined interaction path. Instead a toolbox approach should be preferred that allows the user to select the tools that are most appropriate to support a specific situation. For example some issues might require deep analysis of the eCitizens opinion on the political matter, while others can be decided based on statistical analysis of objective data solely.

Adaptability is a controversial issue with ICT systems in the policy making domain. While it adds flexibility to the solution strict workflows provide better process control by guiding the inexperienced user through the process steps. Depending on the level of expertise of the system's users one or the other might be more valuable, meaning that it generates better results.

BUILDING BLOCKS: THE SYSTEM'S COMPONENTS

ICT systems for policy modeling are usually composed of various modules that come in different technologies. All together they should cover the whole process. However depending on the focus of the system some modules might be implemented in higher quality than others or the system could include alternative tools for the same purpose (i.e. selection of more than one traffic simulator: a fast one for real-time simulations and a more accurate, but slower one for simulating the impacts of a construction site on the city's traffic situation).

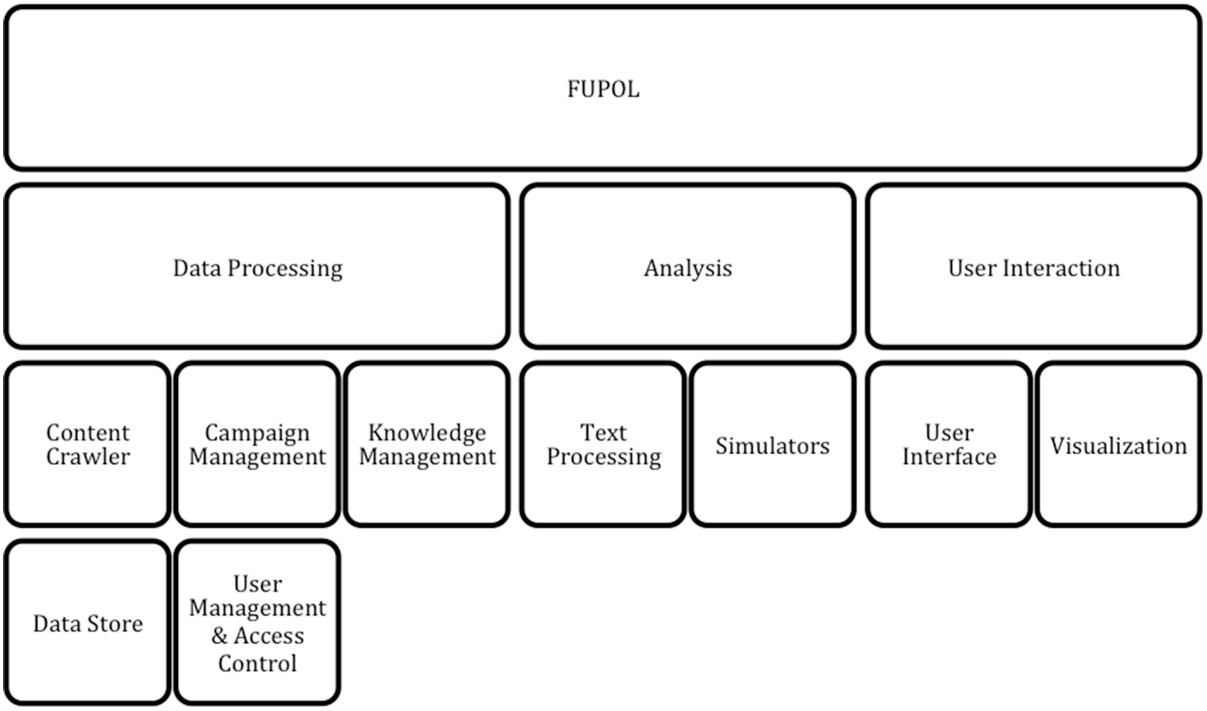
This section is heavily influenced by the FUPOL system, a possible implementation of such a system. The following diagram shows the main building blocks of FUPOL:

Data Store

Every ICT system includes a data store that is capable to store and link data. As already mentioned in policy modeling several different kind of data must be processed:

- Semantic data is used to represent less-structured media content originated from traditional media (tv/radio, newspapers) and from the Internet (microblogging sites, social networks, blogs, email, …). In order to analyze the content in an efficient way it's unified/normalized by using ontologies (i.e. FOAF, SIOC, DC, SKOS, …) so that the technical representation of semantic data is more-or-less equal independent of the content's source. Semantic data is stored as RDF triples/quads in an RDF store, a technology borrowed form the semantic web technology stack. SparQL is used to access semantic data. RDF stores are less mature than relational databases, but they offer advanced features (i.e. inference and federated queries joining internal data and external open linked data). As with FUPOL semantic data is by far the fastest growing one in volume.
- Statistical data is used to represent objective information. Most data is originating from statistical institutions like Eurostat. Statistical data can be stored in different form, often in relational databases. There are ontologies available to represent statistical data in RDF (i.e. W3C's Data Cube ontology), an approach that was taken by FUPOL. Most of this data is timelines of some indicators, often it's geo-referenced as well (i.e. with the NUTS region).
- Geographical data is used to put content in its geographic context. For example mobile clients often add GPS coordinates to social media posts (i.e. micro-blog posts). Furthermore geographical data is used to draw maps (base maps for rendering the background). Geographical information systems (GIS) are used to store, manage and process this kind of data.
- Knowledge data is used to represent formal or informal knowledge. Formal knowledge can be used to automatically infer additional knowledge from it (i.e. by reasoning), while informal knowledge supports the human user in understanding a problem or some best practices. Depending on the type of knowledge RDF stores or document management systems are appropriate to handle this kind of data.
- Relational data is used to represent internal technical entities (users, accounts, clients, log-entries, …) and well-structured business entities (campaigns, search definitions, …). Relational data are stored in a

Figure 3. FUPOL's components and core functions



relational database. SQL is used to access the data. Relational databases are fast and mature.

User Interface

For interacting with the systems users a graphical user interface is required. Depending on the user group different interfaces are appropriate:

- Internal users (decision makers, civil servants) will use the system within their office. Thus the system must use existing directory services for account management. Internal users can either use a web based interface or a rich client.
- External users (eCitizens) will use the system either intentionally (active eParticipation) or unintentionally (passive eParticipation). In either case the ICT system should remove all obstacles that might prevent the eCitizen from using the system. Such an obstacle is a new account, so FUPOL uses open authentication (OAuth) whenever possible for eCitizens. With OAuth people can use their existing social media accounts (Facebook, Twitter) and their existing passwords to use the system.

Another aspect is that eCitizens might use the system in another context. FUPOL provides tools that can be embedded in external websites (i.e. the mayor's blog; the homepage of some political organization, …), above all questionnaires (electronic forms for collecting structured answers) and opinion maps (interactive maps for collecting geo-referenced opinions).

Embedding tools into other sites removes another barrier: people use their well-known sites and don't have to open another one. Mobile devices might add additional channels for user interaction.

Text Processing

Policy modeling systems use objective and subjective data. Subjective data is provided by eCitizens, i.e.:

- Social media posts (microblog posts, comments, blog posts, …),
- Emails,
- Forum posts,
- Etc.

In addition to that there are other sources of subjective data:

- Newspapers (including RSS streams).
- Spoken language from TV/radio broadcasters. This content must be transcribed into text, which is a complex process involving advanced speech processing technology. Unfortunately the existing solutions only support a predefined and limited set of languages. For example FUPOL currently supports English, Spanish, Arabic, French and German using an external speech-to-text system.

The collected content is managed in the RDF store. It's called the text corpus.

Based on the text content several analysis tools can be used to summarize the content:

- Topic extraction is the process of extracting the topics that are discussed in the text corpus. This kind of summarization is well-suited to address the development of topics over time.
- Hot topic sensing is the process of identifying the most relevant topics at a given point in time.
- Summarization is used to select the most representative sentences from the text corpus. Summarization is very user-friendly, as it picks content authored from other users and doesn't generate any artificial information.
- Sentiment analysis is used to understand the emotional bias behind a post. Sentiment analysis is language dependent and thus not all content might be covered (or in the same quality). Today's technology is not very accurate, though.

Overall these text processing tools extract the 'big picture' from the large volumes of data.

Visualization

Visualization tools are used to understand trends and correlations in the data. Dashboards provide a means of combining different sets of data (even different types of data) on the same screen.

The element of interactivity is essential for visual analytics, as the mode of operation is browsing through the data and not that of studying predefined reports. Thus these tools must support real-time interaction between the user and large datasets.

In many cases the user will want to understand different aspects related to the semantic (content), social (relationships, gender, age, …), geography (GPS coordinates of the sender, spatial distribution of topics,…) and time (i.e. the content's timestamp) of information.

Depending on the type of data, specialized visualizations that illustrate selected aspects of the data will be required (i.e. for social analysis or impact analysis).

Simulator

Simulators can be used to anticipate the consequences of a changed policy. A simulator is a tool that imitates the operation of a real-world process or system over time (Banks, Carson, Nelson, Nicol, 2001).

In the context of policy modeling such processes or systems might be:

- Economic systems (i.e. production, trade, …),
- Social systems (i.e. to understand how changes to the housing policy might affect crime in a city),
- Public transportation (i.e. to optimize bus lines and their schedule),
- Traffic (i.e. to understand the impact of a construction site on the city's traffic),
- …and many more, as soon as there's a simulation model available for it.

In many cases policy makers would like to have some kind of "universal simulator" that is able to simulate many or even all aspects of their city or nation, but unfortunately such simulators don't exist. In reality current simulation technology is capable to simulate single or at least very few domains or processes, but the integration of several simulation models in one simulator is challenging both for simulation modelers and for the implementation.

In addition to the theoretical limitations of today's simulation technology, using these tools in the context of policy modeling requires specific skills that are not always available in governmental organizations and setting up the required models takes time. Furthermore the parameterization of the simulation models depends on the availability of accurate data (i.e. for boundary conditions).

In reality simulation should be seen as one of many other inputs and tools for policy modeling and not as a machine that would take accurate and unambiguous decisions. The simulation results are still to be interpreted by experts and depending on the used models different simulators might even produce contradicting results.

As we've already discussed there's no one-fits-all simulator available and for many policy modeling aspects the decision maker will want to simulate more than one process or system. This usually requires different models and simulators to be used. Thus an ICT system for policy modeling that supports simulation should be extendible in a way that allows the integration of several – even external - simulators. Tightly coupled point-to-point connections between the ICT system and the simulators should be replaced with simulator APIs that can be accessed by the simulators in order to fetch data and store simulation results. FUPOL uses such a well-defined API that is based on REST calls and standard protocols so that other simulators can be integrated with minimum effort.

Content Crawler

Text based data from traditional media (newspapers, TV, radio) and social media (social network sites, micro-blogging, blogs, etc.) must be collected and stored in the system in order to use it for analysis. The content crawler is a module that is capable of accessing these external sites – either by standard protocols like RSS, or by accessing their proprietary APIs (i.e. Facebook's Graph API or Twitter's streaming API). Content from these sites must be normalized to fit into some internal storage format (i.e. RDF with ontology-based structures) and stored together with meta-information that describes the data (i.e. its origin, timestamp of creation, author, content type, language, etc.).

Storing the content in a normalized form is important as the ICT system will use the same algorithms for analyzing content, independently of its source.

These normalizations include preprocessing steps that must be performed for some source channels. For example RSS feeds contain links that point to web URIs which subsequently must be fetched and parsed to get the content. These web pages often contain boilerplate code like advertisements, menus, links to other sites etc. In order to extract the content that the policy modeling software is interested in (usually a news article) the boilerplate code must be stripped from the page, which is a non-trivial task. There are several approaches available and most of them are based on pattern matching and structural analysis. FUPOL uses an approach outlined in (Kohlschütter, Fankhauser, Nejdl, 2010).

Content crawling imposes some scalability limitations:

- Content from social network sites (i.e. Facebook) or micro-blogging sites (i.e. Twitter) is available to the public via the site vendor's proprietary APIs, but there are strict and quite low rate limits that prevent the collection of huge amounts of social media data. These rate limits can be lifted by paying for the content, though. In the context of policy modeling it might not be possible to get funds for purchasing such data for financial or political reasons. Such reasons could be – besides the obvious financial constraints – the sensitivity of the public towards mass-scale social media analysis.
- Crawling public sources like RSS streams, accessing the web pages behind and normalizing the content takes considerable time. Even if multiple threads are used for performing this task there are limitations to the number of channels that can be crawled and processed at the same time (latency time).

Knowledge Management

The Oxford Dictionary defines knowledge as "facts, information, and skills acquired by a person through experience or education" (The Oxford Dictionary). In the context of policy modeling this means an understanding of best practices, successful policies, lessons learned and other policy related material, originating from within the political organization or from other sources. The purpose of this is pragmatic and less formal.

Knowledge management in an ICT system for policy modeling can be done in several ways, some are less formal than others. First of all technology can support knowledge management, but the process itself is still very human-centric, at least if the representation of knowledge is done in less formal ways (documents, multimedia content, …). Furthermore organization and individuals use tacit knowledge daily without explicit representations of it.

The idea behind knowledge management in policy modeling is that the reuse of experience from the past or from other organizations might lead to better policies (i.e. by supporting informed decisions over best guesses). The problem behind this is that knowledge that was relevant for an organization that modelled their policy in their context might not be transferable to another organization or it might not be applicable at all. A naive approach of writing down experience into documents, transferring these to another organization, reading and interpreting them there will omit all forms of tacit knowledge if the process of knowledge engineering was not performed thoroughly.

Nonaka and Takeuchi (Nonaka, Takeuchi, 1995) describe a spiral model for transforming tacit (implicit) knowledge to explicit knowledge and vice versa. Both transformation directions are rooted in an organizations social system.

Technology can only support this process, but not automate it. The diagram to the right shows this model.

User Management and Access Control

User management and access control are technical implementations of authentication and authorization procedures.

For the internal parts of an ICT system for policy modeling (used by decision makers and civil servants) the implementation is quite straightforward. Usually these systems access existing user directory services.

For the external parts that are visible to eCitizens less restrictive mechanisms should be used. In order to encourage eCitizens to use the system all barriers that would prevent citizens from using it should be avoided. Such a barrier is setting up an account, memorizing yet another username and password. Thus these systems should reuse existing accounts whenever possible. Open authentication (OAuth) is an open protocol for standardized and secure authorization that is in widespread use with desktop, web-based and mobile applications. It allows the eCitizen to reuse an existing account for signing up and using another service.

In FUPOL eCitizens can use their Facebook and Twitter accounts to sign in to the protected parts of the system.

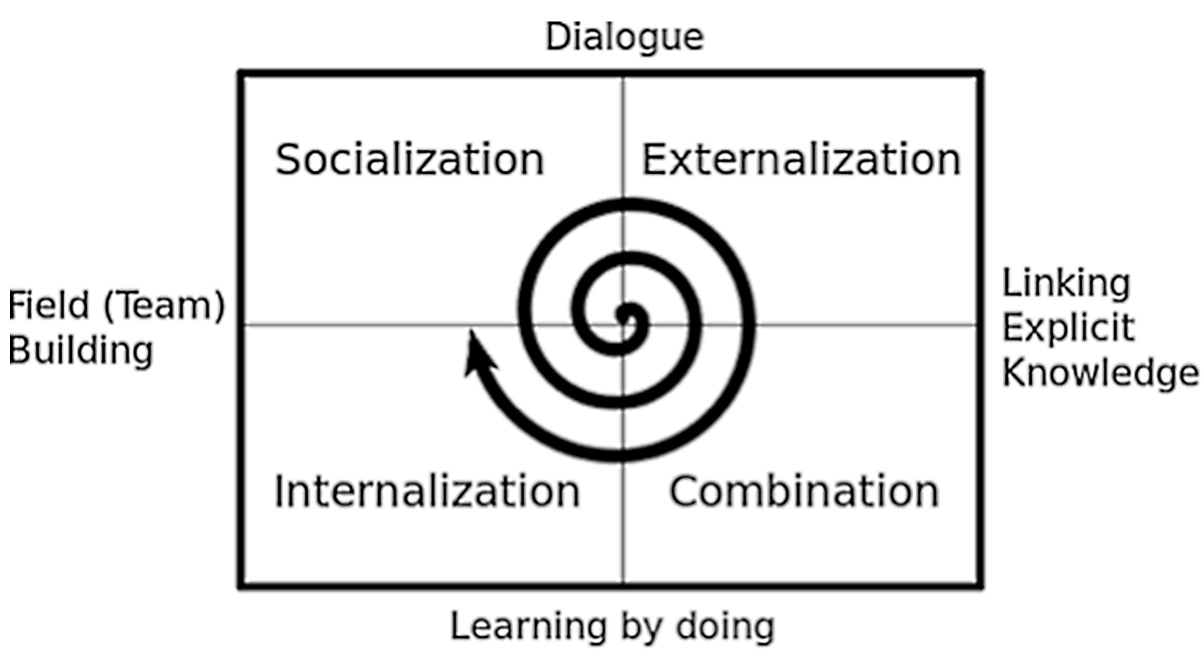
Campaign Management

Policy modeling is a process with a defined start and end point. All steps between these two points can be performed under the umbrella of a campaign. Campaigns share many aspects with projects:

- They have a defined set of goals,
- They have a defined start and end date,
- They are supported by a team and a process.

Campaigns allow an ICT system for policy modeling to provide a data container for the

Figure 4. Nonaka and Takeuchi's spiral model for knowledge processing within an organization



campaign's team, including a local data store, social media search definitions etc. Within the campaign's sandbox data shall be transferred between the available tools in a flexible way, so that the toolbox approach can be used. External data can be imported into the campaign's data store, additional data is generated from the tools (social media searches, simulation cycles, analysis results, …) and added to the campaign. Once the campaign has produced its final results data can be exported from there (either to another campaign or to the knowledge base).

SYSTEM INTEGRATION

As we've now outlined the bits and pieces that an ICT system for policy modeling might be composed of the question of appropriate integration arises. Most – but not all – of the modules communicate with each other in real-time and work on the same data.

An ICT system's architecture is mostly driven by its non-functional requirements (NFRs). We've identified:

- Scalability.
- Extensibility.
- Adaptability.

These are the most important NFRs. So the system's architecture must allow the growth in capacity, be extended with future technology and be adapted to the policy maker's specific needs. Overall flexibility is the most important architectural goal, more important than accuracy and performance. This is in alignment with the system's domain and the data quality (social media content, natural language, opinions) that the system must process. Policy making is not rocket-science and there's much uncertainty and systemic error involved in doing so. A system that delivers high value to its users – especially to the decision maker – should provide an acceptable result within reasonable time and not a precise result that arrives too late. This includes the requirements that the tool must be seen as a supplement to policy making that must follow an external process instead of a workflow tool that defines how political decisions should be made.

Coupling

The most important architectural decision is that of the inter-module coupling within the system. Coupling is the degree to which each module relies on any other module in the same system (Stevens, Myers, Constantine, 1974). The two extreme positions are loose coupling and tight coupling:

In general a tightly coupled system is easier to keep in a consistent, synchronized state (i.e. by using transactional communication), but at a high price:

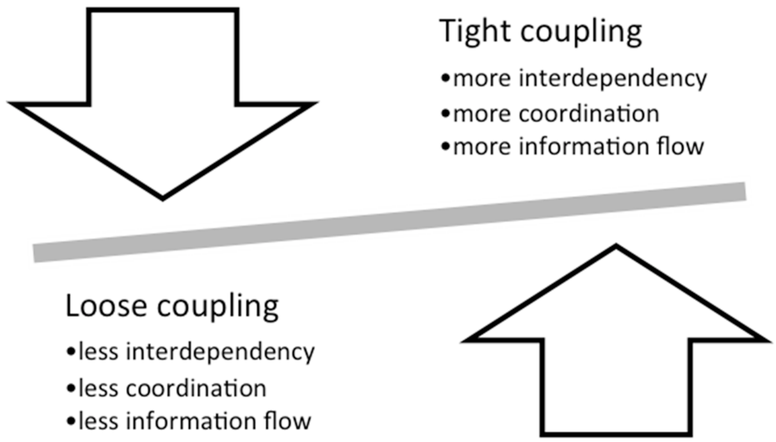
1. A change to one module can cause a ripple effect on other modules (due to the lower cohesion of the modules).
2. Integration is more complex (due to the dependencies between the modules).
3. Replacing modules with (i.e. more advanced) substitutes is often difficult (due to 1 and 2).

Given our architectural goals it's quite obvious that it'll be easier to achieve them with a loosely coupled system, as shown in Table 1.

Obviously a monolithic, tightly coupled approach is not suitable to achieve our architectural goals, as it would sacrifice all aspects of flexibility for performance. So a loosely coupled system must be considered.

The requirement of extensibility here means that the system must allow the extension of its functionality with modules that use technology that is not available by the time when the system was designed. Thus the architecture must support the (at least future) integration of platforms

Figure 5. Tight coupling vs. loose coupling



and technologies that are unknown now. Again, loosely coupled systems are better suited for that. A promising approach to achieve this "technological independence" is to treat the modules not as technical pieces but as services. Thus the details of the technical implementation are hidden behind service interface descriptions. A service oriented architecture (SOA) is suitable for such an approach.

Service Oriented Architecture

A service oriented architecture is a software design and software architecture pattern that is based on the idea of modules that provide services to other modules (services). Those services encapsulate well-defined pieces of functionality and expose them over well-defined APIs. The overall system

Table 1. Architectural goals and how well they can be achieved with loose and tight coupling

Architectural Goal	Tight Coupling	Loose Coupling
Scalability	Difficult, as the interfaces between the modules usually transfer larger volumes of data (less cohesion), so there are more chances for "internal scalability bottlenecks". Tightly coupled systems can't be decomposed by design. So the possibilities for horizontal scaling are reduced. However, tightly integrated systems might perform better than loosely coupled ones.	Easier, as it's easier to identify scalability and performance bottlenecks. In addition to that in loosely coupled systems it's easier to replace modules with (more scalable) substitutes and to physically separate modules (clustering, cloud computing). However, loosely coupled systems tend to be "less efficient" and thus their performance might be lower than that of a tightly coupled system.
Extensibility	Difficult, as the modules depend on each other and local changes impose global effects (ripple effect)	Easier, as the modules are more cohesive (well defined APIs, less chatty communication) Furthermore it's easier to combine diverse technology and platforms within the same system.
Adaptability	Difficult, as the modules are depending on each other. Changes to the workflow after the system has been designed/implemented often lead to a complete redesign.	Easier, as the overall complexity of the interactions (between the modules) is lower than in a tightly coupled system.

is composed of such services. While this idea is not new service-oriented architectures combines best-practices from disciplines like modular programming, event-oriented design and interface/component based design with today's technology, especially with standardized protocols and data representations (web services, XML).

Services themselves are self-contained units of functionality that are integrated in a loosely coupled way. The integration of these services uses metadata that describes the services (characteristics, data) and their interfaces and infrastructural components that fulfill services like service discovery, communication and communication orchestration. In its extreme form service oriented architectures can be used to form ad-hoc systems.

SOA is based on the following service-oriented design principles (http://serviceorientation.com, summaries from http://en.wikipedia.org):

- **Standardized Service Contract:** Services adhere to a communications agreement, as defined collectively by one or more service-description documents.
- **Service Loose Coupling:** Services maintain a relationship that minimizes dependencies and only requires that they maintain an awareness of each other.
- **Service Abstraction:** Beyond descriptions in the service contract, services hide logic from the outside world.
- **Service Reusability:** Logic is divided into services with the intention of promoting reuse.
- **Service Autonomy:** Services have control over the logic they encapsulate.
- **Service Statelessness:** Services minimize resource consumption by deferring the management of state information when necessary.
- **Service Discoverability:** Services are supplemented with communicative meta data by which they can be effectively discovered and interpreted.
- **Service Composability:** Services are effective composition participants, regardless of the size and complexity of the composition.

Most of these design principles match very well with our architectural goals, as shown in Table 2.

Obviously extensibility benefits most from a service oriented architecture as it addresses the core-challenges of it.

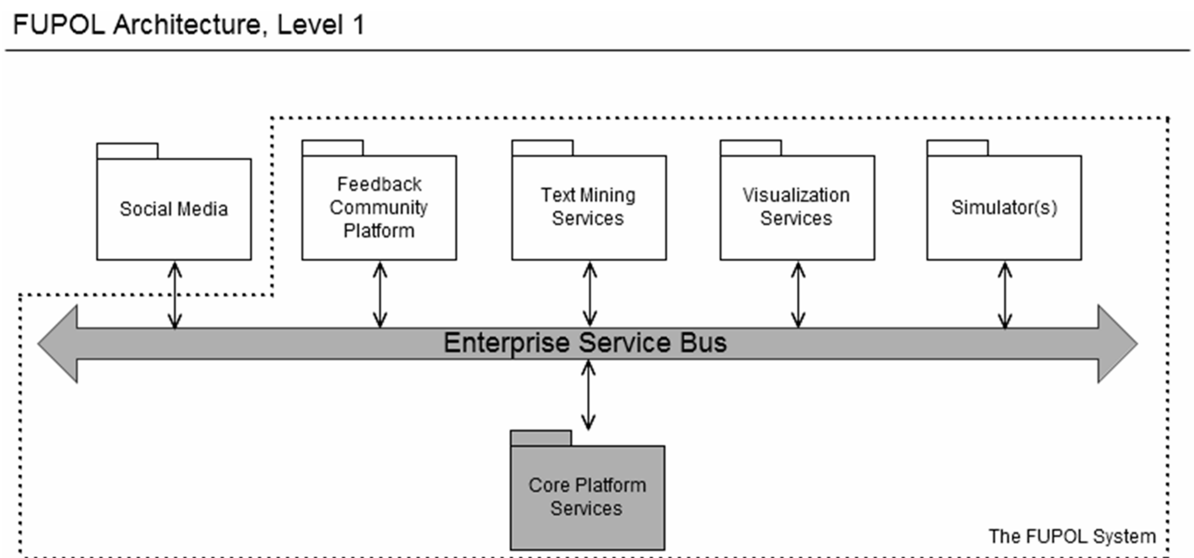
Enterprise Service Bus

One possible solution for coupling the modules in a SOA based system is the use of an enterprise service bus (ESB). An ESB is an evolution of the client/server model that is focused on solving the communication and interaction requirements of

Table 2. SOA's design principles and how they match with the system's architectural goals

SOA Design Principle	Scalability	Extensibility	Adaptability
Formal contract		X	
Loose coupling	X	X	X
Abstraction	X	X	X
Reusability		X	
Autonomy	X	X	X
Statelessness	X		
Discoverability	X	X	X
Composability		X	

Figure 6. FUPOL's SOA architecture is based on an enterprise service bus



heterogeneous large-scale enterprise systems. The core idea behind it was taken over from hardware engineering, where (physical) bus systems were used to transmit all kinds of information between electronic components (CPU, memory, GPU, …). Many network protocols followed the same principles as well (including http and the world wide web) and software bus systems were already in use in operating system designs.

Enterprise service bus systems are pieces of software that provide the following features to the services in a SOA based architecture:

- Commodity services (security and access control, event queueing, exception handling, quality of service measurement, data transformation and protocol conversion, event handling),
- Message communication (reliable, monitored, conforming to standards, orchestrated),
- Resource control between concurring modules,
- Lifecycle services (deployment, versioning),
- Scaling (redundant services).

FUPOL's architecture follows a SOA approach and uses an enterprise service bus for coupling the system's services (the core platform is a bundle of services for authentication, data storage, crawlers, campaign management, knowledge management and others):

For a thorough description of the core platform's requirements and architecture we refer to our deliverables D3.1/D3.6 and D3.2.

Standard Protocols

All modules are exposed to the system as services with well defined APIs that are based on standard protocols whenever possible.

Some protocols in use are shown in Table 3. All of them are based on XML (note that only the "high level" protocols are listed; "low level" protocols like HTTP or JDBC are omitted).

Table 3. Standard protocols for data exchange

Protocol	Purpose	Services that Use it
SparQL	Access semantic data (i.e. media data)	• Data store. • Text processing. • Visualization. • Simulator.
RDF	Represent semantic data	
FOAF/SIOC/DC/SKOS	Represent media data	
SDMX	Represent statistical data	
OWL	Represent the ontology	
WFS/WMS	Access geospatial data	• Data store. • Visualization. • Simulator.
WML	Represent geospatial data	
REST	Access other relational data (i.e. campaigns)	All

Protocols that are used to link the system to external entities are all based on web services (i.e. Facebook's Graph API, Twitter's streaming API, eurostat's RDF datasets).

FUTURE RESEARCH DIRECTIONS

Social media analysis is now a standard tool in product marketing and even used in the political domain (albeit for special occasions i.e. for supporting election campaigns), but this technology has not yet diffused into everyday policy modeling. The reasons for this are both related to technology and to a lack of knowledge in the administrations (especially outside of political parties). Existing tools with their focus on brand marketing are very capable of tracking the occurance of brand names in social media, but they lack the capability to sense generic political opinions as these usually don't relate to keywords but instead must be correlated to taxonomies of political topics.

FUPOL with its 'soft' topic-based approach should be capable of sensing geographical, topical and to a lesser extent demographic relevance of political issues. However the final proof for the applicability of FUPOL's topic analysis approach has still to be shown. This is why the FUPOL consortium includes various pilot organizations, from smaller municipalities to large cities. Another pilot is located in Mtwapa, Kenya, where UN Habitat uses the FUPOL tools to improve the situation of slum dwellers. The project's work package "WP7 Large Scale Demonstrators" will research the practical applicability and validate the output in the pilot organizations.

Another challenge that has to be solved is the support for the full policy modeling process, especially in terms of acceptance by the political decision makers who tend to base their decisions on factors that might not always be grounded on research and data.

Technically there are many future research opportunities that we are unable to address in the FUPOL project, i.e.:

- Scaling up the system by adding additional channels or by increasing the imported data volumes so that it becomes a real 'big data' processing unit. There are many research opportunities here, especially for the semantic web technologies that FUPOL uses (i.e. cloud based RDF stores).
- Utilizing additional data (i.e. mobile device data, sensor data, image processing data, …). It would be interesting if these

data sources are useful to increase the system's accuracy. Another interesting problem is how the available statistical data can be linked to or correlated with the observations that the system processes.

- Semantic web technology provides features that are not yet used in FUPOL, but that could add value to the system. Examples are the execution of analysis tasks directly inside the RDF store (i.e. by using agent based analyzers and/or reasoning).
- Forecasting of political opinions is a feature that has been requested by many decision makers and that could use the data and the analysis results that FUPOL provides. Even short-term forecasts (several hours) sometimes have their value.

CONCLUSION

The chapter is focused on the technical design and architecture of an ICT system that supports the policy modeling lifecycle.

As with every system the non-functional requirements are the drivers of the architecture. In particular these are…

- **Scalability:** Expect huge volumes of data (but not "big data").
- **Extensibility:** Build a system that can grow in features based on the businesses demand. This includes the integration of (future) technologies as soon as they might be available.
- **Adaptability:** Design the architecture in a way that allows the users to customize the system to their specific needs. Those needs are driven by the political issues that are going to be addressed with it.

Besides that the system must support a tool box approach that allows the user to select the appropriate tools for her specific situation without imposing the restrictions of a strict workflow based solution.

Additional requirements that must be considered are rooted in culture, ethics and finally in their legal representation, especially when it comes to data protection, privacy and social media usage.

We've shown that the bits and pieces that are necessary to build such an ICT system are already available and that by combining them using a flexible, service-oriented architecture the modules that implement those components can be developed further without interfering with the rest of the system, allowing us to exploit the opportunities that scientific advances and new technologies provide.

The main message here is an ICT system that supports as many steps of the FUPOL policy modeling approach as possible is never "finished", but instead it must be adapted and enhanced based on the technologies that are available by that time. Its users are slowly (but steady) changing the way that they use media and the system must follow them, using technology that best matches the demand. If it doesn't its accuracy will diminish over time, rendering the system useless.

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KEY TERMS AND DEFINITIONS

Adaptability: A system's ability that allows the change of its behaviour to the actual user needs once the development of the system has finished.

eGovernance: Means that governance is driven by ICT whilst delivering government or public services and products.

eParticipation: The support and enhancement of public participation in the government decision making process by ICT, especially by social media.

Extensibility: The design principle that considers the future growth of an application with minimum effort.

FUPOL (Future Policy Modeling): An FP7 project providing an integrated approach to e-Governance, e-participation and policy modeling.

ICT Tools for Policy Design and Implementation: All features required and available to increase the quality and acceptance of policy measure by the public, such as social media tools, opinion maps, hot topic sensing, visualization and simulation tools.

Policy Lifecycle: The life cycle of a policy, beginning from its identification and analysation, its detailed formulation, the decision making process, its implementation and the monitoring and evaluation of the policy impact.

Policy Modeling: The representation of the real life policy in a model and to predict the impact of policy measures in a de facto laboratory environment.

Scalability: The ability of a system, network, or process to handle a growing amount of work in a capable manner or its ability to be enlarged to accommodate that growth (Bondi 2000, p. 195).

Service Oriented Architecture: A software design and software architecture pattern that is based on the idea of modules that provide services to other modules (services).

Section 4

Best Practice Cases and Research Projects

Chapter 15
Zagreb Case:
Improvement of Social Infrastructure

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ABSTRACT

This chapter explains the manner of implementing FUPOL policy model and FUPOL platform in the process of creating the actual policies in the City of Zagreb. For that purpose, two pilot initiatives have been chosen, and based on them, the whole policy lifecycle has been covered. The background of these pilots is explained, as well as the challenges that the City of Zagreb has faced. In addition, the results of concrete actions and possible solutions are presented. All of them use a new integrated approach to policy design and implementation that consists of an advanced policy lifecycle and an IT-solution (FUPOL) with features supporting all phases of the proposed lifecycle.

INTRODUCTION

The City of Zagreb is involved in the FUPOL project as a pilot city and the evaluator of FUPOL models. The reasons and motivation for the City of Zagreb participating in this project are to be involved in the development of new technologies enabling citizens to participate in the creation of urban politics, as well as providing better understanding of the citizens' needs by public authorities.

It was noted that the current methods of consultation with the citizens do not reduce the risk of missing important details and the exclusion of certain groups of citizens, and ultimately it leads to the rejection of the political decisions and policies. For that reason the FUPOL consortium has elaborated a comprehensive approach to further advance the research and development in simulation, policy process modeling, semantic analysis and visualization (Sonntagbauer, 2013). The scientific approach is based on complexity science. It is aimed at reducing the complexity through a comprehensive policy spiral design lifecycle approach deemed appropriate for complex societal problems (Palmisano, 2012).

DOI: 10.4018/978-1-4666-6236-0.ch015

Building on the current political environment and the public sector collective data FUPOL has enabled all stakeholders (interested citizens, companies, NGO etc.) to better forecast and understand future trends. While the approach and the technologies itself are generic and can be used in any policy domain, the projects focus is on urban policy challenges since the majority of the world's population is living in urban areas.

The City of Zagreb has tested the new FUPOL policy lifecycle and tool in the field of using the land for the purpose of social infrastructure improvement, applying them to different issues in this area.

The different social networks, such as Facebook and Twitter, as well as various electronic media, portals and blogs are channels that have been used in the new FUPOL tool for automatic collections and analysis. The City of Zagreb is able to interpret the results of the analysis and the opinions of the interested public. It provides a better understanding of the citizens' needs and more effective policy modeling.

BACKGROUND

The City of Zagreb has implemented two pilots in the domain of Land Use & Improvement of Social Infrastructure (Jones, 2012), (Jones, 2013), (Topham, 2013). The first one consists of two tests, one regarding the policy setting in the field of social infrastructure, and the other one for gathering the opinions apropos the Centre for autism. The second pilot also consists of two tests, one for the policy setting in the field of social infrastructure as well, and the other one for gathering the opinions apropos the children's playground in Remete. This chapter presents only the first pilot that has already started and provided some initial results.

First pilot initiative was launched in May 2013. The aim of the pilot initiative was through FUPOL approaches and platforms to include a greater number of citizens in the campaign aimed to define the city's policy on the issue of improving the social infrastructure in Zagreb, and the construction of the Centre for Autism and accompanying sensory park. In this way accomplished are also the preconditions for the evaluation of the new FUPOL solutions.

Test 1: Social Infrastructure

The City of Zagreb ensures the necessary infrastructure for the education of preschool (kindergartens) and school children as well as for their everyday sports activities and access to the city's cultural facilities. Taking part in sports activities and access to cultural facilities should be enabled for all other Zagreb's citizens and visitors, too.

In the drafting of the City's Development Strategy (Gradski ured za strategijsko planiranje i razvoj Grada, Zagreba, 2013), the principal of the City Office for Strategic Planning and Development of the City *con* the principal of the City Office for Education, Culture and Sports. The principal of that Office made an analysis of the existing state and problems arising from it. Further given is an overview and analysis of the perceived problems in the area of preschool education, elementary and secondary education, university education, culture and sports.

Preschool education (*Službeni glasnik Grada Zagreba* 18/12, 16/13):

- The existing number of the city's preschool institutions does not meet the need, especially in the areas of the city districts of Sesvete, Stenjevec, Podsused - Vrapče, and in certain parts of Črnomerec, Dubrava - Gornja and Donja, Maksimir, Podsljeme, Trešnjevka - north and south, Novi Zagreb - east and west, and of Brezovica.
- Most cities' preschool institutions are more than 30 years old on the average and about

25% of them are residential and business premises refitted for accommodation of children.

- Refitted facilities, in most cases, do not have adequate gym halls nor playgrounds or other areas for daily outdoor activities.
- Residential and business facilities refitted for accommodating children are not an adequate solution and may only be of temporary service (until facilities dedicated for the purpose are built)

Primary and secondary education (*Službeni glasnik Grada Zagreba,* 18/12, 16/13):

- Lack of school premises in the existing primary and secondary school facilities, due to which a large number of such schools operates in two shifts.
- Dilapidation of a part of the existing school facilities (most of them were built 30 years ago) in primary and secondary schools.
- Lack of gym halls and playgrounds in primary and secondary schools (50% of the schools do not have adequate gym halls).
- The number of primary and secondary schools with special education programs is significantly below the requirement.
- In some city districts there is an insufficient number of primary and secondary schools since the matter at hand are districts with prominent residential building construction and districts in which the internal city migration flow is directed toward the edges of the city.

University education (*Službeni glasnik Grada Zagreba,* Zagreb 18/12, 16/13):

- Lack of premises for holding classes, because of which some faculties hold classes in 5 to 10 different locations.
- Lack of accommodation facilities for an increasing number of students coming from other parts of Croatia and from abroad.

Culture (*Službeni glasnik Grada Zagreba,* 18/12, 16/13):

- Unequal distribution of cultural programs across city districts, especially in the newly constructed districts.
- Lack of premises and other conditions for satisfying and meeting the citizens' and visitors' cultural needs (lack of libraries and reading rooms, halls for exhibitions, dancing, art workshops and other cultural needs).

Sports (*Službeni glasnik Grada Zagreba,* 18/12, 16/13):

- The number of sports facilities is at 50% in view of the level of construction as regards European standards and citizens' actual needs for sports activities.
- Most sports recreation associations do not have their own sports facilities, and the existing facilities do not meet the need neither in respect of surface area nor quality.
- An unequal distribution of sports and recreation facilities across city districts, and an evidently increased need for sports facilities as regards their availability in the entire city's area.
- Insufficient number and inadequately equipped playgrounds.

The principal of the City Office for Education, Culture and Sports has informed the principal of the City Office for Strategic Planning and Development of the City of the above-mentioned issues. He stressed the need for using land for the purpose of building facilities for the needs of preschool and school education, culture and sports. The principal of the City Office for Strategic Planning and Development of the City accepted the proposals of the principal of the City Office for Education, Culture and Sports and incorporated them into the Development Strategy of the City of Zagreb – ZagrebPlan.

Test 2: Centre for Autism

The City office for Education, Culture and Sports and the City office for social protection and people with disabilities made a decision to build the Center for autism on the sight of the Oporovec area, with a total of 29801 m^2 planned for the construction of a new elementary school including all necessary utility infrastructures (Official Gazette of the City of Zagreb 16/07, 8/09, 7/13), (*Službeni glasnik Grada Zagreba,* 8/01, 16/02, 11/03, 2/06, 1/09, 8/09), (*Službeni glasnik Grada Zagreba,* 13/12).

The area included by the UPU Oporovec-south is located in the eastern part of the city, north of Dubrava and Klaka area. This is the part by the central zone of former Granešina area, located south of the Novoselečki put.

The existing land subdivision is historical, with incorrect shape and elongated in the north – south direction. In the zone towards the east there is an agricultural area today, which too UPU is turning into a theme park.

The plan foresees various uses for that area. It is expected, regarding the area position in the City's northern residential part, that most part of the zone is intended for mostly residential areas.

For this area the detailed plan elaboration is mandatory, by which all basic urban parameters for land use will be defined, as well as the way in which the area will be used and decorated, according to its planned purpose for public and social needs and respecting the values and specificities of the surrounding area.

The transformation of this area will include construction which will offer a high quality of living to the future inhabitants with its spatial – functional determinations. Since the local population is very interested in using the surrounding land for their own needs, it is necessary to examine the possibility of the Centre for Autism's construction regarding its high significance. It is an institution that takes care of the children and adults with autism and mental illness. The Centre for the Autism organizes educational work for:

- 21 students from I.-VIII grade divided in 4 classes;
- 137 students from 7 to 21 years of age in 30,5 educational groups; and
- 108 adults participating in 14 educational groups.

Since the educational activities of the Centre for Autism are carried out in 7 different locations, it is estimated that a positive educational results will be accomplished by building a new facility.

Team work and respect for all professions and persons involved is necessary to accomplish excellence in the realization of this project.

MAIN FOCUS OF THE CHAPTER

Issues, Controversies, Problems

For the purpose of defining the new policy of improvement of the social infrastructure and building the Centre for Autism with the sensory park, a public dialogue should be held in accordance with the Croatian regulations. Public presentations, discussions and collection of written remarks and suggestions should be organized at city level and at the level of city districts. The principals of the said offices have agreed that, because of prior negative experiences, the public should need to be included more extensively.

It is a main issue that these offices and the City of Zagreb in general should cope with. How to enable involvement of citizens at a larger scale and how to provide mechanisms for collecting opinions from different groups of stakeholders are the questions that arose.

Solutions and Recommendations

The FUPOL policy lifecycle and the FUPOL platform are recognized as possible solutions. The actual topics have been opened for discussion on the websites of the City of Zagreb, on the social network pages of the City of Zagreb and blog (http://zagreb-fupol.blogspot.com/). For this purpose the FUPOL platform has been used, which allows the actors involved search the most used social networks to collect people's opinions on this topic. Such opinions can also be geo-referenced through a specific opinion map (Sonntagbauer, 2013).

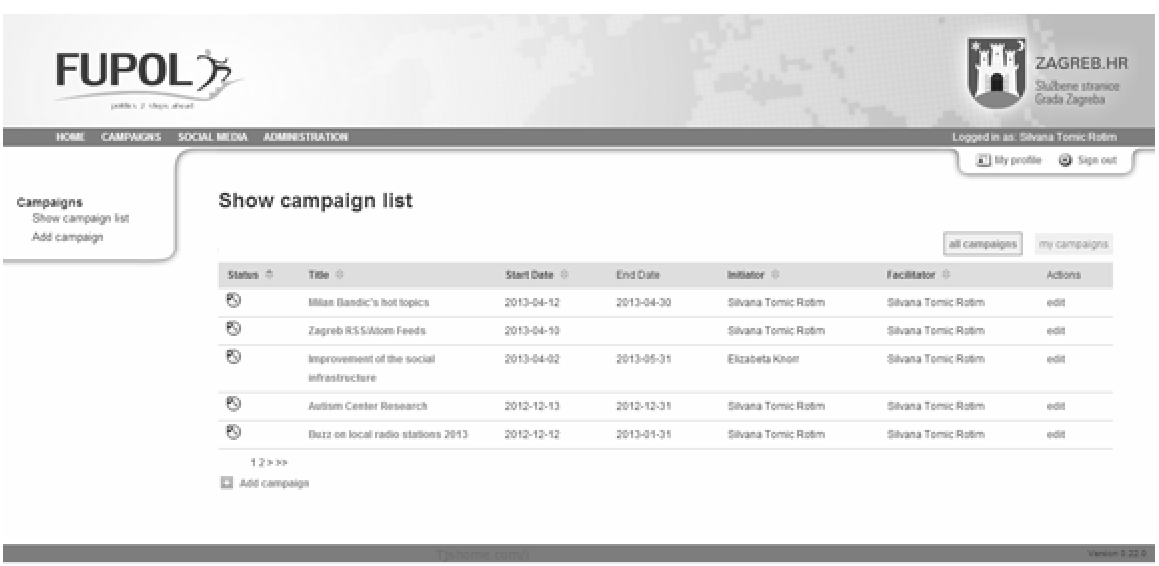
City of Zagreb via FUPOL platform launched a campaign to gather citizen input on social infrastructure in Zagreb, Figure 1.

For that purpose it created four opinion maps, for schools, kindergartens, sports facilities and the Centre for autism with sensory park. The media has been informed about the new campaign through the Press Conference, the website of the City of Zagreb and Twitter and Facebook of the City of Zagreb. The FUPOL leaflet has been designed, printed and distributed to 32 locations in the City. The articles about the beginning of the campaign regarding social infrastructure and the Centre for autism have been published on the following portals, such as www.dalje.com, www.zagreb.hr, www.zih.hr, www.tjedno.hr, www.cro.time.mk, www.vecernji.hr, www.nedstor.com, www.hina.hr, www.trazi.hr, www.odisej.biz, www.soundset.hr and www.predobro.com.

All employees of the city government involved in policy-making in the two aforementioned domains are educated, they are given access rights and they are provided with continuous support in using FUPOL platform. Facilitators continuously followed up changes in social media window, and citizens' opinions obtained through maps and questioners, available on the blog.

Through the blogs the facilitators lead a discussion on how to provide the most suitable ideas for the observed facilities, such as the Centre for Autism and the public park in the area "Oporovec-

Figure 1. Campaign "Social Infrastructure Improvement"



south". The plan is to construct a regular school and a school for children with autistic disorders. The public debate through the blog and social networks (Facebook and Twitter) is targeted to the green area very close of these schools. This green area is planned as a public park with a stream, which we would like to develop as a sensory park. During the previous considerations regarding the Oporovec project, we have emphasized the need for the sensory park for persons with autistic disorders. This park would be also used by children from the local community and from other parts of the city, regardless of whether they have difficulties or not. This type of the public park would help the integration of people with autistic disorders. For the purpose of defining the optimal content and equipment disposition in this park the FUPOL feature for simulation and impact visualization has been used. It enables the public administrators to make simulation regarding the best solution for the sensory park.

Figure 2 shows blog and opinion map to gather citizen input in the running of the campaign.

Also, using the FUPOL platform, its feature for social network aggregation and single window display, the City of Zagreb created social media windows for searching through the social media sources, Figure 3. Once such content is available, the facilitator can use the specific platform functionalities (hot topic sensing) to tropicalize it to extract the most debated issues; he can also provide certain graphs to present the results to decision makers in the City. It is a way to recognize the most interesting suggestions and include them in the agenda for the definition of new policy issues in the management of social infrastructure improvement.

In order to implement the policy of social infrastructure improvement, it is necessary to include various city offices and consider the possibility of implementing the policy from various aspects. Thereat, various data bases would be consulted (GIS, statistics, regulations, etc.) in order to identify areas suitable for building the social infrastructure facilities. Before the decision on the extension of the existing and the construction

Figure 2. Blog and opinion map

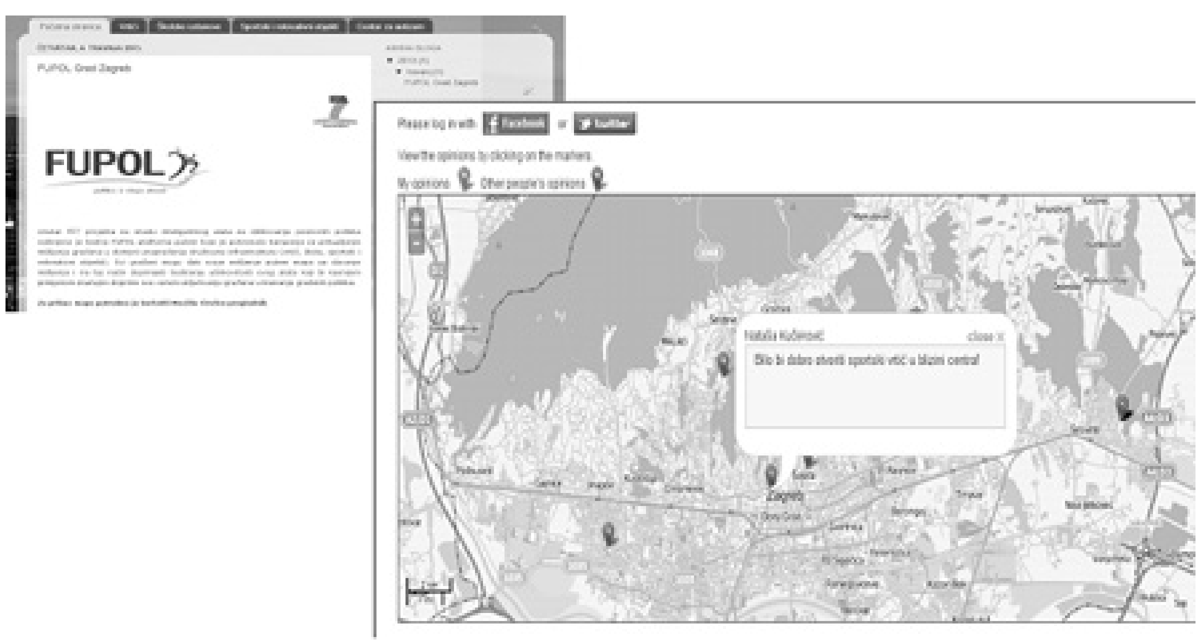


Figure 3. Social media window

of new respective facilities on certain locations is made, the public should be informed and a dialogue initiated with all the stakeholders. The dialogue with the public would be of iterative character and it would follow the entire process: from agenda setting to policy formulation, policy implementation and monitoring.

By applying the FUPOL platform City of Zagreb ensured the involvement of citizens in all these phases. So far conducted phases are setting the agenda and creating the city's policies in the defined domains, and certainly plans to apply FUPOL approach in the phase of implementation and monitoring. FUPOL approach and platform proved to be a very good mechanism for the inclusion of a greater number of citizens in the campaign and simplify information sharing and gathering opinions in all phases of creating the city's policies.

FUTURE RESEARCH DIRECTIONS

The key success factor for achieving the objectives in regards to project as such is the involvement of all important participants, especially citizens, therefore it is very important to start public campaigns in early stages of the project. Also, it is very important to involve the key public administrators and enable a good mechanism for evaluating the success of the project. There are various mechanisms on how to do that. It could be done through:

- FUPOL platform and a questionnaire which could be formed inside the platform.
- E-mail and the available blog.
- Organized forums and workshops in city districts.
- Selecting and involving trusted users .

- Announcements in different media, social networks etc.

Beside the above mentioned mechanisms, there are possibilities to recognize the ones that could result in larger response.

During the campaign for the two tests described in this article, held were two evaluation workshops with representatives of the city administration. One of them was related to the evaluation of simulation model and simulator, and other to evaluating other FUPOL features used in the campaign:

- Campaign.
- Opinion maps.
- Questionnaires.
- Social media aggregation.

Results of the evaluation of the simulation model are shown in Table 1, and the results of the evaluation of the simulator in Table 2.

Since the target value of the evaluation simulation model and simulator is set at score of 3.5 in the range of 1 to 5, the results of the evaluation indicate that it has not been achieved. Therefore a large number of improvements to the simulation model as well as to the simulator have been proposed. These improvements should be implemented in the continuation of the project.

Table 1. The Simulation model evaluation

No	Question	Average grade (1 – 5)
7.	All user requirements are fully incorporated in the model	**3.8**
8.	The model encompasses everything that is essential to simulate the construction of playgrounds	**3.7**
9.	The model is quite clear and understandable	**3.5**
10.	The model is easy to use	**3.1**
11.	The results of this simulation model are meaningful and acceptable	**3.3**
12.	Generally I'm satisfied with the simulation model and I would recommend it to other cities	**3.3**
Average grade of Simulation model		**3.45**

Table 2. The Simulator evaluation

No	Question	Average grade (1 – 5)
8.	The Simulator completely covers all functionalities defined by simulation model and user requirements	**3.2**
9.	The Simulator provides meaningful and useful results	**3.2**
10.	The Simulator has a good interface, easy to use by the user	**3.1**
11.	User by himself can set input parameters for the simulation and add new ones, depending on specific needs	**3.5**
12.	The simulations are performed quickly, in a short time	**2.4**
13.	The simulation results are extremely useful in planning the construction of playgrounds	**3.5**
14.	Generally I'm satisfied with the simulator and I would recommend it to other cities	**3.5**
Average grade of Simulator		**3.2**

Results of the evaluation of other listed FUPOL features are shown in Table 3.

As for the evaluation of of FUPOL platform and its four mentioned features as the evaluation target value is set at score of 3.5, the results indicate that it's realized. Nevertheless recognised are the possibilities of improving these features which will be analysed and applied in the following months working on the project.

Also, the area of hot topic sensing and visualization is open for further research and providing better and more useful data that could be used in the process of policy creation and implementation.

CONCLUSION

A case of applying a new integrated approach to policy creation and implementation in the City of Zagreb has been outlined. The main issues and challenges have been recognized, as well as the way of coping with them. The campaign started using FUPOL platform and its results have been presented, and as the main benefits following are recognized:

- Decision makers from the City can get a better understanding of the needs of citizen as well as businesses.
- Direct, better feedback from all political participants through multichannel social network based communication between politicians and citizens.
- Improved prediction of impacts of policy measures leading to more efficient implementation of government policies.
- Better decisions through forecasting of the potential impact of political decisions.
- Increased engagement of citizens and wider use of ICT tools resulting in higher

Table 3. Evaluation of the FUPOL platform

No	Question	Average grade (1 – 5)
11.	FUPOL platform entirely covers all the functionality arising from the needs of users while creating the city's policies	**3.5**
12.	FUPOL platform has a good interface, easy to use by users	**3.7**
13.	FUPOL feature "Campaign" provides an opportunity for input and monitor of all parameters essential in creating the city's policies	**4**
14.	FUPOL feature "Social media window / social media aggregation" provides an opportunity for the input of all relevant sources, easily search and meaningful results	**3.1**
15.	FUPOL feature "Opinion maps" provides the ability to create maps easily and monitoring the entered opinions	**3.6**
16.	FUPOL feature "Questionnaires" offers the possibility of creating a questionnaire easily, the analysis and different representations of the results	**3.3**
17.	FUPOL platform is efficient, provides a fast operation, without long waiting the response of the system	**2.5**
18.	The results obtained using FUPOL platform are extremely useful in the process of selecting areas for creating urban policies (agenda setting)	**3.9**
19.	The results obtained using FUPOL platform are extremely useful in the phases of analysis and creating the urban policies	**3.8**
20.	In general I am satisfied with FUPOL platform and I would recommend it to the other cities	**4.1**
Average grade for whole FUPOL platform		**3.55**

potential of innovation concerning interaction of citizens with the government.
- Simulations should assist the authorities in the process of policy development.

Also, based on current usage of FUPOL approach and platform, and their evaluation, identified are areas of improvement thereof and thereby provided feedback to partners who work on developing FUPOL features. This will ensure that in the next planning cycle in the City of Zagreb used is improved FUPOL platform.

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KEY TERMS AND DEFINITIONS

FUPOL (Future Policy Modeling): A new approach and software for modeling and implementing policies.

Hot Topic Sensing: The HTS system is responsible for monitoring trends and detecting "hot issues" from the web.

Opinion Map: A graphical map that shows all citizens' opinions collected in a specified area by social networks.

Policy Lifecycle: All phases in a public policy creating, implementing and monitoring – agenda setting, analysis, policy creation, decision making, policy implementation and policy monitoring.

Public Policy: Declared objectives that a city seeks to achieve and preserve in the interest of citizenry.

Sensory Park: A park created to be accessible and enjoyable to disabled and non-disabled visitors, with the purpose of providing individual and combined sensory opportunities for the user such that they may not normally experience.

Social Infrastructure: The facilities that accommodate social services, they include educational facilities, sports facilities, kindergartens and public amenities which are aspects that focus on the community.

Social Networks: Dedicated websites or other applications which enables users to communicate with each other by posting information, comments, messages, images, etc., such as Facebook and Twitter.

Chapter 16

Future Policy Implementation:
A Case Study Optimization of Recreational Activities at the Vodno Mountain

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ABSTRACT

This chapter presents an optimization model intended to support the policy design regarding the scheduling of different recreational activities at the Vodno Mountain. It is aimed to explore barriers and facilitators in order to measure this mountain's recreation and amenity values, while preserving the natural environment, minimizing noise pollution and criminal activity, and avoiding conflicts as much as possible. The final goal is to achieve the undertaking of different recreational activities in such a manner that they do not interfere with each other. Optimization functions are defined as an input to a simulation model, which will be developed in the future. In addition, citizens are included in the process of policy decision making by creating social media surveys and gathering online public opinion. Thus, citizens would also understand how and why certain decisions and laws for the recreational use of Vodno will be imposed.

1. INTRODUCTION

Since the City of Skopje is considered as an area with impaired environment quality, there has been an above-average dynamics in the spatial, functional and demographic development. Being a complex, dynamic system with a high concentration of functions and population, the city of Skopje as well as its wider surroundings (especially the Vodno Mountain) is in an urgent need of measures and activities, so that a healthier environment can be provided for its citizens. One of the forms of keeping a high level of citizens' health is providing the appropriate opportunities for available locations and condition for undertaking recreational activities (Stefanoski, 2002).

Our research will lead to better policy decisions, more efficient implementation of government poli-

DOI: 10.4018/978-1-4666-6236-0.ch016

cies as well as better identification of consequences for citizens and businesses. It aims at reducing the complexity through a comprehensive policy spiral design lifecycle approach deemed appropriate for complex societal problems, through developing optimization models which will provide an input for a simulation tool, to be created in the future. Prior to our optimization models, social media tools will be used to gather information about the citizens' preferences concerning the policy decision making process.

By improving the policy decision making process, this research will achieve optimal scheduling of recreational activities at the Vodno mountain, and most importantly, include citizens' opinions about this specific problem.

The rest of the paper is organized as follows. Section 2 gives a background on optimization as a process, as well as some information about the Vodno Mountain which is our point of interest. Related work is given in Section 3. Section 4 provides an analysis of the current situation, that is, a short historical description of Vodno as well as the actual problems with which we are faced there. Finally, section 5 explains the optimization methodology, which is followed by Section 6 - conclusion and future work.

2. BACKGROUND

According to the normative for the needed quantum of green areas which satisfy the environmental demands, approximately 120m^2 are needed per citizen, or, for the entire city of Skopje with 500.000 citizens at least 6000ha of green areas are needed in the very city as well as in its immediate surroundings (PEPG, 2013). With reforestation and though other types of green areas various environmental effect are achieved. The so-called polyvalent functions are considered the most important forest functions. In other words, this is actually a term explaining the influence on the general improvement of the environment, soil protection, regulation of the water regime, air filtering and others.

The forest balances the water quantity. On bare land slopes, after intensive rains the water flow can be up to 80% of the fallen rain. On grasslands, the flow has an index of 0,6. On a terrain covered with a complete forest canopy cover, the flow has a maximum of 0,25. On bare lands, the water is mechanically polluted with great amounts of silt originated by the soil erosion processes. On forested areas there is virtually no silt in the water. Especially important is the influence of the forest on the flood peaks with the prolongation of the flow timing on the hydrogram, which decreases its peak. The forest is an effective sound buffer, it influences the decrease of noise, it decreases the temperature amplitudes in the air and soil, it influences the absolute and relative humidity of the air. According to scientific literature, the refreshment effect of one tree is equivalent to ten air-conditioners. The green areas, in regard of different tree species, release active gaseous materials, which decrease the number of bacteria per m3 in the air, up to 250 times regarding the air in the cities. The sanitary importance of the forest also influences the oxygen ionization. One m3 forest air contains between 2000 and 2500 light negative ions oxygen, the same atmosphere without the forest influence has approximately 1000, and in confined spaces it contains between 25 and 100 heavy negative ions (PEPG, 2013).

Having considered the aforementioned facts concerning the environmental state of the City of Skopje, as well as its wider surroundings (mainly concentrating on the Vodno Mountain), our goal is to apply optimization methods in order to provide an input for a simulation model which will aid in scheduling the different recreational activities undertaken at the Vodno Mountain, in such a manner that prevents them from interfering with each other, while taking care of natural preservation, increasing the overall citizens' safety, as well as improving their general health.

Firstly, we will explain the term *optimization* and its characteristics. Pinter (2002) states that optimization concepts and tools are frequently used in the process of making engineering, economic and scientific studies quantitative decisions. Optimizing means finding the "absolutely best" decision, which is illustrated by the minimum (or maximum) of a suitable objective function, while it satisfies a given collection of feasibility constraints. This objective function expresses overall (modeled) system performance, such as loss, risk or error. The constraints include physical, technical or other considerations (Pinter, 2002).

These formal descriptions of the optimization process helped us in defining the optimization functions concerning the input for recreation activities schedule in Vodno, which will be explained later in this paper.

This research encourages the scheduling of recreational activities in the forest area of Skopje, mainly the Vodno Mountain, which is an essential necessity to all the citizens on a daily basis. Thus, we can define four basic values, the goal of which is to improve the quality of life, constitute the "nucleus" of the idea for a rational and healthy development of the city:

1. Development,
2. Environmental sustainability,
3. Freedom,
4. Solidarity.
    - **Development:** The concept of development goes beyond the economic prosperity or growth. It includes also social, cultural, traffic and other aspects.
    - **Environmental Sustainability:** Development must not deprive the future generations of their chances. Sustainability in this sense is not achieved everywhere. However, it is possible to arrive even closer to this value with the help of well-planned and properly oriented actions.
    - **Freedom:** Freedom implies the possibility of making choices in accordance with individual preferences – within the limits defined with respect to those other people wishing the same. There is no freedom without participation. Dependence is an important means for achieving participation. It also helps to improve the quality of decisions.
    - **Solidarity:** Solidarity is a characteristic of a society that cares and that shares the benefits of development.

Furthermore, we have defined and explained our research's objectives which are listed below:

- Encouraging the cooperation between the stakeholders at all levels, in the interest of environment improvement;
- Developing and improving the existing infrastructure in the forest areas;
- Encouraging protection, conservation and regeneration of the environment;
- Improving the recreational activities infrastructure;
- Supporting and creating conditions for investments, especially for the marketing;
- Improving the cooperation in the field of health care, education, etc. (Stefanoski, 2002).

Finally, we will discuss the term *recreation*. Recreation is an activity of leisure, leisure being discretionary time (Yukic, 1970). Recreation has many health benefits, and, accordingly, recreational therapy has been developed to take advantage of this effect. Such therapy is applied in rehabilitation, and in the care of the elderly, the disabled, or people with chronic diseases. Recreational physical activity is important to reduce obesity, and the risk of various deceases (Smith & Raab, 1986). According to Burt and Brewer, outdoor recreation has become an important consumption commodity due to the advances in transportation technology, need for leisure and the increased incomes. Therefore, the need for objective, quantitative criteria for effective outdoor recreational activities scheduling is acute and recognized by most entities delegated for allocation of public funds among such investments. The goal is to make the optimal decisions concerning the scheduling of outdoor recreational activities (Burt & Brower, 1971). Furthermore, Jacob and Schreyer have built a theory of Recreational Conflict and identified its characteristics. They define conflict of outdoor recreational activities as goal interference attributed to others behavior. The major factors behind outdoor recreational conflicts have been found to be: 1) Activity Style; 2) Resource Specificity; 3) Mode of Experience; and 4) Lifestyle Tolerance.

The intensity of the above factors, differences between factors for the two groups, and amount of interaction (usually determined by population of the groups, size of the area, and speed of the activity) can be used to estimate intensity of Recreational Conflict in an area (Jacob & Schreyer, 1980).

Burch Jr. (1969) explains that standard variables such as income, age, race and sex, at its most fundamental level, give an explanation of the extremely diverse behavior possibilities found in leisure. As an example, he mentions that social class position or income level are associated with some form of leisure activity. Mainly, the activity may be something of a monopoly held by a particular class, yet only a small proportion of the likely participants actually engage in the activity. (Burch Jr., 1969).

More specifically, Ramthun (1995) explored the possible conflicts between mountain biking and other user groups by undertaking a study concerning the Mill Creek Canyon near Salt Lake City, UT. This study examined the following 4 factors: out-group evaluation (judgment of other users based on group membership), leisure activity identification (how strongly users identify with the activity), years of experience, as well as frequency of participation. The results shown a few methods of reducing the possible conflict, listed below:

- Efforts that help users understand the behaviors, motivation, and land use needs of others.
- Materials to educate hikers about the rationale for cyclists' distinctive clothing and about riding techniques that cyclists must use to ensure their safety. Educational materials may also include references to efforts made by cycling organizations to develop trail etiquette or maintain local trails.
- Similar efforts aimed at cyclists could emphasize orientation toward local recreation areas shared by hikers, bikers, and other user groups (Ramthun, 1995).

According to The Federal Highway Administration and The National Recreational Trails Advisory Committee technical report (FHA & NRTAC, 2003), there are 12 principles for minimizing conflicts on multiple-use trails: 1. Recognize Conflict as Goal Interference; 2. Provide Adequate Trail Opportunities; 3. Minimize Number of Contacts in Problem Areas; 4. Involve Users as Early as Possible; 5. Understand User Needs; 6. Identify the Actual Sources of Conflict; 7. Work with Affected Users; 8. Promote Trail Etiquette; 9. Encourage Positive Interaction Among Different Users; 10. Favor "Light-Handed Management"; 11. Plan and Act Locally; and 12. Monitor Progress.

Furthermore, advancement in this field has been made. Taking the overall technology progress into consideration, Devall & Harry (1981) explain the impact of recreational technologies on the social relationships in outdoor recreation.

These authors claim that recreationists participate in clusters of technologically similar recreations, and also users of less obtrusive technologies resent users of more physically obtrusive technologies. Also, the diversification in recreational technologies occurs in hybridization or combination of pre-existing devices and activities. An example of this is water skiing, a combination of skiing and motor boating. This kind of hybridization tends to give rise to technological clusters of related activities. The activities of boating and fishing yield a variety of activities including: motor boat fishing, rowboat fishing, shore fishing, motor boating, rowing, etc. The authors suggest that an individual will tend to participate in activities within a cluster much more frequently than those of other clusters (Devall & Harry, 1981).

3. ANALYSIS OF CURRENT SITUATION

In this section we present a short history of the Park forest Vodno and overview actual problems.

History of the Park Forest Vodno

In the past, the Mountain Karshijak (Vodno), as a result of the unsuitable use by the local population, by forest clearing for wood and agricultural land, which resulted into turning the forest areas into bare land. As a result, the soil became unprotected from the intensive rainfalls and the strong erosion processes, the hydrology regime was disturbed, so the city of Skopje permanently was endangered from the Vodno torrents. The last such torrent was in 1951, when many houses were damaged, one person was killed and approximately 20 000 m3 of silt were sedimented near “Mala stanica”. (PEPG, 2013)

Afterwards, Vodno was pronounced for erosive land and according to the then existing regulative, different anti-erosion operations were taken. Part of the bare land was reforested with one main goal: protection of the soil from erosion, balancing of the water regime and protection of Skopje from the torrents (for which were built hydrological objects) and air filtering.

Later, in order to increase the protection and to accomplish the many benefits of the forest, with a decision of the city assembly in the Official register of the city of Skopje number 17 from the 20-th of December 1988, article 1, item 14, the park-forest Vodno is put under management and care of RO Komunalec OOZT Maintenance of city greenery, today PE Parks and greenery. The exact border of the park-forest was defined in Official register of the city of Skopje number 6 from the 31-st of May 1989. The area of Vodno is 4573 ha, from which 2168 ha are under forest, 1555ha are non forest areas, and 850 ha are agricultural land and other privately owned areas.

Today, Vodno encompasses approximately 35-40% of the needed greenery for the city and represents the “lungs” of Skopje, as well as the most attractive recreational spot for the citizens. (PEPG, 2013)

Actual Problems

According to the established criteria, Skopje does not have the needed greenery to satisfy the needs of the citizens (PEPG, 2013). The park-forest is managed by the PE Parks and greenery, however, it doesn’t have the means to completely solve the problems concerning the park-forest. We have listed the top problems concerning the Vodno Mountain.

- **Distribution and Dangers from the Bare Lands:** The bare lands and the degraded pastures have little ecological value and represent a permanent danger for the soil and the water regime. The areas under bare lands are still large and not spatially determined. They exist even on the northern part of the mountain and represent a possible threat for the city, therefore, reforestation of this areas is needed.

- **Forest Fires:** As a result of the changed ecological and climate conditions, as well as the human impact, the number of forest fires is increasing. In the period from 2000 to 2004 approximately 40 ha (5% of the forest area of Vodno, mainly black pine) were affected by forest fires. The fires not only destroy the forest areas, but also degrade the soil, affect the water regime and contribute to the air pollution (according to statistical date for middle Europe, the biggest percent of CO_2 is a result of forest fires). PEPG doesn't have the resources for adequate forest fire prevention and protection: adequate transportation, communications and other equipment, and the employees don't have the needed training.
- **Silvicultural Activities:** Silvicultural activities are necessary in order to improve the development and functions of the forest. On Vodno, such measures are necessary and urgent. It is pressing matter to remove the dead, degenerated and infected trees on approximately 50 ha under pine tree, from the total of approximately 200 ha. Due to the lack of resources, this measures have been taken only sporadically on smaller areas.
- **Reforestation:** This activity is performed by the employees of PEPG, as well as different citizen's and other associations. The success of reforestation varies, due to the inadequate training of the participants (except for PEPG), as well as the inadequate species and methods chosen for the reforestation.
- **Recreational Infrastructure:** On the territory of the park-forest, only two informative panel exist, and the path signs and panels for the recreational spots do not exist. The number of benches is inadequate, and part of them is worn-out. The same counts for the forest houses. Part of the paths are overgrown and degraded.
- **Low Public Awareness:** Unscrupulous citizens tend to destroy the recreational infrastructure, they break branches, gather different forest fruits, take out stones (even from the paths), cause fires, bring animal for grazing, throw garbage etc. Big part of the citizens do not know the situation and problems with Vodno from 50 years ago and they are not aware of the meaning of the park-forest for the city of Skopje.
- **IT System:** The contemporary management of activities requires the existence of an adequate IT system. PEPG doesn't have the necessary capacity for such system which is indispensable for the future, as well as for the communication with other public enterprises. The IT system will also allow a more efficient management of the existing green areas in the city The existence of such a system will also allow work on different scientific researches which could use the newly formed database. PEPG doesn't have the needed resources for this purpose. The Faculty of Forestry, as the highest educational and scientific institution in the area of forestry has the needed human resources to perform various educational activities, however it also lacks the needed resources (PEPG, 2013).

4. METHODOLOGY

Our optimization model aims at organizing the recreational activities on Vodno Mountain while preserving its natural environment and avoiding conflicts as much as possible. In fact, it will be used to integrate revealed service preferences to measure recreation and amenity values provided how citizens respond to different types of Vodno configuration alternatives, from multiple perspectives, stakeholder viewpoints trying to minimize the conflicts between the different activities. The output is an optimized schedule of different recreational activities on the Vodno Mountain, satisfying the defined constraints.

The stakeholders are all active citizens, which comprise approximately 80% of the population of Skopje. This percentage includes every day as well as weekend recreationists, people recreating on the mountain for both professional sports and pleasure, elder citizens that only recreate along specifically adapted routes, younger high-school or university students which have stronger preferences for bicycles, families with children and many more. It is very important to state that the citizens of Skopje will be previously educated on the impacts of their recreation on the environment on Vodno, and they will also be led to understand how and why certain decisions and laws for the recreational use of Vodno were imposed. By conducting a survey and analyzing it, we will be involving the citizens of Skopje in the decision and policy making processes by integrating their opinions and thus raising the transparency of policy-making, prior to performing the Vodno recreational use optimization by using various cases, considering safety, cleanliness, aesthetics and nature preservation.

Formal Problem Description

The recreational activities concerning the Vodno Mountain are shown in Table 1. Total of $N_A = 36$ activities are presented. Facilities for some of them are planned until 2017.

Resources are identified with three types: locations, transport and services. There are $N_L = 11$ different locations analyzed in this paper: Sredno Vodno, Postenski Dom, Monastery Nerezi, Markovo Kruvce, Vrv, Vidikovec 1, Vidikovec 2, Detsko Odmoraliste, Martino Brdo and Matka. Matka is found on a connected neighboring mountain, but we include Matka in this analysis, since it offers continuous recreation facilities next to Vodno. Note that there are other locations, which are now not analyzed in this paper, since they are not visited a lot as recreation facilities, nor something is planned. Services that offer hotel, restaurant, bar and shops are also not of interest in this research.

Table 2 presents transport facilities, which cause conflicts and are of interest in this research. Note that some locations (Nerezi, Kozle 2, Trnodol, Kozle 1, Spansko selo, Detska Bolnica, Policija, Olimpisko Selo, IZIS, Crnice, Przino, Pintija, Sopiste, Dolno Sonje, Gorno Sonje) identified in Table 2 are in Skopje wider area, and are used to present locations from where the road is identified.

The number of transport facilities is $N_T = 8$. Besides them there are $N_P = 16$ parking lots. The first 6 are equipped with full parking facilities, while the others are just gravel made, or act as road extensions. Table 3 presents all parking lots and their capacity. Note that during weekends, when the weather is nice, due to insufficient parking lots, one of the road lanes is occupied for parking.

Another type of resource are $N_H = 26$ hiking trails, as presented in Table 4. These trails are mostly visited by people who would like to walk, hike, trek, climb through woods, but also by mountain bikers or those experiencing extreme sports.

Transport roads are asphalt or gravel roads. There is a special regime for the road RT4 from Sredno Vodno to Vrv. The cars and vehicles are not allowed (only for special transport), but there are a lot of bikers using the same resource.

Connections between activities and transport resources are presented in Table 5 and between activities and hiking trails in Tables 6 and 7. Those positions marked with 1 mean there are connections, and empty spaces mean there are

Table 1. Recreation activities in the Vodno Mountain

Activity ID	Activity Name	Transport Means
A1	general walking	-
A2	walking with children	-
A3	walking with pets	-
A4	walking with elder person	-
A5	climbing	-
A6	trekking	-
A7	hiking	-
A8	rock climbing	-
A9	mountain biking	bike
A10	extreme biking	bike
A11	skiing	ski
A12	moto biking	motorbike
A13	driving with car	car
A14	parking motor vehicle	car
A15	public transport	bus
A16	picnic	-
A17	lunch/eating at restaurant	-
A18	drinking coffee at a café	-
A19	panorama	-
A20	playing with children	-
A21	off-road biking	bike
A22	ATV driving	ATV vehicle
A23	car racing	car
A24	paragliding	paraglide
A25	bird watching	-
A26	mountain safari	-
A27	"go ape" entertainment	-
A28	team building	-
A29	biking	bike
A30	bike parking	bike
A31	motorbike parking	motorbike
A32	free-style skiing	ski
A33	racing	motorbike
A34	racing	bike
A35	special transport	truck, tractor, fire brigade
A36	using sport equipment	-

Table 2. Transport roads as Resources for recreation in the Vodno Mountain

Resource ID	Type	Location
RT1	Asphalt road	Olimpisko selo - Sredno Vodno
RT2	Asphalt road	Sredno Vodno - Nerezi
RT3	Asphalt road	Nerezi -Kozle
RT4	Asphalt road	Sredno Vodno - Vrv
RT5	Cable car	Sredno Vodno - Vrv
RT6	Dirt road	trim road: Sredno Vodno - Markovo Kruvce
RT7	Dirt road	Sonje - Sredno Vodno
RT8	Dirt road	Matka – Vrv

Table 3. Parking lots as resources for recreation in the Vodno Mountain

Resource ID	Type	Location	Capacity
RP1	Parking lot	Vidikovec 1	25 cars
RP2	Parking lot	Vidikovec 2	60 cars
RP3	Parking lot	Hotel Vodno	50 cars
RP4	Parking lot	Sredno Vodno 1	100 cars
RP5	Parking lot	Sredno Vodno 2	50 cars
RP6	Parking lot	Monastery	15 cars
RP7	Parking lot	Dirt road Forest 1	20 cars
RP8	Parking lot	Dirt road Forest 2	15 cars
RP9	Parking lot	Dirt road Curve 1	10 cars
RP10	Parking lot	Dirt road Cesma 1	10 cars
RP11	Parking lot	Dirt road Curve 2	10 cars
RP12	Parking lot	Dirt road Crossing	10 cars
RP13	Parking lot	Dirt road Church	10 cars
RP14	Parking lot	Dirt road Predavatel	10 cars
RP15	Parking lot	Dirt road Cesma 2	10 cars
RP16	Parking lot	Dirt road Cesma 3	10 cars

not connections, i.e. the corresponding activity cannot be performed on the given resource.

Generally, the most important connections of activities and resources where conflicts arise are the following two cases:

- Activities on transport facilities with asphalt road: walking with children, walking with pets, walking for older persons, general walking, also car, motorbike, bike and bus transport, as presented in Table 5.
- Activities on hiking paths: climbing, hiking, trekking, general walking, walking with children, also bikes and extreme sports, as presented in Table 6 and 7.

Some activities are incompatible with the others. A complete table of incompatible activities

Table 4. Hiking trails as resources for recreation in the Vodno Mountain

Resource ID	Type	Direction
RH1	Hiking trail	Nerezi – Detsko Odmoraliste
RH2	Hiking trail	Kozle 2 – Postenski dom
RH3	Hiking trail	Trnodol – Postenski dom
RH4	Hiking trail	Kozle 1 – Sredno Vodno
RH5	Hiking trail	Spansko selo – Sredno Vodno
RH6	Hiking trail	Detska Bolnica – Sredno Vodno
RH7	Hiking trail	Policija – Sredno Vodno
RH8	Hiking trail	Policija – Sredno Vodno – branch
RH9	Hiking trail	Olipmisko selo – Vidikovec 2
RH10	Hiking trail	IZIS – Vidikovec 2
RH11	Hiking trail	Crnice – IZIS
RH12	Hiking trail	Crnice – Vidikovec 1
RH13	Hiking trail	Vidikovec 1 – Sredno Vodno
RH14	Hiking trail	Przino – Martino Brdo
RH15	Hiking trail	Martino Brdo – Sredno Vodno
RH16	Hiking trail	Pintija – Markovo Kruvce
RH17	Hiking trail	Sopiste – Markovo Kruvce
RH18	Hiking trail	Penzionerska: Markovo Kruvce – Vrv
RH19	Hiking trail	Cvetkova: Sredno Vodno – Vrv
RH20	Hiking trail	Mirkova: Sredno Vodno – Vrv
RH21	Hiking trail	Sopiste – Vrv
RH22	Hiking trail	Dolno Sonje – Vrv
RH23	Hiking trail	Gorno Sonje – Vrv – trail 1
RH24	Hiking trail	Gorno Sonje – Vrv – trail 2
RH25	Hiking trail	Gorno Sonje – Vrv – trail 3
RH26	Hiking trail	Pokraj zicara: Sredno vodno - Vrv

would contain a squared matrix where rows and columns present a single activity. We will present a simplified version of this table, by clustering the activities, as presented in Table 8. Those marked with on foot are realized by humans without necessity of any sport equipment or facilities, like walking. The second cluster is sport that requires special locations equipped with facilities. Stationary activities include services like refreshment and entertainment. The other clusters include transport with vehicles, biking, extreme sports and different types of racing.

Table 9 presents the incompatibility activities between different clusters. 1 denotes there

Table 5. Activities performed on transport roads in Vodno Mountain (only rows with connections)

	RT1	RT2	RT3	RT4	RT5	RT6	RT7	RT8
A1	1	1	1	1		1	1	1
A2				1		1		
A3				1		1		
A4				1		1		
A12	1	1	1	1		1	1	1
A13	1	1	1	1				
A15	1				1			
A21						1	1	1
A22	1	1	1	1				
A23	1							
A29	1	1	1	1		1	1	1
A33	1							
A34	1							
A35	1	1	1	1		1	1	1

Table 6. Activities performed on hiking trails in Vodno Mountain (part 1)

	RH1	RH2	RH3	RH4	RH5	RH6	RH7	RH8	RH9	RH10	RH11	RH12	RH13
A1	1	1	1	1	1	1	1	1	1	1	1	1	1
A2							1	1	1	1	1		
A3							1		1				
A4							1	1	1	1	1		
A5	1	1	1	1	1	1	1	1	1	1	1	1	1
A6	1	1	1	1	1	1	1	1	1	1	1	1	1
A7	1	1	1	1	1	1	1	1	1	1	1	1	1
A9	1				1		1	1	1	1			
A10							1	1					
A21	1	1	1	1	1	1	1	1	1	1	1	1	1
A28	1	1	1	1	1	1	1	1	1	1	1	1	1
A32													

is an incompatibility between activities in two clusters, i.e. if there is a certain activity in one of the clusters that is incompatible with an activity in the other cluster. The conflicts arise when activities from these incompatible clusters use the same resource. Note that the incompatibility can also refer activities within the same cluster. For example, Table 9 shows that clusters C6 and C7 contain activities that are incompatible with each other, such as, extreme biking, a sport that is is incompatible with free-style skiing if they use the resource RH26.

Table 7. Activities performed on hiking trails in Vodno Mountain (part 2)

	RH14	RH15	RH16	RH17	RH18	RH19	RH20	RH21	RH22	RH23	RH24	RH25	RH26
A1	1	1	1	1	1	1	1	1	1	1	1	1	1
A2					1								
A3					1								
A4					1								
A5	1	1	1	1	1	1	1	1	1	1	1	1	1
A6	1	1	1	1	1	1	1	1	1	1	1	1	1
A7	1	1	1	1	1	1	1	1	1	1	1	1	1
A9					1								
A10						1	1						1
A21	1	1	1	1	1	1	1	1	1	1	1	1	1
A28	1	1	1	1	1	1	1	1	1	1	1	1	1
A32													1

Table 8. Clustering activities for recreation in Vodno Mountain

	Description	Activities
C1	On foot	A1, A2, A3, A4, A5, A6, A7, A25, A26, A28
C2	Sport on facilities	A8, A11, A24, A27, A28, A36
C3	Stationary	A14, A16, A17, A18, A19, A20, A30, A31
C4	Transport	A12, A13, A15, A22, A29, A35
C5	Biking	A9, A21, A29
C6	Extreme sport	A10, A32
C7	Racing	A23, A33, A34

Table 9. Conflicting clusters of activities for recreation in Vodno Mountain

	C1	C2	C3	C4	C5	C6	C7
C1				1	1	1	1
C2							
C3							
C4	1					1	1
C5	1					1	1
C6	1			1	1	1	1
C7	1			1	1	1	1

Formally, the operational rules are the following:

- The resources should be used economically, because the nature should be protected and preserved.
- Mountain bikers use the tracks for riding at high speeds which poses a danger for climbers and especially for families with little children who'd like to run free and carelessly.
- Motor bikers drive at high speeds and disturb all other recreationists.
- Hiking and trekking trails should be as less crowded as possible.
- Skiers can ski only when there's snow (December-February).
- Mountain-bikers do not use Vodno when there's snow.
- Hikers, trekkers, climbers are in much smaller number when there's snow.
- Number of visitors is increased if weather is nice, on weekends, especially in summer when it is very hot in the city, or when after severe cold weather, the sun offers nice stay in Vodno.

The following problems are identified and need to be solved, although they do not cause resource conflicts analyzed in this paper.

- Car parking becomes a problem for increased number of visitors, (for example in weekends and especially in summer when the weather is very hot in the city.
- Insufficient identification and facilities for picnics.
- Insufficient number of restaurants and cafes, or other facilities for leisure and entertainment.

5. OPTIMIZED SCHEDULE

Pinter (2002) formulates the continuous global optimization problem (CGOP) as minimum of the desired function when the parameters are within a given domain of values. Taking the aforementioned into consideration, we have defined and explained the key optimization functions and its parameters in the next paragraphs.

We are interested in analysis of those transport resources that are shared among different activities.

Let N_R be number of available shared resources. In our case it will be sum of the number of transport roads and number of hiking trails, i.e $N_R = N_T + N_A$.

Usual recreation schedule is defined by the number of recreationists for a given activity on a given resource in a given time period, presented as value $N_{ij}(\mathrm{t_k})$, where the identification is for:

- A specific activity A_i for $i = 1,2,\dots,N_A$ as specified in Table 1; and
- A specific resource R_j for $j = 1,2,\dots,N_R$ as specified in Tables 2 and 4.

t_k is the time slot period, where $k = 0,1,\dots,23$ .It is presenting an 1 hour period starting at the hour value. For example, t_{12} presents an hour starting at 12h and ending at 13h.

This paper reflects usage of sophisticated technology to express the public opinion for the optimization model. It means that social media and appropriate tools with FUPOL project will be used to represent all those who would like to practice some recreational activities in Vodno Mountain. This input will be publicly available and help calculation of optimization functions and enable administration to make better decisions based on public opinion. We plan to collect input data for all those who would like to practice a certain activity at a given time period. Denote this value as initial value $N_{ij\ \min}$ for identified time slot t_k.

The constraints for calculation of an optimized schedule are also the capacity of the resources. Denote by $N_{ij\ \max}$ the maximum potential number of recreationists for a given activity and resource. It might happen that the interest raised by FUPOL social networks tools can generate demand more than capacity, and in this case we will set

$$N_{ij\ \min}(\mathrm{t_k}) = N_{ij\ \max}(\mathrm{t_k})$$

to avoid this situation. Therefore, the initial constraints are

$$N_{ij\ \min}(\mathrm{t_k}) \leq N_{ij}(\mathrm{t_k}) \leq N_{ij\ \max}(\mathrm{t_k})$$

Since some would practice several activities on different resources at a given time slot, the total number of recreationists N in a given time interval t_k is:

$$N(\mathrm{t_k}) \leq \sum_{i=1}^{N_A} \sum_{j=1}^{N_R} N_{ij}(\mathrm{t_k})$$

Note that humans change activities in the same or different time periods. For example, a family might use a car to get to Sredno Vodno and cable car to Vrv. The will perform activity A13 – car driving on resource RT1 at 10.10h, and A14 – car parking on resource RP4 at 10.30h, and activity A15 – public transport on resource RT5 - cable car at 10.40h, all performed in time interval t_{10}. Afterwards they might trek and hike on resource RT8 for 3 hours, that is, in t_{11}, t_{12} and t_{13}.

Note that the number of recreationists depends on the following general input parameters: weather condition index, time of the day index, day of the week index and the month index. The following function can calculate the number of recreationists in a given time period t_k within a year, and day with predefined weather conditions.

$$N_{ij}(\mathrm{t_k}) = W \cdot T \cdot D \cdot M \cdot N_{ij\ \max} \quad (1)$$

General input coefficients are:

W **:** Weather conditions index, ranging from 0 to 1. The highest index is bright and sunny weather, and the lowest index is cloudy, rainy, snowy or windy weather, (bright and nice with 1, sunny 0.8, cloudy 0.5, rainy 0.2, storm 0.1). Number of recreationists is higher with higher values of weather conditions.

T **:** Time of the day index, ranging from 0 to 1. The higher the value is, more recreationists use various activities. For example: most of recreationists are expected in the afternoon hours with a time index value of 1, whereas late nights may have a value of 0.1. Table 10 specifies the T index.

D **:** Day of the week index, ranging from 0 to 1. For example: more recreationists use the Vodno facilities on weekends, and less on working days. Table 11 presents the D index values.

M **:** Month index, ranging from 0 to 1. For example: more recreationists use the Vodno facilities in spring and autumn, in winter it

Table 10. T index values

Time Period	T Index
00.00 – 05.00	0.1
05.00 – 07.00	0.2
07.00 – 09.00	0.4
09.00 – 12.00	0.6
12.00 – 14.00	0.8
14.00 – 17.00	1.0
17.00 – 20.00	0.5
20.00 – 24.00	0.3

Table 11. D index values

Day of the Week	D Index
Monday	0.5
Tuesday	0.3
Wednesday	0.2
Thursday	0.4
Friday	0.7
Saturday	0.8
Sunday	1.0
Holiday (on any working day)	1.0

decreases, and also in high summer, due to the fact that most of the population uses holidays somewhere else. Table 12 presents the index M values.

In this paper we are aiming to find a schedule of recreation activities, different from (1) with goal to find a schedule with minimized conflicts and that would enable optimal values of functions that preserve ecology and safety indicators for humans and nature in Vodno. The schedule aims to maximize the potential number of recreationists for each activity N_{ij}, which is not to be confused by n_{ij}.

Optimization Functions

To develop the optimization model we have to specify the coordinating optimization functions. The optimization function should avoid conflicts as much as possible.

First we will present the connections between activities and resources with the function

$$CN_{ij} = CN_{ij}(A_i, R_j) \in \{0,1\},$$

identified for a specific activity A_i for $i = 1,2,\dots,N_A$ as specified in Table 1, and a specific resource R_j for $j = 1,2,\dots,N_R$ as specified in Tables 2 and 4. Parking lots (Table 3) do not incur conflicts, so they will not be analyzed in

Table 12. M index values

Month	M Index
January	0.1
February	0.2
March	0.6
April	0.8
May	0.9
June	1.0
July, August	0.7
September	1.0
October	0.9
November	0.6
December	0.4

this paper. The value 0 means that there is no connection and 1 means activity A_i can be performed on resource R_j. Values of this function are presented in Tables 5, 6 and 7. Note that zeros are not presented in the tables and they are left as empty spaces.

We denote the compatibility function with

$$CM_{ik} = CM_{ik}(A_i, A_k) \in \{0,1\}$$

identified for two activities A_i and A_K for $i,k = 1,2,\dots,N_A$ specified in Table 1. The value 0 means that there is no conflict and 1 means activity A_i makes a conflict with activity A_K if performed on a same resource. Values of this function are presented in Table 9. Although presented conflicts in Table 9 are among clusters of activities, the function refers to specific activities and not clusters. Empty spaces in the table present zeros.

Denote by $FN(t_k)$ the number of conflicts between activities A_i and A_l arise using the same resource R_j in given time period t_k calculated by the relation shown in Box 1.

Note that CN and CM can have binary values 0 or 1, indicating if there is incompatibility and if the activity is performed on the give resource.

Box 1.

$$FN(t_k) = \sum_{i=1}^{N_A}\sum_{j=1}^{N_R}\sum_{l=1}^{N_A} CN(A_i, R_j)CN(A_l, R_j)CM(A_i, A_l)N_{ij}(t_k)N_{lj}(t_k)$$

So their product will be 0 or 1 if there is a conflict. The value of function FN is than calculated by the product of the number of recreationists using both the conflicting activities. The higher the value, the higher conflicts arise. So our first goal is to find appropriate schedule $N_{ij}(t_k)$ that minimizes the number of conflicts FN in a given time period.

Next we explain other minimization functions, which are relevant for the optimization schedule. We will start with description of the specific optimization input parameters, and then the corresponding functions. Specific Optimization Input Parameters are as follows:

C_{PL} **:** The *contamination (pollution) coefficient* depending on activity and resource. The value range is between 0 and 1. The minimal value produces no pollution, while the maximal value is 1. For example: walking causes 0 contamination, while motorbikes cause 1 contamination.

C_{NP} **:** The *noise pollution coefficient* depending on activity and resource. It ranges between 0 and 1, being the minimal and maximal values. For example: no activity causes 0 noise pollution, walking with elders may cause 0.1 noise whereas walking with children may cause 0.3, while a group of motorbikes would cause a noise pollution of 1.

C_{CS} **:** The *crime index*, ranging between 0 and 1, calculated as an estimation of overall level of crime. No crime is depicted with a crime index of 0 while heavy crimes (murder, slaughter etc) would result in a crime index of 1.

C_{PS} **:** The *safety index*, ranging between 0 and 1, calculated as an estimation of overall level of safety. No injuries gives a safety index of 0, while heavy injuries or accidents mean a safety index of 1. C_{CL} is the *littering index*, ranging between 0 and 1, calculated as an estimate of overall littering. No littering is depicted with an index of 0, while extreme cases of junk cluttering means an index of 1.

C_{NR} **:** The *natural preservation* index, with value range between 0 and 1. It is calculated as an estimation of overall natural preservation. Highest natural preservation is depicted with an index of 1, while the lowest natural preservation is depicted with an index of 0.

Some specific parameter values are illustrated in Tables 13 and 14.

Furthermore, we define and explain the optimization functions which are to be analyzed in terms of finding out which of their parameters maximize or minimize their values. Our aim is to set optimum values for the parameters which define the value of this function in order to achieve its minimum or maximum value. Optimization functions are explained as follows.

- **Contamination (Pollution):** The introduction of contaminants into the natural environment that cause adverse change. Our goal is to minimize the contamination. As we can see, a minimum value is achieved when a "lighter" activity is undertaken (ex. A1-A5) and there are less recreationists. In this case the weather is

Table 13. Various coefficients dependent on activities for the optimization functions

Activity ID	Activity Name	Contamination Coefficient (C_{PL})	Noise Pollution (C_{NP})	Littering Index (C_{CL})
A1	Walking	0.2	0.3	0.2
A3	Walking with pets	0.4	0.7	0.4
A7	Hiking	0.3	0.6	0.3
A12	Motorbiking	0.9	0.9	0.2
A16	Picnic	0.6	0.7	0.7

Table 14. Various coefficients dependent on locations for the optimization function

Resource	Location	Crime Index (C_{CS})	Safety Index (C_{PS})
RL1	Sredno Vodno	0.4	0.1
RL2	Postenski Dom	0.7	0.7
RL5	Vrv	0.3	0.7
RL6	Matka	0.5	0.9

bad, and the recreationists use the mountain for a shorter period of time, or during the work days and during the night. We use these parameter values to calculate $PL\min$ and use that information for further analysis. The pollution function is calculated by the following function:

$$PL = \sum_{i=1}^{N_A} \sum_{j=1}^{N_R} C_{PL}(\mathrm{A_i}, \mathrm{R_j}) \cdot N_{ij}$$

- **Noise Pollution:** Some animals living on Vodno are affected by human recreational activities, and we aim to minimize the noise pollution. Similar to the previous case, a minimum value is achieved when a "lighter" activity is undertaken (ex. A1-A5) and there are less recreationists, such as when the weather is bad. The optimization function calculates the minimum value of $NP\min$. The closer to this value NP for different parameters gets, the better the results are. This function is expressed by

$$NP = \sum_{i=1}^{N_A} \sum_{j=1}^{N_R} C_{NP}(\mathrm{A_i}, \mathrm{R_j}) \cdot N_{ij}$$

- **Criminal Safety:** The mountain as a hangout for youth gangs engaged in criminal activity, a place for drinking and drug use, and as a habitat for the homeless. The overall goal is to maximize the criminal safety. Similar to the previous case, a maximum value is achieved when a "lighter" activity is undertaken (ex. A1-A5) and there are less recreationists, such as when the recreationists use the mountain for a shorter period of time, or during the night, which incurs a greater possibility for crime. The optimization value is to calculate a maximal value of CS computing the function

$$CS = \sum_{i=1}^{N_A}\sum_{j=1}^{N_R} C_{CS}(\mathrm{A_i}, \mathrm{R_j}) \cdot N_{ij}$$

- **Physical Safety:** Presents a condition when each recreationist is safe with respect to other leisure activities in near distance, such as extreme sports. One would like to maximize the physical safety. Similar to the previous case, a maximum value is achieved when a "lighter" activity is undertaken (ex. A1-A5) and there are less recreationists, such as when the recreationists use the mountain during the work days. We use these parameter values to calculate the maximal value of PS using the following function:

$$PS = \sum_{i=1}^{N_A}\sum_{j=1}^{N_R} C_{PS}(\mathrm{A_i}, \mathrm{R_j}) \cdot N_{ij}$$

- **Natural Preservation:** Beyond enjoyment and use, the natural environment should be preserved in the Vodno re-design with goal to maximize the natural preservation. When a "lighter" activity is undertaken (ex. A1-A5) and there are less recreationists we can expect higher natural preservation. So the calculation of maximal value of NR is the optimization goal for further analysis, by calculating

$$NR = \sum_{i=1}^{N_A}\sum_{j=1}^{N_R} C_{NR}(\mathrm{A_i}, \mathrm{R_j}) \cdot N_{ij}$$

- **Cleanliness:** (Littering) index and maintenance are by far the top concern of stakeholders, and we aim to maximize its value. It can be achieved when a "lighter" activity is undertaken (ex. A1-A5) and there are less recreationists. The optimization function calculates the maximal value of CL with the following function

$$CL = \sum_{i=1}^{N_A}\sum_{j=1}^{N_R} C_{CL}(\mathrm{A_i}, \mathrm{R_j}) \cdot N_{ij}$$

Our goal is to find a schedule of recreation activities that enables optimal functions of analyzed function for (contamination) pollution, noise pollution, criminal safety, physical safety, natural preservation, and cleanliness. Optimization aims to find the minimal values of pollution and noise pollution, and maximum values of criminal and physical safety, natural preservation and cleanliness. The overall optimization function is summarized as follows:

Find a schedule $N_{ij}(\mathrm{t_k})$ by optimizing

$$\min(\mathrm{FN}, \mathrm{PL}, \mathrm{NP})$$

and

$$\max(\mathrm{CS}, \mathrm{PS}, \mathrm{NR}, \mathrm{CL})$$

subject to

$$C_{PL}, C_{NP}, C_{CS}, C_{PS}, C_{NR}, C_{CL} \in [0,1]$$

and

$$N_{ij\,\min}(\mathrm{t_k}) \le N_{ij}(\mathrm{t_k}) \le N_{ij\,\max}(\mathrm{t_k})$$

Benefits and Impacts

Recreational activities in a mountain close to a city increase the richness of services provided by urban ecosystems. The ecosystem services of a mountain such as Vodno could include the use of natural areas for recreation, and also amenity services such as esthetics, that should be evaluated from four interdependent "human dimensions" of greenways:

- Cleanliness use to be by far the top concern of stakeholders. Condition and maintenance is also a topic to be considered.
- Natural preservation is a key dimension that people relate to in any ecosystem, no matter how urban it is. Thus, beyond enjoyment and use, the natural environment, with vegetation are aspects that should be preserved in the Vodno re-design.
- **Aesthetics:** People's immediate response to environments is often aesthetic in nature, and how the environment looks can color people's perceptions of how well it is managed.
- Safety is an important dimension in the perception of urban environments and one that is sometimes perceived to be at odds with enhancing the naturalness and aesthetics of urban green space. Both physical safety (extreme sports with respect to other leisure activities) and personal safety (the mountain as a hangout for youth gangs engaged in criminal activity, a place for drinking and drug use, and as habitat for the homeless).

The planning of recreation activities inevitably involves trade-offs among the services provided to the different users and stakeholders. An efficient use of land should account for how the gain in one service compares to the loss of other services, and even whether the land is suited for a certain recreation activity or better left for development.

Using tools from the FUPOL project can make efficient e-Government decisions for its future use. For example, FUPOL social media tools can collect public opinion and interest for various recreation activities and resources at given time interval. This will lead to an adjustment of the number and type of recreational activities. FUPOL simulation tools can support calculation of the optimization functions, and also allow a visualization of ideal, extreme, and optimal cases. This, in turn, FUPOL tools will bring ideas about resolving potential conflicts by defining appropriate schedule. Moreover, the simulation tool will be publically available to anyone interested in seeing how Vodno is used. In this way, the citizens of Skopje can be educated on the impacts of their recreation. Also, they can be led to understand how and why certain decisions and laws for the recreation were imposed.

6. CONCLUSION

In this paper, we have presented a case study about Vodno Mountain recreation facilities by presenting an optimization model, which aims to avoid conflicts as much as possible and preserve the nature and humans at most. The model calculates an optimal schedule by defining the number of recreationists allowed on a certain resource for a given time slot in a given day determined by month and day of the week index. The optimization schedule tries to find an optimal schedule of number of recreationists for a given time slot to satisfy the constraints and optimization functions. The optimization functions are avoiding conflicts, pollution, noise pollution, crime and physical safety, natural preservation and cleanliness. The optimal schedule also defines a need for establishing appropriate infrastructure and facilities.

The way the optimization is possible to calculate is by numerical methods, or by using simulation and FUPOL project deliverables. FUPOL gives an opportunity for new policy design model comprised of including the citizens in the decision making process by gathering online public opinion and social media surveys, defining optimization functions, their maximum and minimum values, which would serve as an input for a simulation model to be developed. The final goal is to define an optimal scheduling of different recreational activities at the Vodno Mountain in such a manner that they don't interfere with each other, minimize the conflicts, littering and noise pollution, and maximize the criminal and physical safety, natural preservation and cleanliness. Ultimately, undertaking these recreational activities will lead to general citizen health improvement, followed by raising the transparency of policy design by including citizens' opinions and needs.

7. FUTURE RESEARCH DIRECTIONS

In the future, we plan to conduct further analysis on different current problems concerning the City of Skopje and its outmost surroundings by using this same analytical approach, and thus improving the capital of our country's overall living conditions and making it a better place for everyone.

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KEY TERMS AND DEFINITIONS

Computer Simulation: An attempt to model a real-life or hypothetical situation on a computer so that it can be studied to see how the system works.

Environmental Preservation: A practice of protecting the natural environment on individual, organizational or governmental levels, for the benefit of the natural environment and humans.

FUPOL (FUture POLicy modeling): A project which proposes a comprehensive new governance model to support the policy design and implementation lifecycle.

Optimization: A process of finding the minimum (or maximum) of a suitable objective function, while it satisfies a given collection of feasibility constraints.

Policy Implementation: The stage of policy-making between the establishment of a policy and the consequences of the policy for the people whom it affects. Implementation involves translating the goals and objectives of a policy into an operating, on-going program.

Recreation: An activity of leisure, leisure being discretionary time.

Vodno: A mountain in Macedonia, located in the northern part of the country, to the southwest of the capital city Skopje.

Chapter 17
Future Policy Implementation:
A Case Study Fostering Bicycle Inter-Modality in Skopje

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ABSTRACT

This chapter presents a comprehensive new governance model to support the policy design and implementation lifecycle. The innovations are driven by the demand of citizens and political decision makers to support the policy domains in urban regions with appropriate ICT technologies. It will target domains such as sustainably development, urban planning, and more specifically, fostering bicycle inter-modality in the city of Skopje. The scientific approach is based on complexity science. The proposed optimization model is aimed to explore barriers and facilitators to using bicycles as a transport means in Skopje, considering bicycle riding for transport on private bicycles, and different share schemes.

1. INTRODUCTION

The urban agglomeration Skopje is a complex, dynamic system with an extremely high concentration of functions and population within the Republic of Macedonia and in the wider surroundings. The intensity of the spatial, functional and demographic development registered over the past period includes Skopje among agglomerations with an above-average developmental dynamics in Macedonia. The City of Skopje is considered to be an area with an impaired quality of the environment. There is an urgent need to undertake measures and activities in order to provide a healthy environment for the citizens of Skopje (Stefanoski, 2004). One such measure is fostering intermodality in the daily transportation of people and goods, more specifically, the use of bicycles.

Intermodal passenger transport, also called mixed-mode commuting, involves using two or

DOI: 10.4018/978-1-4666-6236-0.ch017

more modes of transportation in a journey. For example, Herman et al. (1999) give a specific action plan full of well thought out and pragmatic recommendations as a challenge to New York City to treat its cycling citizens better and to promote bicycling as a tool for achieving a more livable city. The goal of mixed-mode commuting is often to combine the strengths (and offset the weaknesses) of various transportation options. A major goal of modern intermodal passenger transport is to reduce dependence on the automobile as the major mode of ground transportation and increase use of public transport.

The benefits of the use of bicycles for flexible mobility are multiple, some of which include emission reductions, physical activity benefits, reduced congestion and fuel use, individual financial savings. However, there are some barriers that should be properly addressed to successfully promote the use of bicycle as an alternative to well consolidated transport means.

Among the barriers, safety is a major concern including a perceived lack of suitable bicycle infrastructure, as well as regular a negative attitude of some car drivers. Considering the former concern, it has been reported that the right location of bicycle docking stations to be better integrated with public transport, as well as suburban locations, beyond the inner areas bordering the municipalities is a critical factor to be analysed.

Unsurprisingly, the support for a more pronounced bicycle use is great among the citizens of Skopje. Also, it is perceived that the community accepts government‘s measures in allowing multimodal transport connections. Various citizen associations have already raised numerous independent initiatives (Na Tochak, 2013) to promote the bicycle use in Skopje. Intermodal transport means, and more specifically, the use of bicycles, is a hot topic in Skopje, which requires attention by the government officials.

Last studies (IDORM, 2010), (JP Ulici i Patista, 2012) and (GUP, 2012) showed that bike usage in Skopje varies between 1.4% to 2,5%, which is very low in comparison to average European cities. Therefore, the overall goal of the administration of City of Skopje is to increase the bike usage up to 5% by one of the following measures, introducing intermodality (car parking and bike-renting around Skopje central region), improving existing bike paths, establishing new bike paths, establishing new facilities for bike parking and rent-a-bike, etc. However, with limited budget disables an instant action on realization of all planned projects and the overall optimization, simulation and visualization tools will help the administration of City of Skopje to make better decisions what measures to be taken step by step in the next period and start the projects with highest impact.

Our research will use input data gathered from sophisticated channels, including surveys and social networks. The goal is to develop an optimization model that will analyse the needs and will propose an optimal schedule of number of bike users that will include bikes as transportation mean. The derived optimization model will lead to better policy decisions, more efficient implementation of government policies as well as better identification of consequences for citizens and businesses. It aims at reducing the complexity through a comprehensive policy spiral design lifecycle approach deemed appropriate for complex societal problems.

The rest of the chapter is organized as follows. Section 2 gives a background on project to increase the bike usage in Skopje, by fostering bicycle inter-modality. Section 3 provides an analysis of the current situation, as well as overview of actual problems we are trying to solve. Finally, Section 4 explains the optimization methodology, followed by discussion; conclusion and future work in Section 5.

2. BACKGROUND

In the next sections we will describe the general concept to foster bike usage in Skopje. The project itself is part of the initiatives for Skopje's transformation in a modern and clean city based on the principles of sustainable development. There is a big potential for increasing the bicycle use as transport mean, reflected in the favourable geographic and climatic characteristics, and the demographic potential. The success implies not only economic development and environmental protection, but also a balanced spatial development of the urban area in Skopje. This project conforms the following objectives:

- Encouraging the cooperation between the stakeholders at all levels, in the interest of environment improvement;
- Developing and improving the existing infrastructure in the area of traffic;
- Encouraging protection, conservation and regeneration of the environment;
- Improving the traffic infrastructure (and more specifically of the bicycle traffic component);
- Reducing all types of obstacles for the free flow of people and services;
- Supporting and creating conditions for investments, especially for the marketing;
- Supporting the professional training in the field of advocacy;
- Improving the cooperation in the field of health care, education etc.;
- Developing or introducing services and resources for improvement of the education and the advocacy, through media such as television, radio, newspapers;
- Supporting and promoting the use of alternative and environment-friendly means of transport;
- Raising the public awareness on alternative transport models and on healthy environment;
- Defining socially acceptable transport systems.

The specific objectives include:

- Increasing continuously the interest in using a bicycle;
- Improving the safety of bikers in Skopje;
- Developing a broad city bicycle system with all the necessary elements that will satisfy the needs of all categories of users during all types of travels;
- Encouraging public participation through coordination of the local and the city authorities;
- Establishing and improving the instruments for planning, projection, implementation and maintenance of bicycle paths;
- Defining the needs for the use of bicycles both as a means of transport and for recreational purposes.

Governmental decisions for modernization of current transport can be made based on several simulation tools or optimization model we are describing in this paper. The usage of sophisticated tools for survey analysis and social networks can be efficiently used as input in the developed model. The optimization model will calculate optimal values of several functions, including environment and human protection functions, increasing the number of bike users.

The expected output will not support only the governmental decisions; it will also provide more precise data on planning sufficient infrastructure, like parking lots, bike paths, resolving the conflicts and overcoming the constraints.

It is expected that the bicycle acceptability will change along the years together with population and economic expectations. Therefore, a set of boundary conditions specified as input parameters to the optimization model will change and the model will calculate new output.

3. ANALYSIS OF CURRENT SITUATION

Being a capital and an industrial center with a population of more than 400.000 (indexmundi), Skopje is among those cities that need a good transport model. The traffic is for the most part composed of motor vehicles. Usually, City center is already well serviced by public transport. Major destinations are interlinked and connections to suburbs are available. However, the use of bicycle is still at a very low level, i.e. insignificant.

Yet, Skopje has very favourable conditions for bicycle transport. Stretching on an area of 7,000 ha, length of 22 km, width of 9 km, having mild slopes ranging from $0{,}1^0$ to $0{,}7^0$, good carrying capacity of the terrain, average temperature of 4^0 to 30^0C, only 4 to 32 days with snow and 30 with ice, and maximum mean wind speed of 4,2 m/sec (AMSM, GIS, NHS, 2012), Skopje is among the cities with a lot of natural prerequisites for construction and use of bicycle paths.

The latest indicator of 1,9% (JP Ulici i Patista, 2012) of travels carried out with a bicycle out of the total number of daily travels, for a city with such terrain, climatic, population and economic conditions like Skopje, is a negligible percentage that needs to be increased up to 5% in the foreseeable future, with the help of an appropriate strategy.

The main obstacle for this is the lack of a good bicycle infrastructure. The inexistence of bicycle paths or the lack of connections between the existing ones hinder the functioning of bicycle traffic. Bicycle lanes use to fail to provide a continuous route to their destination and that leads to longer route in order to avoid "problem spots" (Stefanoski, 2004).

According to the worldwide classification (iBike, 2013), bicycle paths are categorized into several categories such as:

Category 1: Bicycle paths or multi-purposed paths (traffic arteries). They enable bicycle movement on paths that are completely separated from any street or highway.

Category 2: This relates to one-way bicycle paths located on the right hand-side of every traffic artery, usually collecting and primary routes, which enable a direct communication through the traffic system of the city.

Category 3: It relates only to bicycle movement combined with pedestrian or motor vehicle movement, and marked only with horizontal signalization.

There is another way of moving with a bicycle that is not regulated - thus couldn't be included in any of the categories mentioned – which is movement with a bicycle on a traffic artery for motor vehicles without signalization. This is by far the most represented way bicycles are used.

Regarding the existing bicycle paths in Skopje, the length of which is 48,5 km (of which 1,5 km one-way and 47 km two-way paths), what is most notable is their fragmentation, i.e. the inexistence of continuity (velosipedi.mk). This is due to the lack of enough financial resources to provide continuous paths both for pedestrians and cyclists and to set up appropriate signalization, as well as to the lack of appropriate planning documentation for the development of the bicycle traffic in Skopje.

If one takes into account that the situation regarding the accomplished primary traffic arteries in Skopje is 135 km of existing length, the 36% of accomplished bicycle paths along them is relatively small given the fact that the planned profile of each of these traffic arteries contains a bicycle path. Moreover, if one takes into account the fact that nearly 90% of all accomplished bicycle paths are two-way, the percentage of presence of bicycle paths along the primary traffic arteries decreases for a half, i.e. it is estimated that bicycle paths have been constructed on only 20% of the primary traffic arteries (velosipedi.mk).

In addition to bicycle paths that constitute the active bicycle traffic, there are other facilities in the bicycle traffic as well, among which bicycle parking spaces. They can have the form of bicycle holders, bicycle cassettes, and fenced areas. The holders are the cheapest means for parking bicycles, with a capacity of 2-4 bicycles, located on the most visible spots. Cassettes are closed elements, usually for 2 bicycles, which provide a high degree of protection and are placed most often in commercial areas. The fenced areas are the most often located in public and school premises. They are mobile systems of space fencing that are of temporary nature and a parking space for a larger number of bicycles, assuming the presence of a guard. Other facilities are those serving for changing and keeping clothes and equipment. None of these facilities is represented in the public space of Skopje. Table 1 explains the existing bicycle paths in the city of Skopje. A more detailed table showing all streets with their profile, width, length, area, bicycle lanes can be found in the Bicycle Master Plan of Skopje (Stefanoski, 2004)

A large number of the one-way bicycle paths are along the primary traffic arteries, as integral part of their profile. The latter consists of: two lanes 10,5 m wide; a 5 m separation middle belt; 2,5 m bicycle paths in both ways; and sidewalks of around 3 m. They are also integral part of the profile of the collecting traffic arteries, which consists of one road surface of 10,5 m; 2,5 m bicycle paths in both ways; and sidewalks of varying width. The two-way bicycle paths are mainly along the collecting traffic arteries (velosipedi.mk).

All existing bicycle paths can be grouped into category 2 according to the worldwide classification of bicycle paths, which relates to both one-way and two-way bicycle paths, located on the right hand-side mainly along collecting and primary routes and enabling a direct communication through the traffic system of the city.

With regards to the quality of the existing paths, one can conclude that almost 90% of them are asphalt, which is in a bad shape because of the lack of regular maintenance. Those 650m done with bechaton are new and are in good shape. All existing bicycle paths have both the width and possibilities for overcoming obstacles in accordance with the valid regulations and criteria for this type of traffic areas.

What hinders the normal movement of cyclists on the existing bicycle paths are the “black points”, i.e. the barriers due to which a large number of potential cyclists give up this type of transportation. One is referring here to the correlation between bicycle paths and bus stations, since there are many situations where bicycle paths are used by people waiting for a bus due to the reason that the path does not change its direction at bus stations. Parked vehicles are also a huge problem,

Table 1. Existing bicycle paths in the city of Skopje (Stefanovski, 2012)

Profile	Total length (m)	Area (m^2)
One-way – for one line of bicycles	1550.0	1.530
Two-way – for two lines of bicycles	46848.0	117.120
Total:	48403.0	118.650
With asphalt:	47778.0	118.150
With bechaton:	625.0	500

since they occupy bicycle paths due to the lack of parking space. Very often containers for solid waste can be found on bicycle paths, since this is the simplest and fastest way for the relevant waste disposal services to get to them. Problematic to some extent are the kiosks located in the green "belt" behind bicycle paths, since they are used for access and non-rarely for standing around in front of the kiosks.

From the analysis of the GUP of Skopje for the period 2002 – 2020 (GUP Skopje), it can be seen that it contains no general plan for development of the bicycle traffic as integral part of the overall development of the city Moreover, it does not treat bicycle paths as a system, but as integral part of the profile of certain traffic arteries. The results of the field surveys conducted for the needs of the GUP, in which 6,20% of the population of Skopje was surveyed in 1999 (the last survey conducted), show that the bicycle participates with 1,9% in the traffic, with a tendency of increase (Ralev, 2002).

4. METHODOLOGY

Our optimization model is aimed to explore the barriers and facilitators in using bicycles as a transport mean in Skopje, considering bicycle riding for transport on private bicycles and different share schemes. The model will consider different citizens categories: Infrequent and non-cyclists, Regular bicycle riders and Cycle Associations members, altogether with the placement of bicycle docking stations and other bicycle path infrastructures.

The stakeholders of the simulation are all commuters, which comprise approximately 80% of the population of Skopje. This percentage includes every day as well as weekend commuters, people commuting around the city for both business and pleasure, elder citizens that only travel along specific bus routes, younger high-school or university students which have stronger preferences for bicycles and many more.

The output would provide the usage rates (i.e. trips per bike per day) considering different aspects of: Amount of docking stations, capacity of the docking stations and the location of the docking stations (close to residential and work areas) paying special attention to fostering inter-modality.

Formal Problem Description

The optimization aims to find out:

- Optimal selection of projects that will increase the bicycle infrastructure;
- Optimal number of docking stations, their distribution and size (besides locations we consider sizing of slots for private bikes parking and bike rental);
- Optimal selection of new bike paths by building connections between stations (which one connects with which other) considering an approximation of the distance between them; and
- Optimal selection of improving the existing bike paths.

A typical use case would be in commuting different transportation means in a frequent commune with regards to time, pollution and/or cost. For example, commuters may wish to visualize their journey from the suburb Radisani to the City center, including a calculation of the walking distance, and a schedule of intermodal transfers to public transport such as bus or taxi. Thus, they may plan their journey. The output can also be used in visualizing the aggregate impact of many commuters if they used motor vehicles instead of public transport or bikes. Another use case scenario would be adjusting the number of bicycle docking station and regulating the effect this would have on the number of commuters.

Many parameters are included in designing the model. The current traffic system and the spatial plan - the "skeleton and bloodstream" of Skopje - are represented. Our model incorporates all of the following:

- The street system from capacity and length perspective,
- The profiles of the traffic arteries,
- The capacity of the crossroads,
- The signalization system,
- The distribution of pedestrian crossings,
- The distribution of parking spaces,
- The distribution of public transport (bus and taxi) stations,
- The pollution parameters (exhaust gasses, noise, vibrations, etc.),
- The activities of people (walking, car driving, taxi riding, bus riding, bicycle riding)

As seen in the use cases before, a commuter may select alternating between bicycle and bus in his daily commute. On the other hand, a commuter may opt for driving a car to work for the lack of sufficient or frequent bus lines. Similarly, a commuter may use an individual motor vehicle because no viable bicycle path connects to his house, or because bicycle docking stations may not exist nearby.

These conditions and constraints in the bicycle use are called operational rules in our simulation model. Formally, the operational rules are the following:

- Many streets do not have a bicycle lane,
- For the larger part, current streets cannot be further widened,
- For the larger part, new streets cannot be constructed,
- Some routes are heavily used, whereas others are avoided,
- Motor vehicles (buses, taxis, cars and motorbikes) drive on motor lanes,
- On streets where there isn't a bicycle lane, bicycles are ridden on the pavement intended for pedestrians, or on the lanes intended for motor vehicles,
- Bicycles are less used during winter (November-March) and in hot weather,
- Bicycle parking spaces are virtually non-existent,
- Bicycle theft or vandalism are a real threat,
- CO_2 emission should be as low as possible,
- Weather conditions strongly impact the transport,
- Public transport delays increase commuters' dissatisfaction,
- Traffic jams mostly occur each workday in the rush hours (8 to 9 am and 3 to 5 pm)

Resource Identification and Analysis

The use of a bicycle can make a typical 10km bus journey attractive even if the endpoints of the journey each sit 1km out from the stations: the 20 minutes walking time becomes 8 minutes bicycling time. Choosing this commute is thus, an optimization function between different trade-offs.

The resources as presented in Table 1, (Stefanoski, 2004) are approx. 48km. We have provided a deeper study and identified 268 locations used as bus stations or micro zones within populated regions where the people will require transportation means. These locations are found in 10 municipalities in Skopje with population of 527840 in urban city region.

Denote the locations with L1, L2, …, L268. We have identified 363 possible tracks between neighbouring locations denoted with R1, R2, …, R363. Table 2 identifies how many tracks are build as bike paths, planned bike paths to be build in near future, and possible tracks which allows building a new bike track. Figure 1 gives a better view on these data with comparison parameters expressed as percentage of all these identified tracks.

25% of identified tracks are realized as bike paths and there is a possibility or plan to extend this number by 15%. Currently, the latest urban plan (GUP, 2012) does not allow for other 60%

Table 2. Identified tracks R1, R2, ..., R363 between neighbouring locations L1, L2, ..., L268, as realized, planned or possible bike paths in City of Skopje

Number of Tracks	363
Bike paths	90
Possible	38
Planned	17
Road only	218

of tracks to have bike paths, either due to small width of road or other similar reasons.

We have introduced an indicator of bike path quality using a methodology presented in Table 3. This indicator will help to identify the quality of a bike path, according to disruptions found the path. Figure 2 presents the quality of the existing bike paths.

We have previously concluded that only 25% of all identified tracks are realized as bike paths. However, most of the existing tracks have medium disruptions, such as 53% of bike paths with bus stations or cars parked on the bike path, and on 41% of bike paths there are drainage pipes, garbage bins, trees, inappropriate width, etc. Only 1% of tracks satisfy quality norms and 5% are in very bad condition, almost inappropriate to use them.

Input Parameters

To make proper policy decision about projects' priority one might use simulation and visualization methods or optimization model presented in this paper. Both methods use input parameters that can be defined with two different approaches. The first approach is based on identification of user groups of those who use bikes as transport means. For example, in our research we have identified 77 user groups classified by 4 purpose

Figure 1. Distribution of bike paths within identified tracks in Skopje

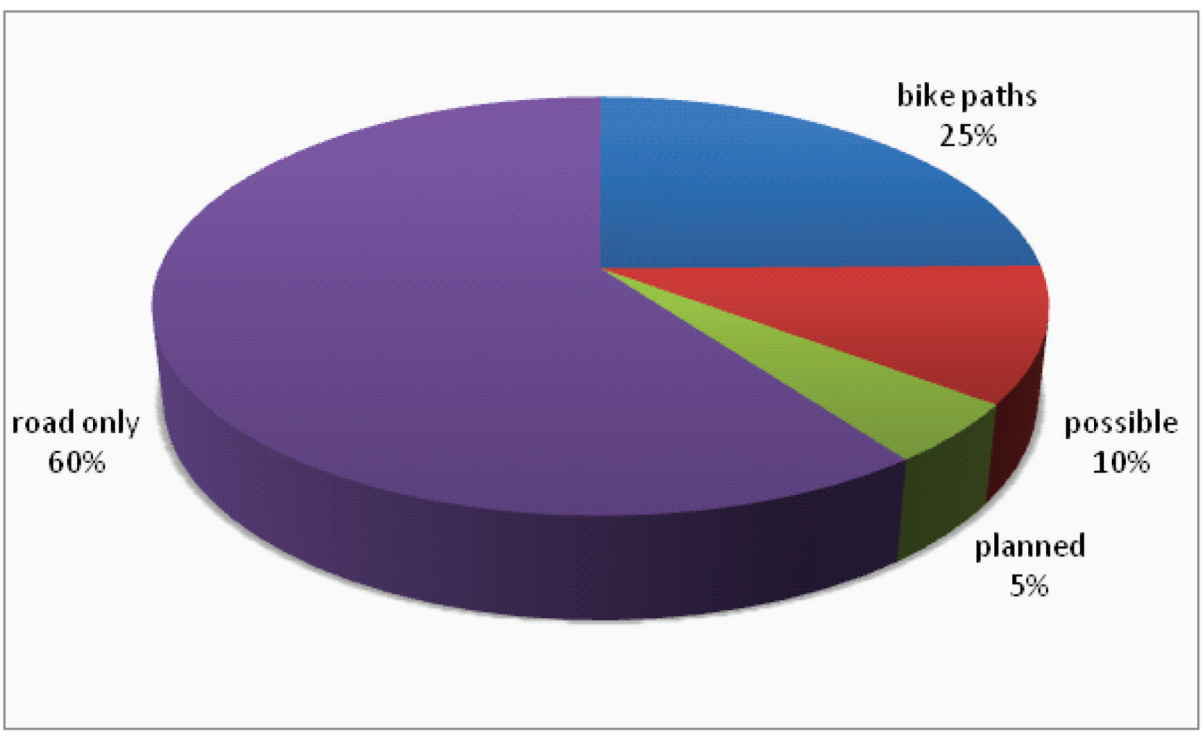
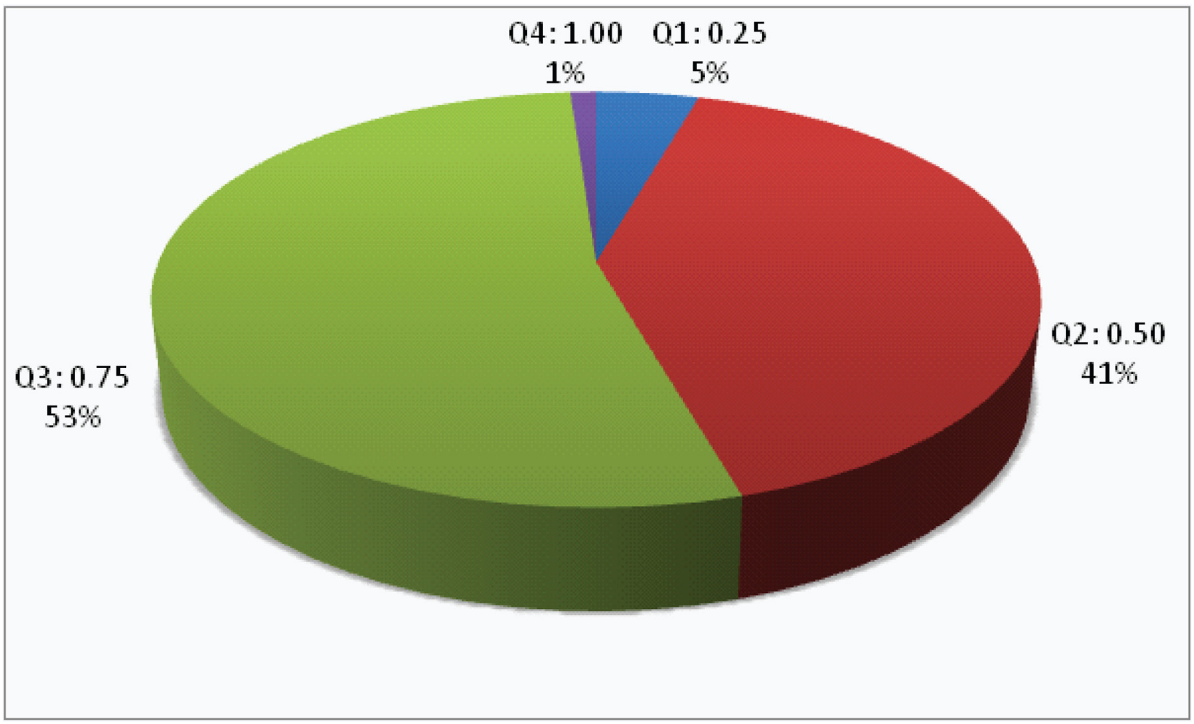


Table 3. Methodology for identification of quality of existing bike paths

Quality	Description	# 90
Q1: 0.25	Bike path in very bad condition, a lot of holes and major disruptions	4
Q2: 0.50	Big disruptions, such as drainage pipes, garbage bins, trees, etc.	37
Q3: 0.75	Small disruptions, such as, bus stations, car parked on a part of bike path	48
Q4: 1.00	Bike path in good quality without noticeable disruptions	1

Figure 2. Quality of existing bike paths in Skopje



types of traveling as business, education, shopping, entertainment/ recreation.

To enable sufficient simulation we determined the destination of each user group the arrival time when they are expecting to arrive at the destination and also the return departure time. We have also identified if these activity happen only on working week days, or on weekends. We assume that those that live within 1 km away from destination or less than 10 min walk will usually walk to the destination. In addition, those that live up to 3km will probably use bikes as transport means and will determine sources for passenger trips.

The second approach to use input parameters is based on using a more formal analysis about traffic analysis, which identifies the number of passengers between identified locations (micro zones). According to the recent study (IDORM, 2010) there are average daily 639593 passenger trips among different locations. Note that this number should be divided by two in case of return trips. These passengers identified 5018 different pairs of sources and destination points within identified 268 locations. Using a predefined coefficient of 2.5% population using bikes we end up with 14056 possible bike users for these trips.

For both approaches, to enable better calculation we introduce weather and month condition parameters, denoted as C_m and C_w correspondingly and presented in Tables 4 and 5. The values are between 0.1 meaning only 10% of exiting bike users will bikes and 1.0 meaning all bike users would use bikes.

Typical weather conditions to be simulated are given according the official meteorological data, as presented by number of days in a given month with corresponding weather conditions in Table 6.

The number of bike users depends on user satisfaction. We have already presented a grading scale for quality of bike path infrastructure with a methodology presented in Table 3. Each track R_i is associated with quality indicator $C_Q(R_i)$, having the value 0.25, 0.5, 0.75 and 1.

Next we present a definition of bike user satisfaction as relative ratio of those who are using bikes as transport means in relation to all those who posses bikes. According to experiments we have provided, we found that this user satisfaction indicator correlates to the quality of infrastructure for the given bike track. Note that this reflects only those, which trip includes source and destination with bike paths.

Previous factors can determine the number of bike users N for a given track R_i. Assume that N_{max} is the maximum number of bike users for

Table 4. Month condition C_m as input parameter for bike usage

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.1	0.2	0.4	0.7	0.9	1.0	1.0	1.0	0.8	0.5	0.3	0.1

Table 5. Weather condition C_w as input parameter for bike usage

Bright	Sunny	Cloudy	Rainy	Snowy	Storm
0.1	0.2	0.4	0.7	0.9	1.0

Table 6. Number of days with corresponding weather conditions in Skopje

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bright	10	10	11	11	11	11	5	6	11	11	10	10
Sunny	7	7	8	8	7	10	20	18	11	8	8	2
Cloudy	7	5	4	3	2	2	2	2	4	4	6	8
Rainy	1	3	6	8	7	4	4	5	4	5	4	5
Snowy	2	1	0	0	0	0	0	0	0	0	1	3
Storm	4	2	2	0	4	4	0	0	0	3	1	3
Total	**31**	**28**	**31**	**30**	**31**	**31**	**31**	**31**	**30**	**31**	**30**	**31**

a given track R_i. Therefore, the average number of bike users will be dependent on user satisfaction, month and weather conditions and will be equal to:

$$N(R_i) = N_{max}(R_i) C_Q C_m C_w$$

The average weighted quality measure about bike path infrastructure is a new quality measure equal to weighted average of the number of tracks with appropriate quality weight. Denote by K_{Q_1}, K_{Q_2}, K_{Q_3} and K_{Q_4} correspondigly the number of tracks with quality values C_{Q_1}, C_{Q_2}, C_{Q_3} and C_{Q_4}. The average weighted quality measure is equal to

$$Q = \frac{\sum_{k=1}^{4} K_{Q_k} C_{Q_k}}{\sum_{k=1}^{4} K_{Q_k}}$$

According to the values presented in Table 3 we calculated the average weighted quality of existing bike paths in City of Skopje to be 0,628. One might also calculate the average weighted quality measure using the path length, instead of number of tracks, and in this case we obtained a very similar value of 0.617.

Our experiment have shown that that average user satisfaction measure is equal to the quality of bike path infrastructure, and make a conclusion that in City of Skopje, all those that use bikes as transport means are 62,8% of those who possess bikes, their sources and destinations are connected with bike paths and the distances between source and destination is within a bike driving perimeter. In this paper we assumed that people are walking if the distances are less than 1 km and if distances are less than 3 km the people would prefer bikes as transport means if there is a corresponding bike path with sufficient quality. We are aware that other factors (costs to drive a car, motivation for physical activities, etc.) influence the decision to use a bike, car, public transport or to walk. However, we accept that the average usage of European City is approximately 5% and aim to reach this value.

Denote with T the transport means to be used by those that travel between two locations (micro zones) using a series of neighbouring tracks R_i. The latest comprehensive traffic study (IDORM, 2010) determines the average percentage of population using these transport means with values 35% of population is walking to destinations, 33.6% is using private transport (cars), 30% is using public transport, and 1.5% is driving a bicycle.

To realize optimization functions we will specify some other input parameters:

C_p **:** Contamination (pollution) index for transportation means, which ranges between 0 and 1. For example: walking causes no or 0 contamination, motorbikes may cause 0.7, and old busses may cause maximum contamination of 1.

C_n **:** Noise coefficient depending on activity, ranges between 0 and 1. Example: walking may cause small noise with value of 0.1, whereas riding a bicycle may cause a slightly more noise with value of 0.2, and a group of motorbikes may cause a maximum noise with value of 1.0.

Optimizations

The planned measures (projects) with goal to increase the bike usage as transport means in City of Skopje are presented in Table 7. There are total of 5 different measures and each measure can be realized with a different number of projects. For example, there are 90 existing bike tracks, and each can be improved to enable better quality for bike transportation, which the first measure, or there are possibilities to build 55 new bike tracks which is the second measure. Introducing bike intermodality is a measure that will enable car

Table 7. Measures and projects for increasing bike usage in Skopje

Measure	Description	# Projects
M1	Improve existing bike path infrastructure	90
M2	Build new bike paths	55
M3	Build bike parking facilities	80
M4	Build rent-a-bike facilities	25
M5	Introduce bike intermodality	8

parking and rent-a-bike facilities, planned to be cheaper service than just car parking in the City Central region. Note that these 258 projects are just reflecting the existing urban plan development and may increase with increased demand in the next years.

To enable better mathematical notation of a particular project we will use notation of P_{ij}, where *i,* $1 \leq i \leq 5$ is identification of the corresponding measure and *j* as identification of the corresponding project within the given measure.

Two important functions used in this optimization model are the cost function $C(P_{ij})$ and time duration $T(P_{ij})$ of a given of a selected project P_{ij}.

Dimensioning the facilities is another topic in this project. For example, making a bike parking facility for a given location has to be dimensioned with its capacity, that is, the number of bike parking lots. Both these two factors influence the user satisfaction factor and motivation to use bikes as transport means.

To calculate the optimal size of parking lots and rent-a-bike facilities (docking stations) one have to make deeper analyses of source destination transport matrix, which indicates the number of transport needs between different micro zones. Like in previous analysis we try to fit into the 5% average of bike users in a typical European city. So the capacity of docking stations can be calculated by implementing numbers found in the source destination transport matrix.

The goal of this paper is to maximize the impact within a given limited budget. It means to select a combination of projects that will realize the highest impact.

Lets denote by *S* the set of all projects that can be realized to increase the bike usage in City of Skopje. Selection is actually a process of defining a subset of projects $S_{opt} \subseteq S$, which satisfies certain optimization functions. The process of choosing a subset of a set with 258 projects, as specified in Table 7, is computationally complex process and needs a lot of calculations to find the optimal value. Before we will explain our algorithm, let's start with analysis of limitations and then define the optimization functions.

The first limitation addresses the budget allowance *B*. Suppose that there are *N* selected projects P_{ij}. The following relation expresses the budget limit:

$$\sum_{k=1}^{N} C\left(P_{ij}\right) \leq B$$

The second limitation corresponds to the time duration T_{max} indicator, that is, each selected project P_{ij} will fit in the given time frame limit, as expressed by the following relation:

$$T\left(P_{ij}\right) \leq T_{max}$$

We continue with description of parameters that will estimate the impact. There are measurable and quantifiable indicators and also quality indicators. The following is definition of the quantifiable and measurable indicators used in this paper as optimization functions to find out which of their parameters optimize the impact value.

- **Traffic (Congestion Index):** Traffic jams, traffic congestion. In our case this is expressed by the *overall transportation time,* as a specific measure for the traffic impact. For this purpose we select typical points found on the urban City perimeter where usual traffic congestion starts to appear. In our case there are 8 such points that express locations where the City Administration plans to build intermodality facilities – places where someone can park the car and use rent-a-bike paying less for this service, instead of just using car parking in the City Center. We measure a typical transportation time by car between these points in congestion drive time periods (8-9 AM and 16-17 PM). Denote the sum of these travels with T_{tsp}. Increasing the number of bike users will lead to fewer cars in normal traffic and will mean decreased congestion and smaller T_{tsp}.

The procedure to measure the T_{tsp} is making a weekly average of timings to complete all predefined trips between selected points. The trips are usually selected to be between diagonal or most distant pairs of these locations. In our case we have selected $M = 6$ characteristic trips and measure the time t_i to travel along the *i*-th trip, where $1 \leq i \leq M$. The average timing T_{avg} along the *M* characteristic trips is equal to

$$T_{avg} = \frac{\sum_{i=1}^{M} t_i}{M}$$

The value T_{tsp} can be obtained as average value of all these partial measurements T_{avg} during a complete week in both peak drive times (8-9AM and 16-17PM).

- **Pollution:** Motor vehicles use combustion of a fossil fuel, a process that emits gasses and affects the environment. The values can be measured by special equipment distributed in specific city locations. However, we define a different relative measure of pollution expressed as a value dependent on transportation means. A high pollution value is bad for the environment, preferring bikes and walking instead of cars. Denote by N_{com}, N_{pub}, N_{car}, N_{bike}, N_{walk} correspondingly the number of all commuters, those that use public transport, cars, bicycle or walk. We assume that the parameter is within a given set of 4 values

$$i \in \{pub, car, bike, walk\},$$

and that the number of all analysed commuters is

$$N_{com} = \sum_{i \in \{pub,car,bike,walk\}} N_i$$

In this case, the pollution is equal to

$$P = \Big(\sum_{i \in \{pub,car,bike,walk\}} C_p\left(i\right) * N_i \Big) / N_{com}$$

It has value between 0 and 1, where 1 will denote when all commuters will use transport means, which initiates the highest pollution as defined by coefficient C_p.

- **Noise Pollution:** Encompasses roadway noise. Normal procedure to measure noise is done by corresponding equipment on specific city locations. However, in this paper we use relative measure similar to the explanation for pollution. In this case, the noise pollution is equal to

$$NP = (\sum_{i \in \{pub,car,bike,walk\}} C_n(i) * N_i) / N_{com}$$

The values range between 0 and 1. High noise pollution values are undesirable.

Finally, the optimization model is defined as

Find a subset of projects $S_{opt} \subseteq S$ by optimizing

$$\min(T, P, NP)$$

and

$$\max N(N_{max}, C_Q, C_m, C_w)$$

subject to

$$C_Q, \mathrm{C}_n, \mathrm{C}_P, \mathrm{C}_m, \mathrm{C}_w \in [0,1]$$

and

$$\sum_{k=1}^{N} C(P_{ij}) \leq B \text{, and } T(P_{ij}) \leq T_{max}$$

Our algorithm is not using the “try all possibilities” approach to find the optimal subset of projects since it is a time consuming function. Rather, we suggest using a greedy algorithm, which first calculates the optimization functions of all individual projects and rank the projects according to the calculated values. The ranking is primarily realized according to minimize the timing function T and then by other parameters. The list of selected projects is constructed based on greedy selecting the top ranked projects until the budget and time duration fit in the function.

The overall quality indicator is the increased overall percentage of users that use a bike as transport means. This value can be measured by providing a traffic analysis study, which is a time consuming activity. This study will determine the number of bike users N and find out the corresponding percentage indicator, by simulating increased infrastructure and presented model.

We also refer to the FUPOL project and development of a simulation and visualisation tool. This tool will create a simulation environment based on user parameter model that creates users and simulates their traffic behaviour and transportation needs in their life. This approach provides a better understanding of stakeholders and also citizens, since they can interactively specify various parameters and simulate various scenarios that will result with democratic process of proposing right projects to improve the overall bike usage as transport means.

5. CONCLUSION AND FUTURE WORK

This research aims to build an optimization model to support the project to foster bicycle inter-modality. Our research on data available from relevant studies and deeper analysis of existing situation showed a list of 5 measures and 268 projects to be realized to increase the number of bike users up to the value of 5% found as average in modern European cities. This process faces budget limits and various other limitations, which are listed in the paper. The challenge to make a selection of projects that will make the highest impact is the overall goal of this optimization model. In this paper we have described relevant input parameters, a set of limitations and optimization functions. The model defines an algorithm that can find the most optimal selection of projects that will make the most impact.

Another approach based on simulation and visualization is also used in the FUPOL project. This complementary approach uses the same input parameters and has the same overall goal, but is based on simulation of user behaviour instead of using predefined or calculated statistical values. Besides the fact that this approach will give a proof of concept, it will also enable an environment to involve citizens in the policy making processes. It will be realised in the form of online web application, intended for travellers and decision makers to plan, understand, schedule and visualize the bicycle use in Skopje.

The results from both the optimization model and simulation/visualization approach will assist and encourage intermodal transport, and show what measures and which projects to be undertaken to improve the existing bike path infrastructure, and establish bike docking stations.

Driven by the citizen's demands, our research will lead to better policy decisions, more efficient implementation of government policies as well as better identification of consequences for citizens and businesses. With the help of multichannel social computing, policy topic sensing and extraction, advanced visualization including integration with GIS, multilingual semantic analysis, advanced policy modeling and model repository, dynamic agent based simulation, cloud computing and IMS supported crowd sourcing, we aim to address the bicycle intermodality problem, improve the bike infrastructure and increase bike usage as transport means in Skopje. Moreover, an estimation of pollution impact and an estimation of motor vehicles flux reduction will be also outputs of the optimization model.

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KEY TERMS AND DEFINITIONS

Bicycle Docking Station: A place in the city where citizens can pick up and drop off their bicycles.

Computer Simulation: An attempt to model a real-life or hypothetical situation on a computer so that it can be studied to see how the system works.

Environmental Preservation: A practice of protecting the natural environment on individual, organizational or governmental levels, for the benefit of the natural environment and humans.

FUPOL (FUture POLicy modeling): A project which proposes a comprehensive new governance model to support the policy design and implementation lifecycle.

Intermodality: (Intermodal Passenger Transport): A way of commuting which involves using two or more modes of transportation in a journey, with a goal to combine the strengths (and offset the weaknesses) of various transportation options. Also, it aims to reduce dependence on the automobile as the major mode of ground transportation and increase use of public transport.

Optimization: A process of finding the minimum (or maximum) of a suitable objective function, while it satisfies a given collection of feasibility constraints.

Policy Implementation: The stage of policy-making between the establishment of a policy and the consequences of the policy for the people whom it affects. Implementation involves translating the goals and objectives of a policy into an operating, on-going program.

Recreation: An activity of leisure, leisure being discretionary time.

Chapter 18
Is Political Participation Online Effective?
A Case Study of the E-Democracy Initiative Conducted by the Brazilian Chamber of Deputies

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ABSTRACT

The Brazilian Chamber of Deputies (Câmara dos Deputados) conducts an e-democracy initiative that enables people to participate in political decisions regarding legislation. "Portal E-Democracia" is the name of this website in which people can participate in several different ways to speak their minds regarding legislative activities. This chapter analyses the effectiveness of citizens' engagement in the e-democracy initiative through the case study of the discussion of the Internet Civilian Landmark – a bill to regulate Internet use in Brazil. The authors analyse two types of participation: comments to the draft bill and suggestions. To measure the effectiveness of user-participation in such a case of collaborative lawmaking, the authors compare the content of the first draft, the final draft, and the suggestions made through the wikilegis in order to assess whether the discussions maintained within the e-democracy platform were or were not taken into account. This procedure also reveals to what extent online discussion was able to reach political decision-makers and effectively change the Internet's Bill of Rights.

INTRODUCTION

The growing presence of organized civil society's actors and stakeholders and the participation of governmental and non-governmental institutions in the Internet motivate a debate of possible effects of such phenomenon in various political instances, such as participation, democratic governance and citizenship. Within this framework, the Internet's democratic potential is constantly thematized as well as questioned (Chadwick, 2009; Coleman; Moss, 2012; Coleman; Blumler, 2009; Dahlberg,

DOI: 10.4018/978-1-4666-6236-0.ch018

2007; 2011; Maia, Gomes, Marques, 2011). However, a huge gap keeps at bay the opportunities offered by virtual environments and an effective strengthening of relations between elected representatives and those they represent. The reason for this arm's length reality is that online political participation depends not only on the citizens being willing to participate but also on politicians and governments being open to recommendations and guidance flowing in from online popular participation. In this context, it is relevant to ask how effective is virtual engagement vis-à-vis institutional tools of political participation.

To address such issue, this chapter seeks to analyze the efficacy of virtual participation in *Portal E-Democracia*, a tool for civil society participation in political decision-making. This is an innovative landmark project, created in 2007 by the Federal House of Representatives in Brazil. It seeks to widen and deepen popular involvement in issues debated by their elected federal representatives.

This chapter dwells on virtual engagement on the *E-Democracia* portal, and focus on the Case Study of the bill of law of the Brazilian Internet Civilian Landmark, whose goal is to regulate Internet use in the country. To grasp how sizable is the gap between opportunities for virtual participation and effective citizenry influence on political decision-making, we analyzed to what extent political participation through a virtual platform was able to actually affect the discussion of the bill of law in the Brazilian House of Representatives.

Brazil is among the top countries investing in democratic innovations (Avritzer, 2009; Goodin, 2008; Coelho, et al. 2005; Smith, 2009), a major example of participatory-budget adoptions which have, more recently, integrated virtual stages (Peixoto, 2009; Sampaio, Maia & Marques, 2010). In this sense, it is important to highlight that the initial first draft of the Brazilian Internet Civilian Landmark, that seeks to regulate Internet use in the country, is the end result of a popular consultation process stage, involving various sectors of society in the discussion of issues to be addressed in regulating Internet use in the country (Sampaio, Nicolás & Bragatto, 2013; Steibel, 2012). Even though virtual democracy initiatives run into many barriers (social, economic, cultural), affecting participation (Coleman; Blumler, 2009), the Internet Civilian Landmark case can be is regarded as a successful initiative of grassroots civilian participation in decision-making processes.

Despite Brazil's tradition of fostering popular participation, one must carefully analyze any sweeping generalized adoption of participative tools that, at first sight, might suggest that the political realm would be willing to listen to what civil society has to say. Possibilities of institutionalized online participation are many and varied, but our research is driven by the following questioning: Is online political participation effective? Is a virtual engagement in institutional tools of political participation (in the Portal E-Democracia) capable of influencing political decision-making?

This study is less focused on the deliberative stage of the online discussion of the Internet Civilian Landmark (in a Forum and Chat Rooms designed for this purpose); it rather focuses its attention on the efficacy of user participation in the process. Put in more precise terms, we pay attention to the opportunities to act and influence the collaborative process of discussing the bill of law, since we seek to verify whether or not the legislative committee was open to popular demands regarding Internet regulation.

This chapter surveys the contribution of recent studies on virtual participation and the adoption of digital tools by different spheres of institutionalized politics, in order to contextualize our research. We next lay out the methodological procedures applied to the two participative stages of the *wikilegis* tool, namely: comments and suggestions. In a subsequent section, the results and conclusions of this paper are presented. The study argues that the legislative branch can benefit from virtual participation. It concludes that, in the case of the Brazilian Internet Civilian Landmark, the political decision-making instances were permeable to suggestions coming from the population.

INTERNET, DELIBERATION, AND POLITICAL PARTICIPATION

The possible political effects of daily Internet use are part of a wide-ranging research agenda (Chadwick, 2009; Chadwick; May, 2003; Coleman; Blumler, 2009; Dahlberg, 2004; 2007; 2011; Dahlgren, 2005; Maia; Gomes; Marques, 2011; Rossini, 2013; Papacharissi, 2002; 2004). Adopting a careful standpoint in the debate on the Internet's democratic potential, this article sides with the argument that the digital world, by itself, does not change political habits and practices. Only when appropriated by citizens, the Internet is able to foster, facilitate and support various processes, including participation, engagement and access to information. Internet tools certainly can empower citizens in several circumstances, ranging from free expression of opinion to directly or indirectly interfering in the public sphere and in political decision-making. Getting involved with politics online is now easier for many reasons – people are able to participate without leaving home; citizens can interact with others who share the same interests, run campaigns and organize public acts online and offline as well as communicate with political agents through websites and e-mails, support certain causes by signing virtual petitions and so forth.

One could argue that the lesser the cost of online political participation, the lesser the validity, the relevance or the effectiveness of such an engagement. A number of scholars have suggested that many forms of virtual participation, or *slacktivism*[1], face barriers to secure credibility beyond the Internet environment, thus having a limited effect on the public sphere and on the policy-makers (Christensen, 2011).

The Internet is a constructed environment and cannot be seen as a democratizing tool itself. Its democratizing potential is based on contingent circumstances and depends upon cultural and social variables (Coleman, Blumler, 2009; Coleman; Moss, 2013; Dahlberg, 2004; Dahlgren, 2005; Papacharissi, 2002). However, these authors stress four Internet aspects that can contribute to democracy. The internet enables: 1) the construction of a public constituted by predominantly active users; 2) the discursive engagement in civic dialogue (many persons can exchange information and experiences online); 3) hosting endless data and information, accessible to users, in different depth levels, according to their interests; 4) the possibility of point-to-point or many-to-many horizontal communication, thus ensuring greater symmetry of communication power vis-à-vis unilateral means (Coleman; Blumler, 2009:12-13).

Many studies on the Internet's potential to strengthen democracy are based on models of deliberative democracy. An often-asked question in this literature is how political decisions are made (Dahlberg, 2004; 2007; 2011; Dahlgren, 2005; Papacharissi, 2002; 2004; Smith, 2009). In various ways, these studies shed light on a key Habermas (1996) concern; that is, they offer an explanation of how society, organized into various institutions, plays the role of intermediating the relations between the state and the citizens, and how demands from different sectors in the political system's periphery reach the public sphere, in order to influence political decision-making.

In Habermas' perspective, participation in the public sphere should occur through a particular type of communication, one that is characterized by a willingness to argue; by mutual acknowledgement of the interlocutors' equality and by the attempt to solve problems through rationally-motivated consensus. Communication based on attempts to reach mutual understanding occurs when the subjects grant communicative freedom to their counterparts, exchange of arguments and justifications; assume that all those interested should have equal opportunities to participate and have their sayings equally taken into accounts, and interactions are based on reciprocity and non-coercion (Dahlberg, 2004; Dahlgren, 2005; Steiner et al., 2004; Stromer-Galley, 2007; Maia 2012). Thus, deliberation is considered an exigent and rare practice.

If democratic participation is not an intrinsic characteristic of citizens, but the outcome of a citizenship built through primary and secondary socialization processes (Coleman e Moss 2012; Dahlgren, 2009, 2013), it becomes important to understand which social and technological practices facilitate forms of deliberative political participation. In this sense, a growing stream of research on online deliberation has sought to identify the influence of technical and organizational specificities of the Internet communication environments on particular forms of deliberative citizenship (Coleman; Moss, 2012; Janssen; Kies, 2004; Wright; Street, 2007).

Some authors argue that a rigorous normative concern with deliberation could set aside other forms of less demanding political participation and civic conversation (Chadwick, 2009; Coleman, Moss, 2012). In this sense, it is argued that engagement in rational and reflexive exchanges has a high cost in terms of time and effort. This is why it should not be considered the only form of relevant political communication. Coleman & Moss (2012) argue that, in some contexts, the orientation to the communicative reason for deliberation is too restrictive and it does not consider other major forms of political conversation (2012, p. 7).

In this sense, we understand that it is important to characterize the deliberation phenomenon, through precise criteria, in order to avoid stretching the concept to the point of it losing its validity. This does not mean that deliberation cannot occur intercalated with other communicative forms and political processes. Nor does it mean that other communicative forms, such as storytelling, rhetoric and humor are not conducive to critical reflection with potentially democratic effects. Indeed, various communicative forms cant lead to deliberation, under diverse conditions and circumstances. We assume that deliberation is a rare and fragile phenomenon, as Habermas says everywhere (1996: 323; see also 2006) and each deliberation criterion sparks a wide-ranging debate on normative controversies, to enlighten their sense and application in real politics. Such debate has led to advance normative criteria, while its normative core has been maintained (Rosemberg, 2007; Dryzek, 2010; Mansbridge, 2010; Neblo, 2005; Steiner, 2012; Maia, 2012). This debate could not be developed within the framework of this chapter.

For our purposes, it suffices saying that the normative criteria, albeit they are demanding and seldom wholly found in deliberative processes in the "real world", must be observed as ideal conditions. They intend to be critical and challenge reality (Bachtinger et al., 2009; Coleman; Moss, 2012; Dahlberg, 2004; Dahlgren, 2005; Janssen; Kies, 2004; Maia, 2012). In this work, we follow scholars who argue that the normative criteria offer us guidance to investigate empirical phenomena and to evaluate the significance of our results. Consequently, they also tell us something about goals to achieve and promote, and how existing institutions and practices could be improved (Dahlberg, 2004; Dahlgren, 2005; Steiner, 2012, Maia 2012).

Our interest here is to explore the interface between online political participation and its capacity to produce real effects in the political sphere. Chadwick (2009) argues that a growing number of virtual platforms based on content created by users and social networks (Web 2.0) will positively impact online political participation. The author suggests seven principles in which Web 2.0 tools can influence citizens' engagement in politics: "the Internet as a platform for political discourse; the collective intelligence emergent from political web use; the importance of data over particular software and hardware applications; perpetual experimentalism in the public domain; the creation of small scale forms of political engagement through consumerism; the propagation of political content over multiple applications; and rich user experiences on political websites" (2009: 19).

The last principle, user experience in political websites, is adequate for analyzing the *Portal E-Democracia* from the Brazilian Federal House of Representatives. Beyond a consulting little-participative format staking out the first stage of governmental and political websites (Chadwick; May, 2003; Maia; Gomes; Marques, 2011), political institutions have invested in developing virtual environments aimed at increasing political participation through experiences that are richer to users.

These principles suggest a vision of new technologies as a territory of possibilities, even if Internet access is not determinant of political activities that – in the final analysis – depend on user's motivation to access diversified information sources, participation in discussions or somehow interacting with the democratic processes (Papacharissi, 2004; Shirky, 2010). We understand that Internet use for political purposes is clearly a minor activity if compared to other motivations to access it, such as searching for entertainment (Dahlgren, 2005). Even as it integrates itself evermore into the consolidated systems of political communication, the Internet is also used to question and challenge power structures. Concerning the possibility of political participation, we support Peter Dahlgren's argument that the relevant issue is that, for those with access and political motivation, and live in open and democratic societies, the Internet offers very feasible opportunities for civic interaction, even if this clearly cannot promise a quick fix for democracy (Dahlgren, 2005, p. 151).

Strongly influenced by Web 2.0's tools (especially the social networks), many of the E-democracy platforms have incorporated semi-open access and adopted mechanisms intended motivate citizens to display their true identity and to increase the levels of trust, confidence and honesty among participants (such as use of personal profiles with bona-fide data, photos, etc.) .Such a concern with developing platforms to motivate honest political engagement reflects a growing line of studies that focus on the impacts of technical and design features on the users' deliberative experience (Coleman; Moss, 2012; Janssen; Kies, 2004; Wright; Street, 2007). In this sense, it might be argued that institutionalized virtual participation and communication platforms made available in these experiments attribute distinct role to citizens, corresponding to different participation models. While incorporating digital technologies in processes of governance, governments, political parties and other political institutions make a series of decisions that determine different types of citizens' possible uses of these tools; and these tools create or restrict opportunities of participation and interaction between representatives and those represented by them. We will deal with this on-going debate in the following session.

DIGITAL DEMOCRACY: PARTICIPATION MODELS

Virtual environments specifically created to support political participation, such as websites and platforms developed by political institutions, are now major communication channels between citizens and their representatives. Governments and legislative houses in several countries have invested evermore in technology, to offer more access and transparency to the public. Given the Internet's ubiquitous use around the world, it is no longer a matter of whether or not governments are online, but rather how are these technologies used and do they contribute to make the political sphere more receptive to society's interests? (Chadwick; May, 2003).

Under ideal conditions, strengthening citizenry relations with institutional political entities (governments, legislatures etc.) would be possible using virtual tools as a way to increase civil society's participation, making available opportunities of involvement in debates and discussions, at reduced cost to citizens. Within such framework, it could be argued that the Internet is fertile territory for "democratic innovations", as put by Smith (2009) – institutions entrusted with developing and strengthening citizen's involvement in the political decision-making processes. Once political institutions develop virtual participation platforms, to further interaction between representatives and those they represent, it behooves to ask whether this opening of institutional political structures to effective civilian participation is indeed effective, in the sense of ensuring citizens the possibility of influencing various decision-making processes. After all, as argued by Coleman and Blumler (2009, p.3), "for democratic participation to significantly impact political results, institutions that are inclusive and responsible must offer effective interaction between citizens and their elected representatives.

Chadwick and May (2003) have developed three interaction models to describe institutional and government efforts regarding the use of Internet-based communication technologies. The first one is the Managerial Model of Interaction, in which the Internet is seen as an improvement of previous technologies, to be used to renew government functions already efficiently established - resulting in "greater speed combined with cost reduction " (2003, p. 276). Information flow is predominantly linear and top-down, that is, from governments to citizens. The overriding goal is reduction of bureaucracy and costs, providing relevant information to citizens, to communication media and to businesses (2003, p.276-278).

Governments greatly benefit from this model, insofar as administrations are renewed, become more efficient and less bureaucratic; there is integrated access to government information and benefit transfers; government taxes and fees are digitally paid; social information databases are created, among other beneficial aspects. Interaction mechanisms in this managerial model relate to less red-tape in citizens' demands (tax reimbursement, rebates, benefit claims, public data and documents are more easily updated, data are better added for social research and survey, and so forth and so on). This model privileges administrative efficacy but does not foster openings to popular participation (Chadwick; May, 2003, p.277).

The Consultative Model, on the other hand, encourages interaction to promote democratic participation, seeking citizens' opinion on specific issues, in order to guide decision-making processes. Although this model effectively improves public and administrative policies, as it takes into account society's opinion, the political sphere regulates the agenda, the information flow is linear and the overall approach is top-down. In other words, persons can only offer their opinions on issues previously defined by the governments (Chadwick; May, 2003, p.277). According to Chadwick and May, this is a transition model between the Administrative and the Participative one, as it facilitates the development of more receptive practices within digital governance (idem, p.279). However, critics argue that there are problems inherent to this type of participation, such as unequal Internet access (usually having to do with differences in schooling and income), which become a selection criterion as to who may or may not participate. Inasmuch as several factors inhibit universal participation, this model allows governments to consult selected parts of the population, in order to make legitimate the interests of certain groups (Chadwick; May, 2003).

Finally, the Participatory Model is the one supporting a more complex, horizontal and multidirectional interactivity between citizens and politicians. This perspective assumes that, even though the State may facilitate the political discussion, the State is only one of many associations in civil society. The underlying idea is that discussion and interaction environments emerge from inter-citizen communication, even if the State remains the chief target of organized political action. This model acknowledges that knowledge is discursive, contingent and transformative. It emerges from interaction processes – which are the cornerstones constituting democracy. Opinion formation and the political action taking place in online forums, groups, communities and networks that operate as meeting environments for people with similar interests must contribute to the development of civil society. Marching against the grain of the previous models, this perspective recognizes that citizens and organized groups have something to say and that governments must be open to this dialogue.

At the time of Chadwick and May's empirical study (2003), the administrative model prevailed in E-democracy initiatives in the United States, the European Union and Great-Britain. However, it could well be outdated, as it refers to a time when technologies were not ubiquitous for either party, and government invested in experiences with scarcely any Internet involvement. In a more recent study, Chadwick (2011) argues that success or failure of virtual engagement strongly relates to the institutional organization of initiatives - a sidestepping conclusion that detours questioning the relevance of E-democracy projects to the institutional universe of politics.

Participative Models are more and more adopted in contemporary democratic countries. This translates into the incorporation of initiatives such as participative budgeting, portals to participate in institutional politics, E-democracy tools and digital governance. In addition to not treating a citizen as just a client or a consumer, nothing more than a recipient of political practices, these platforms ensure that their users have a voice to be heard and opportunities to actively participate in political decision-making processes.

Brazil is among the major countries investing in democratic innovations. A well-known initiative is Porto Alegre's Participatory Budgeting. In this state capital of Rio Grande do Sul, the Participatory Budgeting was implemented in 1989 and widely replicated in other Brazilian and Latin American cities (Avritzer, 2009, Coelho et al. 2005.; Goodin, 2008, Smith, 2009). This Brazilian participatory experience is rooted on forming mini-publics in three stages. Firstly, in open-participation Assemblies representatives are elected for the second stage, Regional Budget Forums. Those participants elected at this regional stage participate in the Municipal Budget Councils, third and final decision-making stage. This initiative has proven to be effective in macro-political terms, as budget priorities can be defined according to the interests of the population. Participatory Budgeting is generally successful, particularly when there are voluntary associations and civil society participation, favorable political society will and absence of radical oppositions (Avritzer, 2009; Coelho et al. 2005).

As Information and Communications Technologies (ICT) become more available, several countries have invested in digital versions of Participatory Budgeting and in consultative methods mixing both online and offline stages (Peixoto, 2009). Brazil is among those countries adopting digital mechanisms to expand the possibilities for Participatory Budgeting. Rationale for ICT use in Participatory Budgeting includes process modernization, the possibility of greater citizen participation (thus reducing engagement costs) and expanding scope and information on public investments to be popularly voted (Best et al.,2010; Peixoto, 2009; Sampaio, Maia & Marques, 2010).

Despite the tradition to encourage popular participation in Brazil, one must be careful in analyzing the generalized adoption of participatory tools that, at first sight, might suggest that the political sphere is willing to hear what civil society has to say. In this sense, the effectiveness of online participation in the Portal E-Democracia could be called into question. Even taking into consideration the existence of a variety of possibilities for online institutionalized participation, a question remains: is an engagement in these tools able to influence political decision-making?

PORTAL E-DEMOCRACIA: A SUCCESSFUL CASE?

The "Portal E-Democracia" (Figure 1) is a platform linked to the Brazilian Federal House of Representatives. Created in 2007, it aims at making available to citizens opportunities to be engaged in the process of discussing and making public-policy laws and guidelines. This is a much resourceful tool, incorporating some aspects of virtual communities and social networks, in order to promote the meeting of users with a common interest in specific themes.

Forms of participation vary. The website is organized around legislative communities – with a theme defined as per the discussion agenda in the House of Representatives – in interactive events, which are public hearings and legislative committee seminars, in which users can participate through chat rooms in real time and open spaces, and can create forums to debate a variety of issues.

Available forms of interaction and debates in the legislative communities (figure 2) are determined by the stage at which the Bills of Law are being discussed in the House of Representatives

Figure 1. Screenshot of the main page of the Portal

(Federal Chamber of Deputies, in Portuguese). There are four major stages, in which different forms of participation are possible, namely:

- **Stage 1:** Suggestions to the bill of law, in its initial presentation, and possible participation with the use of wikilegis tools, virtual library and forum;
- **Stage 2:** Re-shaping of the bill of law, including the three above-mentioned resources and a "chat room" that makes it possible for online users to participate in public hearings and seminars;
- **Stage 3:** Preliminary report is submitted along with the Bill of Law, making possible new suggestions through wikikegis, forum and virtual library;
- **Stage 4:** Appreciation of Final Report, consolidated text is presented in the virtual library and the forum.

Even though the forum tool remained accessible in all stages, the debates during the final report's appreciation did not generate new contributions, since the discussion in the legislative committee ends with the presentation of the final process and is only resumed during the appreciation in the plenary, when the elected representatives make a decision.

The construction and organization of the virtual spaces created to spark the political debate is part of a growing agenda of research (Coleman; Moss, 2012; Janssen; Kies, 2007; Wright; Street, 2007). The literature suggests that decisions re-

Figure 2. Screenshot of the Marco Civil da Internet community page

garding designing and organizing virtual spaces contribute to develop (or inhibit) the presence of some fundamental deliberation principles in political participation, such as respect, reflexivity, exchange of rational arguments, non-coercion and inclusivity.

For Janssen and Kies (2004), four factors must be taken into account when one thinks about how communication spaces may affect the level of deliberation, as regards the organization and design choices: identification; openness and freedom of speech; moderation; agenda setting. These scholars propose such criteria as an attempt to call researchers' attention to the different instances in which structural characteristics, intrinsic to virtual discursive spaces, can impact negatively or positively on the level of deliberation.

As to the opening, access to the E-Democracy Portal is partly closed: the citizen can visualize the content without being registered, but can only effectively participate after registering and building a profile (with personal information, photo, etc). Registered users can participate in legislative communities focused on specific issues and free-theme forums created by users. As to discursive freedom, it is possible to identify considerable flexibility and opening, since there is space for participants to introduce debates and no limitation to either frequency or access.

The need to register and use virtual profiles is a design choice, substantially affecting users' participation. Personal identification is a controversial parameter - while anonymity can contribute to increase the actors' freedom of expression, especially when debating embarrassing themes or taboos, it also protects the identity of those who behave aggressively or who bear bias or prejudices. Davies and Chandler (2011) point out that anonymity can increase one's willingness to participate in the debate, yet tends to reduce the participants' feeling of satisfaction, due to an emotional inter-participant distance. Use of real identities constrains and restricts freedom of expression, yet can be positive because it tends to reduce undesirable behavior (lies, false arguments, violence and lack of respect) in network discussions (boyd; Ellison, 2007; Donath; boyd, 2004; Janssen; Kies, 2004).

Space moderation can play a double role - censoring perspectives not congruent with the space's ideology and proposal, while also promoting deliberation that gives visibility to minority opinions, synthesizing the debate, offering additional information on the issue, etc. In the Portal E-Democracia, a participating "team" can act as debate moderator. However, in the specific case of the Brazilian Internet Civilian Landmark, this moderation guided participants on process rules and encouraged moderation – for instance, kicking off topics having to do with users' presentation, without actually moderating or censuring the debate.

Finally, by "agenda setting" the authors mean whoever sets (determines) the discussion topic: participants (a decentralized agenda), organizers (a centralized agenda) or both (a partly centralized agenda) (Janssen; Kies, 2004, p. 5). In E-Democracy, the agenda is partly centralized: the organizers define the legislative communities' theme, but the participants may create new forums to debate the themes they desire.

Among the available tools for civil society participation in the Portal E-Democracia, this paper aims to analyse the wikilegis, a resource that makes possible for users to visualize the Bill of Law while also inserting suggestions for amendments or writing paragraphs and articles directly in the bill's text, in addition to allowing comments (on the original or others' suggestions).

This study focuses on the legislative community of the Brazilian Internet Civilian Landmark, a bill of law whose objective is to regulate Internet use in Brazil, as already mentioned. Its initial draft was consolidated after wide-ranging public consultation, with online and offline stages (Steibel, 2011). The topic was widely debated and publicized in news websites and online portals. It brought over 12,300 members[2] to the website.

Since this topic directly impacts Internet users and dwells on their rights and duties, there was considerable interest on this bill of law. Between April 14, 2012 (when discussion began on the website) and August 13, 2013, the Internet Civilian Landmark community had 34,961 visits (27,754 unique visitors), visualizing 114,371 pages in the portal. The number of recurrent visitors is expressive and corresponds to 35.5% of the total. The overwhelming majority of visits (94.08%, or 32,892) were from Brazil, but the page also caught the attention of hundreds of users in the United States, Spain and Portugal. The Civilian Landmark community accounted for 8.5% of accesses to E-Democracia in the period[3].

This study is less centered on the deliberative stage of the online discussion of the Internet Civilian Landmark (Forums and Chat Rooms). It rather focuses its attention on the efficacy of user participation using the *wikilegis* (Figure 3). More precisely, we looked at opportunities to act and influence the collaborative process in discussing the bill of law, seeking to verify whether the legislative committee was open and receptive to popular demands regarding Internet regulation.

It should be pointed out that the data collected in the *wikilegis* tool led to a necessity to investigate the content of discursive exchanges triggered in this space (Figure 4). This procedure seemed necessary because participants have actively engaged

Figure 3. Screenshot of the wikilegis page from the Marco Civil da Internet community

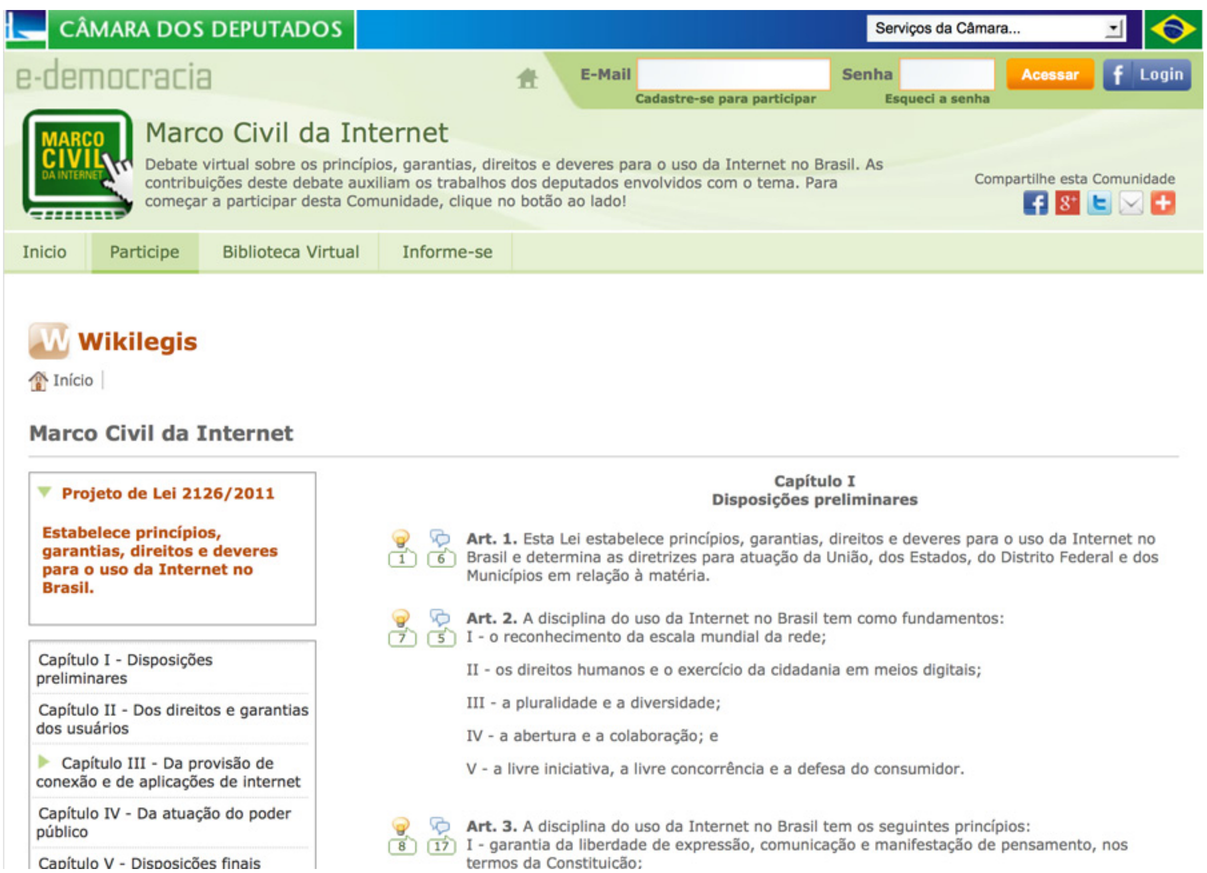
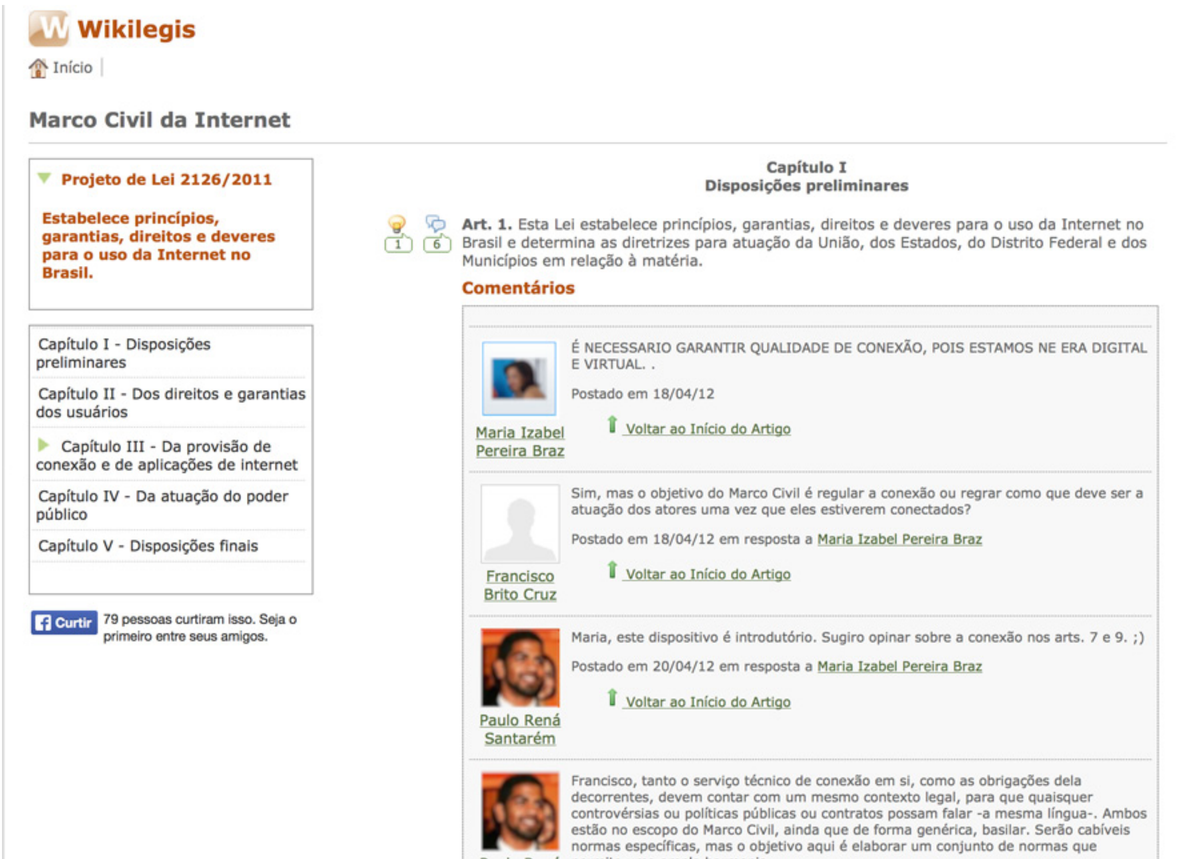


Figure 4. screenshot of users commenting on the Bill of Law in the wikilegis tool



in debates based on comments and remarks on the Bill of Law, even though this tool was configured for this proposal. In fact, participation and discussion at the wikilegis stage substantially outpaced the Forum stage. Given this appropriation of this space for debate, we considered it important to to capture the quality of the participants' contributions. The methodological procedures in each of these analytical stages will be described in the following sections.

It is relevant to stress that, when this chapter was written, the Internet Civilian Landmark's final report was ready to be voted in the House of Representatives and could receive new changes in the plenary discussions. Hence, the following analysis only takes into account the initial and final drafts that were open to users' suggestions.

METHODS

This research considers the wikilegis tool in its totality. It is a participation instrument designed to enable comments and suggestions directly on the bill of law that does not necessarily involve a discursive exchange among participants. Such tool makes two modalities of contribution possible: comments on the text and sending proposals.

The first one allows users to insert comments in the Bill of Law's articles and paragraphs, without necessarily justifying their opinions. These remarks are made in the same exhibition page of the text. The second modality makes it possible to suggest amendments and proposals to each article. As the proposals assume direct interventions in the text (text reformulation, item inclusion or exclusion, and the like), there is a space for submitting rationales.

This study used a two-stage methodology, referring to two forms of tool interaction. First,, the comments on wikilegis are analyzed, in order to verify the quality of the Bill of Law debate. In the second stage, we analyze the openness of the process consolidating the Bill of Law to Internet-made contributions.

As to the discursive appropriation of the space for comments, this paper is aligned with the empirical studies on deliberative democracy. In this sense, different researchers have sought to render operational normative criteria on deliberation, strongly influenced by Habermas' theoretical framework (Bachtinger et al, 20009; Dahlberg, 2004; Steiner et al., 2004). In locked step with this perspective, we think a systematic analysis of the users' speeches in this space, followed some deliberative parameters, even if adapted to a discursive appropriation of wikilegis.

For Dahlberg (2004, p. 32-35), the ideal deliberation should meet six normative criteria: thematization and rational critiques of validity pretensions; reflexivity, "ideal role taking"; sincerity; inclusion and discursive equality; autonomy of the state and of economic power. Among the codification models adopted in the literature (Bachtinger et al. 2010; Dahlberg, 2004; Steiner et al., 2004; Stromer-Galley, 2007), we consider the criteria outlined by Stromer-Galley (2007) adequate to our objectives. This methodological proposal foresees the adoption of six elements needed to measure deliberation level: reasoned opinion expression; sourcing (references to external sources when articulating opinions); expressions of disagreement; coherence with regard to the structure and topic; engagement among participants; equal levels of participation (Stromer-Galley, 2007).

.Taking into due account the peculiarities of the wikilegis tool and the online communication environment itself, the Stromer-Galley coding scheme was adapted to our objectives. As this is a digital tool whose participation is open to any interested user, registered free of charge, we have excluded codification equality. Despite the fact that equality is deemed to be a fundamental normative condition for deliberation, we have considered wikilegis an equalitarian space, as it has no form of coercion whatsoever, whether technical or social or restrictive to participation[4]. In this sense, we consider that eventual disparities in participation frequency are due to different levels of user interest in participating in the debate

Reasoned opinion expression can be defined as an actor's expression of opinion about the world (Stromer-Galley, 2007). It is codified with 1, if an opinion is presented, or 0, if not. Taking into consideration a light approach to deliberative criteria, we take 'expression of rational opinion' to mean demonstrating an attempt to justify an opinion expressed regarding a bill of law - which does not necessarily mean that there is justification.

The criterion *justification* refers to the signs that the person is seeking to explain his/her arguments, presenting motives or explanations about the problem. Values attributed are 0 for absence of justification and 1 if there is justification. There is no intention to categorize the types of justification used or the sophistication of arguments, but rather to identify whether or not there is an attempt to justify the opinions (Stromer-Galley, 2007, p.10).

Reasoned opinion expression and justification are strongly related criteria. However, there were exceptions when personal opinion re the bill of law presented no justification, so that the message was codified as 1 for reasoned opinion expression and as 0 for justification[5].

Unlike in Stromer-Galley scheme (2007), the amount of *agreement and disagreement* is not included under *reasoned opinion expression*. We made this alteration on account of the object's nature. As this is a debate mediated by a digital environment, in which the participants do not interact simultaneously, more than just reflecting on the relation of users agreeing or disagreeing on a bill of law's content, we strove to understand how they position themselves vis-à-vis their peers. Thus, agreement and disagreement relate to the reflexivity and consideration of the actors' perspective. Hence, agreement (1) is codified as an expression of agreeing with the opinions of other actors, and disagreement (2) as expressing an opinion contrary to or alternative to the others. If there is no sign of agreement or disagreement, the speech is classified as 0.

The criterion *sourcing* analyzes the references to external information sources that could support the arguments. In spite of Stromer-Galley's proposal (2007) considering only references to mass media and other informative resources available in her case study, our sourcing codification seeks to pinpoint whether there is one (1) or more (2) sources of information or other resources to sustain the argument, or whether the argument quotes no sources (0). Therefore, in our study, this criterion is closely related to the level of justification, as it unveils the users' commitment to present arguments grounded on external references, in order to corroborate his/her comments.

In the *engagement* category, our effort was to identify whether the participants spoke to each other. This is important to evaluate the discussion's reflexivity. "It is conceivable, especially in online environments, that participants in the discussion talk at each other rather than genuinely engage each other" (Stromer-Galley, 2007, p.12). The speeches were classified as 0 - no engagement; 1- there is implicit engagement (actor demonstrates reflexivity, but does not identify the other participants); 2 - there is explicit engagement (actor directly refers to another participant).

Lastly "coherence with regard to the structure and topic of deliberation" strives to identify whether the participants are talking about the right topic (1) - that is, about the articles or paragraphs they are commenting on, or about topics which come up in the conversation (2) or speak about topics unrelated to the discussion (0).

The second empirical stage in the chapter seeks to asses show effective is the digital participation in the Brazilian Internet Civilian Landmark discussion. In order to ascertain whether citizens' engagement in the wikilegis tool made possible the insertion of new demands on the Bill of Law's text, we compared the initial and the final drafts of the projects, considering also the proposals in wikilegis. In other words, the receptivity of decision-making spheres to society's demands are the Internet regulatory landmark will be appraised by the yardstick of virtual proposals being included in the project's final draft.

Therefore, the analytical corpus comprises the report compared to the Bill of Law, made available in E-Democracy, suggestions made in wikilegis and a document drawn up by Federal Congressman Alessandro Molon (Worker's - Party State of Rio) who reported the bill of law and was responsible for incorporating the contributions in E-Democracy and in the public hearings debating the Internet Civilian Landmark with interested sectors and stakeholders (telecoms, service and content providers, academic research centers) and society at large.

FROM PROPOSAL TO DEBATE: DELIBERATIVE APPROPRIATIONS OF WIKILEGIS

Wikilegis initially intended to focus on suggestions to the legislative text. However, remarks and comments made within this environments led to a series of inter-user debates, in more intense fashion than in the then-appropriate forum for such discussions. In addition to commenting on the legislative text, participants were also interested in the opinions of others and interacted to endorse or question proposals made.

The initial corpus had 104 wikilegis comments. Among the actors, we ruled out the participation of an institutional profile (the Brazilian Ministry of Justice's Office of Legislative Matters), whose participation in all comments was limited to presenting its own considerations regarding the bill of law, therefore not being a participative actor in the debate. Albeit participants had occasionally used the comments from this Office as a basis for their own comments, the statements from this Office were not codified in order to avoid that the high level of elaboration in the interventions of this institutional organ would not influence the analysis of citizenry participation. Once we excluded the 25 comments made by this actor, the corpus was reduced to 79 statements, which were coded to identify the presence or absence of the criteria already indicated herein, namely: reasoned opinion expression, justification, expressions of agreement and disagreement, sourcing, engagement and topic.

Reasoned opinion expression was present in 93.67% of the comments. This indicates that those using wikilegis attempted to submit reasons for their positioning. However, it does not necessarily mean that the participants actually justified their own opinions: in some cases the user expressed an opinion regarding the Bill of Law and suggested an alteration to it, but did not justify his/her positioning. In other words, no explanations or motives were submitted to support his/her perspective. This combination of reasoned opinion expression and absence of justification was not common, occurring only in 7.59% of the messages.

Justification was a criterion present in 86% of the wikilegis comments, revealing that participants sought to base their opinions on justified arguments. This is an interesting datum because it suggests that the participants were committed to the debate, as they sought to anchor their opinions of justifications that could be understood and possibly accepted by their peers.

As to the sophistication of the justification, measured in this paper by the use of one or more external sources of information as support to an argument, we noticed arguments not grounded on external sources of information in 56.96% of the comments. An information source was used to corroborate an argument in 13.92% of the pronouncements and two or more sources were present in 29% of the participations. Generally, the opinion-supporting sources used were the Brazilian Federal Constitution and other Brazilian legislations, in addition to examples of Internet regulation in other countries.

Reflexivity - or a participant's consideration of another in the debate - is measured in two parameters: implicit or explicit indication of a participant and the expression of agreement or disagreement regarding an opinion expressed. As regards engagement with other users, 49.36% of the messages showed no reference: users just expressed their opinions without considering the other participants; 16.45% of the messages implicitly mentioned other participants - albeit there is no direct citation, the message's content nevertheless demonstrates consideration of other opinions present - and 34.17% of the messages revealed explicit interaction, that is, direct back-and-forth responses among users.

This result shows that, in 50.62% of the cases, users considered the other participants as bona-fide participants and effectively engaged in debating with them. Instead of simply expressing their own opinions and not considering their peers' views, as is often par-for-the-course in online interactions (Stromer Galley, 2007), users of wikilegis demonstrated the intention to take into due account their peers' positions.

As to expressing agreement or disagreement with the total corpus, 63.29% of the messages were rated as neutral, 16.45% demonstrated agreement and 20.25% revealed inter-opinion disagreement.

If considering only those comments with implicit or explicit engagement, 33% of them were neutral, 28% showed inter-agent agreement and 40% disagreement. This reveals that messages based on another participant's opinion predominantly reveal a mostly-negative positioning. In other words, citizens disagree among themselves more than they build shared understanding during the debate. The fact that users stayed in a discursive environment predominantly of disagreements shows that participants, in this debate, were willing to respect other opinions, even when those defied their own perspectives.

Lastly, the respect-the-topic criterion showed solid participant engagement in the wikilegis proposal: an overwhelming majority of comments (94%) kept within the topic and only 6% brought up other related themes. This observation corroborates findings of another study focused on the first stage of virtual consultation (Sampaio; Bragatto; Nicolás, 2013),that revealed a debate environment predominantly of respect, reflexivity and exchange of justified arguments.

In terms of opening and pluralism, our analysis identifies the same situation in the first stage of public consultation on the Civilian Landmark as described in other studies (Sampaio; Bragatto; Nicolás, 2013). Only 24 users accounted for 79 comments on the Bill of Law in wikilegis6. The number of participants offering suggestions was even fewer: 14 users contributed with 52 proposals[7].

EFFECTIVENESS OF WIKILEGIS PARTICIPATION

This section presents the results of the analysis of virtual engagement effectiveness in the consolidation of the Bill of Law on the Brazilian Internet Civilian Landmark. This Bill of Law was an outcome of the discussion in the Federal Chamber of Deputies covering, in addition to the E-Democracy Portal, public hearings, seminars and meetings of the Committee responsible for drawing up the report. It is made up of 25 articles, broken down into five chapters.

Via the wikilegis tool alone, citizens sent 52 suggestions[8]. As shown in the Comparative Table of the initial and the final drafts of the Bill of Law, contributions were also received from NGOs (non-government organizations) interest groups, researchers, service providers and other civil society entities.

In comparing the Civilian Landmark's initial and final drafts, we observed that suggestions through the E-Democracy Portal led to amendments of three articles, while contributions from organized society were incorporated into two other articles. The Internet Civilian Landmark Special Committee, through the bill of law's reporter, Federal Congressman Alessandro Molon (Workers' Party - State of Rio de Janeiro) was responsible for eight more amendments.

The bill of law's reviewer is also co-author of some proposals put forth by the civil society and by E-Democracy users. A possible explanation for this might be his participation in consolidating the proposals for the final report, flowing in from the Internet and from civil society, but without any substantial participation in the content or drawing up of such proposals. The final draft of the bill of law was made available in the E-Democracy Portal, indicating those articles altered vis-a-vis the initial text's draft. Based on this document, sent through the wikilegis tool, we analyzed the effectiveness of online participation.

The three contributions from the E-Democracy Portal, indicated in the final report, revealed users' concern with fundamental issues are the rights and duties of Internet users and service providers. The alterations were made in Articles 2º, 3º and 10º[9].

Article 2º received seven wikilegis suggestions, two of which were accepted and, indeed, added two fundamentals to Internet use in Brazil: personality development, listed among human rights, and exercising citizenship in digital media. These alterations also added a new bedrock foundation to the project: the network's social purpose. It should be explained that these suggestions were incorporated into the Bill of Law as adaptations, not as they were originally proposed.

Article 3º dealt with proposals sent via Twitter, the E-Democracy Portal and by experts, researchers and organized civil society. Eight suggestions were made via wikilegis. The alteration made by the bill's reporter removes from caput IV the necessity of regulation to ensure network neutrality. It is interesting to point out that this article was particularly polemical as regards comments, having received 17 contributions, and this debate on comments was cited in the justification of the user who had his proposal accepted.

Article 10's first paragraph (keeping files and records of service providers' access) accepted the suggestion of an participant in the wikilegis. Adapted by the bill's reporter, it made the text technically clearer and more specific, facilitating the understanding of which types of registrations could be made available by court order. This wikilegis-sent suggestion includes the existing access terminals in question, arguing that service providers have no means to identify users, but access terminals do. Unlike the other altered articles, which actually received more suggestions, this Article 10 received three proposals and four comments.

In our view, the comparative documents of changes show that three E-Democracy suggestions were accepted, contemplating four participants. This number is significant, inasmuch as only 14 persons sent justified proposals to the Bill of Law. We do not exclude the possibility that Internet-sent proposals became the basis for amendments suggested by the bill's reporter or that proposals sent through other tools and at other E-Democracy stages other than wikilegis were taken into due consideration.

Analysis of contributions by users who effectively influenced the reporting and drawing up of the Bill of Law's final draft allows a conclusion that Internet users participating in the E-Democracy Portal were able to make public their concerns with Internet, specifically regarding the network's transparency and the accountability (legal or otherwise) of service providers and regulation mechanisms - two variables directly affecting Internet users. Wikilegis-suggested alterations to the Bill of Law demonstrate high engagement, since an amendment proposal requires the elaboration of justified arguments in order to solidly bring about alterations.

However, as the final decision is top-down (the House Special Committee holding the power to decide if and how to accept suggestions), there is no assurance that alterations harking back to virtual participation will be maintained by the congressmen in the wake of their in-House discussions. This seems a case, as suggested by Coleman and Blumler (2009), in which citizens are invited to participate to potentially exert influence on decision-makers, and not as participants in the decision-making process itself. This is also supported by the literature on offline political participation (Gastil and Levine, 2005; Avritzer, 2009).

CONCLUSION

This case study suggests that legislative systems stand to benefit much from online political participation, even if improvements in efficacy and in opening to users' perspectives remain needed. Albeit there are still numerous hurdles (social, economic, cultural and the like) to be overcome so that better levels of participation and citizenship in public environments of virtual political discussion and government consultations may be reached, this Case Study demonstrates that citizens engaged in discussing Bills of Law can reach such heights. Our results show that online discussions on the Brazilian Internet Civilian Landmark were able to influence political decision-making, and citizen-provided suggestions were included in the Bill of Law. Even in a top-down decision-making model, there was still considerable receptivity to proposals sent through the E-Democracy Portal.

The fact that both debate and participation were concentrated in only a few voices makes evident that, for citizens with sufficient motivation, technical conditions and resources to participate, the Internet is a major mechanism to interact with the political sphere (Dahlgren, 2005; Shirky, 2010), particularly institutional websites and initiatives. However, political use of the Internet still seems little attractive to Brazilian users, who would rather use the Internet for other activities - such as communication, entertainment, etc. (CGI, 2013). On the other hand, the predominance of justified arguments and the engagement of users whose positions often clashed in the debates point to their high commitment as citizens participating in the legislative community. Results suggest that users sufficiently interested in debate participation find therein an environment of respect and reflexivity.

Even if there are evidences that digital democracy initiatives, such as the Portal E-Democracia in the Brazilian House of Representatives, can effectively strengthen communication between citizens and politicians and make decision-making more open to civil society's demands, participation costs in these environments are high, in terms of searching for information to formulate justified proposals. Surely many people do not participate due to lack of interest or of information on how these platforms work or even because of mistrusting politicians and institutions. This negative perception often relates to a feeling of hopeless inefficacy or of being ill-represented in the institutions and by the elected representatives.

Unquestionably, the Internet has great potential to strengthen democracy, especially as regards information access and transparency on activities and issues related to political institutions. There still remains a significant gap as how digital democracy initiatives should empower citizens and provide real opportunities to influence the political agenda and decision-making process, as users with interest, information and opportunity to interfere in political issues still remain, to this day, a minority. Yet, our study shows how significant steps towards improvement in democratic institutions and processes can be made in practice.

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KEY TERMS AND DEFINITIONS

Brazilian Internet Civilian Landmark: Bill of Law drafted in 2009 to regulate Internet use in Brazil. It forecasts principles, guarantees, rights and duties of Internet users and service providers. It also establishes guidelines for the actions of the state.

Democratic Innovations: Tools or institutions created to enable and/or deepen citizen participation in political decision-making processes.

E-Democracy: Online environments designed and organized to enable citizens' engagement with the political sphere. It may be tied to political institutions but can also emerge from collective intelligence and active citizenship.

Online Deliberation: Political talk online aimed on discussing relevant issues, based on exchange of rational arguments and mutual respect between participants. It may enable decision-making or consensus, but it is usually seen as a broader and less demanding form of deliberation.

Political Participation: Citizens engagement in a variety of political activities, including political institutions, social movements, political parties, elections, political discussion, political decision-making and so forth.

ENDNOTES

1. "Slacktivism" - This term refers to political activities in digital environments with little or no impact on the real political universe, but it does increase a feeling of wellbeing among participants..
2. Number of participants on August 14, 2013, last portal-access day.

3 Google Analytics data supplied by the E-Democracy Portal, upon information request.

4 There is no social coercion because the users cannot constrain the others' freedom of speech and there is no technical coercion because the tool does not restrict the number of times the user can comment nor the space limit for his/her participation. Although one must be registered in E-Democracy to participate in the debate, we consider the environment non restrictive because registration is free of charge.

5 For instance: [id=57: "(...) suggests that Article 10 has been altered to clearly define penalties for non-fulfillment of data protection requirements."]. In this speech, the user expresses an opinion and suggests an alteration, yet does not justify his/her positioning. The message is codified as 1 for reasoned opinion expression and as 0 for justification.

6 Altogether, 104 comments. However, as explained, the 25 contributions from the aforementioned institutional profile of the Brazilian Ministry of Justice's Office of Legislative Matters were excluded from the corpus.

7 projeto/-/blogs/conheca-a-ultima-versao-do-relatorio-do-marco-civil-11-7 (last accessed on August 15, 2013).

8 Available in: http://edemocracia.camara.gov.br/web/marco-civil-da-Internet/wiki.

9 In our comparative analysis, we identified the inclusion of one suggestion not pinpointed as coming from E-Democracy, but starting with its users - in this case known as bloggers from the Southern Brazilian state of Paraná who were affiliated to a political party (the Progressist Party). Despite this suggestion not having come from wikilegis, it was presented at the tool forum, for debate with the users (9) and indeed even received suggestions in this context. This proposal creates a sole paragraph in Article 16, determining that professional providers of Internet applications must replace contents rendered unavailable by the motivation or by the court order that made them unavailable.

Chapter 19
Social Media Development and Implication on eGovernance in China

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ABSTRACT

The rapid development of social media in China brings both challenges and opportunities for China's eGovernance construction. This chapter seeks to research the information society construction in China during the 12th 5-year plan period (2011-2015), especially the efforts of involving citizens in participating in the decision-making process, whilst also exploring the interlinks between the fast development of social media and the ever-changing government services. The chapter summarizes the strengths and weaknesses in the practice of public participation and finds that rapid development of information technology cannot guarantee that eParticipation will be fully effective, and measures and policy should be taken to change the situation. China has made considerable progress in social media development, but more efforts are needed from the government to further engage its citizens in the decision-making process.

INTRODUCTION: CHINA'S INFORMATIZATION PROCESS AND E-GOVERNANCE

With more than 30 years of economic boom and social change, China has made considerable progress in its efforts to build up an information society that includes e-Governance. The development of modern ICT technology, the introduction of social media and an improved IT infrastructure have contributed largely to economic success, whilst simultaneously they have helped to improve the efficiency of government administration. The Chinese society is increasingly dependent on and benefits from the development of its IT industry and the efficiencies resulting from the use of ICT. Assisted by the progress made in the development of the information technology industry, China's

DOI: 10.4018/978-1-4666-6236-0.ch019

e-Governance and consequently e-Participation level also became an important element of China's economic success.

China attaches high importance to informatization work and elevating informatization to the height of a national strategy. In China, the word 'informatization' is similar to 'industrialization' and means the application of ICT in traditional industries or the use of ICT to improve the traditional industries. In the Report of the 16th National Congress of CPC, it was specifically pointed out that "Informatization is a logical choice for China to speed up industrializations and modernization". It was proposed to "persist in industrialization driven by informatization and informatization promoted by industrialization" and takes a new road towards industrialization. It was further pointed out in the Strategy on the National Informatization Development from 2006 to 2020 that "Greatly pushing forward informatization is a strategic measure which covers the overall situation of China's modernization drive, as well as the urgent need and logical choice for implementing the scientific view of development, building a well-off society in an all-round way, establishing a socialist harmonious society and building an innovation-oriented country". It was also proposed that China should achieve its strategic informatization goals before 2020. These goals include: a comprehensive information infrastructure is basically established, the ability of independent information technology innovations is notably strengthened, the structure of the information industry is fully optimized, the level of national information security assurance is greatly improved, notable achievements in informatization in the national economy and society are achieved, a new development model of industrialization is preliminarily established, the institutional environment and policy system for national informatization development are basically improved, citizens' ability to apply information technology is notably improved and a firm foundation is laid for China to enter an information society.

As 2013 MIIT Work Statement mentioned, (Wang&Kong,2013) the development plan is rather macro level and lacks qualitative indicators. However, it clearly sets out the goal that China is aiming to build up an information society that conforms to the economic development level. And above all, it is an "informatization plan" that meets the increasing requirements of the industry and modern government.

Guided by its national strategy and national informatization development strategy, China has done a great deal of work in informatization building. The development of the environment for informatization has been improved, comprehensive information infrastructure building has been fully conducted, and the ability of independent innovations in information technology has been gradually strengthened. While the information industry continued to grow fast, its structure has been optimized. The level of assurance for national information security is improved further, while the ability to apply information technology is raised significantly. Great achievements have been made in informatization in the national economy and in all social fields. E-commerce is developing well: the scale of e-commerce increased 21.3% in 2013 compare with last year, reached 9,900 billion RMB. (http://www.cnii.com.cn/wlkb/rmydb/content/2014-01/20/content_1292916.htm)

Notable achievements are scored in E-commerce building as represented by the "Twelve Golden Projects", including Golden Customs, Golden Card and Golden Taxation. Important progress has been made in the development and application of information resources. Legal system building, standardization building and talent building for informatization are continuously being pushed forward. Meanwhile, to promote and guarantee informatization development and speed up the process of informatization, China has also made active participationin international cooperation an important way for it to fulfill its strategic informatization goals.

In addition to quick development of eCommerce and eGovernance, China also attached great importance to international cooperation for its IT sector. The Information Society (also known as Informatization in China) offers a promising vision of a citizen-centered, inclusive and development-oriented society, in which everyone can create; access; utilize and share information and knowledge, enabling individuals, communities and peoples to achieve their full potential in promoting their sustainable development and improving their quality of life. The enabler of the vision is Information and Telecommunication Technologies (ICT), and the strategy to achieve this vision is a unique multiple stakeholder approach, i.e., participation, commitment and cooperation of all stakeholders around the world. The government of China has recognized the importance of the information society for its national development strategy of an "all-round affluent Society" and the significance of the eight UN Millennium Development Goals (MDGs). It has formulated the "National Informatization Development Strategy 2006-2020", and explicitly placed special emphasis on international cooperation in order to team up with stakeholders at national, regional and international levels towards the achievement of the common objectives.

Informatization has become an important trend of scientific, technological, social and economic developments in the world today. It is related to the political, economic, social, cultural and security situation of a country. It is also a strategic high ground for international competition. Through many years of efforts, China has scored notable achievements in informatization building. Informatization now plays a more and more important role in promoting the development of the national economy and social information. However, China still has a rather big gap to bridge with developed countries in the world in terms of the overall level of informatization. Current informatization still cannot fully meet the social and economic development needs in China.

As the globalization process continuously progresses, countries in the world are facing unprecedented challenges when they advance sustainable development. Information communication technology offers tremendous potentials for coping with such challenges. Establishing a tolerant information society is no longer merely a challenge facing any one government. The private sector, civilian bodies and international organizations at large all need to take part in it. The information society has become a concept that has extended to different levels worldwide and is continuously evolving. Thanks to this and particularly promotion by the World Summit on the Information Society, multi-stakeholder partnership (MSP)-based international cooperation has become an important way to push forward the integration of mainstream information communication technologies into society and all fields of life. Such forms of international cooperation have received wide acceptance. International cooperation in the information society has been strengthened gradually and become active. Such cooperation has been fully conducted in various forms at the national, regional and international levels, and covers all aspects of the information society.

We noted that China pays great attention to informatization work. The country has elevated informatization to the height of a national strategy, and has also done a great amount of work in informatization building, especially in the domain of e-governance. E-participation, as the most important component of e-governance, has attracted a lot of attention from Chinese government at all levels. It can be said that the construction of Chinese e-Participation is synchronizing with the world, and meanwhile has its own characteristic. Relevant characteristics of Chinese e-Participation could be summarized as follows: first of all, citizens gain information through the internet; secondly, citizens (e-Participators) express their appeals through multi-channels by using the internet and thirdly, Chinese government officials communicate with citizens online normally and directly. All these three points will be described in more detail below.

Firstly, for Chinese citizens, especially those who live in the city are used to knowing about politics through the internet. Citizens could browse all kinds of news both international and domestic on many websites, including “Sina”, “Sohu” or government portals in each city. They could focus on anything which they are interested in. Here we take the Chinese Ministry of Defense as an example. On 20th August 2009, the Chinese ministry of defense website was in a trial process. On the first day, traffic to the website reached 130 million. In the following three years the average traffic to the website per day was 10 million. The case has proved that the official website has provided an unlocked channel to the public. It has enhanced the initiative of e-Participators greatly.

The form of e-Participation in China is various. The government at all levels in China has realized the importance of e-participation, thus various channels have been provided to citizens in order to optimize their e-Participation experiences. Micro-blog, for instance “Sina-Weibo”, now has become one of the most important channels for government and citizens to jointly become involved in the e-Participation process. According to data from Sina (www.sina.com), until early November of 2011 there were 18,500 micro-blogs which belonged to government or with a government background. Among them, there are 9,960 government official micro-blogs and 8,628 official personal micro-blogs, covering 34 provinces and cities. As the other important form of e-Participation in China, online voting is reflecting its advantage gradually. For instance, in Chengdu, Citizens could attend the policies process through online voting, and to date citizens have attended the policy making processes of 44 local laws and 25 government regulations. Apart from these two forms, citizens in China also could use BBS, for instance sina, sohu and some city portal BBS etc., to express their views, or to provide suggestions towards national politics, economic, law, culture, education and governance etc.(Wang & Wang, 2013)

Of great significance for Chinese e-Participation, is that a secular online communication mechanism has already been established. Behind it is a long-term construction of e-governance and socialist democracy. It is full of Chinese characteristics and is realistic and useful. This form of e-participation is the most common and popular one. The best practice of this form was on 20th June, 2008 when Mr.HujinTao,then President of the People’s Republic of China, communicated with the public through a nongovernmental BBS, in recent years, with the development of the internet in China, more and more of the public have joined the e-Participation. (Cui, 2011) Government officials have paid more and more attention to the construction of relevant online-communication platform. In this way, citizens can be involved in all kinds of current social affairs, and ask questions which they care about. The public could get official feedback from government departments quickly and directly. With this help, the government could provide a better service to the public.

Meanwhile, as an efficient way to improve its own IT industry, especially to encourage innovative technologies and structure design, to fill identified gaps, the Chinese government strives to cooperate with western countries to promote and guarantee informatization development and speed up the informatization process, China has long attached importance to taking part in international cooperation in the informatization field. As MIIT ‘The twelfth five-year Plan’ mentioned, (Wang&Kong,2013) from 2016 to 2020 the country has made “Strengthening international exchanges and cooperation in informatization” one guaranteed measure for promoting information system development in China. In recent years, international exchanges and cooperation in informatization in China have continued to deepen, forming a multi-level, multi-field 3D cooperation framework. Much positive progress has been made. This includes: actively staging international exchanges and dialogues, and laying a good foundation for international cooperation in informatization; continuingto expand the bilateral and multilateral cooperation fields, and earnestly push forward international cooperation in informatization; establishing a broad world vision, and actively participating in work to formulate international standards in the informatization field.

From the five aspects of government, private sector, international organizations, regional cooperative organizations and technical standards, it is found that the Chinese government has paid great attention to international cooperation in informatization. Based on promotion through high-level dialogues, the Chinese government has established multi-level cooperation channels and a sound cooperation system. On this basis, the concerned central departments, local governments, industry associations and enterprises actively promote exchanges in the informatization field between China and other countries, and among the various private sectors, international organizations and regional organizations.

Multi-level communication channels have been preliminarily established, and wide cooperation has been forged in numerous fields. Jointly promoted by the government, organizational institutions and enterprises, China has staged wide-ranging international cooperation in all fields and at all levels of informatization, forming a diversified, comprehensive and wide-field development pattern with great success.

All this has greatly raised the level of informatization and narrowed the digital divide in China. The successful experiences which China has had in international cooperation in informatization mainly include: concentrating on international cooperation in informatization from the strategic point of view, and ensuring that international cooperation can be smoothly conducted; establishing multi-level cooperation channels, and establishing a sound cooperation system; capitalizing on the enthusiasm of local governments, and strongly pushing forward international cooperation in informatization; guiding enterprises to take part in international cooperation in informatization, and making full use of international resources to raise the level of informatization in China actively participating in the formulation of international standards, and improving the right of discourse in international competitions.

Challenges and Existing Problems

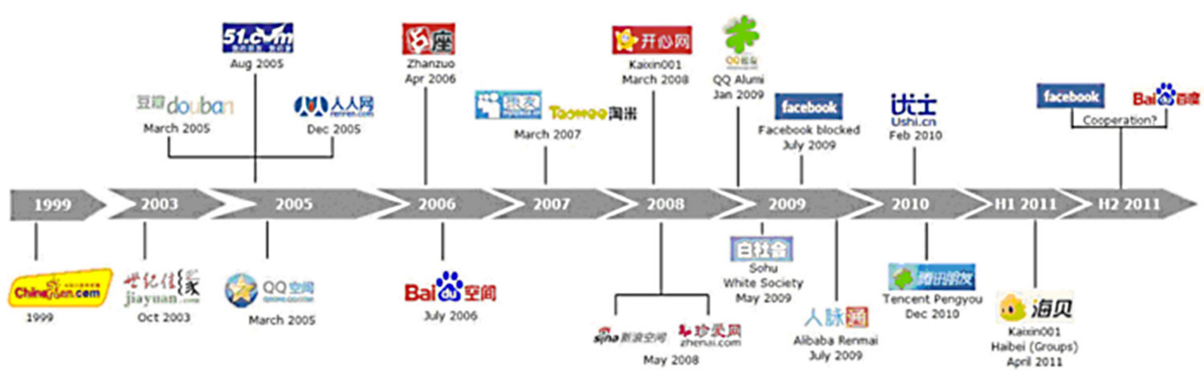
However, there are still certain deficiencies behind the achievements that China has scored in international cooperation in informatization. These include lack of effective overall strategic plans, insufficient width and depth of cooperation, inadequate fund inputs into international cooperation, and insufficient promotion of cooperation achievements. In future international cooperation, there is a need to centre on China's overall strategic informatization goals to establish and improve mechanisms for international exchanges and cooperation in informatization in relation to the construction and development needs of and the actual problems facing informatization in the country, and strengthen exchanges and cooperation in the fields of information technology, information resources and talent training. The current survey suggests that international cooperation in informatization in China be accelerated in eight areas.One is to greatly push forward the establishment of a new international information order, and promote cross-border equal participation in exchanges and cooperation. The second is to strengthen bilateral and multilateral cooperation and cooperation with regional organizations, and specify corresponding key areas of cooperation regarding the characteristics and needs of different countries, regions and organizations. The third is to formulate mid- and long-term development plans for international cooperation in informatization, and improve the existing international cooperation plans as well as project management and participatory mechanisms. The fourth is to improve the policy environment for informatization, and innovate development mechanisms for international cooperation. The fifth is to establish a multi-form, multi-level and multi entity cooperation system for international cooperation in informatization and promote the development of multi-stakeholder partnerships. The sixth is to set up a special fund for international cooperation in informatization. The seventh is to establish and improve mechanisms for international cooperation and exchanges in informatization talents, train and introduce technical and management talents. The eighth is to establish and improve international informatization cooperation information banks and databases and greatly promote the exchange of information and the application of information achievement.

Background

Social media was introduced to the Chinese society with the incoming of SNS networks, blogs, and most recently, microblogs, wechats, with booming subscribers and bursts of information exchanges. The introduction of social media enriched people's knowledge of new information but brought enormous challenges to the regulatory authority in relation to protection of privacy, copyright and information security; in addition, the administration was forced to adopt to new social media methods to address the needs of information sharing from citizens, and reach out to the public to promote its own voice and influence public opinion, and transform traditional administrative habits. This chapter reviewed the progress of China's development of social media and the impact it brings to e-Governance.

Based on CNMC statistics published in March 2013 on the survey of China Mobile internet development, we know thatup until June 2012, internet use by citizens reached 538 million, with internet penetration rate 39.9%. Among them, mobile internet users reached 380 million being the fastest development trend. In the meantime, the citizens who used desktop computers reached 70.7%, a reduction of 2.7% compared with 2011. Citizens who used mobile phone connection to the internet increased 72.2%, which indicates the coming of mobile internet. This means internet usage can be anytime and anywhere, as long as there's a network, anyone can receive and send information instantly. This will further promote information transparency and make governance information spread in an unprecedented way. On the one hand,

Figure 1. Social media development timeline



it benefits eGovernment implementation, on the other hand, it brings a challenge for government to manage a crisis and carry out administrative procedures. (Wang&Kong, 2013)

In researching major social media and its impact on citizens' behavior, we find social media's introduction to a large extent increasingly influences the information exchange, communication flow, and above all, citizens' behavior, especially the Chinese youth. This is reflected by increasing internet users, and booming mobile application industry in modern Chinese society.

The rapid introduction of social media tools including blogs, microblogs (Weibo), and other social media meant that large numbers of the Chinese population were communicating via the internet. Economic improvement brings increasing discussion and participation of government service provision. Not only has it created news channels of G2C and G2B connections, but also prompts the transformation of government functions, eventually leading to structure and methodology changes.

The rise of social media changed the habit and style of communication, and is changing the way citizens participate in politics. The social media in China represented by Weibo extended the limit of traditional media with the inter-activeness, immediacy and transparency that are features of its function. Social media is on the way to promote citizen participation in a width and depth that will have a significant impact to the improvement of democratic values. However, innovation and new technology are only catalysts to organizational and system transformation, and must be applied with caution and scientific methodology, to ensure that the potential advantage of social media is turned into reality.

As social media makes it possible for citizens to draft and share information voluntarily, and provide comments and join discussion instantly, ordinary citizens can contribute information and spread their own opinion widely, thus speeding up participation in politics and producing enormous challenges to traditional governance.

When citizens efficiently participate in the political agenda, it requires efficient tools, and the availability and access to these tools to a large extend depends on technological development, especially the progress of ICT. In a society with low level information communication, policy transparency and implementation is a slow process, usually spread in a linear way from high to lower lever institutions. There exists a limited channel for citizen participation, mostly through a delegated linear channel from bottom to top, receiving feedback from one level of institution to a lower level. Constrained by low level communication, citizen participation and opinion are not effectively fed back, and even worse, opinions and information can be twisted and lose value. Therefore, citizen participation has limited impact on policy making.

Social media has comparative advantage in comparison with traditional media such as newspapers, broadcasts and television; social media provide more participation channels. For example, there's a selection and screening process by traditional media on reports. The owners and disseminators of traditional media undergo information and media controls. The traditional media processes the news in a way that means the raw message has to pass through the "gate". Only very limited information is passed to recipients and audiences. The audience, belong to the very end of an information dissemination process and have no choice but to passively receive information. In this system, interaction between audience and information reporter are only theoretical. (Feng, 2011)

Therefore, in the era of traditional media, anyone who controls media institutions and publishing organizations will control the news and discussions. It is obvious that citizen opinion passed through traditional channels is indirect and has to rely on the work of editors and reporters. In this process, not all citizen opinion can be present, but has to pass through the screening and censoring of editors and reporters. Even messages that passed the selection process were heavily influenced by editor's and reporter's judgments. Social media successfully bypassed editors and reporters by making every citizen a reporter and editor; in addition, the amount of information disseminated andthe speeds achieved was simply unimaginable in the old times. Therefore, social media breaks the monopoly and control of the traditional media, and enables a more free, equal and instant communication process. According to John Fiske, an American culture researcher, the information published in social media can be viewed as open public text, while the traditional media produce closed public information. (Cao, 2011) Social media's openness will allow any participants in the network to provide comments for or against a certain opinion, present their own opinion and try to convince others to accept that opinion. At the same time, citizens are able to listen to the opinions of others, making the policy decision process more rational and fair.

The discussion and involvement of social media usually takes place from horizontal and slope up angle, therefore, communication become more transparent, information acquire become more fast. It provided pre-condition for efficient e-Government participation. The wide usage of social media lowers participation costs for citizens both in terms of money and time. (Zhu, 2011)Citizens don't necessarily need to meet government staff in order to make suggestions and complaints; communication and discussion can go beyond the limits of time and venue. Furthermore, the application of social media tools enlarges opportunities for citizen participation. Hyperlink can be exchanged through email, topics can be explored at social networks; information and opinions can be posted on Weibo, discussion can be conducted via blogs. Government agencies, on the other hand, can use social media to collect public opinions and reach out to a variety of audiences through online voting, group email questionnaires, specific online discussions, and interactive communication with netizens. The practice not only further improves administration efficiency, but also increases citizen participation in topics concerning their daily life.

It is fair to state that by anonymity and equality, pros and cons around an issue can be sufficiently presented and discussed, until mainstream opinion is forged and common ground reached. Senior officials or ordinary citizens have the same weight and way of influencing public opinion. To a certain extent, citizens can avoid opportunity costs in reality and easily and quickly participate in the political agenda, which in the long run can cultivate democratic sense and involvement level.

THE EFFECT ON E-GOVERNANCE OF THE DEVELOPMENT OF SOCIAL MEDIA IN CHINA

Issues, Controversies, and Problems

This section illustrates social media's latest development level in Yantaiand provides a general, analysis of the development achieved in the past decade by China's social media, and implications for e-Governance at large. We will also examine the problems existing in China's social media development, and ICT construction in general.

Nowadays the concept of 'Social Media' is accepted by more and more government officials. However, by presenting the availability and accessibility of e-Government facilities and social media in Yantai, we concluded social media development has contributed greatly to the social and economic change. However, China's social development level is still lagging behind compared with European standards. People have to do more works in order to further improve government function reformation, and participation levels from citizens and businesses.

The 'China Yantai' eGovernment portal (www.yantai.gov.cn) has now become a major platform of communication between the city government of Yantai and the outside world. At the time of writing, information sharing has already been achieved between the Yantai eGovernment portal and the website of 96 city government agencies and 13 district/county level governments. The characteristics of the portals reflected at three main points as below.

First of all, the Yantai eGovernment portal has now become a major source for government documents. There are in total 16,000 city government documents available for the general public to access online. This is complemented by the online publication of 580 guidelines on public e-Services and 280 electronic forms for download. In total the Yantai e-Government portal publishes 10 million items of information., Making information available online for public access is surely the first, and an important, step towards achieving government transparency through e-Government.

Secondly, the Yantai e-Government has enabled online enquiries about a selected range of public service areas. More specifically, citizens in Yantai can make online enquiries about 30 public services in 11 categories. The city government of Yantai receives on average 9,000 enquiries every day.

Thirdly, the Yantai e-Government Portal has become an important channel through which the government can get to know more about issues of public concern. Through the online dialogue channels established by 94 city government agencies, citizens reported over 60,000 issues in 2006 and 97% of these got a response.Through the Yantai e-Government portalGovernment e-Services providers could reach not only citizens but also businesses. For instance, over 90% of local companies in Yantai have started paying corporate tax online; over 70% of custom clearance can be completed electronically. There also 1,480 hotels that have been linked to the information and security system of the local police for the purpose of crime reporting.Specialized applications such as online petitions, the labor and employment administration system, the tourism information management system, the online procurement system, the quality inspection system and the science and technology administration system have helped make Yantai a pilot city in Shandong Province for the development of e-Government..

More than 200 senior officials from the central and local ministries responsible for e-government and information technology in China, research and academia institutions engaged in e-government, as well as several industry representatives attended the launch of the Chinese language edition of the “United Nations E-Government Survey 2012: E-Government for the People” in Beijing, China, on 26 March 2012.

In his opening statement, Mr. Yi Hong, Vice President, CAG, welcomed Ms. HaiyanQian, Director, DPADM/UNDESA and highly praised the work undertaken by DPADM/UNDESA in promoting administrative reform through technological renovation. He also expressed the willingness of CAG to further cooperate with UNDESA in e-government and other areas. Ms. HaiyanQian thanked CAG for their great work on the release of the Chinese language edition of the United Nations E-Government Survey 2012, and supported the proposal of further collaboration between DPADM/UNDESA and CAG.

Ms. HaiyanQian then proceeded to share global findings and development trends related to the United Nations E-Government Survey 2012. Mr. Hongren Zhou, Executive Vice-Chairman of the Advisory Committee for State Informatization, who is also responsible for the development of information systems for the Chinese Government, reported on the past, current and future development of China’s e-government. The launch ceremony was moderated by Mr. Yimin Wang, Deputy Director of the E-government Research Centre, CAG.

Since 2001, the United Nations Department of Economic and Social Affairs has been assessing United Nations Member States’ e-government development in order to help countries better understand the current situation of e-government development worldwide and their own position compared to other countries, as well as to provide references to policy recommendations for the promotion of comprehensive and sustainable e-government strategies and programs.

The United Nations E-government Survey 2012 assesses the 193 United Nation Member States' e-government development over the past two years. The Member States are ranked in accordance with the E-Government Development Index (EGDI). The EGDI is a weighted average of four normalized scores on the most important dimensions of e-government, namely: scope and quality of online services, development status of telecommunication infrastructure, human capital and e-participation. Each of these sets of indices is itself a composite measure that can be extracted and analyzed independently.

In the 2012 Survey, China's EGDI is 0.5359, resulting in a ranking of 78. The Survey notes that, "This is no small feat since it is a country of 1.2 billion people and a large land mass – both of which require more effort from the government, especially if the population is widely dispersed, than would a country with a small population living within a limited area. China has enhanced the quality of its government portal by providing comprehensive information, more integrated services across different sectors, and greater interactions between government officials and citizens."

Other results of the 2012 Survey reveal that the Republic of Korea maintained its first rank position from the previous 2010 Survey, followed by the Netherlands which advanced three positions since 2010, and the United Kingdom which advanced by one position to become respectively the second and the third most advanced e-governments in the world. Denmark, the United States, France and Sweden follow closely to take their place among the global leaders of e-government. Overall, the 2012 Survey finds that countries have typically moved from a decentralized single-purpose model of e-government to a unified whole-of-government model.

In addition, the Survey emphasizes that social media (such as Microblogs) has great potential to expand the application of e-government. How to seize the opportunities brought by social media has already become an important topic for public service. Social media has created new information and public service channels for governments, and can be used to improve the quality of public service, lower costs and enhance the transparency of governments.

The Survey recommends that governments put greater emphasis on e-government to develop and solidify institutional cohesion, and integrate administration and service delivery. The ultimate goal is for legitimate and effective public governance to result in smart, inclusive and equitable growth for today's and tomorrow's generations.

There are three main styles of social media which are used commonly by Yantai government departments. First of all is the government portal. Secondly is Microblog. The final one is an online public opinions feedback platform. All of these will be described in details in the following section.

1. **Yantai Municipal Government Portal:** 'Yantai China' government portal (www.yantai.gov.cn) was officially opened up on May 22nd 2003. The portal is directed by Yantai municipal government, and managed by the office of Yantai municipal government. The Yantai economic and information technology committee is responsible for the portal's construction and daily maintenance. The portal consists of one main website and 150 sub webs which belong to party and government organs, companies and institutions and all fourteen counties and districts of Yantai. The portal is an information-rich

website, containing more than 2.09 million information bites and every day more than 67 thousand e-Civilians browse the website. (Deng&Jiang,2010) The portal enables the public to pose questions and have an online chat with senior municipal government representatives, via their web browser.

2. **MicroBlog:** A microblog is different from a traditional blog. It allows users to express their ideas or points of view in both actual and aggregate file size. Microblogging services have revolutionized the way that citizens communicate with city administration. It has become a new informal communication medium for the citizen and government. Yantai Municipal departments use MicroBlog to raise public awareness of their services, news and events. Citizens of Yantai could get the newest information about policy formulated by government.
3. **JiaodongOnline - People Voice Online:** People Voice Online is a site that enables citizens to communicate with municipal government. It also provides periodic, interactive webcasts that are chaired by representatives from various government departments and institutions. Yantai municipal administration departments and institutions use People Voice Online to listen to citizens' interests, problems and troubles.

With the rapid development and spread of internet technology, the space for expression by the Chinese public is spreading constantly. According to the recent data from CNNIC(Zhu,2011), ending June 2010, the number of Chinese blog users has increased to 231 million. The development of Microblogging is much faster, with the public using social media to disseminate personal information more and more conveniently day by day.

Almost all news dissemination platforms in China have provided a comments function for the public to air their own views about specific articles, special coverage or events.

In addition, the Chinese network BBS relates to social life in all areas. It has become the most active and far-ranging platform for the public to discuss social and political issues. According to data from CNNIC on July 2010, by the end of June 2008 the access rate of forum/BBS was 31.5%. Thus enabling the Chinese public to express their own ideas through this variety of social media autonomously, immediately and widely.

Generally speaking, social media usage still follows traditional media channels including TV, radio and newspapers, but with the booming of the economy, especially the coming of the new media, more citizens are familiar with internet usage and therefore smart phones, internet, and handheld tablets are widely used, especially among young people.

The government, in response to the evolving social media landscape, is penetrating sectors such as SMS management, website construction, "the Mayor's mailbox", micro-blog (Chinese equivalent of twitter) and online eGovernment service. New applications designed for easy access to government servicesare entering the social media landscape.

In the following paragraphs the 'People Voice Online' will be used as the example to evaluate the use of social media in Yantai.It will focus on analyzing the workflow, the target audiences, and the core of the platform, through the analysis people could realize the operation mode of the platform clearly which could offer a great help to the understanding of Chinese social media and its influences towards the e-governance.

Since the year 2004, Yantai municipal government began to study the possibilities of using social media in the policy making process and the city administration field. The first attempt to use social media occurred in May 2003, when the first Chinese network governance platform "People Voice Online" was put into operation.

The People Voice Online plays the role of communication platform between government departments and the public. Using this platform, the public could turn to government departments for advice when they encounter the problems in their social lifeand could understand the policies and procedures which are formulated by government departments. They could put forward some personal ideas and suggestions that focus on public social issues. The People Voice Online platform has connected the public with government departments and formed a long-effect communication mechanism. It raised the possibility greatly for public issues of solving, consultation, replying and suggestion adopting. The information from social media (people voice online) provides a lot of public opinion information to government departments which could help them to improve their work. The information could also provide good evidence for public decision-making.

As the social media platform, People Voice Online is the carrier and the concrete manifestation of "the network asks politics in Yantai." The main responsibilities of People Voice Online are as follows: First of all, it provides the function support for the interaction communications between government departments and e-Citizens. Secondly, it provides the system support for the communication between e-Citizens and government departments which enables a standardization and long-term information exchange between the two.

E-Citizens are important components of People Voice Online's operational model. The characteristics of e-Citizens are large-scale, high concentration and high anonymous performance etc. The e-Citizen is one part of the public and the proportion of eCitizens in the public is increasing gradually-Citizens use People Voice Online as the platform to express their opinions. The opinions expressed by e-Citizen are increasingly becoming mainstream public opinions. The opinion from e-Citizens on the platform could be divided into several main types. The first one is 'Advisory', in specific, public consultation with the appropriate policy that they do not understand. The second one is 'Problem solving', where the public hope the related government department could solve problems which affect their own interests, for example the urban public traffic network design. The third one is 'Reflecting the issue'. In their concern about public affairs, people transmit the information they know about to government departments. The fourth one is 'Complaint' which can be divided into two types, first of all the complaints about public functionaries' service attitude and quality, secondly the complaints about general violations against law. The final one is 'Advice and suggestion', where the public provide their own opinions to government, focusing on the social problems or decision making of public affairs, for instance the suggestions for the site selection of an airport, the proposals for traffic jam solution etc.

The government department is the core of People Voice Online's operational mode. The generalized definition of the government is the complex of a national legislative body, an administrative organ and a judicial organ etc. The definition of government in the narrow sense is the administrative organ in a national power mechanism. At present, many government departments and institutions have started their businesses on the platform, for instance the administrative organs of Yantai, judicial organs and some key enterprises which include communication industries and large banks etc. The government departments were established for the purpose of public welfare, therefore when the government exercises its power in making decisions, it needs to honor the public's right to know, to express their views and to participate in public decision making through corresponding social media. In particular, on the People Voice Online platform the government department undertakes the following duties:

- Understanding public opinion,
- Problems solving,
- Communication and Negotiation.

Table 1 is the evaluation of the usage of People Voice Online from 1st January, to 8th August 2010 (Deng & Jiang, 2010).

Table 1. Usage of People Voice Online

Department Name	Number of Comment from eCitizens	Department Name	Number of Comment from eCitizens
Public Security Bureau	2964	Yantai customs	42
Planning Administration Bureau	2564	Justice Bureau	42
Department of Housing Management	2553	State-owned Assets Supervision and Administration Commission	38
Education Bureau	2517	Agriculture Bureau	37
Roads and traffic Authority	2102	local taxation bureau	352
Urban Administration Bureau	1898	national taxation bureau	249
Labour and social security bureau	1866	intermediate court	259
Building and Construction Authority	1290	power supply companies	242
Personnel Bureau	734	China Construction Bank	135
Environmental protection bureau	657	Telecommunication Company	110
Industrial and Commercial bureau	654	Cultural Affairs Bureau	182
Land Resource Bureau	616	Municipal government	220
Public Health Bureau	552	Municipal government	180
Broadcasting Board	515	Radio station and media	50
Department of Civil affairs	423	Municipal government	66

The operation of People Voice Online includes four main parts: first of all, e-Citizen messages which includes complaints, consultations and suggestions etc. Secondly, the comments of e-Citizen will be examined and verified by the background system of People Voice Online website. Thirdly, government departments give feedback to all kinds of comments from e-Citizens. Finally, e-Citizens give feedback to the government departments' handling of the related issues.

E-Citizens comments are the starting point of the whole process. The platform has formulated several specific operation standards in order to construct a formal interactive web communication platform.

The related operation standards are as below:

1. **Comment Method:** The comment method includes user's login comment and anonymity comment. There is not any difference between these two kinds of comment methods. The main purpose of user login comment is to provide convenience to e-Citizens in order to track the feedback to their comments.
2. **Provide the Title and Contents of Main Body:** The People Voice Online platform has adopted some technical methods in order to limit the comment title number between 10 to 25 words. In this way e-Citizen could conclude the comment contents accurately and communicate with government departments conveniently.
3. **Select and Provide the Type of Comment:** E-Citizen could chose the comment type from the following types:
    a. Complaint.
    b. Consultation.
    c. Suggestion.
    d. Feedback.

The background system could record and statistically analyse the comment types chosen by e-Citizens in order to provide the data reference to public sentiment analysis.

4. **Provide Private Information:** The People Voice Online platform requires e-Citizens to supply their name, telephone number and email etc., in order to keep in touch with them.

Each comment posted on People Voice Online must be examined and verified by the background system of the platform. Each day the system examines and verifies more than 200 comments which are posted by e-Citizens.

After being examined and verified by the background system, the messages from e-Citizens will be delivered to the related government department. This step is the core of the platform's workflow. The government departments on the platform will solve the problems according to the process below:

1. Accept the message,
2. Communicate with messenger,
3. Give an official written reply to the subordinate body,
4. Give feedback on the platform.

The relevant government departments appoint a specially-assigned person to answer e-Citizens' comments in a fixed time period. It is determined that all departments on the platform to solve e-Citizens' comments within three working days; the latest deadline cannot be later than seven days.

Yantai Government also requires all municipal administration departments involved in People Voice Online to document the listening and responses of e-Citizens' comments into the annual target management assessment.

In order to appraise the attendance of all government departments on the platform, there are two important parameters: 'Response rate' and 'satisfactory rate'. Response rate means the ratio of department feedback responses to the number of e-Citizens' comments. Response rate could reflect if the department gives the feedback to e-Citizens as soon as possible. 'Satisfactory rate' mean the satisfaction degree of e-Citizens toward the feedback from government departments.

The feedback section is the last step of the People Voice Online workflow. When e-Citizens get feedback from the government departments, they could use the feedback site to post their satisfaction and the issue resolved. If they are not satisfied with the results they could keep the communication going with related government departments until the problems are solved perfectly

The usage of People Voice Online in Yantai, especially in city administration and policy making fields has formulated a long-term effective mechanism which enables the equality-based communication between government and the public to become habitual behavior. With social media like People Voice Online, the interactive communication has eliminated the gap between government and public maximally.

Below are some real-world cases of using social media in the policy making process and city administration fields:

- **Case 1:** Zhifu District Education affairs Bureau modified the holiday policy for school students.
    - **Case Summary:** In China there are many traditional holidays and the Dragon Boat Festival is an important example. On 27th May, 2011 the Education affairs Bureau of Zhifu District received more than 600 comments (Deng & Jiang, 2010), most of them suggestions relating to school students' holiday arrangements. Many members of the public posted messages on People Voice Online platform highlighting the problem that the holiday arrangements of

school students were different to adult arrangements, meaning that children and parents could not enjoy their holiday together.
    - **Case Result:** On 2nd June, 2011, two days before the Dragon Boat Festival, the Education affairs Bureau of Zhifu District modified the holiday arrangements for school students and promised to consider public opinion in future policy making.
- **Case 2:** Old urban area's re-modeling and building in YuHuangDing Street.
    - **Case Summary:** In 2010, Yantai municipal government started to formulate the old urban rebuilding policy and began to seek the advice of the public through social media. Thousands of members of the public responded to the online survey and provided more than two thousand suggestions and complaints which related to communication, environment health and community life etc.
    - **Case Result:** By adopting the suggestions and complaints from the public, the government departments established many related policies which ensured that the rebuilding and re-modeling of the old urban district went smoothly.

Implication of Rapid Social Media Development on E-Governance in China

After illustrating social media construction in Yantai, we conclude that social media development enhanced citizen involvement in the social and economic agenda and is forcing improvement and reform of the e-Governance landscape in China. Learning the challenges and developing the skills of handling new media and encouraging participation have become essential matters for the Chinese government.

Based on CNMC statics published in March 2013 on the survey of China Mobile internet development, we know that up until June 2012, internet use by citizenshad reached 538 millions. This included a mobile internet user figure of 380 million, the fastest development trend. At the meantime, the netizen who use desktop computer reaches 70.7%, reduced 2.7% comparing with 2011. Citizens who use mobile phone connects in to internet increased 72.2%, which declares the coming of mobile internet. (Deng&Jiang, 2010) This mean the internet usage can be at anytime anywhere, as long as there's network, any once can receive and send information the first time. This will further promote information transparency, make governance information spread in an unprecedented way. On the one hand, it benefits eGovernment implementation, on the other hand, it brings challenges for government to manage a crisis and for processing administrative procedures. (Wang&Kong, 2013)

There are five major categories of social media, the first type is those who compose contents and publish them, made up of Blogs and message boards, Micro-blog or Weibo, the second type is information sharing, including photo sharing, video sharing, music sharing, and review sharing.

The third type is coordinated editing of social media, including Wikipedia and social questions and answers. The fourth type is social service type, including SNS, check in, instant message, mobile chat; the fifth type is C2C (consumer to consumer), Taobao.com and Deal-of-the-day website are their representatives. We noticed that some social media are poplar overseas including Digg, and second life, but it is not well recognized in China. Therefore we didn't include them into the graphs. (Lin, 2013)

According to statistics, up till March 20, 2011, there were 1,708 verified public administrative account, with government officials owning 720

Figure 2. Chinese social development report

Company	Type	Founded	Target	Registered User Base	Financial Status*
Sohu ChinaRen	Integrated	1999	Alumni	100mn	N/A
Douban	Standalone	Mar 2005	Teens, trendy user	50mn	N/A
QZone	Integrated	Mar 2005	Teens & rural users	388mn	Profitable
51.com	Standalone	Aug 2005	Small cities	180mn	Breakeven
Renren (Xiaonei)	Standalone	Dec 2005	College students	120mn	$76.5mn in 2010
Baidu Space	Integrated	Jul 2006	All	100mn	N/A
MySpace	Standalone	Mar 2007	Music fans	~10mn	N/A
TaoMee	Standalone	Oct 2007	Children	180mn	$35mn in 2010. Profitable.
Kaixin001	Standalone	Mar 2008	White-collar workers	90mn	~$30mn in 2010
Sina Space	Integrated	May 2008	All	Closed	N/A
Sohu White Society	Integrated	May 2009	White-collar workers	15mn+	N/A
Alibaba Ren Mai Tong	Integrated	July 2009	Business	N/A	N/A

accounts. According to administrative areas, 28 provinces and 4 direct municipalities opened Weibo accounts; based on functions of the government branch, 1,671 Weibo accounts are administrative which takes up 97%, the party system take 3 persons which accounts to 35. There are fewer accounts set up via the congress system. In addition, there are links between administrative accounts and civil servant accounts. According to service providers, 1,050 accounts were registered in Sina Weibo, accounting for 86%, 176 accounts were registered with TecentWeibo, accounting for 14%, and a small number of accounts were registered with the Renmin website. Civil servants also prefer to set up accounts in SinaWeibo, a total of 594, which accounts for 85%. TencentWeibo has 67 accounts, accounting for 10%. The Renmin website accounts for 5% with 33 accounts. (Deng & Jiang, 2010)

The latest report published in December 2013 by Renmin Web suggested 2013 witnessed an increase in both the number and type of administrative activities on the Weibo account.

At to the end of October 2013, the administrative SinaWeibo account reached 100,151, including institutions with 66,830, 33,321 civil servants, an increase of 40,000 compared with last year, about a 60% increase rate. The figures indicate a high development level. Of the 100,151 administrative Weibo accounts, 24,270 are in the areas of legal and judicial, including 17,279 institutional Weibo accounts and 6,991 personal accounts.

The top 1,000 accounts published 8,609,428 messages, an average of 3,057 messages per account per year for officials, and 5,553 messages for every institution. We are expecting the number of institutional and personal administrative accounts will reach 1.5 times more by the end of 2014.(Remmin,2013)

There are more accounts setup for institutions than individual politicians. Provinces in southern

Figure 3. Domestic social media and international social media comparison (Andera, 2013)

China have a strong sense of using Weibo to link citizens. The institution's accounts cover more areas and administrative issues than politician's accounts cover. And it is obvious Beijing politicians are more active than local politicians in using Weibo.

Based on the statistics, Jiangsu institutional accounts reached 279, while 5 provinces, namely Fu Jian, Guangdong, Zhejiang, Sichuan and Jiangxi opened more than 100 accounts respectively, all in the southern province. Among them, the Judicial Department of Haining, Zhejiang province is using Weibo to send out administrative papers. 22 departments of the judicial system registered verified accounts, and the administrative paper was disseminated through Weibo. The practice attracted wide attention and stirred intense discussion. The administrative Weibo represented by Guangdong Public Security Bureau, due to its early launch, was widely reported and recognized and therefore hada big influence.

Public security takes the biggest portion, with a strong willingness to provide a service. Transport, tourism, and promotion are the major areas of Weibo coverage. Most government agencies within the public security, transport, tourism, judicial system and public relations department use Weibo as a tool. It is relatively fast, practical and interactive in these areas.

Among all the government agencies, public security systems use Weibo to disseminate information, provide services, collect information, and investigate and research evidence. The practice greatly improved efficiency and saved time for these agencies, and increasingly became an important tool of information transparency and information coordination. For example, Jiang Su and Guang Dong maintained a very active public security Weibo account, Peace Beijing collected valuable information through the Weibo account and provided strong initiatives for disseminating public related information, providing pre-warning messages, and played a key function in linking citizens with the government. The Weibo activities are concentrated around the areas of transport, tourism, and public relations. And it is in progress for government agencies and politicians to explore Weibo's function to link with citizens. (Deng&Jiang, 2010)

According to statistics, provincial politicians opened 19 accounts, while provincial politicians opened 105 accounts, 238 Weibo accounts were registered by county level officials, and 333 accounts were registered with even lower level politicians. (Deng&Jiang, 2010) Lower rank officials tend to be more open and willing to applyWeibo tools and are more determined to link citizens with modern social medias. However, despite a limited number of accounts, provincial and county level officials pay more attention to impact and recognition of their Weibo account. Deputy Chair of Jilin Province Political Consulting Conference, for example, was more widely recognized due to the large numbers of fans and its activeness. During the party congress, proposals were submitted and discussion was initiated through the Weibo account, and it's quite active with citizen's participation. Permanent member of Zhejiang provincial party branch, Director Cai Qi of the organizational department, openly promoted hisWeibo account at the party conference, and therefore gained considerable influence. The Party Secretary of Xinjiang Urgur Autonomous region was recognized as "most senior politician who has a Weiboaccount", and he conducted a very active campaign in TencentWeibo during the party congress in 2013, widely reported by the media.

In studying the development of social media and its implications for China's eGovernance landscape, we make the following observations of social media development in China:

From 2009 to 2010, there were very few Weibo accounts registered by government institutions and civil servants. The administrative Weibo was newly developed therefore few were active. However, 2011 and 2012 witnessed increasing and active subscription of Weibo accounts by public administrations, totaling 1,600. During these two years, social media started to cast influence on social issues. It is expected in the next year that the administrative Weibo account will increase 1.5 fold compared with last year. However, with the existing Weibo accounts, the government has to make them active and interactive, and put focus on providing additional government services. (Tang,2012)

SinaWeibo and other social media channels have become the largest information platforms, the biggest opinion exchange forums, the most important channels for joining social welfare and charity and above all, the gateway to information.

Social media and Weibo's development changed people's online behavior, the internet surfing tool changed from PC to mobile device, and people used fragmented time to go online anytime anywhere. The trend is for people to share their opinion instantly with short messages instead of writing a long opinionated piece at a designated time; in addition, netizens tends to use Weibo as a news gateway instead of news channel. And most importantly, the feedback was imminent with large volumes. (Cui, 2011).

Social Media and Weibo changed traditional information dissemination channels. Traditionally news was processed by newspaper, radio stations and TV stations. In the social media era, everyone becomes a reporter and disseminator of news on Weibo. There are actually two channels of receiving information and disseminating information. Traditional media also uses Weibo as an equal way of publishing information, and adopts new internet languages, which are shorter and simpler. Short, precise Weibo report is fast and convenient, and allows almost immediate feedback from the target audience.

It changed the way government administers to and serves citizens. It provided a new platform for government to interact with citizens, where everyone can participate, send appeals, and monitor social and economic information. It provided an emergency response outlet, and above all, a market place where government can sell and provide services.

FUTURE RESEARCH DIRECTIONS

This chapter explored the current status of social media development in China, in particular re-Weibo, blogs and bulletin board and online BBS. However, due to the size and expansion of China's ICT sector and transformation of the information industry, new tools and innovative technology arise rapidly. Future research should consider the areas below, which are the areas these authors will continue to follow themselves:

1. Transforming of policy on the management of social media by the Chinese government.

While this article was in process, the Chinese government further tightened its control on social media, online information dissemination, and space for netizens to publish their opinion. These leads to re-adjustment of the way information sharing and communication channel, however, the width and depth of the policy influence remain to be examined.

2. The rise of new social media and the impact for information sharing.

Other than the government portal, SNS online messenger, social network websites, Weibo, blogs; the introduction of Weixin, a mobile online chat and messaging tool, has already changed the way information flows. The introduction of other functions including mobile eBay and mobile games will further increase its popularity. And most importantly, the free voice and online messaging brought enormous challenges to traditional information communication providers such as traditional mobile voice/message providers. The topic is worth further observation and research.

3. The interlink between China's social and political institutions change and development of social media

China is experiencing structural institutional change after the 18th party congress conducted on November 8, 2012. The new Chinese leadership is committed to building up an "all front Xiaokang" society, within its four point modernization plan with informatization, i.e., the development of the information society, as one of the objectives together with urbanization, modern industry and modern agriculture. Informatization contributes to industrialization and is one of the key elements in reaching those goals.

The demand and opportunities brought about by institutional change will feed into the improvement of public administration, and create a ripple effect towards social media and ever changing social life. How these factors and transformations shape the future landscape of China's social media requires close observation.

Solutions and Recommendations

In conclusion,China's e-Governance has made considerable progress in both width and dimension that is unparalleled in the world, thanks to rapid economic development. The investment in basic IT infrastructure enabled Chinese society and its citizens to greatly benefit from information accessibility, information sharing and above all, greatly increased the level of citizen's participation in China's political and economic agenda. The information flow and exchange to a large extent transformed and continues to transform the landscape of Chinese political and social life. It brought enormous opportunities for business development, economic reform and information flow. At the same time, the involvement of public opinion and the participation of citizens in decision making processes brought both opportunities and challenges to the Chinese governance.

China is still on the way to developing into a fully-fledged information society. The introduction of modern ICT was very recent and despite China enjoying the advantage of adopting the most matures technology as a late comer, it is still facing challenges of a disintegrated system, both on a technology front but also an organizational front. Local governments face the challenges of building up a systematic and integrated information managing system. The difficulties caused by a disintegrated institution set-up, and different development levels, on hardware and software, constantly bother architecture designers and practitioners within the IT industry.

With increasing exposure to the outside world, especially on information society building, in cooperation with EU countries, China is learning the best practices and gradually building up systems and applications that are suitable for its own information society building, or informatization. At the same time, China benefited from international cooperation on information society construction with the EU countries. China's own e-Governance development reveals its own comparative advantage of a well-planned structure design, strong implementation capacities and employment on a large scale, which also sets an example and provides lessons for the rest of the world.

The introduction of social media including the SNS website, online information sharing, and online trading is transforming Chinese society, alongside other changes such as economic development, social reform and opening up. Chinese society is increasingly changing into a diversified and multi-player society. The openness and information exchange needs provide social media opportunities but create challenges and sometimes problems of regulation, management and improvement of information channels.

The Chinese government responded to rapid social media development by quickly learning and mastering techniques and methods relevant to social media. The government actively joined in the process by setting up a government institution associated Weibo account, further revamped the government portal, and introduced new channels to government administration. However, as discovered by this research, there's still a gap between the public's needfor information transparency and good management and the government's capacity to manage social media in the new era. Maintaining an ordered and efficient participation and usage of the internet and social media whilst controlling and managing information security and data protection are still a challenge for the government.

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KEY TERMS AND DEFINITIONS

CAG: Chinese Academy of Government.

E-Governance: Means that governance is driven by ICT whilst delivering government or public services and products.

E-Participation: E-Participation (also written eParticipation and e-Participation) is the generally accepted term referring to "ICT-supported participation in processes involved in government and governance". It is the support and enhancement of public participation in the government decision making process by ICT, especially by social media.

Government E-Service: Consists of the digital interactions between a government and citizens (G2C), government and businesses/Commerce (G2B), government and employees (G2E), and also between government and governments / agencies (G2G).

Government Portal: The Government Portal here means 'China Yantai' Municipal Government Website.

Informationization: The word 'informatization' is similar to 'industrialization' and means the application of ICT in traditional industries or use ICT to improve the traditional industries.

Netizens: Netizens means internet uses among citizens.

People Voice Online: Means that government establishes a web-based platform which enabled citizens to provide their opinions, ideas and arguments towards government's policies and governance.

Sina: A famous Chinese portal website; the link is www.sina.com.

Social Media: Social media refers to interaction among people in which they create, share, and/or exchange information and ideas in virtual communities and networks.

Sohu: A famous Chinese website; the link is www.sohu.com.

Weibo: Launched by SINA Corporation, the most visited Chinese Weibo service, and sometime simply referred to as "Weibo".

Chapter 20
Singapore Policy-Making Processes:
The Impact of ICT to Enhance Public Participation and Gather Meaningful Insights

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ABSTRACT

In Singapore, ICT plays a key role in enabling technology for most of the sectors, several initiatives have been launched to gather insights from these large amount of data, and the utilization of visual solutions as a means to provide useful insights represents the basis for policymakers' decisions. In addition, Singapore is promoting the usage of new channels of communications to optimise the processes of e-Participation, to enhance public inputs in governmental activities, and other initiatives to gather insights from geo-spatial, behavioural, commercial, and scientific data. This chapter provides an overview about Singapore IT strategy development and the relation between government and key stakeholders to define and establish new policies, governance, and the framework implemented through the value add provided by IT and visual solutions ad-hoc utilised.

INTRODUCTION

In last decade cities and countries in Asia expanded at a rapid pace as consequence of economic advances, industrialisation processes, population growth, enlargement, migration and shifts in global trade and capital flows. The chapter focuses on the case of Singapore, that although a very young city-state with a multi-ethnic population achieved significant economic success. This chapter addresses the solid structure residing behind Singapore, an island in which the state

DOI: 10.4018/978-1-4666-6236-0.ch020

is actively involved in the management of the economy and in the active implementation of policies involving private and public sector as a whole through the implementation and the usage of ICT technologies. Before moving into the core of the topic, the author provides a description of the current political, social and economic situation representing Singapore's environment and the background to shape and perform policies implementation. Following is presented the ICT sector growth in order to underline the effort put by Singapore in the ICT development for achieving a more democratic and aware policy implementation and post – evaluation process. It also strengthens the overall strategy that the state initialized for creating a governance network to better address policy directions. Such network has also been investigated through an analysis of how stakeholders, both private and public and citizens are involved in the governmental initiatives throughout e-participation initiatives. The chapter shows how ICT applications in the public sectors and government have been planned, evolved and supported by enabling components such as information infrastructure, IT human resources development, ICT industry sector, and ICT governance and institutions. It also underlines the importance and the strategic investment the state put into the development of R&D strategies focused on the implementation of International Research Centers focusing their activities under interactive digital media and social network studies for more insights gathering.

Among the most distinguishing features of Singapore enabling the achievement of this advanced system are: its committed political and public service leadership, creating an environment for cumulative institutional learning, public – private collaboration, investment in a competitive information infrastructure, clear cyber policies, and dynamic governance based on result orientation and accountability (Chua, 2012). Finally the chapter will describe a policy best practice implemented by Singapore to oversee issues such as traffic congestion and ICT infrastructure improvement to bring the city towards a sustainable living. In this scenario the ICT sector can strongly be considered as a government partner and as enabler of the overall economic transformation of the city nation.

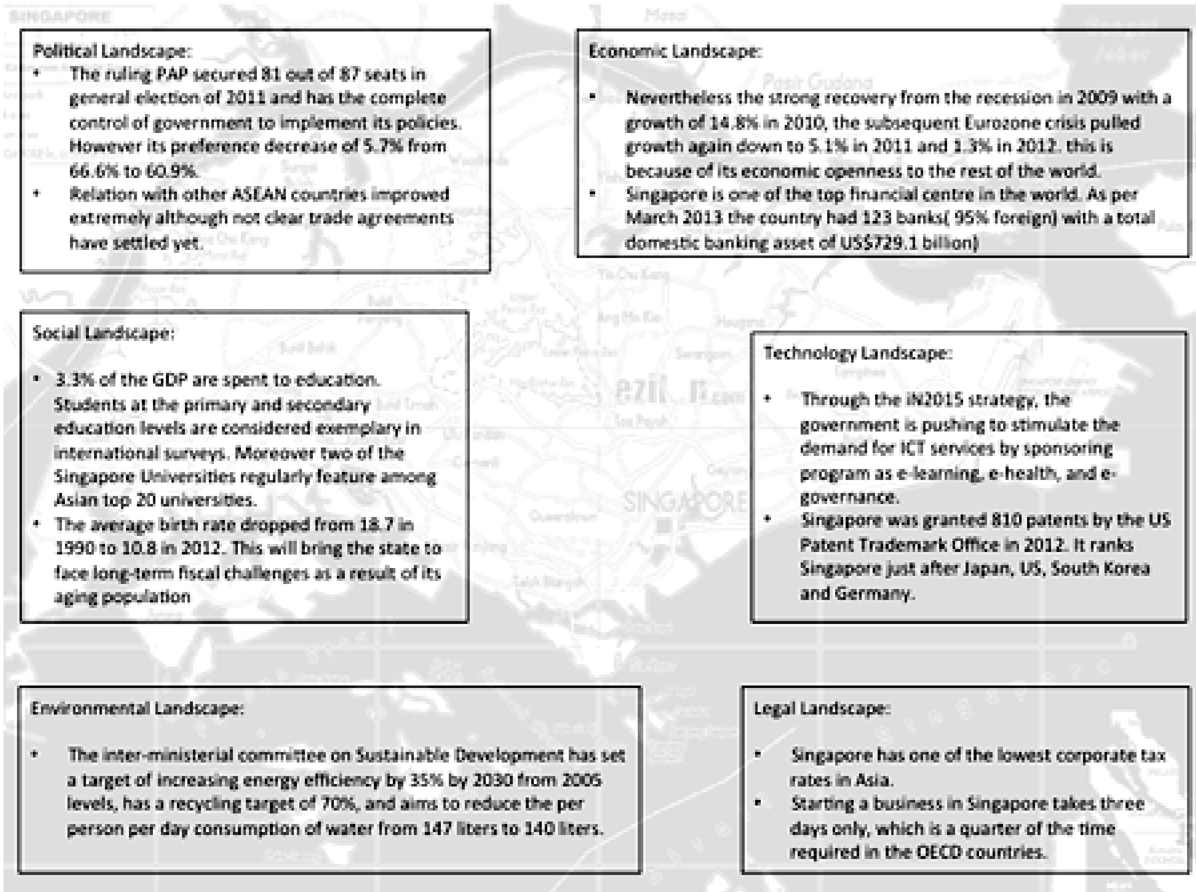
SINGAPORE: THE YOUNG CITY NATION AND THE EVOLUTION OF THE ICT SECTOR

In 1819 Sir Thomas Stamford Raffles claimed Singapore as a trading post for the British East India Company, and after combined with Penang and Malacca in an administrative entity known as the Straits Settlements, became a crown colony of Britain in 1867. The Japanese invasion, after the Second World War, in 1942 interrupted the colonial rule. In 1959 Singapore was granted the right of internal self-government and joined Malaysian Federation in 1963. But due to irreconcilable differences broke away two years later. Singapore began as a place for maritime trade. During its new life Singapore faced daunting challenges in economic development. Unemployment was high and with the withdrawal of British troops, many jobs opportunities were lost. Furthermore urban slums proliferated, crime rates were high and only half of the population was literate. Its multi-racial and multi-religious population also created natural fault lines that were an ever-present source of potential social instability. Singapore situation was also compounded by its natural attributes. The limited land area of about 700 Km^2 caused immense challenges in land use planning to house the needs of its nation state, in developing sustainable and strategic industry cluster, and a robust infrastructure of transportation system to support the growing economy. Nevertheless doubts of the small island survival arose, Singapore flourished under the leadership of Lee Kuan Yew and the People Action Party (PAP). The PAP won elections in 1959 and has remained in office ever since keeping today 81 out of 87 seats in the unicameral parliamentary republic (Henderson, 2012). During this period Singapore's openness to the rest of the world was not a choice but a necessity due to its almost total lack of natural resources. The most of policies were build under two strategic imperatives: economic development and domestic stability. This has formed the backdrop of Singapore's development and underpinned the foundations of governance based on connectivity.

Nowadays Singapore is achieving a global – city status, its economic and physical transformation has been accompanied by changes in its relationships with the rest of the world. This underlines the importance Singapore put in its international relations. The Ministry of Foreign Affairs (MFA) in its early years was to protect sovereignty by securing international recognition and friendly relations. In 2012 Singapore had a strong global presence represented by nineteen embassies, seven high commissions, two permanent missions, thirteen consulates general and four consulates around the world, compared to just six overseas missions in 1966. As foreign-policy fundamentals Singapore includes seeking the maintenance of a free and open multilateral trading system and welcoming trade with any state for mutual benefit. The government negotiated free-trade agreement with Australia, New Zealand, Japan, USA, South Korea, Panama, China, Peru, the European Free Trade Association and the Gulf Cooperative Council of the Middle East, and nowadays discussions are being carried out with the rest of the ASEAN countries including Myanmar. If the above mentioned strategies perfectly works to improve the economic development strengthening both internal and external trades, on the second imperative strategy, the domestic stability, the state is acting more carefully with the advent of new democratic media. In 2011, the Prime Minister Lee Hsien Loong during his National Day Rally Speech warned that the cyberspace is full of "many negative views and ridiculous untruths". According to (Cherian, 2012) this problem pre-dates the advent of Facebook and Twitter and even of older technologies like television, telephone and telegraph. It goes directly to the heart of one of democratic's theory dilemmas: what is a reasonable level of "informedness" that people should expect of the public, and whether and how it can be achieved. In such matter the Singapore PAP has a tradition of being straight and sometimes brutally honest about Singapore's challenges, limitations and vulnerabilities. The PAP believes that the democracy needs to be protected from itself, it believes that in some areas decisions are simply too technical for the masses to grasp, in other areas the gulf between short-term individual interests and long-term societal interests is too cavernous for most people minds to bridge. Consequently the Singapore strategy thus far has been to develop a public opinion that can be trusted to follow wise leadership, but not attempt to take the lead. In parallel Singapore learned and took advantage from the people's beahviour and feelings gathered from the utilisation of the new social media. Means by which the state is building and strenghtening a social trust, by which is pushing the government presence in the people's daily life through the implementation of public fora and of social web spaces where information and feedback are continuously exchanged. To achieve such level of success Singapore embraced the ICT revolution with tremendous effort to promote economic growth. Such impetus is also pushed by the government's awareness to attain more democratic governance coupled with a widespread public interest in the potential of ICT to empower citizens. The following image offers a PESTLE analysis for Singapore.

The ICT development in Singapore mirrored the economic development and the social needs. (Vu, 2013) underlines that the Singapore's remarkable success in economic development has been strongly associated with the country's vigorous efforts to embrace the Information and Communication Technology revolution to promote economic growth. His study underlined three

Figure 1. Singapore PESTLE Analysis. Personal elaboration from Singapore Country Report. (MONETARY Authority of Singapore, 2013).



important key findings: there is a strong positive association between the intensity of ICT use and value-added and labour productivity growth at a sectoral level, ICT investment contributed approximately 1 percentage point to Singapore GDP during 1990 – 2008 and its role in driving economic growth has become increasingly important over time, and the contribution of ICT manufacturing sector to Singapore's growth was notable but it was on decline and faced difficult restructuring challenges.

The decision to focus on a solid IT development was taken during the late 1970s, when government realized that the island nation could not compete with much larger regional countries in labour-intense industries and the only alternative was to move up the value-chain and focus on capital – intensive and technology – intensive activities. IT was identified as the key technology that would support and help the Singapore economic performance by doing more with less: increasing labour productivity and delivering better services to customers. Since then the Government focused on technological innovation to solve problems, increase efficiencies, develop new products and services, and create new knowledge. This process led to the development of a globally competitive Infocomm industry and knowledge – based economy. The policies to improve and consolidate the ICT as enabling technology began in 1980 with their first Master plan until the ongoing iN2015.

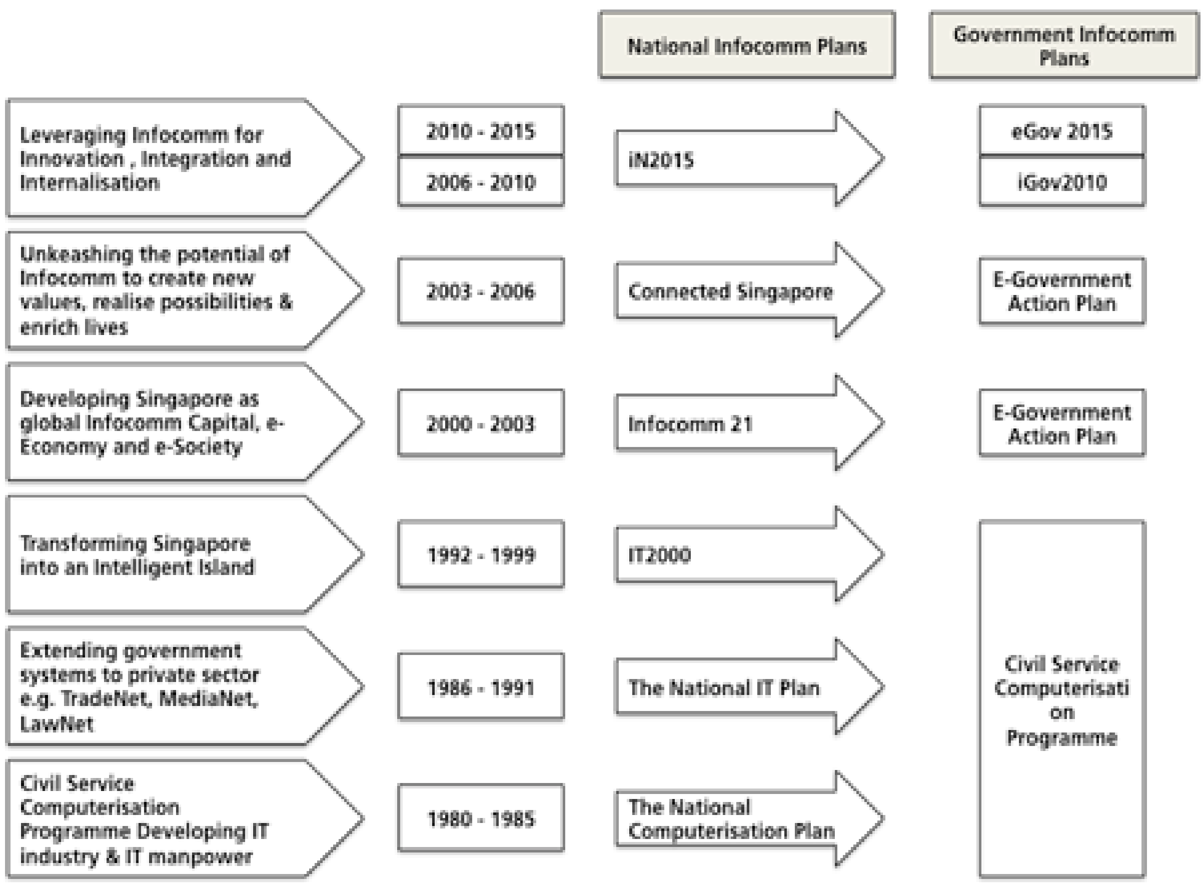
One of the advantage of the policy implemented by the government was to build a solid ICT infrastructure through a progressive evolution characterised by two prominent features: building a clear policy for each stage of development and government's pioneering role in establishing an e-government framework that leverages ICT to enhance its efficiency and effectiveness.

Implemented policies took Singapore at the forefront of the ICT readiness and transformed the city nation in one of the leading country in ICT-readiness and e-Government performance.

SINGAPORE NETWORK GOVERNANCE AND MAJOR ICT STAKEHOLDERS

Before introducing the relevance ICT plays among the Singapore policymaking process and the way e-Participation takes place, it is worth to provide the reader with a description of the Singaporean Government and its governance. As the literature states government types can be categorized into two mainstreams (Ho, 2013): big government and small government. Small government the opposite of big government, reduces the role of the state in the economy, lowers costs and promotes efficiency by allowing the market to dictate the prices and

Figure 2. Singapore ICT Master Plans Development. Source: IDA.



economic outcomes. Big governments have a vice versa approach. In respect to Singapore government some analysts see it as exercising "big" or substantial influence on the overall policies and economic decisions. It exercises jurisdiction, not only in areas like defence, macroeconomics and infrastructures, but also in areas more related to municipalities and/or personal activities. From other perspectives it can be considered as a small government, i.e. in relation to the Government expenditures considered a categorizing dimension for Governments by the Washington Think Tank, the Heritage Foundation and the Wall Street Journal, that compile together an annual "Index of Economic Freedom" measuring several dimensions of a country's economic freedom. According to such index, Singapore is thus considered a small government: its expenditure constituted the 17% of the GDP, one of the lowest in the world, in comparison Hong Kong spent 18.6% of GDP without any allocation to defence industry, USA spent the 38.9% of GDP, Australia the 34.3% and New Zealand the 41.1%.

The same author states that Singapore perfectly fits into a framework developed by the economist Dani Rodrik. Such framework is helpful to understand the way Singapore behaves to blend the work of markets and government:

- In first instance the government has sought to enable markets including industrial policy and capability development;
- Second, government sought to regulate markets, super visioning the financial sector, competition regulation, and taxation of negative externalities;
- Third, government has sought to stabilize markets; and
- Fourth, to legitimise markets.

In respect to the 2011 general election, the government pushed for a more collaborative framework, with governance that requires collaboration across the public, private and people's sectors.

In previous periods the focus of Singapore's policy options and directions was "execution was paramount" and about getting things done in a more efficient way. Since there was the absence of other viable institutions, the public sector drove all aspects of the development both of Singapore economy and society. Public sector worked strictly together with the political leadership to shape and mould the values of the Singapore society. The main vehicles for the implementation of economic and social policies became entities such as statutory boards that although if reporting to parent ministries, have greater flexibility than government departments in daily operations.

Such statutory boards include the Economic Development Board (EDB), Monetary Authority of Singapore (MAS), Housing Development Board (HDB), Building and Construction Authority (BCA), Energy Market Authority (EMA), National Environmental Authority (NEA), and others.

In respect to the ICT sector, during the past the responsibility to develop sectoral policies was shared by three different sector-specific agencies under the purview of three different ministries:

- Information technology, including e-commerce, was under the responsibility of the National Computer Board (NCB) under the Ministry of Trade and Industry (MTI);
- Telecommunications, under the Telecommunication Authority of Singapore (TAS) under the previous Ministry of Communications; and
- Broadcasting, by the then Singapore Broadcasting Authority (SBA) under the

former ministry of Information and the Arts. Internet is also considered a form of broadcasting.

When the ICT market was then opened to the private sector, the government restructured these entities according to the respective regulatory and commercial activities.

The Telecommunication Authority of Singapore formed its corporatized arm, one of the actual major telecommunication carriers in Singapore, named SingTel, while Singapore Broadcasting Authority also formed its corporatized arm, the Singapore Broadcast Corporation (SBC). The National Communication Board was anyway the principal IT solution provider to the government. The government then pushed the spearhead development of the ICT industry and the use of ICT in the public sector creating the National Computer Systems Pte Ltd (NCS), which was then incorporated by the NCB in 1996, when the ICT industry began to ensure maximum return on investment.

In the meanwhile government opened its markets, it realised that many of its agencies had to develop overlapping responsibilities with respect to the ICT industry. As a result, the legislation was tabled to create a single agency that would combine all governmental promotional and regulatory efforts of the industry, in 1999 the Infocomm Development Authority was created and TAS and NCB were both disbanded. IDA strategic goal was to cultivate a vibrant and competitive ICT industry in Singapore. In 2001, IDA was moved under the purview of the expanded Ministry of Information, Communications and the Arts (MICA), which also supervise the SBA, enabling a more integrated policy approach. Other agencies supporting the role of IDA and SBA are the agencies under the Ministry of Trade and Investments like EDB, International Enterprise (IE) Singapore, Agency of Star, Technology and Research (A*STAR), and Standard, Productivity and Innovation Board (SPRING Singapore). MTI's main task is to set broad direction, while the agencies under it each have distinct promotion roles and supplement the efforts of the lead sectoral agencies to align and integrate the promotional programme and plans. IDA works closely with them to:

- Plan and execute strategies to make Singapore an ICT hub for businesses and investments, together with EDB;
- Help local ICT companies to reach the overseas markets, together with IE Singapore;
- Cultivate local R&D in the ICT sector, together with A*STAR; and
- Help local SMEs to transform their internal processes through the use of ICT and help the growth of the overall local ICT industry, together with SPRING.

The ICT sector is also supported legally by the Ministry of Law and by the Attorney General's Chamber of Singapore (AGC) that provide the legislation governing the ICT and the broadcasting sectors. Together with them there is also the Intellectual Property Office of Singapore (IPOS) that is responsible for providing the infrastructure, platform and environment for the greater creation, protection and exploitation of intellectually property. Singapore succeeded to establish the service sector as a leading and growing sector. The next step was to reposition Singapore as a "total Business Centre" to continuously push the growth of service and service-related activities. Many Multi National Corporations (MNCs) were invited to set up their Operational Head Quarters in Singapore; actions also foresaw the support of local SMEs in their own right through the National Productivity Board and Small Business Bureau. Furthermore Government-linked companies and statutory boards were identified for divestment to give private sector firms scope to take over. Consequently also other statutory boards were converted to private companies, like the Public Utilities Board, the Port of Singapore Authority, and the National Computer Board.

THE PROCESS OF POLICYMAKING AND THE E-GOVERNMENT EVOLUTION

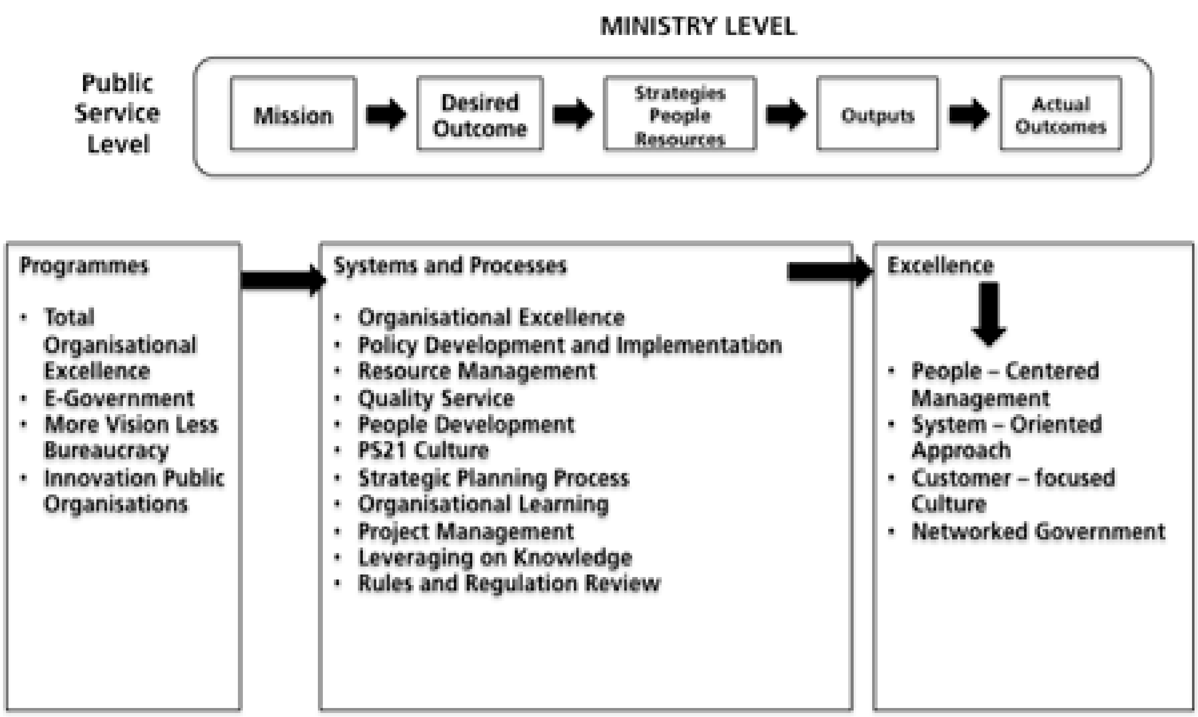
Singapore's model of private sector development consists of a network of partnerships among statutory board agencies and between these agencies and private sectors actors, such as business and organized labour, as integral policy stakeholders. During the last Singaporean ICT evolution, also the mentioned network faced a gradual reconfiguration to include a greater role also for local enterprises in the policy process. Conteh (2009) offers an integrated meaning of the term 'network' ad hoc used in the Singapore Governance Model. Primarily, it refers to the new form of policy implementation or service delivery involving a complex partnership among public sector agencies and organized non-state actors within a policy arena (O'Toole, 1997). Afterward scholars such as (Knoke, 1993) and (Marsh & Rhodes, 1992) describe the flexible and dynamic policy formation and implementation process within particular policy subsystem. As a final integration (McGuire, 2002) defines network as a 'public policy making and administrative structures involving multiple nodes (agencies and organisations) with multiple linkages'. Such definition offers the network framework Singapore environment operates in, including interlinked collaborators in policy formulation and implementation. It is worth to provide the reader with also a definition of the used term 'governance' as it is here intended: it is referred to the conscious effort of the state to engage in forms of collaboration with selected number of organized and active non-state actors within a particular policy arena, even though these actors are outsid the traditional boundaries constituting the public sector. In Singapore private sector policy stakeholders consists of firms and enterpreuners who serves as organized private actors within the market sphere or a certain economic sector and markets are not viewed merely as economic relationships, but also as social fabric of knowledge creation and transfer (Morosini, 2004). Provided the network governance framework description it is essential also to understand how both the private and the public sector evolved. To get a better understanding of the private sector development policy in Singapore it is required an appreciation of strategic planning as a mechanism of economic policy formulation and implementation. Singapore practises what is referred as an indicative planning. Planning in Singapore is pragmatic or strategic in the sense that it has inherent flexibility and is also logically consistent with market operations. Also more important is that Singapore planning does not seek to exclude the private sector but, rather, to provide leadership, directions and market signals. Behind such policies the public sector played a key role in the Singapore's modernization process and continues to go through reforms in its relentless drive to anticipate changes and to stay relevant. The people's perception of the public service in Singapore has always been positive, efficient, smooth and able to keep pace with citizen's expectations. In 1995 an important initiative, the Public Service in the twenty-first century (PS21), was launched to achieve a world class public service sector. The rationale behind PS21 was to build an adaptable public service that could assist Singapore Government in meeting the challenges of a rapidly changing global environment. One of the key focus area of PS21 was the establishment of an e-government that recognises the impact of Infocomm technologies on governance in the Digital Economy and exploits these technolgies in the workplace and in internal processes for the delivery of citizen-centric public services. This focus area was under the Managing For Excellence (MFE) movement (Chua, 2012).

Included in the various stage of the ICT Master Plans there was the parallel development of the e-government initiatives as strategy to bring Singapore at the forefront of IT infrastructure and services usage in all the governement processes.

Focus on e-Government evolved at each stage of planning and maturity as follows:

- From 1980 to 1999 with the Civil Service Computerisation Programme, e-government actions focused on:
    - Improving public administration through the effective use of infocomm technologies,
    - Setting up data hubs, such as People Hub, Land Hub and Establishment Hub,
    - Consolidation of computing resources, namely Singapore Government Email System (SGEMS), Singapore Network (SGNet), Government Finance System (NFS),
    - Provision of one-stop services such as TradeNet, LawNet and MediNet.
- From 2000 to 2006 under the e-government action plan I and II, strategies focused on:
    - Moving services online,
    - Deliver accessible, integrated and value-adding public services to the people, help and build communities of citizens to make them closer together.
- From 2006 to 2010 under i-Gov2010:
    - Build an integrated Government (iGov) that delights customers and connects citizens through Infocomm Technologies.
- From to 2011 to 2015, under eGov2015, strategies focused and focus on:
    - Establish a Collaborative Government to facilitate more co-creation and interaction between the Government, the people and the private sector,

Figure 3. Singapore Management For Excellence movement. Source: Chua 2012.



- Building and consolidate three strategic trusts:
    - Co-creating for greater value, where citizens can activilely participate in the creation of new e-services,
    - Connecting for active participation, to enphasize processes of knowledge sharing and knowledge creation for a major involvement of citizens in government and national policies,
    - Catalysing whole-of-government transformation where whole-of-government collaboration is enhanced through innovative and sustainable technologies.

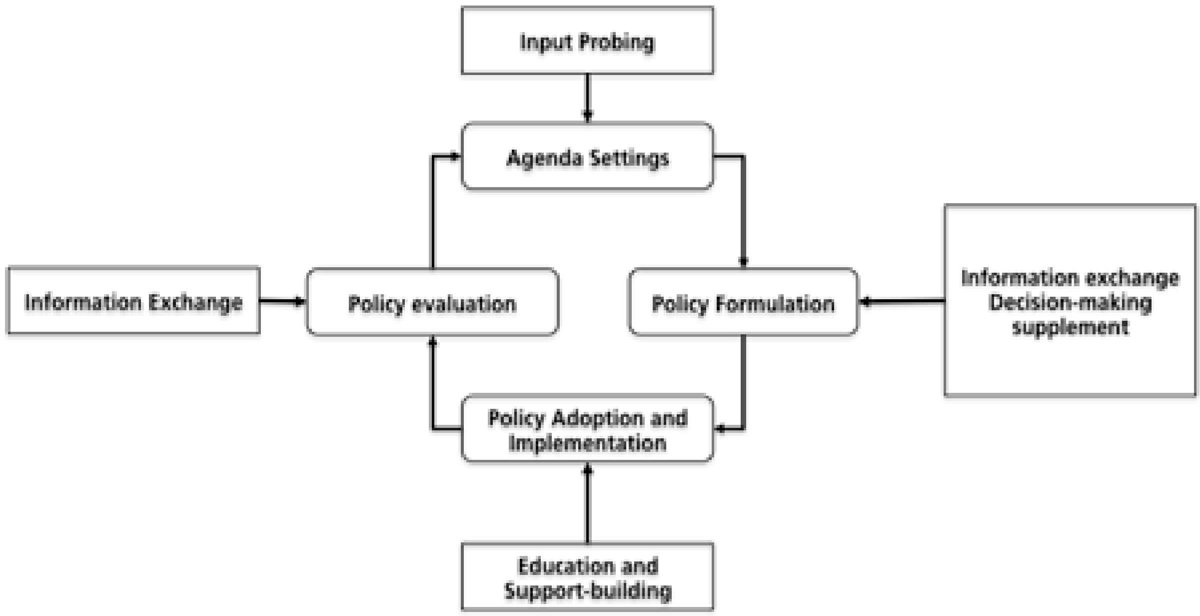
To better frame this evolution Singapore Government used a stakeholder-centric approach. Stakeholders were grouped in three specific categories: (1) Employees, (2) Business and Customers, and (3) Citizens according to their expected interaction with Government in terms of e-services consumption. Each stakeholder category was targeted with different scope and strategy. For Employees, Government-to-Employees (G2E), the guiding principles focuses on leveraging ICT for efficiency in government processes, equipping public officers with relevant Infocomm technologies and skills and sharing relevant information between agencies through ICT trainings, Government Intranet/Email/Network, Common Applications such as Human Resources, Finance and Procurement. For Business and Customers, Government-to-Business and Customers (G2BC), the guiding principles are to build customer-centricity with the Government behaving as a service provider and about providing a better service experience. This included the development of several services delivered from several agencies in once, such as the Online Business Licensing System (OBLS), the Central Provident Fund Mandatory Retirement Account System, the one-stop One-Monitoring.com.sg portal for motorist, the online passport application. For Citizens, Government-to-Citizens (G2C), the guiding principles are to build informed citizenry and value opinions of citizens. This approach included public consultation, e-referendum, e-voting, new media to explain government policies. The G2C implemented services like the portal Reaching Everyone for Active Citizenry @ Home (REACH), where more than 40 agencies seek online feedback on various topics.

THE ROLE OF CITIZENS IN POLICY IMPLEMENTATION: SINGAPORE E-PARTICIPATION AND THE FUTURE INFOCOMM ROADMAP

E-Participation represents a key strategy for the Singapore Government. The impetus on e-participation initiatives can be attributed to government's awareness for the need to attain more democratic governance with the advent of the new social media coupled with a widespread of public interest in the potential of ICT to empower citizens. Singapore believes that e-Participation initiatives can serve to encourage two-way communication between government and citizens, to educate citizens about the rationale and complexity of policy making, to legitimize government decisions and to provide opportunities for mutual learning. The following image offers a framework, developed by Phang & Kankanhalli (2008), that shows how e-participation taps into the various stages of policymaking process and which perfectly fits into the Singapore Government implementation strategies.

A brief description of the various processes is following provided. The process of Information exchange to supplement the Decision-making aims to bring government planners and citizens together for open sharing of ideas and concerns, to promote mutual understanding of the different positions

Figure 4. E-Participation initiatives in different phases of policy making. Source: Phang & Kankanhalli, 2008.



and views and their rationales. On this manner, ICT technologies to support e-participation effort with the information exchange objective should be able to create an environment for easy and open communication between the government planners and citizens. The process to educate and build support aims to inform citizens about the why and how of government's policy plans, and to create a favourable climate for execution of such plans. Such actions aim to gain support from citizens on a policy to be implemented by educating them about the diverse and often contradictory viewpoints requiring consideration and the resource constraints faced in planning. Infocomm technologies to support this effort should facilitate the selection of target participants and maintaining contact with them over a period of time. The objective of Decision-making supplement effort is to extract specific information from citizens, such as their preferences, behavioural patterns, financial habits, geospatial information, traffic congestions, and similar. The e-participation efforts with the input-probing objective aim to obtain citizens' views on relatively under-explored policy issues. Such effort should provide planners with an initial understanding of citizens' opinions about policy planning. The Singapore Government, through the effort put into the development of a solid and efficient Infocomm infrastructure coupled with the scope to involve always more the citizenry and the private sector in the policy making processes, consolidated the use and adoption of such processes. The REACH portal, previously mentioned, represents a best practice that describes one point information sharing between the government, the citizens and private sector.

According to Ho (2013) Singapore Government effort to push e-Participation and involving more the public are basically driven by several emerging factors:

- Public issues are becoming more multi-dimensional and complex,
- Mobile technologies now allow busy but tech-savvy citizenry to stay connected,
- A more educated and connected public expects greater openness and transparency from government.

The most these considerations coupled with social behaviours are considered when building the information, the more impact the public information will have on citizenry and will consolidate the already established positive image of the Singapore Government.

To achieve such positive image, Singapore passed also through the process of building trust in Government to enhance e-Participation. To adopt and use e-government processes, citizens must have the will to engage in e-government, which encompasses the intention to receive and to provide information through online channels. In a study conducted by Shirish & Thompson (2009) Singapore, in the latest years, is moving towards a successful e-government from the citizen trust perspective. Singapore has been able to sustain a high level of citizen trust in government and also to substantially increase the citizen trust in Infocomm technologies. The reason of its success is to be found in the continuous effort put by the government for the economic and technological development of the nation, which had a profound impact on citizens.

As matter of fact Singapore already developed, through IDA, its Infocomm road-map as basis for the next steps to better position itself at the top of the connected and most innovative Infocomm cities in the world.

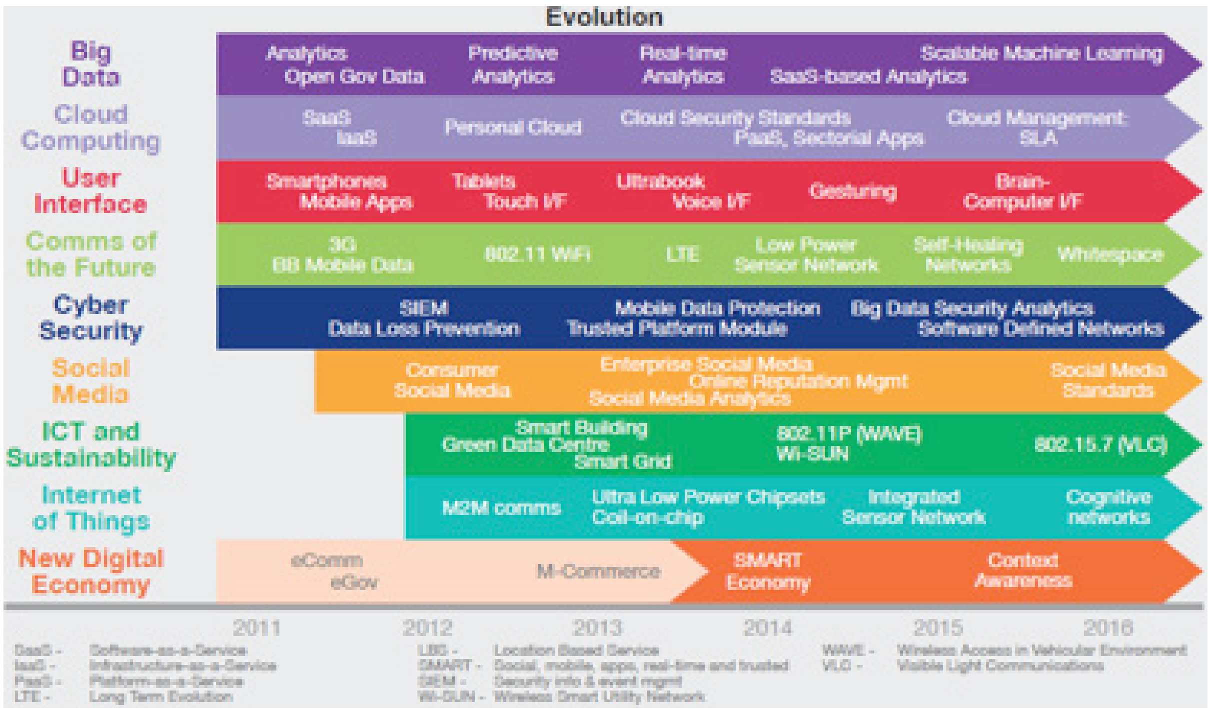
The future drivers for the road map development will also be used to gather meaningful insights from the big amount of data that would help policy decision makers to understand which directions and next steps are needed to keep and/or to improve the actual favourable economic and social moment of the city nation. Investment are consistently made in R&D and in the Infocomm industry to build and to exploit Infocomm technologies that could enhance and simplify the overall connectivity, trust and process of data understanding and data manipulation.

The IDA, under the iN2015 Master Plan published the next years Infocomm roadmap.

The roadmap pushes for the development/optimisation of several aspects of Infocomm technologies and focuses on nine main areas: (1) Big Data, (2) Cloud Computing, (3) User Interface, (4) Comms of the future, (5) Cyber Security, (6) Social Media, (7) ICT and Sustainability, (8) Internet of Things and (9) New Digital Economy.

Of these areas, all of them are visioning a safer Infocomm infrastructure also for a more democratic e-Participation, where a key focus is represented by the User Interface development. User interface and interaction technologies are strongly believed to provide end-users with new ways to interact with data, systems and with the overall environment where they work, live and play. The paradigm shift in the concept of user interface, of which the user represents now the new interface, is considered fundamental and is about multiple user interface technologies and enablers converging to provide a more holistic and immersive user experience and active participation in the social environment of Singapore. The user interface area will focus on fours different sub-areas such as i. Visual – Augmented Reality, Interactive Visualisation, and Virtual Reality – ii. Inputs – Eye tracking, Haptic, Computer-brain Interface and Speech to speech translation – iii. Displays – Electronic Paper, Volumetric and Holographic Displays, Ambient and Glance-able Displays, Surface Computers, 3D Immersive Telepresences and Ensemble Interactions – iv. Natural Language, Question and Answer Systems-.

Figure 5. Infocomm roadmap. Source: IDA.



POLICY INNOVATIONS IN SINGAPORE: THE CASE OF TRAFFIC CONGESTION

One of the policy innovation Singapore implemented to solve a common problem for most of big cities is related to the improvement of the traffic congestion through the use of tax policies and of a proper Infocomm infrastructure. Between 1960 and 1970 the number of private vehicle in Singapore doubled from 70,100 to 142,500. The Government introduced the Additional Registration Fee (ADF) representing a percentage (15%) of the Open Market Value (OMV) of vehicles. Although if ADF increased until the 100% of the OMV, together with other following policies to reduce and manage the traffic congestions, it turned out to not produce the expected impact. In 1990 the government decided to add a further extreme measure, the Vehicle Quota System (VQS). Under such measure vehicles owners are required to purchase a ten-year license called Certificate of Entitlement (COE), and the number of COEs available for purchase is determined by the Government on the basis of prevailing traffic conditions and road capacity, thus placing the total number of vehicles in the country under direct control of the government. Such policies mix allowed Singapore to keep the car ownership rate one of the lowest among high-income countries worldwide: 101 cars per 1,000 persons.

Advancement in Infocomm technologies revitalised policy instruments aimed at controlling the usage of vehicles in Singapore. IN 1997, the Government introduced Electronic Road Pricing (ERP) to replace the permit-based systems such as ALS. Under ERP, a unit detectable by sensors stationed on gantries over roads and expressways is installed in all vehicles, and these sensors deduct charges automatically from the driver's cash card inserted into the unit as the vehicles passes beneath the gantries. There were 70 gantries in the country in 2012, ERP charges are set to encourage the optimal level of road speeds. ERP charges vary by location of gantry as well as by time, based on traffic volume: when speed exceed the upper threshold (65 Km/h on expressway and 30 Km/h in city district), ERP charges should be reduced to allow more vehicles to use the roads; when the speed falls below the lower threshold (45 Km/h in expressway and 20 Km/h in City district), that represents a sign of traffic congestion, the charge should be increased. Statistics showed the ERP is quite effective in controlling the traffic volume: in 2011, the average speed during peek hours was 62.5 Km/h for expressway and 28.5 Km/h in city districts. But more important is that the combination of VQS and ERP enables the government to balance between vehicle ownership costs and usage charges to minimize the costs of these measures on car owners. In parallel this allowed the government to optimize and implement new policies related to the public transport, which in Singapore is efficient and effective.

CONCLUSION

Singapore excelled in the execution of implementing ICT strategies to develope a proper e-government infrastructure. Some of the driving factors that impacted in such success (Chua, 2012) are:

- **Stable Political Leadership:** The political leadership's confidence in winning elections meant that they were able to adopt a decision-making approach that addressed long-term solutions and sustainable policies in all aspects of the nation's development, rather than short-term political populatority;
- **Industry Collaboration:** Getting the private sector to do more: while in the beginning the Government retained its traditional role of owner and operator of Key Infocomm assets and infrastructure, there was an active industry participation in government projects through tenders, calls for collaboration, competitive dialogues and technology trials. In 2007, more than 290 companies were awarded 653 contracts worth a total value of SGD $ 820 million securing the 64% of the overall investment in Infocomm while the rest went to the MNCs. This collaboration policies still in place confirms the will of governemnt to involve always more the private sector in the production of e-services in Singapore;
- **The Pace of Telecommunications Liberalisation and the Importance of Competition:** The cost of the telecommunications infrastructure and the extent of Singapore's connectivity represent the underlying drivers of ICT adoption;
- The willingness to innovate and to take risks;
- Having a head start in establishing the National Resource/Data Hub. Singapore is nowadays considered as the Infocomm Hub of the all ASEAN region. It had a headstart in setting up the Data Hubs in 1994 to support e-services across governmental agencies. It now achieved a great level of data harmonization between the all private sector and the various governmental agencies;
- **Need for a Dynamic Governance and Network Governance:** The capabilities and capacity to change in a short dymanic governance network are crucial for a sustainable growth and e-development. The critical success factors in Singapore are:
    - Having committed political and public services leaders with vision and high aspirations for Singapore to set the ground for many e-developments in public sector strategies, structure and systems;
    - Creating an environment for continual improvement via institutional learning;

- ◦ Creating innovative processes, agile structures and systems by embedding dynamic capabilities in the change management programmes, integrating change capabilities into operational and management processes, as well as being deliberate in introducing process redesign with strategic intent, supported by effective feedback mechanism for continuous learning.

As the time progresses the Singapore Government will be anyway challenged with the upcoming new generation of citizens, more informed and digitally and socially educated than the previous ones. This will bring the governance to be more democratic in the decision making processes and also in aligning its communications with the new media and Infocomm technologies as the time to come. The next step of the research will be to:

- Understand the level that Infocomm technologies is impacting in the top decision makers;
- See and study through which new processes the Government will embed the new Infocomm technologies as outlined by the IDA roadmap into the overall policy making processes;
- Understand the increasing level of the interaction and of knowledge creation and information sharing between the Government and its stakeholders: Employees, Business and Customers, and Citizens.

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KEY TERMS AND DEFINITIONS

E-Participation: Refers to the involvement of the citizens, the private and public sectors in sharing their views and opinions in the process of policy making through the use of Infocomm Technologies, such as Web Portal, Web Forum and Social Media.

ICT Policy Development: Refers to all the strategies and related actions enabling advancements in the Information and Communication Technologies industry both from an infrastructural and not-infrastructural perspective.

Infocomm Masterplan: Refers to a living blueprint. It is jointly developed by both private and public sectors and defines the policies, strategies and initiatives to improve the Information and Communication Technologies sector.

Infocomm Roadmap: Indicates the ICT specific areas of intervention and the specific targets envisioned in relation to a specific timeline for the Infocomm Industry. Like the Infocomm Masterplan, the Infocomm Roadmap is jointly developed by both the private and the public sector through continuous consultations.

Network Governance: Refers to the operational structure and related procedures to engage and manage the relations with the public and the private sectors. In the specific of the chapter it refers to the structures and methodologies adopted by the Singapore Government to engage, involve and manage all the stakeholders, citizens, SMEs and MNCs, public and private sectors, during the processes of policy making.

Private Sector: Refers to all the Small and Medium Enterprises (SMEs) and the Multi National Companies (MNCs) operating in the Singaporean economical environment.

Public Sector: Refers to all the Ministries, the Governmental Agencies and the Statutory Boards.

Singapore Governance: Refers to the structures, the procedures and regulations in place to execute, monitor and control the decisions making processes and the policies implementation.

Singapore Statutory Board: Organisations that have been given autonomy to perform an operational function by legal statutes passed as Act in Parliament. The statutes define the purpose, rights and powers of the authority.

Chapter 21
E-Participation for Equity in Low-Income Neighborhoods: A Conceptual Framework

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ABSTRACT

New Information and Communications Technologies (ICTs), in particular mobile phones, have proved effective in increasing participation of some sectors of the population in public affairs. ICT are helping to take government closer to the people, making it more transparent and responsive. However, little has been done to help citizens participate online throughout the policy cycle and even less to engage the most vulnerable communities in such processes in order to increase equity. This chapter presents the conceptual framework for e-participation in low- and middle-income neighborhoods, reviewing first the main features of traditional participation and later the strengths and weaknesses of e-participation. As with traditional participation mechanisms, e-participation can be effective if it increases political equality and therefore needs to help engage all social groups including the most vulnerable. However, ICTs can also be limiting and even backfire as they cannot replace a broader participatory process and an institutional design that needs to enhance political equality, avoid elite capture, count on expert opinion, and build on traditional methods of participation. This chapter ends by applying this framework to a slum-upgrading project in Mtwapa, Kenya. The Mtwapa e-participation platform is presented as a proposed institutional design in a low-income context that aims to facilitate an effective process through comprehensive and inexpensive ICT-enabled citizen participation.

INTRODUCTION

New information and communications technologies (ICTs) have proved to be effective in engaging citizens in public affairs. ICTs can remove distance and time and are helping to take government closer to the people making it more transparent and responsive. Hundreds of opportunities are being offered to citizens in poor areas and in slums to expand their voice, be heard and in some cases be better serviced by local or national authorities. Throughout the world, energetic citizens are

DOI: 10.4018/978-1-4666-6236-0.ch021

developing new ways and applications to express their concerns and needs to their communities and governments. From the Vijana Forum in Tanzania and the Palestinian Friendship Center for Development in Gaza (online advocacy groups) to mapkibera.org in Kenya (citizen mapping) to the Khanyisa Youth Network in South Africa (community radio), engaged citizens and youth in particular use old and new technologies like radio, SMS-based applications or social media to speak out (UN-Habitat, 2012b).

These experiences prove how ICTs are no longer an exclusive business for public policies in wealthier countries but also for low-income countries, defined as having a gross national income per capita lower than 1,035 USD. Low-income countries are increasingly interested and ready to adopt new technologies to support their policy making. In 2012, one quarter of all countries worldwide committed to considering the results of e-participation in the policy-making process, including among others Bolivia, Brazil, Hungary, India and Panama. 25 countries (13% of the total) reacted to the feedback received from citizens concerning the improvement of their services, including Brazil, Croatia, Egypt, Mongolia or Oman (United Nations, 2012).

However, little has been done to help citizens participate online throughout the policy cycle in both high and low-income countries and even less to engage the most vulnerable communities in such processes. Only a few experiences have gone a step further and have tried to not only augment the voice capacity of some segments of society but have also created feedback mechanisms that have increased the capacity of the local government to act and have achieved an increased responsiveness and delivery of public authorities. This is the case of local Chief Karioki in a town near Nakuru, Kenya, who, after creating a Twitter account and receiving the trust of the local community, was able to get real-time information from citizens about burglaries and other incidents which in turn resulted in a sharp decrease of crime rates in the area he was responsible for (UN-Habitat 2012a). The Karioki experience is an example of how ICTs can not only support accountability but in fact become a full component of public services at the local level.

At the same time, integrated ICTs platforms that support the policy cycle in a comprehensive manner are rare which in turn creates inconsistent participation from only a few social groups in some instances of the policy cycle. UN-Habitat, together with another 17 public and private entities, is developing a full ICTs policy cycle platform through the Future Policy Modeling research initiative (FUPOL.eu) that aims at bridging this gap.

In addition, better coordination among different levels of government is required for effective ICT-enabled public policies. According to recent surveys, countries around the world are moving from a decentralized single-purpose organization model to an integrated unified whole-of-government model contributing to efficiency and effectiveness (United Nations 2012). It is recognized that "while it is important to continue with service delivery, governments must increasingly [place] greater emphasis on institutional linkages between and among the tiered government structures in a bid to create synergy for inclusive sustainable development" (United Nations 2012), creating more coordinated, cohesive, and integrated processes and institutions.

The use of ICTs is happening while low-income countries are trying to address other global mega trends: rapid urbanization and the youth bulge. While the youth (aged 15 to 24) represent over 1.2 billion people worldwide and is largely located in developing countries (87%), urbanization growth rates in these countries is high at 2.4% in 2010 with for instance the African urban population expected to double in the next two decades (UN-Habitat, 2013).

This is coupled with rampant poverty and informality. Inequalities are rising in cities in Asia and in most of Africa whereas in Latin America and the Caribbean those have slightly narrowed. In high-income countries, those rates have steadily increased for the last 30 years (OECD, 2011). Inequality in African cities has an average Gini coefficient of about 0.58, above the global average of 0.4. The number of people leaving in informal settlements also keeps increasing: of those living in cities in Sub-Saharan Africa (only 32,8% today), almost three quarters (65%) live in slums (AFDB, 2014).

In addition, local governments and communities are extremely weak in capacity and cannot manage basic needs such as the lack of clean water or land management, and not enough consideration is given to future generations. Slums in many countries are still expanding instead of decreasing and numerous cities are becoming unbearable to live in for most of their inhabitants. Instead of economies of scale, citizens encounter diseconomies of scale with negative effects such as overcrowding, congestion, pollution or lack of safety. Such cities become fragile human constructs where the government is unable to reach and parallel governance systems are established. In some cases, criminal or insurgent forces thrive in this urban environment.

It is therefore in low and lower income countries, and in Africa in particular, where cities will grow more rapidly and where more pressure will be placed to local and national governments to provide basic services and fulfill the needs and rights of their citizens. In such context, ICTs can help bridge the gap in societies where enormous structural changes are expected to take place in the next few decades. Designing well-planned city extensions and infill densification with sound regulatory frameworks is what is being advised in such situations and ICTs could help make these expansions more structurally inclusive while building a basic capacity for local authorities. In an increasingly unequal context where poverty is widespread in cities, equity becomes a policy priority but increasingly difficult to apply. Corruption, weak civil society, poor governance or a lack of political will are seen as the greatest barriers to equity (UN-Habitat, 2013).

In this context, ICTs can be used to support more equitable policies. A new ICT-enabled governance paradigm allows governments and communities to use technology to 1) improve policy outcomes; 2) increase inclusiveness and responsiveness; 3) increase public openness and 4) engage citizens as partners, not only recipients, in the governance of towns and cities (UN-Habitat 2012a).

In low-income countries, inexpensive decision-making mechanisms and basic ICT tools could correct the tremendous differences of broadband width and subscription. In Kenya, where the case study is located, the Communications Commission of Kenya (CCK) indicates that mobile telephone penetration in the country is high, with a mobile subscriber base in 2013 of over 29 million, representing over 75% of the population (CCK Report, 2013) which is close to the global average of 88% (United Nations, 2012).

The author will introduce a methodological framework presenting the concept of e-participation for decision-making with the overall aim of supporting towns and cities to become more inclusive, safer and sustainable. This framework will be used in highly informal contexts such as slums and aims at allowing both city and national governments to tackle poverty and informality in contexts of unsustainable urban development.

This chapter advocates for the incremental setting-up of the right legal and institutional arrangements needed to support sustainable urban development and the solid participation of its citizens and the private sector to achieve this vision. This is why a special attention is given in this document to explain the role of participation in public affairs, as e-participation requires a well thought institutional design that understands when and how participation can be applied in an effective and equitable manner.

This chapter is a policy research document and presents the main features of participation in urban governance, decision-making in informal settlements, and the role that ICTs can play as a catalyst for improved governance. The author describes the key elements of an e-participation platform that can be used to support governance at the local level and revitalize government-citizens-private sector relations, even in poor contexts where informality is rampant. The e-participation platform for slum upgrading is proposed as a possible solution for a comprehensive ICT-enabled citizen participation in decision-making. This chapter's framework is to be applied in the town of Mtwapa, Kenya, where UN-Habitat's Participatory Slum Upgrading Programme and the Future Policy Modeling (FUPOL) research project are working with the Kenyan national and local authorities and local communities in the upgrading of a slum. The FUPOL research project, funded by the European Commission, has four additional pilot towns besides Mtwapa: Barnsley (UK), Zagreb (Croatia), Skopje (FYR of Macedonia), Yantai (China) and Pegeia (Cyprus).

The rest of the chapter is organized as follows. Section 2 starts by describing the evolution of urbanization in low-income countries and the need to include the urban poor in decision-making. Section 3 critically analyses the debate about participation in public life, moving beyond the dichotomy between representative and purely participatory political systems. Section 4 describes the main features and challenges of online engagement in local decision-making, whereas Section 5 presents the Mtwapa e-participation platform as a possible adaptable solution to undertake e-participation. Section 6 concludes.

RECOGNIZING MARGINALIZED COMMUNITIES AND NEIGHBORHOODS IN LOCAL DECISION-MAKING

The ICT revolution has allowed for information to be disseminated in an incredibly faster way and communication to become much cheaper worldwide. Their capacity to include and manage data keeps increasing, as does their interactivity and multifunctionality. However, little effort has been put to link technology to development and understand how technology is affecting in-country inequalities.

With political will, technology can undoubtedly also support the development of more equitable societies. For that to happen, ICTs needs to become a new asset for those sectors of society that lack behind in terms of economic, social or cultural resources. To what extent ICTs can play a catalytic role in increasing the voice and opportunities of inhabitants in a low-income context, such as slums, in a structural manner so as to help decrease inequalities, instead of increasing them, is yet to be defined. The ultimate and most extreme example of marginalized communities are slums, which is why the author will focus on these areas.

Slums represent the face of urban poverty and vulnerability. Informal settlements or slums are often not recognized or even reflected on official maps. Consequently, they are excluded from the formal city infrastructure. With informal service provision, land and housing, informal settlements are excluded from most citywide planning, regulatory framework and policy formulation and implementation (UN-Habitat, 2003; UN-Habitat, 2009a; United Nations, 2012c).

Informal settlements indicate an informal tenure set-up, that is, the people's rights to the land are not recognized by others nor protected.

UN-Habitat defined a slum at the household level in 2002 as follows: a group of individuals living under the same roof in an urban area who lack one or more of the five key deprivations (UN-Habitat 2010a):

1. Durable housing (a permanent structure providing protection from extreme climatic conditions);
2. Sufficient living area (no more than three people sharing a room);
3. Access to improved water (water that is sufficient, affordable and can be obtained without extreme effort);
4. Access to improved sanitation facilities (a private or public toilet shared with a reasonable number of people); and
5. Secure tenure (de facto or de jure secure tenure status and protection against forced eviction).

The definition allows for a diversity of "slum types" and therefore does not stand for a homogenous living condition. Slum dwellers are faced with either lacking one or more of the deprivations and within the deprivation the degree of the lack of service or security can differ. A slum dweller can, for example, be someone who has to walk a kilometer to a safe and affordable drinking source or share a room with four or seven people (UN-Habitat, 2003).

The limitation of the slum definition is criticized by a number of authors and researchers. The slum definition omits livelihood and "soft" components such as job creation or strengthening of informal businesses, capacity development, and integrative actions into overall city life, public space and skills training (Marie Huchzermeyer, 2011; World Bank, 2010). In addition, there has also been a critical review of the Cities Alliance Slum Upgrading Programme named "Cities without Slums." A number of authors are advocating a change of the programme title to "Cities with Slums" (Marie Huchzermeyer, 2011). This discussion is interlinked to the security of tenure issue. Evictions and the total exclusion of slum dwellers from physical maps, formal governance systems and processes as well as any service provided by governments are the norm in many low-income countries. Some others question the usefulness of the formal/informal distinction, in particular as it relates to the informal economy (Hart 2006).

Worldwide, 864 million people live in slums. In many low-income countries, the majority of urban inhabitants live in slums or informal settlements. In sub-Saharan Africa, it is estimated that 60% of the urban population live in slums, taking up 10% of the urban landscape. This means that existing policies, legal frameworks and urban plans are insufficient to address the challenges of the majority of their inhabitants. Therefore, the author advocates in favor of inclusive urban policies – supported by effective national urban policies – that reflect the entire city fabric and promote slum upgrading and prevention approaches (UN-Habitat, 2009b). In this context, ICTs have proven useful when mapping slums, an example of this being the work done by Map Kibera in Kenya, and could prove helpful in supporting citizen engagement and accountability with local authorities in a structural manner.

Addressing Slums and Rapid Urbanization

Informal settlements and slums are a consequence of badly managed urbanization, failing or missing public policies, inappropriate regulation, dysfunctional land markets, unresponsive financial systems, lack of political will, and lack of preventive measures including planning in advance or even deliberate neglect and intent (UN-Habitat, 2003; UN-Habitat, 2005).

As previously mentioned, urbanization rates are high in "developing" or low and middle-income countries. Cities and urban centers are growing at rapid pace and the majority of the growth is absorbed by informal settlements or slums, in particular in sub-Saharan Africa and South East Asia. The formal city cannot offer serviced land to the increasing population (UN-Habitat, 2010). Rapid urbanization, as a result of the migration from rural to urban areas, accounts for 25 per cent of the city growth. 50 per cent is due to the natural growth of citizens already in the city and 25 per cent is a result of city-to-city and slum-to-slum migration (UN-Habitat, 2010a).

Rapid urbanization means a rapid change of demands on local and national governments and calls for decision-making frameworks that can cater for rapid responses, adjustment and prevention strategies. Furthermore, it has an enormous economic development potential if inclusive policies and strategies are put in place and the city has instruments for homogenous growth. Cities are the highest contributors to the national GDP. It is assumed that well managed and inclusive urbanization can be a great trigger for national development in developing countries (Nallari, Griffith and Yusuf, 2012; UN-Habitat, 2013).

However, as much as cities can fulfill the potential of economies of agglomeration and economies of scale, there are also diseconomies of scale. In this context, addressing the current urbanization challenges and establishing preventive measures before the rapid urbanization is deemed vital. Upgrading a slum has proved to be up to eight times more expensive than preventing its development (IADB, 2012). In this context, planned city extensions, slum upgrading and ICT-enabled governance can be critical measures that help efficiently tackle the challenges of rapid urbanization in low-income countries in the mid and long terms.

In the Short Term, Upgrading Slums and Planning Well the Extension of Cities

While planning city extensions to cope with the rapid urbanization, existing slums need to be supported and upgraded. As noted before, the majority of urban citizens live in slums or informal settlements in many cities in low-income countries. Millennium Development Goals 7 C and D aimed "*to reduce by half the proportion of people without sustainable access to safe drinking water by 2015"* and *"achieving significant improvement in the lives of at least 100 million slum dwellers by 2020"*. Slum upgrading refers to the improvement of the living conditions in slums that is strictly aligned to the definition of improved and safe water supply, sanitation and related basic urban services, housing improvements and provision of tenure security.

There are important additional components to be taken into consideration for sustainable slum upgrading. It is necessary to go beyond standalone projects that are implemented in a "top-down" approach and which address the physical environment without implicating the target group. Sustainability means that slum dwellers need to be the drivers of the upgrading process and have ownership, while at the same time participate in the full process and are empowered to contribute to the improvement of their own living conditions in the future. This type of sustainability can be achieved if the project is done hand-in-hand with the development of skills and business opportunities which are identified with their living environment and an improved trust relationship between the slum dwellers, government, the private sector and other partners (Fatima Al-Nammari, 2013).

However, as analyzed in the following section, participatory processes in activities such as slum upgrading have in some cases failed to significantly increase political equality and have suffered elite capture. Slum upgrading requires an adaptation of interventions of the living conditions and the social fabric of the slum and the building of capacities, organizations and institutions for replication and up scaling of slum upgrading activities. Further criteria for success need to create or adapt policies and advocate for the "right to policies" for slum dwellers, and the formulation of citywide slum upgrading strategies that integrate the slum in the context of the entire city to define a mandate, a vision and a system that makes stakeholders accountable for their actions (Banerjee, 2009).

In cities where over 60% of the population lives in slums, attention and financing needs to be put in recognizing and supporting low-income communities and neighborhoods such as slums. In this context, participation is a legal or pragmatic requirement to upgrade such slums. In the next section, the pros and cons of traditional participatory processes will be analyzed while delimitating the right balance between deliberative and representative systems.

PARTICIPATION IN THE CITY: DELIMITATING THE RIGHT BALANCE BETWEEN DELIBERATIVE AND REPRESENTATIVE SYSTEMS

Our premise is that in order to develop effective e-participation practices, it is necessary to design sound participatory processes. In this section, an analysis of the term participation is done in order to move away from simplistic interpretations often done in development policy and practice.

Historically, there has been an antagonism between the proponents of representative political systems and proponents of participatory systems. As stated by Fung (2006), "achieving a responsive and just government run by the elites for the benefit of citizens is as utopian as full blown uninterrupted participatory democracy".

The aim of the author is to strike the right balance between these two antagonistic ideals and define possible pragmatic approaches and mechanisms that can make participation effective in the move towards a more equitable and sustainable urban future.

Participation here has to be disassociated from the concepts of consultation, information sharing or e-service and directly affects the policy-making process in a systematic manner. Participation can be defined as follows:

Participation is a fundamental human right […]. All people, particularly young, marginalized and vulnerable groups, have a right to express their views on decisions directly affecting their lives. Participation is not a gift or a privilege bestowed from above (adults to children or Government to citizens), but the right of every person capable of expressing a view. This fundamental right can only be honored if Government-citizen connections are further strengthened. Participation is not an end in itself; as a procedural right, it represents the means through which citizens may take part in and influence processes, decisions and activities in order to achieve justice, influence policy outcomes, expose abuses of power and secure their fundamental rights (ESCWA, 2010).

In this chapter, it is understood that institutional capacity is required in order to facilitate participatory processes. Governance systems however, need to go beyond the construction of institutions and include developing the links with the people so that they are responsive to individual and community aspirations.

While few citizens may be against the concept of participation *per se*, its delivery is very often not optimal and such processes end up eroding public trust instead of strengthening it. For this reason, a review of the rationale of participation and its limitations is described below.

Why Participation?

Legally, the right to "take part in the conduct of public affairs" is a right protected under Article 25 of the International Covenant on Civil and Political Rights and in many national Constitutions. Article 25(a) states that "every citizen shall have the right and the opportunity […] to take part in the conduct of public affairs, directly or through freely chosen representatives".

Representative political systems have proved increasingly limited to address current public challenges. Firstly, formal political engagement (e.g. elections) is decreasing and there is dissatisfaction in traditional politics. In addition, globalization has fostered a considerable dispersal of regulatory competences across different levels of government and private sites of governance. Public policy is increasingly spread within an ever evolving multi-level governance equilibrium between the state, the sub-state (municipal and provincial), the supra state (regional and international) and the private side of governance when tackling the challenges of human kind in different scales. This shift from statism to polycentrism has in turn had important implications for civil society activity (Scholte, 2004). Non-state actors are increasingly recognized in influencing a city or country's prosperity, wellbeing and safety given the complexity of problems we face such as cyber threats, climate change, rapid unplanned urbanization, underinvestment in infrastructure or security. In today's world, overwhelmed by interdependency and the rise of non-state actors, lack of participation becomes less of an option. Some authors have stated "the end of power" through the shift of influence among regions of the world, and three broad revolutions: "more" of everyone and everything that limits the capacity to control; "mobility" of people and ideas making captive audiences obsolete; and "mentality" transformation where individuals take nothing for granted anymore (Naim, 2013).

Global interconnectedness is indeed increasingly a reality in all our economic, environmental and political arenas, and creates an uncertainty which public engagement and social cohesion can help mitigate. Public engagement can also help communities and societies look beyond their lifespan and think of future generations creating intergenerational equity. Finally, another reason for the importance of public engagement is the changes in technology that allow for mass participation, facilitating inputs into policy-making and enhancing oversight. Consequently, countries increasingly are required to work with its citizens, civil society and private sector to achieve their policy objectives. If participation does not happen, reform and change also become more difficult.

According to what governments agreed in the Istanbul Declaration in 1996, popular participation and civic engagement is required to develop sustainable human settlements. This entails establishing regular and broad-based consultative mechanisms, removing legal barriers to participation in public life, establishing agenda-setting participatory mechanisms, promoting equality and equity incorporating gender considerations, providing access to judicial and administrative channels for affected individuals and groups so that they can challenge or seek redress decisions, promote the representation of intergenerational interests, strengthen the capacity of local authorities to set local priorities, and promote the use of new information technologies (UNCHS, 1997).

Participation is therefore a basic requirement in managing public affairs at all levels of government. The common feature of successful participation is that it needs to be effective, increase political equality and entail some sort of redistribution of power. In this context, Arstein (1969) defined eight ladders of citizen participation which distinguishes between forms of participation that are pretended or artificial and those that are meaningful as they result in a direct impact on the final policy outcome and redistribute power: two are considered "nonparticipation" (manipulation and therapy); three are labeled as tokenism or only following the formal requirements of laws and regulations (informing, consultation and placation); and three are called citizen control (partnership, delegation and citizen control).

Here, participation is understood as what the OECD (2001) defined as "active participation": an enhanced two-way channel where citizens have influence over policy formulation, in contrast with "information" (an one-way channel that informs citizens about a variety of resources available) and "consultation" (a limited two-way channel). Participation requires political equality where all citizens have the opportunity to influence public policy.

In sum, participation is necessary for theoretical and practical reasons in an increasingly polycentric world. For it to be meaningful, it is necessary to ensure that all citizens can have an impact on the final policy outcome and that there can be a change in the way power is distributed. In addition, it also requires not a thinner regulatory government but a stronger, more confident one with technical expertise and capacity at the local level to manage the processes, and distributive *de facto* political institutions.

Participation vs. Expert Opinion

Expert opinion, or technical expertise, cannot be substituted by participatory inputs, although some politicians may opt for the latter when unclear about what to do next or when they want to be exempt from their responsibilities. The literature on the issue of participation has been evolving and intensified in the 1990s with widespread criticism of conventional top-down technocratic interventions. In 1997, Robert Chambert's *Whose reality counts?* argued that development should be done *by* or *with* the people concerned, rather than *for* or *to* them through a more community-driven and process-oriented approach (Chambers, 1997).

Other academics have disputed an approach focused on the listening to and learning from the beneficiaries by saying that while participation is central to social development, it needs to be reconciled with expertise, low cost decision-making and discipline in organizational systems. They also support a pluralistic approach where all the institutions mediating between users and agencies are strengthened simultaneously (Brett, 2003). Brett (2003) argues that participatory methodology "commonly fails in contexts where local conditions make co-operative and collective action very difficult or where it is manipulated by implementing agencies to justify their own actions or poor performance."

The author agrees that overall high levels of participation need to be combined with technical expertise, inexpensive decision-making mechanisms and discipline in organizations. The expertise of academics and practitioners is also critical to be able to effectively gather good practices and technical capacities that otherwise could not be obtained by community members directly. Nevertheless, technical capacities are too often limited in cities of low and middle-income countries that can undermine the success of a given participatory process.

Participation in Over-Stretched Local Governments

During the last few decades, decentralization has allowed many countries to devolve decision-making and enhance policy responsiveness at the local level. However, particularly in low-income countries, local authorities are over-stretched due to a lack of human and financial resources. Decentralization may only work if the relationship between central and local governments is strong and the central government monitors financial probity and implementation of agreed policies; there are adequate and secure systems for allocating both administrative and financial resources; and time has been allocated to put the reforms in place in an effective manner.

With participation, the capacity of local leaders and administrators may be over-stretched, and sometimes skills and resources may be lacking. There is often a vicious circle of poorly resourced city councils with limited capacity to respond to their local needs, hence limited legitimacy in the eyes of its citizens, continued poor revenue generation and service delivery performance, which in turn reinforces residents' lack of trust (Rakodi, 2008). In fact, increased transparency, which may expose the weaknesses in horizontal and vertical accountability can also de-motivate the interest of public officials in participatory processes. Local history, traditions, politics, and skills are variables that need to be considered as they affect the way local governments respond to changes in rules and procedures (Porter and Onyach-Olaa, 2001).

For participatory processes to have a chance of meeting their objectives, they have to look at adopting the spirit of learning, experimenting and persistent engagement (Mansuri and Rao, 2012) which is extremely challenging in a context where there is often lack of financial resources, technical skills and political will. A basic regulatory framework with decentralized responsibilities for local authorities matched by a minimum budget and autonomy is necessary to provide meaningful participation.

Hence, participatory processes need to be accompanied by support, in terms of capacity and finances, in order to deliver trust and benefit the local authorities and the community in the long term.

Participation and Elite Capture

It has been said that political equality needs to be increased when participation is organized. In this context however, an important challenge is that participation can be easily captured by special interests and groups.

Participatory processes have been criticized as excluding particular perspectives and interests, and it has been said that they reinforce patterns of dominations and inequality (Sanders, 1997; Young, 2000). Some have argued that formal organizations often act to reinforce patterns of inequality and social exclusion (Beall, 2001). New decentralization policies have also allowed for new opportunities for participation in local governance but often not enough attention has been paid to ensure the participation of the most vulnerable parts of the society (Moore and Putzel, 1999) exacerbating social inequalities.

Participation is also inhibited by social dynamics existing at the local level, including in relation to how age, economics, religion, ethnicity, gender or personality of the people plays out in a given place and moment. In some cases, participation can be enforced from the top with influential individuals imposing decisions on other members. There is also a pragmatic argument to be made. Government officials may find it easier and faster to access the community leaders rather than engage with the whole community. It may take greater resources and effort to identify and work with the most vulnerable. Furthermore, officials can be deterred, often without bias, as they are easily accused of commandeering participatory initiatives to further their own connections or for political gains, instead of promoting an active engagement with the poor (Hulme and Siddique, 1997).

Hence, participation is supposed to address the lack of political equality. However, in many cases, participation can exacerbate political inequality. According to Navarro and Font (2013), participation mechanisms are often captured by special interests because of three main reasons: firstly, the unequal distribution of social resources in a given community can affect more aggressively participatory biases for some type of participation activities than others; secondly, there can be a greater motivation to participate among those who are dissatisfied with local government; and thirdly, participation may be concentrated in members of political associations.

Between the "elite" and the "citizens" political and economic institutions are created. According to Acemoglu and Robinson (2008), democratic regimes can also be captured by the elite if the latter controls *de-facto* political power, despite a formal *de jure* political power being controlled by the citizens. Participation is therefore another mechanism that can consolidate or change the equilibrium between *de facto* and *de jure* political power.

In turn, looking at the political economy in participatory processes helps foresee possible bottlenecks. Formal and informal owners and tenants may position themselves differently in relation to important issues such as tenancy rights, building codes, land registration procedures or density permissions. The interests and incentives of each actor in a participatory process need to be analyzed and factored in for it to have more chances to be fair and effective.

Interests of each stakeholder can affect the evolution of a participatory process. However, ideas are also important. For instance, one of the key ideas that has monopolized development thinking from the 1970s onwards is the need to avoid urbanization. In Kenya, the *Population Policy Guidelines* published in 1986 encouraged local councils to "take part in developing rural projects that could discourage rural-urban migration, the main population process by which urban population grows" (Fox, 2013: 199). According to Fox (2013), this anti-urbanization bias has resulted in the adoption of a laissez-faire approach to urban governance despite the rapid growth of cities in sub-Saharan Africa, ensuing the emergence and persistence of slums. Such ideological trends affect the way elites and citizens relate and manage their needs. The new opposite thinking of embracing urbanization and supporting well planned city extensions and densification can make new agreements possible where all can benefit because it would make more urban land available with enough public space and private investments flourish.

After assessing the interests, incentives and ideas of all stakeholders, developing an effective institutional design is required.

Increasing Political Equality and Securing Public Interest

To avoid responding to the interest of only a few individuals, participatory processes need to be guided by the principle of political equality and the need to respond to public interest.

By political equality we refer to the extent to which citizens have an equal voice over governmental decisions. While political equality is more often possible when voting in elections (when all votes have the same weight), there are other participatory mechanisms that require more time or resources that are not available in the same way by every single citizen. In relation to the public interest, there is little consensus over the definition of what public interest is but this can be outlined as the welfare or well being of the general public, with a particular focus on underrepresented groups and individuals within society. This should also mean that, while policy should be guided by the opinion of the majority, it should not endanger the rights of minorities, or the rights of future generations.

To counteract the criticism of elite capture, some argue that the civil society can play a central role between the public and the private sectors. Some civil society entities announce that they guarantee the interests of the most vulnerable and the poor in society. In contexts with weak governance structures where institutions and legal frameworks do not facilitate participatory processes, civil society can play a leading role. Even in efficient governance systems, civil society (and the private sector) can play a key role in complementing the role of governments in securing public interest. Consultative mechanisms have been able to link public administration with organized sectors like NGOs to discuss policies and in influence funds allocations (e.g. group or thematic councils).

Civil society organizations, however, are extremely diverse: many may be sector-based, others may be groups around a specific issue (like informal traders associations) while others can be business organizations. While engagement with organized groups remains a pillar for public policy, it is recognized that it is not enough to achieve sustainable solutions.

During the last two decades, new methodologies have been used that strive to reach out to the median citizen. Such participatory mechanisms can be grouped in two typologies: deliberative mechanisms which look at approaching the median citizen and reach informed decisions through deliberation (e.g. Community Visioning, citizen panels, citizen juries, deliberative surveys); and mechanisms of direct democracy which aim at engaging any citizen (informed or not) and as many of them as possible (through e.g. referendums or assemblies, including using the internet). Other mechanisms that have also emerged during the last two decades include the evaluation of public services, mediation (such as in the process of regeneration of the city center in Bristol, UK) and participatory budgeting. There is no perfect mechanism that matches all criteria for public policy but it is a matter of balancing pros and cons. While some may be useful for representation purposes (e.g. deliberative surveys or juries) or securing informed citizens (e.g. juries or consultative councils), others could help secure education capacity (participatory budgeting), reaching out to all citizens or increasing the impact of a policy (e.g. referendums or participatory budgeting), or reducing the cost or organizational complexity of undertaking such processes (e.g. consultative councils).

In all cases, increasing political equality among stakeholders is needed in civic participation, with institutions protecting the rights of the poor and other vulnerable groups. The policy outcome resulting from such process should be guided by equity, which means systematically distributing the benefits of development to all. Participation requires having public interest as the strategic principle that drives public policy. This must respect the basic rights of all citizens, including future generations, and enhance public goods in political, social, economic and environmental terms.

Our understanding of participation also includes more implicit ways such as the physical form of a given neighborhood that invites or not citizens to engage, like being able to enjoy public spaces, or enjoy public facilities that define and accept inhabitants as members of the community. This is also why a pragmatic planning of city extensions that gradually provide connectivity and public spaces as the city expands is essential for rapidly growing cities in low and middle-income countries.

In concluding this section, it has been argued that participation is increasingly necessary in the decision-making processes of public affairs. Non-state actors are recognized as influencing a given town or country's prosperity, wellbeing and safety and therefore need to be part of the decision-making processes. Citizens need to be engaged in the decision-making, direct participation being a key mechanism for this. However, rules and processes need to be well defined and agreed and the processes need to be focused, the tools appropriate, and they should build on existing traditional public engagement mechanisms. Complementary mechanisms should also be put in place. Other than direct participation or deliberation, there are mechanisms that need to be complementing a participatory process, these are, expert opinions and representative mechanisms. Online tools should follow the same principles.

ONLINE ENGAGEMENT IN LOCAL DECISION-MAKING

As we have seen, ICTs have proven to be a catalyst to improving governance in towns and cities when well used, accessible and affordable, and have become an asset for all citizens, including the most vulnerable communities. ICTs can therefore help push the new frontiers of participatory mechanisms supporting consultative processes, deliberative initiatives or direct democracy mechanisms.

E-participation can be understood as a form of citizen engagement facilitated by elected representatives and governments that uses ICTs to directly influence public decision-making processes. Tambouris et al. (2007) distinguish between seven levels of e-participation: eInform, eConsult, eInvolve, eCollaborate and e-Empower. E-Informing is the one-way online channel that provides citizens with policy and civic information; e-Consulting is defined as the limited two-way channel that has the objective of collecting public feedback and alternatives; e-Involving implies working online with the public and considers public concerns and inputs; e-Collaborating goes further and is a two-way channel between citizens and government where citizens actively participate in the development of policy alternatives and preferred solutions and; finally, e-Empowerment allows for the direct influence and control of policy-making processes. For the purpose of this chapter, the e-Participation here is equivalent to e-Empower.

E-participation tools such as decision-making games, e-petitioning, e-polling, e-voting, podcasts, wikis, blogs, surveys, GIS-tools, online newsletters, alert services, on-demand information channels (e.g. YouTube, Facebook), citizen forums, or online chat rooms can enable a virtual feedback, review, critique and complaint loop between citizens and local authorities and service providers. They enable greater citizen participation in managing and monitoring city administration, interacting with local officials, making their voices heard and understanding the limitations of public administrations. Public officials can be easily reminded of the urgent needs of the population and it can also help public servants become more productive as they focus on addressing the population's real needs.

ICT vs. Traditional Participation Methods in View of the Digital Divide

A critical challenge facing the effective use of ICTs for participation and social change is the fact that there are enormous differences of the use of ICTs between high-income and the low-income countries, as well as between wealthier or poorer people. Technology has in fact often exacerbated inequalities among citizens.

The digital divide is the unequal access to technologies that exists between different groups in society, between marginalized groups in slums and middle and high-income groups, or between the rural and the city context. Firstly, there is a global digital divide between high-income countries, led by the Scandinavian countries, East Asia and the US and Canada and low-income countries like Burkina Faso or Niger. Another digital divide resides within countries. Often, middle and high-income citizens in the "developing" world are much more connected to and have more in common with citizens in high-income countries than with the urban poor or rural populations, creating parallel realities within countries. At the same time, very often marginalized groups in low-income countries are not included in the policy making processes nor are their needs addressed through the same; therefore the digital divide discussion in these countries differs from the discussions in high-income countries where citizen's rights are mostly equally accessible through what Acemoglu and Robinson (2013) would call *de jure* political institutions.

Other divides to be observed relate to the gender and generational perspectives. In many countries, women may often be less exposed to ICT tools than men; further, they are often less educated and have therefore more skills and capacity building needs than men. This is reflective of the traditional governance setting in slums and informal settlements, as men often dominate public decision-making processes by being community leaders. At the same time, youth will be in the best position to overcome the digital divide, as they are already more exposed to ICT tools, are faster learners and have fewer boundaries in exploring and learning ICT-based governance opportunities. This is contrary to the traditional setting where the youth is often excluded from decision-making processes and particularly in slum settings where they are seen as criminal or a social challenge to the community. The majority of slum dwellers are younger than 21 years (UN-Habitat 2012b). Of all social groups, the elderly may be disadvantaged in this regard as they very often experience the biggest barriers in mastering ICT tools. Elderly women are more negatively affected by these phenomena than elderly men. However, there is a difference in that elderly men in low-income countries as they are often the community leaders and have a high level of power, particularly in informal settlements or slums, power that is often inherited.

Furthermore, all slum community members, irrespective of their gender, are faced with limited physical access to ICT infrastructure and thus disadvantaged. This has consequences for integrating into the overall development process. The lack of exposure and access further contributes to the divide between the formal and informal neighborhoods, which means exclusion from the overall rapid development process in the cities of low-income countries.

At the same time, traditional governance structures may co-exist with a low level of political inclusion, and power relations may be very well established, even within communities, resulting in a strong divide in access to decision-making processes. In many cases, traditional practices have now transformed and they can coalesce with new associational forms at community level or religious organizations as well as representative political structures (Rakodi, 2009).

This is why face-to-face community meetings are crucial as complementing e-participation activities. In many cases, traditional platforms of participation need to remain central to the process while ICTs can engage specific groups otherwise disenfranchised as it created new incentives to support healthy relations among stakeholders. In the context of e-participation, it is pivotal to allow users to remain anonymous if they prefer while providing feedback to local administrators.

E-participation can work effectively if there is a citizen-centric or responsive local authorities that is open to feedback and criticisms from citizens. This needs to be coupled with access to ICT equipment and infrastructure, awareness-raising and dedicated personnel that can support and monitor the processes (Relhan et al., 2011). ICT tools must build on existing practices and use existing forums so that they can complement traditional methods of participation.

ICT tools therefore can contribute to decision-making processes if it builds on traditional methods of participation and includes a larger share of the urban population and marginalized groups. It is therefore presumed that ICT-enabled governance frameworks can contribute to the reduction of the digital divide in developing countries and within rapidly urbanizing towns and cities with tools like the Future Policy Modeling platform. To this end, low-cost access to ICT infrastructure need to be established for all, using ICT champions like the youth and empowering women and men.

Learning to Go Beyond E-Service Provision

We have seen how ICTs has exacerbated new divide among population groups and countries. In recent years, great efforts have been put in particular from private and public utilities to improve service provision with ICT tools. E-service provision has led to the improvement of the provision of basic services or at least has allowed deficiencies to be recognized more easily (Salim et al., 2013).

Undertaking e-participation is however a more complex endeavor that e-service provision. Whereas online service provision allows for a more transparent management of basic services increasing the voice capacity of clients to the service provider, e-participation is about involving citizens not as clients but as full partners in the decision-making process with roles and responsibilities while becoming an asset for local authorities when leading more equitable and sustainable towns and cities. In the process of learning how to facilitate e-participation, politicians, public officials and non-state actors have several barriers they need to cross besides the lack of skills and capacity:

- **Time:** In an already weak and constrained administration, they often don't have enough time to engage the public effectively.
- **Political Space:** There is often no political space in the current political systems for e-participation in policy-making. If this is pursued, the government might lose some control and have to face some risks having to respond to criticism.
- **Reaching All:** It is extremely difficult to reach all segments of society and all generations but if not done, using e-participation may be favoring some segments of society over others vilifying the aim of the whole process.
- **Trust:** Aiming at a highly participatory process in a context where there is lack of trust can be difficult and requires creating incentives and alliances aligned to the process.

Therefore, egalitarianism and procedural fairness is as important in new forms of e-participation as it is in offline forms of participation and needs to be secured when developing new governance frameworks, often within contexts of mistrust. At the same time, we have seen how the inputs that are received from citizens in an e-participation process have to be combined with technical expertise and good leadership.

In addition, and as described above, developing the capacity of all stakeholders remains a key test as all stakeholders learn how to engage with each other and use new technology and its applications. Civil servants also need to be trained in policy-making as well as in using e-participation in this process as the leadership roles that the public administration and others used to have may change as a result of the new ways of interacting among stakeholders. E-participation facilitators also need to read the context through political economy lenses and shape a set of incentives for all actors, including public officials, to allow these processes to succeed.

Using E-Participation in a Polycentric World

We have seen how e-participation can help bridge social inequalities if designed intentionally and also can enhance the decision-making processes. In addition, such instrument can also reach out to otherwise disenfranchised communities in an increasingly polycentric world where power is diffused among multiple stakeholders and change is increasingly difficult to bring about.

Power is spreading between the state, the substate, the suprastate, the private site of governance either private sector or civil society. Polycentrism is even more present in informal settlements where there are weak formal governance structures. In a community where power is highly diffused amongst different groups, ICTs can be a way to harness a broad spectrum of inputs.

Forms of online engagement are as prone to conflicting views and the possibility of capture by special interests if badly designed and/or used as offline forms. Attention needs to be paid in curbing these risks and ensuring that ICTs do not act as a resonance box chamber but that articulate the demands and the wishes of all segments of society.

Five key typical challenges can be found when using online engagement in policy-making (OECD, 2003). Firstly, the scale: the government may be challenged to decide how to listen and to respond appropriately to each individual contribution. Secondly, capacity remains a key challenge because the information needs to be accessible and understandable, there needs to be opportunities to engage in debate, bridging the digital divide involving traditionally disenfranchised groups in policy making (e.g. those subject to social exclusion, youth, etc.) and the skills need to be built for active participation. The third challenge relates to the coherence throughout the whole policy making cycle (informing, consulting, participating, analyzing, providing feedback and evaluating). The forth relates to process evaluation while the fifth includes the commitment of stakeholders to analyze and use inputs.

All these challenges apply both in high and low-income countries, as does the additional challenge of lack of privacy in the Internet. High levels of informality, lack of rule of law or safety are challenges that fundamentally affect citizens in low and middle-income countries and need to be managed.

In conclusion, social equity and inclusion are possible in cases where institutional barriers to citizen inclusion are laid down and chances for their participation through ICTs are equitably distributed (United Nations 2012). In the next section, we will lay out the basic features of the institutional design required for an effective e-participation using the Mtwapa project in Kenya as an example.

INSTITUTIONAL DESIGN FOR MTWAPA'S E-PARTICIPATION

We have seen how participation can be used meaningfully and effectively: avoiding capture by special interests, increasing political equality, counting on expert opinions and building on traditional methods of participation. This can be achieved through a sound institutional design from where participation takes place, a proposal of which is described below.

According to OECD (2003), the guiding principles for engaging citizens online in policy making are: start planning early; demonstrate commitment; guarantee personal data protection; tailor your approach to fit your target group; integrate online consultation with traditional methods; test and adapt your tools; promote your online consultation; analyze the results; provide feedback and evaluate the consultation process and its impacts. Special efforts need to be made in low-income countries as local and national authorities may require more support in capacity and skills development.

For the civil service to lead public engagement, a participation process needs to count on legitimacy, convening power, authority and neutrality. At the same time, civil society may also be able to play a key role in building e-participation capacity. Civil society should also ideally count on having the following existing conditions (UNDP 2013; Sadasivam and Førde, 2010; McGee et al., 2010):

- **Legitimacy:** Authority to speak on behalf of constituents, through open and accountable membership-based structures;
- **Managerial Capacity:** To plan and administer activities with consistent objectives and strategies;
- **Advocacy Capacity:** To negotiate and lobby;
- **Connection to Networks and Coalitions:** To create inclusive action;
- **Information and Knowledge Capacity:** To create, interpret and learn from information in order to provide understanding and evidence for accountability;
- **Leadership:** To build alliances and identify entry points for engagement with the public administration;
- **Independence:** To be seen as independent from decision-makers and politicians and base claims on evidence.

In our case, the e-participation platform for slum upgrading is done in close partnership with the governmental authorities. It is proposed as a possible solution for a comprehensive ICT-enabled citizen participation in decision-making. UN-Habitat's Participatory Slum Upgrading Programme principles require government partners to concentrate on participatory approaches: the inclusion of all actors with particular attention to youth and women, the right to participate in urban decision-making and political inclusion as well as the commitment to community-managed funds. They also require leaders to commit avoiding unlawful forced evictions in project areas to secure the individual protection of rights.

Adapting to the Kenyan Context

While being a low-income country with a gross national income per capita of $826 USD, Kenya is adopting ICT tools in far-reaching ways. Its private sector is known for having launched an innovative new tool, Mpesa, that has allowed millions of citizens in the country to access baking services (money transfer and microfinancing) through mobile technology, which has become the most developed mobile payment system in the world.

With regard to the main means of communication in Kenya, it is estimated that 57 per cent of the population use face-to-face communications, 36 per cent get information from the TV and radio, 6 per cent by SMS, 6 per cent by making phone calls and 1 percent through the Internet. More than half of those with no formal education reportedly have sent an SMS (Salim et al., 2013). There is a disparity between male and female participants when it comes to communication through the use of text messages (SMS). A bigger percentage of male respondents send SMS more often than female respondents. 78 per cent of male respondents send SMS on a weekly basis compared to 65 per cent of female respondents. Illiteracy may also influence the gender imbalance, as well as the fact that most phone ownership is reportedly bestowed on the man. According to the same report, younger generations are more frequent users of SMS (Salim et al 2013).

With regard to Internet communication, there has been a steady rise in the number of mobile Internet users across the country, and according to CCK report Quarter 4 2011-2012, 99 per cent of Kenyan Internet users access it through their mobile phones. Education has a big impact as only 5 per cent of those without formal education browse the Internet. At the same time, it has been reported that the majority of those who browse the Internet are males. When asking why they didn't browse the Internet, 67 per cent of female respondents and 59 per cent of the male respondents did not know how to browse, while 40 per cent of users reported not to know how to browse because their phones did not have that functionality (Salim et al, 2013).

In a survey undertaken in three Kenyan counties regarding water provision accountability, 61 per cent of respondents did not know who/where to complain to. If the respondents knew where or rather who to complain to then they would not hesitate to complain, however many do not complain because they think only the wealthy are being listened to; because they are tenants and the responsibility to complain rests with their landlord/landlady; they fear being ejected; or they do not feel they have time to complain (Salim et al. 2013). With regard to traditional methods of accountability, challenges include not being able to watch the news or attend face-to-face meetings or other reasons such as: failing to get the targeted person to give out the required information; fear of victimization (e.g. if they ask for clarification in meetings); failing to get response or action (e.g. when complained); or time/financial constraints (e.g. time invested in attending a meeting) (Salim et al. 2013). When asked what technological platforms they think are best to disseminate information among them, more than half (51 per cent) said SMS (in particular because of its affordability), 35 per cent noted phone calls, 6 per cent using USSD short code, 3 per cent the Internet, and 3 per cent other channels such as radio and TV, while only 1 per cent mentioned social media.

Therefore, technologies that require use of the Internet were not in the top list of platforms people preferred. This can be attributed to the fact that most of them have basic phones that do not have Internet-enabled capabilities, and for the handful whose phones have Internet capabilities, many do not know how to use them. Internet and social media however were seen as more convenient, easy to use, and able to reach a bigger mass audience.

In the case of Kenya, the Internet may not be an effective way of improving governance as only approximately one in every five Kenyans use the Internet. The use of other technologies such as SMS and information centers would thus be more effective in connecting to the majority of community members.

In sum, current traditional information and accountability mechanisms at the local level are reportedly limited and in consequence the need to improve them with other mechanisms can be seen positively by the communities and government. E-participation particularly through SMS and community centers may be effective in improving urban governance as it builds on the current existing structures and use platforms that are familiar within the communities.

Mtwapa E-Participation Case Study

Within the above described Kenyan context, the Mtwapa e-participation initiative has been proposed within a broader framework of a long-term experience of the slum upgrading programme in the same town. The Mtwapa case is based on a participatory slum upgrading pilot project implementation.

The e-participation component is done by FUPOL, the Ministry of Lands, Housing and Urban Development of Kenya, the Kilifi County, UN-Habitat as well as the citizens of Mtwapa's informal settlements. This is expected to help secure political will and community trust. The goal of the initative is to provide conditions for equal access to ICT-enabled governance, participation and management set-up. This includes physical access to the tools and user-friendly information, the adaptation of language, capacity development for efficient participation and public inclusion of all stakeholders involved and the particular support to population groups that are often most excluded from decision-making processes such as women and youth in slums. Testing concentrates on assessing the change in access for slum dwellers to decision-making processes providing all pre-conditions including capacity development for slum dwellers in view of increasing participation in the overall urban planning and policy decision-making processes.

The town of Mtwapa is located in the Kilifi County in coastal Kenya and has a population of 62,680 residents. It is estimated that 37,483 of its residents live in the 11 informal settlements of Mtwapa. UN-Habitat has been working with the Mtwapa authorities and residents since 2008, when it undertook urban profiling first and then organized an action planning and project documentation. This long-term engagement with Mtwapa stakeholders is deemed vital in order to secure an effective process with realistic timelines.

According to the assessments, Mtwapa's informal settlements suffer the following conditions: proliferation of diverse makeshift structures; self-constructed structures often made of diverse materials; informal or traditional land tenure including squatting in private or government land; degradation of existing ecosystem; congestion; rapid unstructured and unplanned developments; poor sanitation networks; lack of basic services e.g. schools, medical services, fire fighting and; poor access with very narrow roads/tracks.

The overall objective of the slum-upgrading project is to create a sustainable and improved environment and living standards for the residents of all informal settlements in Mtwapa town as part of the implementation of the newly prepared Mtwapa Integrated Strategic Urban Development Plan. The specific objective are: 1. to provide security of tenure to the 6,500 households; 2. to provide and improve basic infrastructure and service provision in the 11 settlements (access roads, storm water drainage, security lighting, sanitation facilities, solid waste management, market sheds) and 3. to build capacity of various actors/Institutions in Mtwapa (County Council of Kilifi, Residents

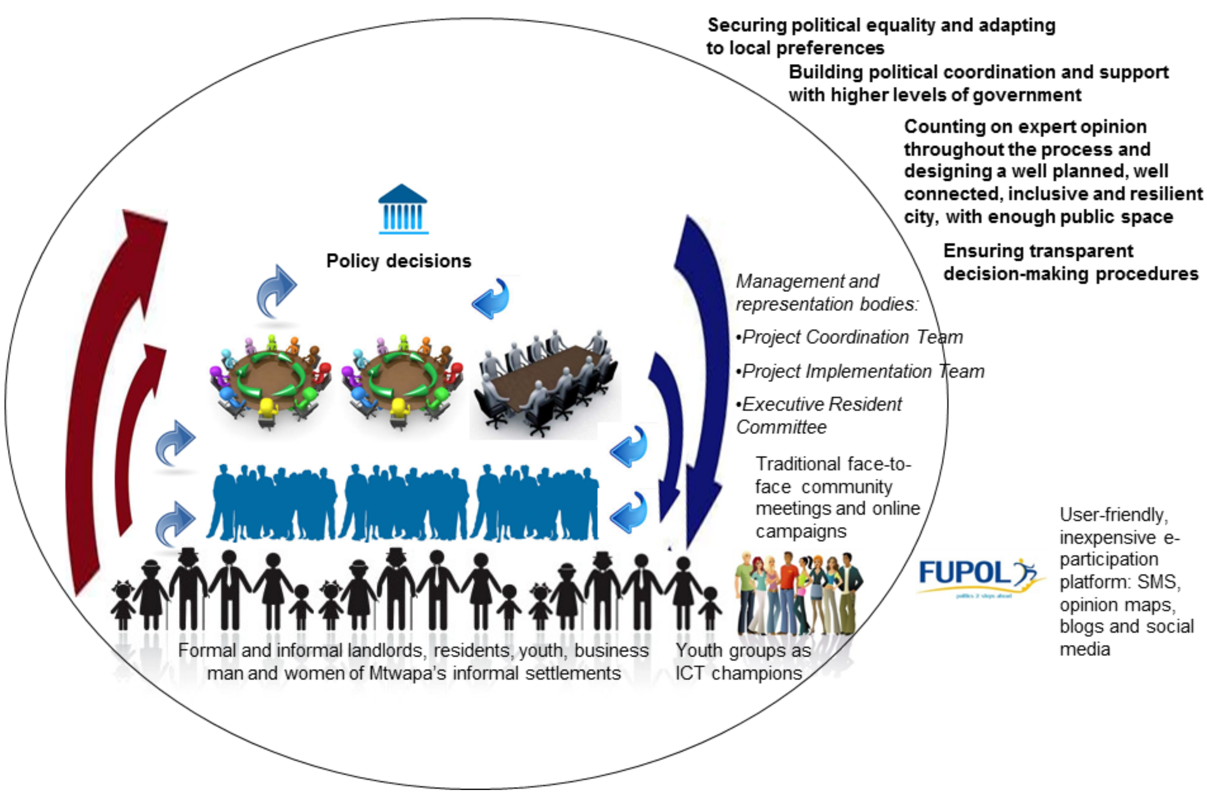
Organizations, Ministry of Local Government, and Community-Based Organizations). The intervention should benefit residents and national and local authorities with the following results: planned layouts and increased security of tenure for the informal settlements residents; improved infrastructure; improved security; improved sanitation and solid waste management; as well as improved capacity of the community and the local council.

An Institutional Design that Addresses Participatory Biases

As discussed earlier in this paper, participation mechanisms tend to create unequal participatory patterns among social groups (Navarro and Font, 2013). To avoid this, it is necessary to establish an institutional design that puts political equality at the centre and avoids elite or other groups' capture. This section outlines the key features of this institutional set-up. The objective of the e-participation platform is to allocate a minimum percentage of the total funding of the slum-upgrading project according to the results that come out of the deliberations of residents both in traditional participation platforms and the online engagement tool.

E-participation is mainstreamed throughout the project cycle of the slum upgrading intervention. This follows the conventional policy cycle process as shown in Figure 1: situation analysis phase, planning phase, negotiations and decisions phase and implementation phase which includes

Figure 1. When, how and why to integrate e-participation in slum upgrading.
Source: Own conception.

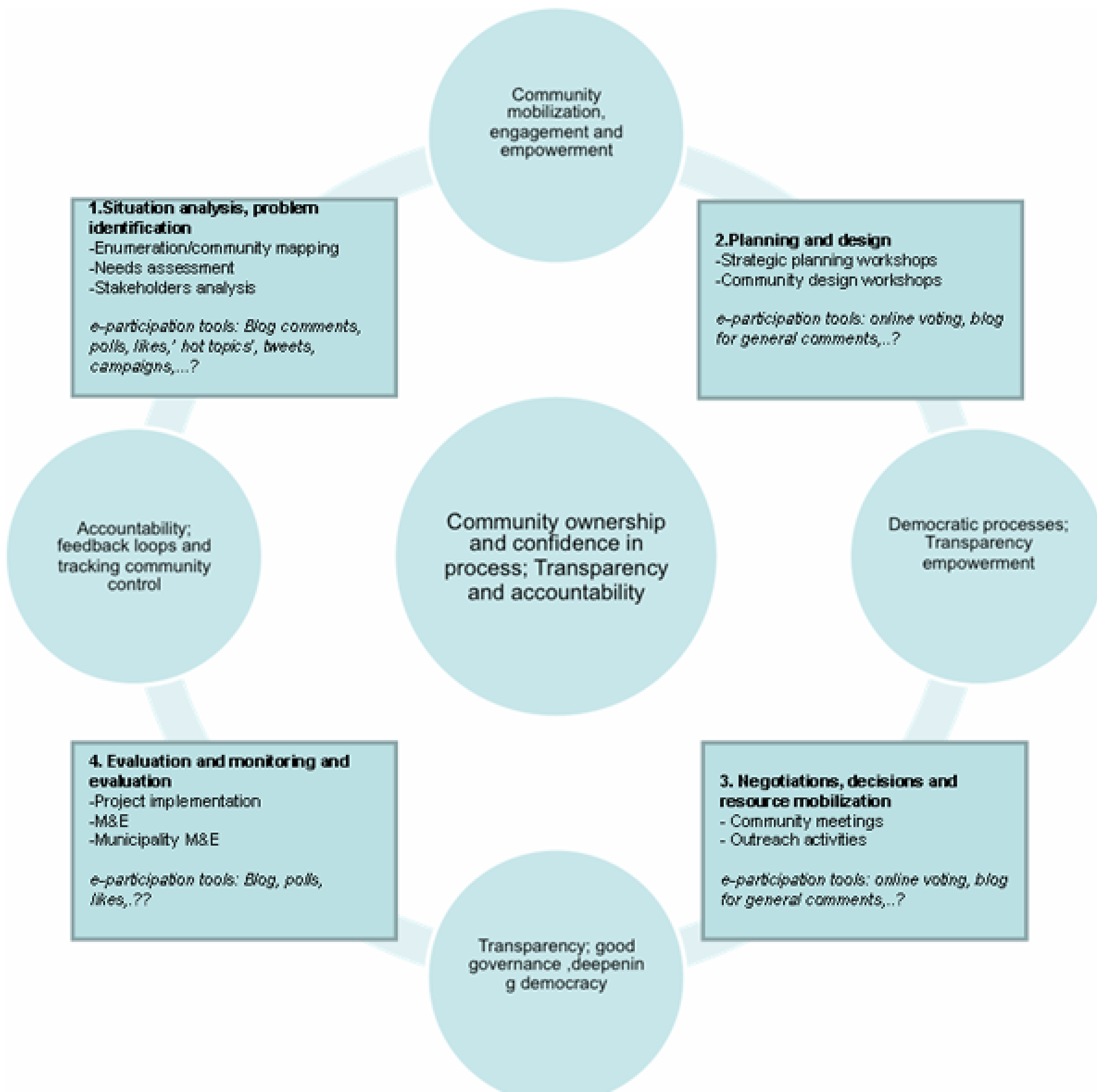


monitoring and evaluation. Therefore such a model may be extrapolated into other types of interventions.

The Mtwapa e-participation platform is designed to secure political buy-in and political equality as much as possible. The platform is designed as an integral part of the longer-term slum upgrading program and it is based on the political will and support, including financial, from the central government and the local authorities.

As portrayed in Figure 2, citizens are grouped according to the settlement they are living in, and as a group, they select a representative for their residents' committees. At the same time, youth and other segments of society become ICT champions providing further civic engagement and helping

Figure 2. Mtwapa's e-Participation Institutional Design.
Source: UN-Habitat.



to mobilize other groups within society such as adults and the elderly who may not be ICT literate. Through the combination of traditional participation mechanisms ("Barazas") and ICT features like SMS, blogging, opinion maps and others, stronger engagement is mobilized through the leadership of the Executive Residents Committees, which are made of all the representatives of all the informal settlements. Each settlement (11 in total) has a Resident Committee that articulates the interests and concerns of their communities with elected representatives from the community.

Deliberative mechanisms will be supported by traditional community assemblies ("Barazas") as well as e-participation campaigns limited in time. E-participation will be supported by an equipped community center and a community mobilizer as well as by a set of trainings for national and local authorities as well as community members. Training of trainers will be provided for identified youth as ICT champions.

This case study will be a learning experience aimed at evaluating the potential of up-scaling ICT-enabled governance systems in rapidly urbanizing low-income countries. The experimental approach, together with the political commitment from national and local governments in a Kenyan context with high political and popular interest towards ICTs as well as the level of financial investment planned for are pre-conditions that form the basis for a feasible initiative.

The Political Economy of E-Participation: Defining Win-Win Situations in the Long Term

The interests and ideas of each actor within a participatory process need to be analyzed and factored in if the process is to be fair and effective. As described above, participation implies that everyone can have a say and impact in the policy outcome and that there is a redistribution of power among the stakeholders. Arnstein (1969: 216) has already pointed out how participation without redistribution of power is an "empty and frustrated process for the powerless."

This crucial change in power distribution can create redistributive outcomes between those with more resources and those with fewer resources if the process is well managed. But, in fact, this rarely happens when the powerful actors do not have anything to win in such change and therefore vehemently oppose such attempts.

This is why a detailed reading of the political economy of the context (the Mtwapa informal settlements in this case) is necessary, so that long-term win-win situations can be designed with all stakeholders. Analyzing the incentives structure helps understand the reasons for the ongoing perpetuation of slums. In some cities, political parties and politicians have appealed to the urban poor for their own particular interests even when this negatively affects new efforts to apply realistic and inclusive planning and regulatory policies. Such negative interferences can be brought by other levels of governments as well such as the national or regional governments, even when they plainly undermine policies established by the local authority (Fox, 2013). In addition, rent-seeking is also exacerbated because of the high level of informality which allows politicians and bureaucrats and other well connected landlords to provide protection in exchange of money or political support. Resistance can also grow as local elites see themselves as gatekeepers to the community (Al-Nammari, 2013), with well-connected landlords and informal service providers having strong incentives for maintaining the *status quo*.

In addition, the distribution of power and mandates among the different layers of government (central, regional and local) can affect the range of incentives that affect participatory processes. In Kenya, a new devolution policy has been adopted with the 2010 Constitution that has provided more powers to the counties (including budget decentralization) while removing electoral accountability at the local level. As the new framework is being implemented and fine-tuned, new opportunities and risks arise. In an extreme scenario, a genuine decentralization of state functions such as planning or infrastructure development could potentially imply a transfer of control of existing patronage instruments such as jobs, contracts, tax breaks, subsidies or loans, creating new risks.

Considering the Risks

The lack of understanding of current local and national incentive structures can become a risk for the process and its members. The traditional set of challenges of participatory processes mentioned above are also still present. In particular, there may be lack of information among citizens despite the available technology infrastructure, there may be frictions with traditional representative structures or there can be problems of representation if the ICT tool is abused or if the use of the tool is unable to secure high participation. Participation also depends on the available free time from citizens, their educational background, their interest in participating in public affairs, their emotional stability as well as their experience in associations and NGOs (Navarro and Font, 2013). In addition, when there is superficial public engagement, the Internet may work as an echo chamber or the agenda-setting power can become reactive.

Given this context and risks, the approach taken in this initiative is focused on scaled solutions, an anticipatory, devolved and flexible network that is simultaneously well connected with local traditional structures as well as with the national and even international actors - a system that can be used for any policy-making process without losing sight of the overall aim of effectively addressing the current development challenges of needed communities. As field research has proved (Mansuri and Rao, 2012), participatory processes can only work if there are project structures that allow for flexible and long term engagement, monitoring and evaluation is informed by economic, social and political analyses and there is a culture of learning by doing.

FUTURE RESEARCH DIRECTIONS

A conceptual framework has been presented to guide an e-participation initiative in Kenya. Its validity will be demonstrated in its application and replication. This document should also serve as a basis for a book that UN-Habitat plans to issue as part of the Future Policy Modeling (FUPOL) project reviewing the use of ICT in improving urban governance in low-income countries.

While context is often considered a critical factor for the success or failure of participatory processes supported by online platforms, little is known in particular about how culture affects these processes.

In addition, further evidence is required to see how participation and e-participation affects and is affected by increasing levels of inequality both in high-income and low-income countries. More research is also needed to analyze e-participation processes within decision-making at the regional or country level. Lastly, privacy remains a key concern hardly treated in the literature for both high-income and low-income countries including privacy violations of technology firms and public actors.

CONCLUSION

This chapter aimed at contributing to the research on the linkage between technology and local development and laid out a framework for making technology a driving force for equity instead of increasing the divide.

It analyzed the controversies on the role of participation in decision-making. While participation is essential for reform in an increasingly polycentric world, it needs to secure an increased political equality and the provision of expert opinion, and should not be captured by special interests.

With the emergence of e-governance initiatives in low-income countries, new opportunities have arisen to improve governance, in particular at the local level. E-participation can play a critical role in poor contexts as a catalyst when the youth are supported and it is well combined with traditional methods of stakeholder engagement. E-participation can harness a broader spectrum of inputs from citizens but can also amplify or weaken power balances and relations.

As slums keep increasing in today's world, e-participation can support leveraging public authorities' efforts with citizens' active engagement. However, the political economy of the slums affects the way participation and e-participation can take place.

This paper presented a normative framework for e-participation in low-income countries describing when and how participation should be used. It has presented a basic institutional design whereby a structured stakeholders' engagement can increase transparency of decision-making and political equality through low-cost technology. A combination of representative mechanisms, deliberative face-to-face methods and direct e-participation campaigns has been proposed in the pilot case study.

ACKNOWLEDGMENT

The author would like to thank Kerstin Sommer for her substantial contribution to this chapter as well as Joan Font, Joe Hooper, Eduardo Moreno and Albert Padró-Solanet for their comments.

NOTE

The views expressed in this chapter are those of the author and do not necessarily reflect the views of the United Nations Human Settlements Programme ("UN-Habitat"). The opinions, figures and estimates set forth in this chapter are not the responsibility of the author, and should not necessarily be considered as reflecting the views or carrying the endorsement of UN-Habitat. The contents of this publication do not necessarily reflect the views or policies of UN-Habitat, nor are they an official record. The contents of this publication do not necessarily reflect the views or policies of UN-Habitat or contributory organizations.

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KEY TERMS AND DEFINITIONS

E-Participation: Form of citizen engagement with direct influence in public decision-making processes facilitated by elected representatives and government officials using Information and Communication Technologies (ICT).

Equity: Something just, impartial, fair. In development, equity involves systematic (re) distribution of the economic benefits of growth, with legal frameworks that ensure a 'level paying field' and institutions that protect the rights of the poor, minorities and vulnerable groups. Promotion of equity involves enhancing socioeconomic equality and providing for civic participation by all in social, political and cultural spheres.

Low-Income Country: Country that has a Gross National Income of 1,035 USD or less (2012 data). The World Bank defines the rest of the countries as lower middle-income (from 1,036 USD to 4,085 USD GNI per capita), upper middle-income (4,086 USD - 12,615 USD), and high-income (12,616 USD or more). Kenya is considered a low-income country.

Political Equality: Situation whereby all citizens have equal opportunities to vote and participate in the political agendas without any form of prejudice. This allows citizens to have equal rights to vote, influence the political agenda, contest elections and criticize the ways of governing.

Slum: At the household level, a slum is a group of individuals living under the same roof in an urban area who lack one or more of the following five key deprivations: durable housing (a permanent structure providing protection from extreme climatic conditions); sufficient living area (no more than three people sharing a room); access to improved water (water that is sufficient, affordable and can be obtained without extreme effort); access to improved sanitation facilities (a private or public toilet shared with a reasonable number of people); and secure tenure (de facto or de jure secure tenure status and protection against forced eviction).

Social Accountability: A form of accountability which emerges from actions by citizens and civil society organization aimed at holding the state to account, as well as efforts by government and other actors (media, private sector, donors) to support these actions.

Urban Governance: Good urban governance is characterized by the interdependent principles of sustainability, equity, efficiency, transparency and accountability, security, civic engagement and citizenship (UN-Habitat, 2002).

Section 5

Future Directions

Chapter 22
A Living Roadmap for Policymaking 2.0

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ABSTRACT

The chapter is based on current research conducted by the authors as part of the "CROSSOVER Project – Bridging Communities for Next Generation Policy Making," an FP7-funded support action of the European Commission, whose main goal is to reach out to and raise the awareness of users, particularly public government practitioners and policymakers, while developing a research roadmap for establishing the scientific and political basis for long-lasting interest and commitment to next generation policymaking. In particular, the chapter identifies the opportunities and benefits resulting from applications of ICT tools for collaborative governance and policy modeling and provides an outline of what technologies are and will be available to meet the needs of policymakers. The project builds on the CROSSROAD model and roadmap with the aim to reach a stronger focus on policy modeling.

INTRODUCTION

In the last thirty years the role of the government has moved consistently away from services provision to regulation. Society and economy has become more interconnected, unstable and unpredictable than ever, and citizens are keener to engage in complex policy making. Within this context, traditional tools for policy making, based upon the perfectly rational representative agent maximizing its own utility in a general equilibrium framework, have been demonstrated to be unable to predict and cope with some of today's most pressing challenges, such as the financial crisis and climate change. Despite the explosion of data availability, the possibility to analyze them through crowdsourcing and large scale collaboration, the advance in modeling and simulation tools for as-

DOI: 10.4018/978-1-4666-6236-0.ch022

sessing non-linear impact of policy options, the full potential offered by the new instruments for policy making has yet to be achieved. Therefore policy makers have not yet at their disposal a set of instruments able to cope with the needs stemming from their decision making activities. This analysis presented in this chapter has the main objective to investigate how ICT tools and methodologies can impact real life governance and policy making, and is based on the roadmapping exercise conducted as part of the CROSSOVER project (Osimo et al., 2013). This international roadmap funded and supported by the European Commission aims to establish the scientific and political basis for long-lasting interest and commitment to next generation policymaking, as well as to provide a clear outline of what technologies are available now for policymakers to improve their work, and what could become available in the future. The research is the result of a highly participative process undergone between the first draft and the final roadmap, with the involvement of hundreds of people through a number of different input methods, from live workshops to online discussion. After a brief introduction of the background, the chapter analyses the demand side: the current status of policy-making, with the key tasks (illustrated by the traditional policy cycle) and existing challenges. The first section of the chapter presents the rationale and the methodology for the roadmap on policy-making 2.0. The second section presents the demand of policy making, stressing in particular the challenges encountered in the activity of the policy maker. The third section represents the core of the chapter and briefly presents the key research challenges related to future policy making, including an additional research challenge concerning the impact of policy-making 2.0 by the mean of counterfactual impact evaluation. Finally, in the last section we summarize the findings of the chapter and we outline the future research avenues, suggesting that policy-making 2.0 cannot be considered the panacea for all issues related to bad public policies, but that at the same time it is more than just a neutral set of disparate tools. It provides an integrated and mutually reinforcing set of methods that share a similar vision of policy-making and that should be addressed in an integrated and strategic way; and it provides opportunities to improve the checks and balances systems behind decision making in government, and as such it should be further pursued.

THE RATIONALE OF THE ROADMAP: WHAT IS THE PROBLEM?

The Project CROSSOVER

The CROSSOVER project aims to consolidate and expand the existing community on ICT for Governance and Policy Modeling (built largely within FP7) by:

- Bringing together and reinforcing the links between the different global communities of researchers and experts: it will create directories of experts and solutions, and animate knowledge exchange across communities of practice both offline and online;
- Reaching out and raising the awareness of non-experts and potential users, with special regard to high-level policy-makers and policy advisors: it will produce multimedia content, a practical handbook and high-level policy conferences with competition for prizes;
- Establishing the scientific and political basis for long-lasting interest and commitment to next generation policy-making, beyond the mere availability of FP7 funding: it will focus on use cases and a demand-driven approach, involving policy-makers and advisors.

The CROSSOVER project pursues this goal through a combination of content production, ad hoc and well-designed online and offline animation; as well as strong links with existing communities outside the CROSSOVER project and outside the realm of e-Government. The present chapter builds on one of the core outputs of the project: the International Research Roadmap on ICT Tools for Governance and Policy Modeling (Osimo et al., 2013). It aims to create a common platform between actors fragmented in different disciplines, policy domains, organisations and geographical areas. But most of all, it aims to provide a clear outline of what technologies are available now for policy-makers to improve their work, and what could become available tomorrow. CROSSOVER builds on the results of the CROSSROAD project, which elaborated a research roadmap (Osimo et al., 2010) on the same topic along the whole of 2010. With respect to the previous roadmap, this document is firstly a revised and updated version. Beside this, it contains some *fundamental novelties*:

- **A Demand-Driven Approach:** Rather than focusing on the technology, the present roadmap starts from the needs and the activities of policy-making and then links the research challenges to them.
- **An Additional Emphasis on Cases and Applications:** For each research challenge, we indicate relevant cases and practical solutions.
- **A Clearer Thematic Focus on ICT for Governance and Policy-Modeling:** By dropping more peripheral grand challenges of Government Service Utility and Scientific Base for ICT-enabled Governance.
- **A Global Coverage:** While CROSSROAD focused on Europe, CROSSOVER includes cases and experiences from all over the world.
- **A Living Roadmap:** The present deliverable is accompanied by an online repositories of tools, people and applications.

An Open and Recursive Methodology

The Research Roadmap on Policy-Making 2.0 has been developed with a sequential approach based on the existing research roadmap developed by the CROSSROAD project. In order to achieve the goals of overcoming the fragmentation, an open and inclusive approach was necessary.

In the initial phase of the project, up to M6 (March 2012), the consortium started a collection of literature, information about software tools and applications cases. In addition to this desk-based review, the document has benefited from the informal discussions being held on the LinkedIn group of the project (Policy-making 2.0), where more than 800 practitioners and researchers are discussing the practices and the challenges of policy-making.

The first draft of the roadmap was then released in M9 (June 2012) of the project, for public feedback. The publication of the deliverable kicked off the engagement activities of the project, designed to provide further input and to improve the roadmap:

- As soon as it was released, the preliminary version of the roadmap was published in commentable format on the project website (http://www.CROSSOVER-project.eu/). Animators stimulated discussion about it and generated comments by researchers and practitioners alike. This participatory process helped enriching the roadmap, which was then published in its final version after validation by the community/ies of practitioners and policy makers;

- Two workshops organised by the project aimed at gathering input on the research challenges and feedback on the proposed roadmap;
- An online survey, as well as several focus groups and meetings with practitioners from civil society and government helped to focus the roadmap on the actual needs.

The process for updating the roadmap included therefore a wide set of contributions. Firstly, the Crossroad roadmap was enriched with desk-based research: 202 cases collected in the platform + 4 cases collected and described in the case studies performed by the National Technical University of Athens (NTUA), and the 50 applications to the prize. This first draft was then published for comments by some of the 800 members of the LinkedIn group who also provided relevant cases. An additional survey of users' needs provides provided insights from 240 respondents and over 200 people presents presented at focus groups. Additional discussions with Global Systems Science community, third party workshops and the US Policy Informatics Network helped in further refining the roadmap. The two workshops provided high-quality insight that enriched the roadmap with specific contributions. In the table below we outline in detail the specific contribution of each section of the roadmap, which is described in full in the following section.

1. **Comments to the Roadmap:** The roadmap has been published in commentable format in two different versions: a short one on Makingspeechtalk (http://makingspeechestalk.com/CROSSOVER/), and a full version (downloadable after answering the survey on the needs of policy-makers) available in the CROSSOVER website (http://www.CROSSOVER-project.eu/ResearchRoadmap.aspx). Everybody was

Figure 1. Outline of the participatory process

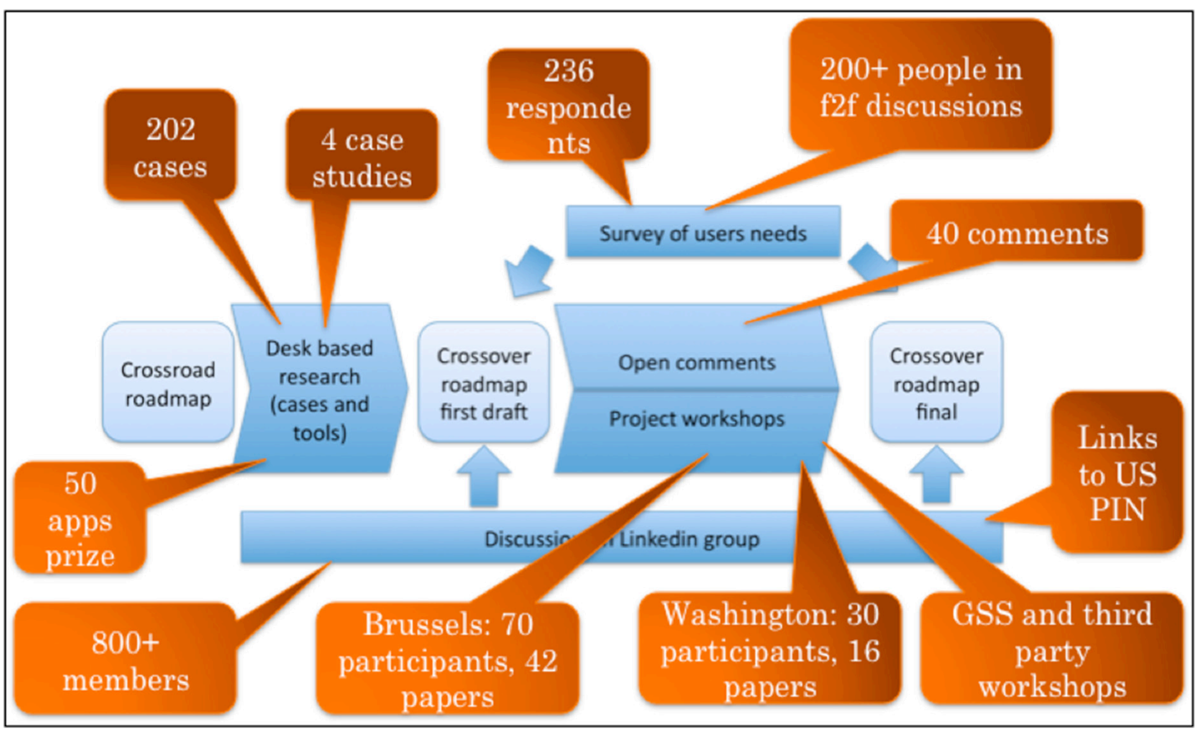


Table 1. Contributions to the roadmap

Type of Contribution	Extent of the Contribution	Contribution to the Roadmap
1. Comments to the roadmap.	• 40 comments. • 9 different experts.	• Visual Analytics. • Systems of Atomized Models. • Model Validation. • Serious Gaming.
2. Presentations in the PMOD workshop.	• Papers received: 42. • Registered participants: 70 . • No. Countries' citizens present: 20.	Linked Open Government Data
3. Presentations in the Transatlantic workshop.	• 16 presentations. • 30 participants.	• Collaborative Modeling. • Systems of Atomized. Models • Opinion Mining.
4. Survey of User's Needs.	• 236 respondents. • 33% engaged in policy design. • 27% engaged in monitoring and evaluation. • 22% engaged in agenda setting. • 18% engaged in policy implementation.	• Impact of policy making 2.0. • Roadmap methodology. • Linked Open Government Data. • Opinion Mining. • Collaborative Governance.
5. Focus groups.	• 139 attendants - Forum PA, the Italian leading conference on e-government. • 35 attendants- INSITE event on sustainability. • 40 attendants - Webinar for the United Nations Development Programme.	• Impact of policy making 2.0. • Roadmap methodology.
6. Case studies.	• Collection of 202 tools and practices. • Elicitation of 20 best practices. • Further elicitation of 4 best practices for in-depth case study.	• Impact of policy making 2.0. • Roadmap methodology. • Annex with a repository of cases.
7. Analysis of the prize.	• 47 submission received. • 10 short listed. • 3 winners.	Analysis of the prize process on the Impact Chapter.
8. LinkedIn group.	• 840 participants.	• Comments to the roadmap. • Increased attendance to the workshops. • Collection of practices and tools.

able to comment on single parts of the roadmap or to propose new topics, application cases and research challenges. The aim of publishing the document in commentable format was to get the input from experts for co-creating the roadmap.

2. **PMOD Workshop:** The June 2012 workshop was the first of three to be organised under the CROSSOVER project. Formally titled "Using Open Data: policy modeling, citizen empowerment, data journalism" but generally referred to by the term PMOD (policy modeling), it set out to explore whether advocates' claims of the huge potential for open data as an engine for a new economy, as an aid to transparency and, of particular relevance to CROSSOVER, as an aid to evidence-based policy modeling, were justified. Most of the results of the workshop were used to improve the research challenge on Linked Open Government Data.
3. **Transatlantic Workshop:** The Transatlantic Research on Policy Modeling Workshop that was held in Washington, DC on January 28th and 29th, 2013. It was organized by the Millennium Institute and the New America

Foundation (NAF), Washington, DC, USA. This event brought together speakers and attendees working and/or interested in improving ICT tools for education and policy makers. The models presented in the workshop have been integrated in the "Collaborative Modeling", "Systems of Atomized Models" and "Opinion Mining" research challenges.

4. **Survey of User's Needs:** The Survey of Users' Needs performed within the scope of the CROSSOVER project aimed at collecting the views and the requirements of policy-making stakeholders. More in particular the survey intended to stimulate actual and potential practitioners, such as decision makers (government official involved in the policy-making process) or policy advisors (technical expert advising decision-makers from outside government) to provide input, feedback and validation to the new research roadmap on ICT tools for Governance and Policy Modeling under development (CROSSOVER, 2012b).
5. **Focus Groups:** In addition to the survey, Tech4i2 ran a series of dedicated meetings where the roadmap was presented and followed up by intense dedicated discussion. These events where all high-profile, attended by policy-makers in the broad sense: not only government officials, but also policy advisors and civil society organisations. More precisely three events have been run:
    a. On the 17th of May 2012 CROSSOVER was invited to give a keynote speech to ForumPA on the CROSSOVER Research Roadmap. FORUM PA is a leading European exhibition exploring innovation in Public Administration and local systems.
    b. On May 24th 2012, CROSSOVER was invited to attend the HUB/Insite project meeting of sustainability practitioners from all over Europe. The Hub and the INSITE Project brought together more than 25 sustainability practitioners working at the cutting edge of innovation within industry, urban development, energy, technology and policy across Europe.
    c. On March 22nd 2012, CROSSOVER was invited to present the policy-making 2.0 model to the practitioners of the "governance" network of UNDP – Europe and CIS, which included about 40 people from Central and Eastern Europe. Webinar for the United Nations Development Programme – Europe and CIS.
6. **Case Studies:** Within the scope of the CROSSOVER project, the European Commission's Joint Research Centre, Institute for Prospective Technological Studies (JRC-IPTS), in collaboration with a team of experts of the National Technical University of Athens (NTUA) carried out the activity of mapping and identification of Case Studies on ICT solutions for governance and policy modeling. The key findings of the analysis of the four cases selected have been shared with the CROSSOVER partners and the community that follows closely the Policy Making 2.0 domain over various Web 2.0 channels, to provide feedback and validation. The key results of the case studies are described later in the impact section.
7. **Analysis of the Prize:** This prize was given to the best policy-making 2.0 applications, that is are for the best use of technology to improve the design, delivery and evaluation of Government policy. The focus of the jury has been on implementations that can show a real impact on policy making, either in terms of better policy or wider participation. These technologies included, but are not limited to: Visual analytics, Open and big data, Modeling and simulation (beyond general equilibrium models), Collaborative governance and crowdsourcing, Serious

gaming, Opinion mining. All the relevant applications received have been integrated in the roadmap.

8. **LinkedIn Group Policy-Making 2.0:** A crucial element in the engagement of stakeholders was given by the creation of a group on LinkedIn called Policy Making 2.0, which is a virtual place where actual and potential practitioners of advanced ICT tools for policy-making can exchange experiences. The group displays a high selected pool of high level members (over 900) engaging in discussions and exchange of views. In particular the group has been used for disseminating the Survey on the ICT Needs of Policy Makers, as well as the roadmap in commentable format.

NOT JUST ANOTHER HYPE: THE DEMAND SIDE OF POLICY- MAKING 2.0

Policy Making 2.0: Scope and Definition

Policy-making 2.0 refers to a *set of methodologies and technological solutions aimed at innovating policy-making*. The scope goes well beyond the focus on "Decision-making" notion typical of eParticipation, and encompasses all phases of the policy cycle. The main goal is limited to improving the quality of policies, not of making them more consensual or representative. More clearly policy-making 2.0 is a new term that we have coined to express in more understandable terms the somehow technical notion of "ICT for governance and policy modeling", and which encompasses clearly a wide set of methodologies and tools. At first sight, it might appear unclear what the common denominator is. In our view, what they share is that they are designed to use technology in order to inform the formulation of more effective public policies. In particular, these technologies share a common approach in taking into account and dealing with the *full complexity of human nature*. As spelled out originally in the CROSSOVER project proposal: "traditional policymaking tools are limited insofar they assume an abstract and unrealistic human being: rational (utility maximizing), consistent (not heterogeneous), atomised (not connected), wise (thinking longterm) and politically committed (as Lisa Simpson)". Policy-making 2.0 thus accounts for this diversity. Its methodologies and tools are designed not to impose change and artificial structures, rather to interact with this diversity. Agent-based models account for the interaction between agents that are different in nature and values; systems thinking accounts for long-term interacting impacts; social network analysis deals with the mutual influences between people rather than fully rational choices; big data analyses observed behaviour rather than theoretical models; persuasive technologies deal with the complex psychology of individuals and introduces gaming values to involve more "casual" participants. Moreover, policy-making 2.0 tools allow all stakeholders to participate to the decision-making process.

Policy: Between Politics and Services

The application of technology to governmental issues is not a new topic. Indeed e-government and the new buzzword of government 2.0, have become mainstream in recent years: how and why a future looking research agenda could still refer to the 2.0 paradigm as innovative? The novelty lies in the "policy" part of the definition. So far, the application of "2.0" technologies to governmental processes has focused mainly on the usage of social media for *political communication*, best exemplified by the Obama campaign. A second area of strong focus proved to be the collaborative provision of *public services* based on peer-to-peer support and open data, best exemplified by the widely spread "appsfordemocracy" contests. Between "politics" and "public services co-delivery", much less attention has been devoted to the usage of social technology to improve public policy. While politics deal with the legislative branch, the Parliament, policy-making is mainly the realm of the executive branch. Typically, the job of policy-making involves a great deal of socio-economic analysis as well as consultation with stakeholders. This chapter aims to fill this gap, by providing a complete picture of how technology can improve policy-making.

In the context of new technologies, we are periodically informed about the emerging wave that will change everything, only to see it quickly forgotten after years or even month in what Gartner calls "trough of disillusionment". While some of this emphasis is certainly driven by commercial interests, in many other cases it reflects a genuine optimism of its proponents, who tend to under-estimate the real-life bottlenecks to adoption by less enthusiast people.

Movzorov (2013) critically calls this cyber-utopianism or technological solutionism; on a similar note, many years of eGovernment policy have revealed the fundamental importance of non-technological factors, such as organisational change, skills, incentives and culture.

One way to prevent policy-making 2.0 to become yet another hype in the Gartner curve, is to precisely spell out the challenges that these new technologies help to address. Indeed, the importance of this demand-driven approach based on grand challenges is fully embraced by the new Horizon2020 research programme of the European Union. Furthermore, a demand-driven approach helps us to frame the technological opportunities in a language understandable to policy-makers, thereby supporting the awareness-raising objective of the CROSSOVER project.

When analysing the demand side, our first consideration is *that policy-making is more important and complex than ever.* The role of government has substantially changed over the last twenty years. Governments have to re-design their role in areas where they were directly involved in service provision, such as utilities but also education and health. This is not simply a matter of privatisation, or of a linear trend towards smaller government. Indeed, even before the recent financial turmoil and nationalisation of parts of the financial system, government role in the European societies was not simply "diminishing", but rather being transformed. At the same time, it is increasingly recognized that the emergence of new and complex problems requires government to increasingly collaborate with non-governmental actors in the understanding and in the addressing of these challenges (Ostrom, 2009). The present challenges governments must face, as described by the OECD, are complex as they are characterised by many non-linear interactions between agents; they emerge from these interactions and are therefore difficult to predict. The financial crisis is probably the foremost example of a complex problem, which proved impossible to predict with traditional decision-making tools.

The Typical Tasks of Policy-Makers: The Policy Cycle

Policy-making is typically carried out through a set of activities described as "policy-cycle" (Howard, 2005). In this document we propose a new way of implementing policies, by first assessing their impacts in a virtual environment. In this context we adopt a simple version articulated in 5 phases:

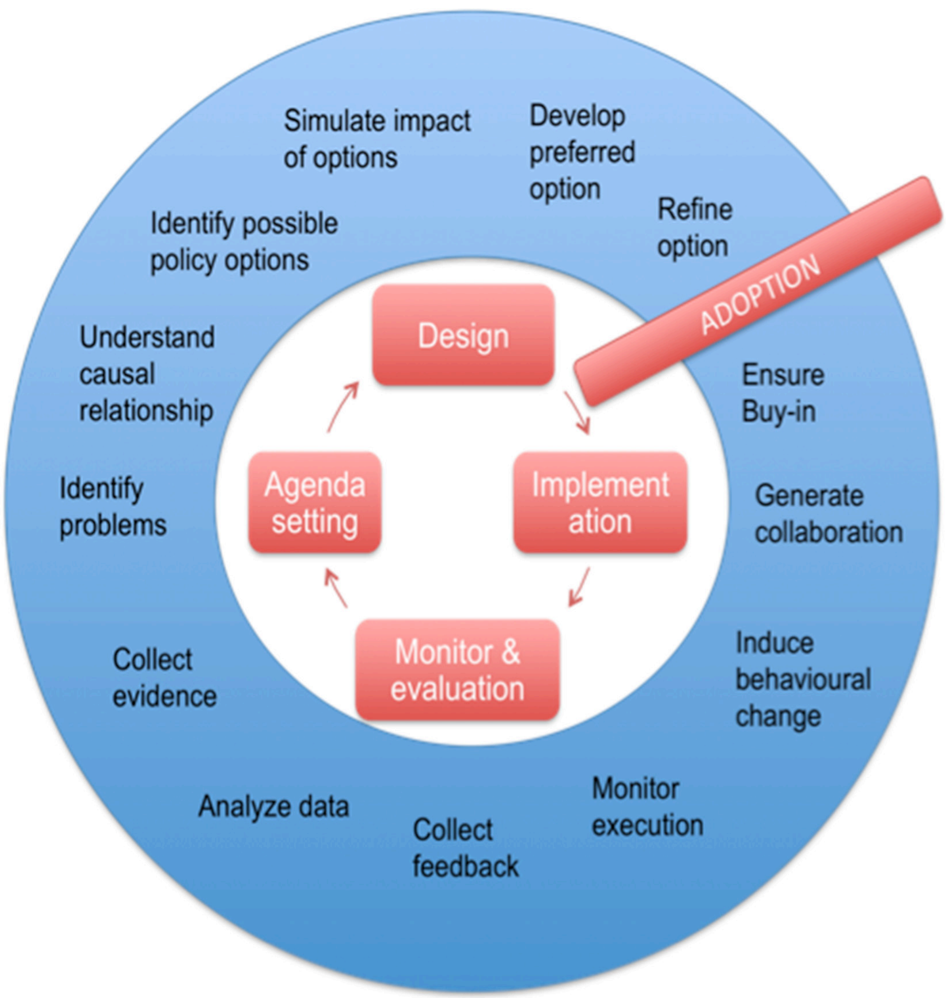
- Agenda setting encompasses the basic analysis on the nature and size of problems at stakes are addressed, including the causal relationships between the different factors.
- Policy design includes the development of the possible solutions, the analysis of

the potential impact of these solutions, the development and revision of a policy proposal.

- Adoption is the cut-off decision on the policy. This is the most delicate and sensitive area, where accountability and representativeness are needed. It is also the area most covered by existing research on e-democracy.
- Implementation is often considered the most challenging phase, as it needs to translate the policy objectives in concrete activities that have to deal with the complexity of the real world. It includes ensuring a broader understanding, the change of behaviour and the active collaboration of all stakeholders.
- Monitoring and evaluation make use of implementation data to assess whether the policy is being implemented as planned, and is achieving the expected objectives.

Figure 2 [authors' elaboration based on Howard (2005) and EC (2009)] illustrates the main phases of the policy cycle (in the internal circle) and the typical concrete activities (external circle) that

Figure 2. Policy cycle and related activities



accompany this cycle. In particular, the identified activities are based on the Impact Assessment Guidelines of the European Commission (2009).

Traditionally, the focus about the impact of technology in policy-making has been on the adoption phase, analysing the implications of ICT for direct democracy. In the context of the CROSSOVER project, we adopt a broader conceptual framework that embraces all phases of policy-making.

The Traditional Tools of Policy-Making

Let us present now what are the methodologies and tools already traditionally adopted in policy-making. Typically, in the agenda-setting phase, statistics are analysed by government and experts contracted by government in order to understand the problems at stake and the underlying causes of the problems. Survey and consultations, including online ones, are frequently used to assess the stakeholders' priorities, and typically analysed in-house. General-equilibrium models are used as an assessment framework. Once the problems and its causes are defined, the policy design phase is typically articulated through an ex-ante impact assessment approach. A limited set of policy options are formulated in house with the involvement of experts and stakeholders. For each option, models are simulated in order to forecast possible sectoral and cross-sectoral impacts. These simulations are typically carried out by general-equilibrium models if the time frame is focused on short and medium term economic impacts of policy implementation. Based on the simulated impact, the best option is submitted for adoption. The adoption phase is typically carried out by the official authority, either legislative or executive (depending on the type of policy). The implementation phase typically is carried out directly by government, using incentives and coercion. The monitoring and evaluation phase is supported by mathematical simulation studies and analysis of government data, typically carried out in-house or by contractors. Final results are published in report format, and fed back to the agenda setting phase.

The Key Challenges of Policy-Makers

Needless to say, the current policy-making process is seldom based on objective evidence and not all views are necessarily represented. Dramatic crises seem to happen too often, and governments struggle to anticipate and deal with them, as the financial crisis has shown. Citizens feel a sense of mistrust towards government, as shown by the decrease in voters' turnout in the elections. In this section, we analyse and identify the specific challenges of policy-making. The goal is to clearly spell out "what is the problem" in the policy making process that policy-making 2.0 tools can help to solve. The challenges have been identified on desk-based research of "government failure" in a variety of contexts, and are illustrated by real-life examples. One first *overarching challenge is the emergence of a distributed governance model.* The traditional division of "market" and "state" no longer fits a reality where public decision and action is effectively carried out by a plurality of actors. Traditionally, the policy cycle is designed as a set of activities belonging to government, from the agenda setting to the delivery and evaluation. However in recent years it has been increasingly recognized that public governance involves a wide range of stakeholders, who are increasingly involved not only in agenda-setting but in designing the policies, adopting them (through the increasing role of self-regulation), implementing them (through collaboration, voluntary action, corporate social responsibility), and evaluating them (such as in the case of civil society as watchdog of government).

Detect and Understand Problems Before They Become Unsolvable

The continuous struggle for evidence-based policy-making can have some important and potentially negative implications in terms of the capacity of prompt identification of problems. Policy-makers have to balance the need for prompt reaction with the need for justified action, by distinguishing signal from noise. Delayed actions are often ineffective; at the same time, short-term evidence can lead to opposite effects. In any case, governments have scarce resources and need to prioritize interventions on the most important problems. The problem in this case is twofold: to collect data more rapidly; and to analyse them with a wider variety of models that account for systemic, long term effects and that are able to detect and anticipate weak signals or unexpected wild cards.

Generate High Involvement of Citizens in Policy-Making

The involvement of citizens in policy-making remains too often associated with short-termism and populism. It is difficult to engage citizens in policy discussions in the first place: public policy issues are not generally appealing and interesting as citizens fail to understand the relevance of the issues. There are innumerable cases where the "right" policies are not adopted because citizens "would not understand" or because it is not politically acceptable. e-participation initiatives often struggle to generate participation, which is often limited to those that are already interested in politics. When participation occurs, online debates tend to focus on eye-catching issues and polarized positions, in part because of the limits of the technology available.

Identify "Good Ideas" and Innovative Solutions to Long-Standing Problems

Innovation in policy-making is a slow process. Because of the technical nature of issues at hand, the policy discussion is often limited to restricted circles. Innovative policies tend to be "imported" through "institutional isomorphism". Innovative ideas, from both civil servants and citizens, fail to surface to the top hierarchy and are often blocked for institutional resistance. Existing instruments for large-scale brainstorming remain limited in usage, and fail to surface the most innovative ideas. Crowdsourcing typically focus on the most "attractive" ideas, rather than the most insightful.

Reduce Uncertainty on the Possible Impacts of Policies

When policy options have been developed, simulations are carried out to anticipate the likely impact of policies. The option with the most positive impact is normally the one that is proposed for adoption. Most existing methodologies and tools for the simulation of policy impacts work decently with well known, linear phenomena. However, they are not effective in times of crisis and fast change, which unfortunately turn out to be exactly the situations where government intervention is most needed. As an example nowadays the European Central Bank bases its analysis of the EURO Area economy and monetary policy on a derived version of the DSGE model developed by Frank Smet and Raf Wouters (Smet & Wouters, 2003). The authors' model is deeply microfounded, allowing for a rigorous theoretical structure of the model. Moreover in this setting the reduced form parameters are related to deep structural parameters in order to mitigate Lucas' critique, while the utility of agents can be taken as a measure of welfare in the economics (Phelps, 1970).

However, the DSGE models suffer from several shortcomings jeopardizing their ability to predict, let alone to prevent, a global crisis:

- Agents are assumed to be perfectly rational, having perfect access to information and adapting instantly to new situations in order to maximize their long-run personal advantage.
- So far agents have entered the models as homogeneous representative entities, while it would be a step forward being able to take into account agents heterogeneity.
- Canonical models consider atomistic agents with little or no interactions and thereby are not able to cope with network externalities.

But most of all it is the very notion of equilibrium which prevents standard models from dealing with crisis. A stable steady state equilibrium is a condition according to which the behaviour of a dynamical system does not change over time or in which a change in one direction is a mere temporary deviation. This condition is proper of general equilibrium theory, in which a stable steady state is believed to be the norm rather than the exception. When in the canonical model we are out of equilibrium, the situation is seen just as a short lapse before the return to the steady state. This is in sharp contrast with the very notion of crisis, which represents a steady deviation from the equilibrium. Loosely speaking, the crisis phenomenon is not even conceived within the framework of standard models. All these flaws are not only related to DSGE models, but also to Computational General Equilibrium (CGE) or macro-econometric forecasting models, which are the traditional policy making tools. In this view it would be very important to find new frameworks capable of avoiding those shortcuts. Some of such methodologies and methods already exist and some governments are using them. Our aim is to push forward in that direction. We need to move away from the equilibrium paradigm in order to be able to assess other issues: evolutionary dynamics; heterogeneity of technologies and firm; political and legal determinants of social stability; incentive structures; better modeling technological change, innovation diffusion and economic systems (taking into account finance, debt and insurance); interactions between heterogeneous economic agents (firms and households) and central governments; heterogeneous responses to government incentives; economic dependence from the ecosystem.

Ensure Long - Term Thinking

In traditional economics, decisions are utility-maximising. Agents rationally evaluate the consequences of their actions, and take the decision that maximizes their utility. However, it is well known that this rationalistic view does not fully capture human nature. We tend to overestimate short-term impact and underestimate the long term. In policy-making, short-termism is a frequent issue. People are reluctant to accept short-term sacrifices for long-term benefits. Politicians have elections typically every 5 years, and often their decisions are taken to maximize the impact "before the elections". There is also the perception that laypeople are less sensitive to long term consequences, which are instead better understood by experts. Overall, long-term impact is less visible and easier to hide, due to lack of evidence and data. As a result, decisions are too often taken looking at short-term benefits, even though they might bring long-term problems. Climate change is a typical policy area where sub-optimal decisions were taken because the short-term costs were considered to outweigh the long-term consequences. The long-term impact is not visible, while the short term sacrifices were, even though ICT had an important role in stimulating the debate and catalysing attention of the media on the issue.

Encourage Behavioural Change and Uptake

Once policies are adopted, a key challenge is to make sure that all stakeholders comply with regulations or follow the recommendations. It is well known how the greatest resistance to a policy is not active opposition, but lack of application. For instance, several programmes to reduce alcohol dependency problems in the UK failed as they excessively relied on positive and negative incentives such as prohibition and taxes, but did not take into account peer-pressure and social relationships. They failed to leverage "the power of networks" (Ormerod, 2010). For instance, any policy related to reduction of alcohol consumption through prohibitions and taxes is designed to fail as long as it does not take into account social networks, as binge drinkers typically have friends who also have similar problems. In another classical example (Christakis & Fowler, 2007), a large-scale longitudinal study showed that the chances of a person becoming obese rose by 57 per cent if he or she had a friend who became obese. The identification of social networks and the role of peer pressure in changing behaviour is not considered in traditional policy-making tools.

Manage Crisis and the "Unknown Unknown"

The job of policy-makers is increasingly one of crisis management. There is robust evidence that the world is increasingly interconnected, and unstable (also because of climate change). Crises are by definition sudden and unpredictable. Dealing with unpredictability is therefore a key requirement of policy-making, but the present capacity to deal with crises is designed for a world where crises are exceptional, rather than the rule. Donald Rumsfeld, former secretary of state, famously said during the Iraq war that while the US government was capable of dealing with the "known unknown", the difficulty was the increasing recurrence of "unknown unknown": those things that we don't known that we don't know. There is evidence that the instability and chaotic natures of our world is increasing, because of its increasing connectedness. Every year, intense climate phenomena throw our cities in disarray, because of snow, flooding, fires. Each crisis seems to find our decision-makers unprepared and unable to deal with it promptly. As Taleb (2008) puts it, we live in the age of "Extremistan": a world of "tipping points" (Schelling, 1969) "cascades" and "power laws" (Barabási, 2003) where extreme events are "the new normal". There are many indications of this extreme instability, not only in negative episodes such as the financial crisis but also in positive development, such as the continuous emergence of new players on the market epitomised by Google.

Moving From Conversations to Action

The collaborative action of people is able to achieve seemingly unachievable goals: experiences such as ZooGalaxy and Wikipedia show that mass collaboration can help achieve disruptive innovation. Yet too often web-based collaboration is confined to complaints and discussions, rather than action. For example, the 2012 Italian elections saw an explosion of activity in social media discussing about the different candidates. This energy then failed to translate into concrete action in the aftermath of the elections.

Detect Non-Compliance and Mis-Spending through Better Transparency

In times of crisis, it is ever more important for governments to ensure that financial resources are well spent and policies are duly implemented. But monitoring is a cost in itself, and a certain margin of inefficiency in resources deployment is somehow "natural". Yet the cost of this mismanagement is staggering: for instance, in 2010, 7.7% of all Structural Funds money was spent in error or against EU rules (Brand, 2011). OECD estimates place the cost of corruption equals 5%

of global GDP (OECD, 2014). Thereby it would be crucially important to be able to avoid the mismanagement with anticipatory corrective actions.

Understand the Impact of Policies

Measuring the impact of policies remains a challenge. Ideally, policy-makers would like to have real-time clear evidence on the direct impact of their choice. Instead, the effects of a policy are often delayed in time; the ultimate impact is affected by a multitude of factors in addition to the policy. Timely and robust evaluation remains an unsolvable puzzle. This is particularly true for research and innovation policy, where the results from investment are naturally expected at years of distance.

Challenges for Policy Makers and the Corresponding Phases in the Policy Cycle

Let us now relate the key challenges of policy making activity with the phases in the policy cycle. The Agenda Setting phase is mostly related to the challenges "Detect and understand problems before they become unsolvable", "Manage crisis and the unknown unknown", and "Ensure long - term thinking: Agenda". The Design phase is mostly related to the challenges "Encourage behavioural change and uptake", "Identify good ideas and innovative solutions to long-standing problems, "Reduce uncertainty on the possible impacts of policies", and "Generate high involvement of citizens in policy-making. The Implementation phase is mostly related to "Moving from conversations to action", and "Reduce uncertainty on the possible impacts of policies". And finally the Monitor and Evaluation phase is mostly related to "Detect non-compliance and mis-spending through better transparency" and "Manage crisis and the unknown unknown".

THE SUPPLY SIDE: CURRENT STATUS AND THE RESEARCH CHALLENGES

In this section, we summarize each research challenge, which needs to be addressed in order to make the vision a reality and address the policy-challenges described in the previous chapter. The research challenges are organized in 2 groups: the first regroups 6 challenges on Policy Modeling, while the second one regroups 9 challenges on Collaborative Governance.

Policy Modeling

- **Systems of Atomized Models:** This research challenge seeks to find the way to model a system by using already existing models or composing more comprehensive models by using smaller building blocks, sometimes also called "atoms", either by reusing existing objects/models or by generating/building them from the very beginning. Therefore, the most important issue is the definition/identification of proper (or most apt) modeling standards, procedures and methodologies by using existing ones or by defining new ones. Further to that, the present sub-challenge calls for establishing the formal mechanisms by which models might be integrated in order to build bigger models or to simply exchange data and valuable information between the models. Finally, the issue of model interoperability as well as the availability of interoperable modeling environments should be tackled, as well as the need for feedback-rich models that are transparent and easy for the public and decision makers to understand.
- **Collaborative Modeling (Also Called Group Model Building):** Refers to a process where a number of people actively

contribute to the creation of a model. The weakest form of involvement is feedback to the session facilitator, similar to the conventional way of modeling. Stronger forms are proposals for changes or (partial) model proposals. In this particular approach the modeling process should be supported by a combination of narrative scenarios, modeling rules, and e-Participation tools (all integrated via an ICT e-Governance platform): so the policy model for a given domain can be created iteratively using cooperation of several stakeholder groups (decision makers, analysts, companies, civic society, and the general public).

- **Easy Access to Information and Knowledge Creation:** According to a cybernetic view of intelligent organisations knowledge supersedes the facts, the data (statements about facts) and the meaningful information (what changes us), the last also defined as "the difference that makes the difference". Knowledge most often defined as "whatever is known, the body of truth, information and principles acquired" by a subject on a certain topic. Therefore knowledge is always embodied in someone. It implies insight, which, in turn, enables orientation, and thus may be also use as a potential for action (when we are able to use information in a certain environment, then we start to learn, which is the process that helps developing and grounding knowledge). Two more concepts come after knowledge on the same scale, and are Understanding and Wisdom. Understanding is the ability to transform knowledge into effective action, i.e. in-depth knowledge, involving both deep insights into patterns of relationships that generate the behaviour of a system and the possibility to convey knowledge to others, whereby wisdom is a higher quality of knowledge and understanding the ethical and aesthetic dimensions. *The research challenge is related to the elicitation of information* which, in turn, during the overall model building and use processes will help decision makers to learn how a certain system works and ultimately to gain insights (knowledge) and understanding (apply the extracted knowledge from those processes) in order to successfully implement a desired policy. It is important to note that other research fields (in particular, ICT disciplines) tend to misuse the word "knowledge" and invert it with "information".
- **Model Validation:** Policy makers need and use information stemming from simulations in order to develop more effective policies. As citizens, public administration and other stakeholders are affected by decisions based on these models, the reliability of applied models is crucial. Model validation can be defined as "substantiation that a computerised model within its domain of applicability possesses a satisfactory range of accuracy consistent with the intended application of the model" (Schlesinger, 1979). Therefore, a policy model should be developed for a specific purpose (or context) and its validity determined with respect to that purpose (or context). If the purpose of such a model is to answer a variety of questions, the validity of the model needs to be determined with respect to each question. A model is considered valid for a set of experimental conditions if the model's accuracy is within its acceptable range, which is the amount of accuracy required for the model's intended purpose. The substantiation that a model is valid is generally considered to be a process and is usually part of the (total) policy model development process (Sargent, 2009). For this purpose, specific and integrated techniques and ICT tools are required to be developed for policy modeling.

- **Immersive Simulation:** As policy models grow in size and complexity, the process of analysing and visualising the resulting large amounts of data becomes an increasingly difficult task. Traditionally, data analysis and visualisation were performed as post-processing steps after a simulation had been completed. As simulations increased in size, this task became increasingly difficult, often requiring significant computation, high-performance machines, high capacity storage, and high bandwidth networks. Computational steering is an emerging technology that addresses this problem by "closing the loop" and providing a mechanism for integrating modeling, simulation, data analysis and visualisation. This integration allows a researcher to interactively control simulations and perform data analysis while avoiding many of the pitfalls associated with the traditional batch / post processing cycle. This research challenge refers to the issue of the integration of visualisation techniques within an integrated simulation environment. This integration plays a crucial role in making the policy modeling process more extensive and, at the same time, comprehensible. In fact, the real aim of interactive simulation is, on the one hand, to allow model developers to easily manage complex models and their integration with data (e.g. real-time data or qualitative data integration) and, on the other hand, to allow the other stakeholders not only to better understand the simulation results, but also to understand the model and, eventually, to be involved in the modeling process. Interactive simulation can dramatically increase the efficiency and effectiveness of the modeling and simulation process, allowing the inclusion and automation of some phases (e.g. output and feedback analysis) that were not managed in a structured way up to this point.
- **Output Analysis and Knowledge Synthesis:** Inputs driving a simulation are often random variables, and because of this randomness in the components driving simulations, the output from a simulation is also random, so statistical techniques must be used to analyse the results. In particular, the output processes are often non-stationary and auto-correlated and classical statistical techniques based on independent identically distributed observations are not directly applicable. In addition, by observing a simulation output, it is possible to infer the general structure of a system, so ultimately gaining insights on that system and being able to synthesise knowledge on it. There is also the possibility to review the initial assumptions by observing the outcome and by comparing it to the expected response of a system, i.e. performing a modeling feedback on the initial model. Finally, one of the most important uses of simulation output analysis is the comparison of competing systems or alternative system configurations.

Data-Powered Collaborative Governance

- **Big Data:** Refers to dataset that cannot be stored, captured, managed and analyzed by means of conventional database software. Thereby Big Data is a subjective rather than a technical definition, because it does not involve a quantitative threshold (e.g. in terms of terabytes), but instead a moving technological one. Keeping that in mind, the definition of Big Data in many sectors ranges from a few terabytes to multiple petabytes. The definition of Big Data does not merely involve the use of very large data sets, but concerns also a computational turn in thought and research (Burkholder, 1992). As stated by Latour (2009) when the tool is changed, also the entire social theory going with it is different. In this view Big Data has emerged a system of knowledge that is already changing the objects of knowledge itself, as it has the capability to inform how we conceive human networks and community. Big Data creates a radical shift in how we think research itself. As argued by Lazer et al. (2009), not only we are offered the possibility to collect and analyze data at an unprecedented depth and scale, but also there is a change in the processes of research, the constitution of knowledge, the engagement with information and the nature and the categorization of reality. The potential stemming from the availability of a massive amount of data is exemplified by Google, as it is widely believed that the success of the Mountain View company is due to its brilliant algorithms, e.g. PageRank. In reality the main novelties introduced in 1998, which brought to second generation search engines, involved the recognition that hyperlinks were an important measure of popularity and the use of the text of hyperlinks (anchortext) in the web index, giving it a weight close to the page title. This is because first generation search engines used only the text of the web pages, while Google added two data set (hyperlinks and anchortext), so that even a less than perfect algorithm exploiting this additional data would obtain roughly the same results as PageRank.

- **Opinion Mining and Sentiment Analysis:** The explosion of social media has created unprecedented opportunities for citizens to publicly voice their opinions, but has created serious bottlenecks when it comes to making sense of these opinions. At the same time, the urgency to gain a real-time understanding of citizens concerns has grown: because of the viral nature of social media (where attention is very unevenly distributed) some issues rapidly and unpredictably become important through word-of-mouth.
    - **Opinion Mining:** Can be defined as a sub-discipline of computational linguistics that focuses on extracting people's opinion from the web. The recent expansion of the web encourages users to contribute and express themselves via blogs, videos, social networking sites, etc. All these platforms provide a huge amount of valuable information that we are interested to analyse. Given a piece of text, opinion-mining systems analyse which part is expressing opinions, who wrote the opinion and what is being commented.
    - **Sentiment Analysis:** Is about determining the subjectivity, polarity (positive or negative) and polarity strength (weakly positive, mildly positive, strongly positive, etc.) of a piece of text – in other words what is the opinion of the writer.
- **Visual Analytics for Collaborative Governance:** The opportunities and the research challenges. In contrast with visualisation traditionally seen as the output of the analytical process, visual analytics (Thomas & Cook, 2005) considers visualisation as a dynamic tool that aims at

integrating the outstanding capabilities of humans in terms of visual information exploration and the enormous processing power of computers to form a powerful knowledge discovery environment. In this view visual analytics is useful for tackling the increasing amount of data available, and for using in the best way the information contained in the data itself. Moreover visual analytics aims at present the data in way suitable for informing the policy making process. More in particular the interdisciplinary field of visual analytics aims at combining human perception and computing power in order to solve the information overload problem. In Thomas and Cooks' (2005) definition, visual analytics is "the science of analytical reasoning supported by interactive visual interfaces". Precisely visual analytics is an iterative process that involves information gathering, data preprocessing, knowledge representation, interaction and decision making.

- **Simulation and Serious Gaming (Also Known as Interactive Learning Environments):** Offer opportunities to impact on personal incentives to action and showing long-term and systemic effects of individual choices, thereby lowering the engagement barrier to collaborative governance and augmenting its impact. In particular, serious games have been developed for educational purposes and raising awareness on particular issues while not requiring high levels of engagement. Simulation tools enable users to see the systemic and long-term impact of their action in a very concrete and tangible form, thereby encouraging more responsible behaviour and long-term thinking. Gaming engages users through the "fun" and "social" dimension, thereby providing incentives towards action. Feedback and simulation systems include both individual and government behaviour, thereby allowing policy-makers and citizens to detect the impact of both individual and policy choices. This challenge depicts ICT solutions that enable behavioural change and action. Even when citizens and government are fully aware of necessary policy choices, they might irrationally choose short-term benefits.
- **Linked Open Government Data:** The notion of Government Data concerns all the information that governmental bodies produce, collect or pay for. This could include geographical data, statistics, meteorological data, data from publicly funded research projects, and digitized books from libraries. In this respect the definition of Open Public Data is applicable when that data can be readily and easily consulted and re-used by anyone with access to a computer. In the European Commission's view 'readily accessible' means much more than the mere absence of a restriction of access to the public. Data openness has resulted in some application in the commercial field, but by far the most relevant applications are created in the context of government data repositories. With regard to linked data in particular, most research is being undertaken in other application domains such as medicine. Government starts to play a leading role towards a web of data. However, current research in the field of open linked data for government is limited.
- **Collaborative Governance:** While all challenges provide opportunities for a more effective large-scale collaboration in public action, the relevant institutional design is far from being introduced. The formal inclusion of citizens input in the policy-making process, the deriving institutional rules, the legitimacy and accountability framework are all issues that have so far been little explored. Instant, open gov-

ernance implies a substantial increase in feedback loops that are of a different scale with respect to the present context. Any system stability is affected by the number, speed and intensity of feedback loops, and the institutional context has been designed for less and slower loops. The definition and design of public sector role is being directly affected by the radical increase in bottom-up collaboration, deriving from the lower cost of self-organisation. There are also important questions to be answered – where does the legitimacy come from, how to gain and maintain the trust of users, how to identify the users online. There is also a very important issue of how to take into the account the diversity of the standpoints, i.e. how to achieve a consensual answer to controversial social issues, especially when we do not offer alternatives (ready-made options) but start from an open question and work throughout different options proposed by participants. Furthermore, the trade-off between direct or representative model of democracy will have to be analysed in this context.

- **Participatory Sensing:** Refers to the usage of sensors, usually embedded in personal devices such as smartphones to allow citizens to feed data of public interest. This could include anything from photos to passive monitoring of movement in the traffic. Participatory sensing involves higher commitment from citizens, contrary to opportunistic sensing where user may not be aware of active applications. The diffusion of mobile phones significantly lowers the barriers of participation and data input by citizens, with automated geo-tagging and time-stamping: given the right architecture, they could act as sensor nodes and location-aware data collection instruments. While traditional sensor nodes are centralised, these sensors are under the owners' control. This would give way to data availability at an unprecedented scale.
- **Digital Identity Management:** Has long been a policy priority in the EU Member States, and large-scale investments have been deployed. In the context of collaborative governance, digital identity constitutes a fundamental pillar of trustworthy cooperation. Identity management systems include control and management of credentials used to authenticate one entity to another, and authorise an entity to adopt a specific role or perform a specific task. Global in nature, they should support non-repudiation mechanisms and policies; dynamic management of identities, roles, and permissions; privacy protection mechanisms and revocation of permissions, roles, and identity credentials. Furthermore, all the identities and associated assertions and credentials must be machine processable and human understandable. At the EU level, the goal is to provide an interoperable privacy protecting infrastructure for eID that is federated across countries, with multiple levels of security for different services, relying on authentic sources, and usable in a private sector context.
- **Global Systems Science:** Current tools available to policy makers are insufficient for providing guidance on a global scale in facing present societal challenges because of the connections across subject domains as well as the globalization of the policy challenges, which range from environmental threats, food security, or energy sufficiency. Such challenges are multi-dimensional and borderless, thereby they cannot be solved by one single country or by one aspect of policy. In fact current public policy making is targeted at individual, rather than interrelated systems, and

thereby struggles in achieving systemic change and in addressing challenges which are global and interconnected in scope, as they arise from the interplay of social, technological, and natural systems. In this respect it is important to integrate scientific evidence into social process for being able to address those challenges. In this view we need a new multidisciplinary system approach taking into account the connections across policy areas (e.g. economy, transport, health and social understanding of system risk) as well as across geographical borders. This new branch of science should take into account the multidimensionality of global problems given by the interconnectedness of decisions across different policy realms. As stated in the Cordis website (http://cordis.europa.eu/), Global System Science "*addresses new ways of supporting policy decision making on globally interconnected challenges such as climate change, financial crises, or containment of pandemics. The ICT engines behind GSS are large-scale computing platforms to simulate highly interconnected systems, data analytics for 'Big Data' to make full use of the abundance of high-dimensional and often uncertain data on social, economic, financial, and ecological systems available today, and novel participatory tools and processes for gathering and linking scientific evidence into the policy process and into societal dialogue. GSS will develop further the scientific and technological foundations in systems science, computer science, and mathematics.*"

Additional Research Challenge: Counterfactual Impact Evaluation of Policy Making 2.0

The findings of the case studies, the survey and the prize are consistent that no systematic evaluation of the impact of policy-making 2.0 is available. This represents a major challenge to further adoption and experimentation in this domain. There is still a number of unresolved questions regarding policy making 2.0 tools and methodologies:

- Do they help engaging new stakeholders and communities?
- Do they help predicting impact better than other models?
- Do they bring new relevant ideas useful for policy-making?
- Do they actually lead to better policies?

These questions could be structured in a new evaluation framework for policy-making 2.0, which encompasses the full intervention logic, from contextual information, to the intervention, uptake, and impact.

The originality of this model lies in its comprehensiveness, in particularly downstream. Typical evaluation of policy making 2.0 initiatives stop

Figure 3. A proposed evaluation framework for policy-making 2.0

at the level of the level of uptake, such as visitors and users. In the best practices identified, it includes actual influence on the decision taken. The proposed framework includes the actual benefits on the quality of policy making, such as the measurement of the prediction capacity, the improved performance of public sectors, and the improved empowerment of citizens. In this respect, there is a lack of systematic robust evaluation of different policy-methods. In fact initial and anecdotal evidence point to the presence of potential impacts, but there is a lack of a proper counterfactual impact evaluation approach available to date. In what follows we present the main methodologies in the field, and how they can be applied to policy making 2.0. We would like to stress the fact that counterfactual impact evaluation is more likely to be used to evaluate policies and initiatives rather than technologies and methodologies. Moreover it is more suitable for evaluating policies impacting a number of distinctive actors. Evaluating the impact of policies is a complex task because one would like to know what would have been the value for a given output/outcome variable in the absence of the project. This is a value that, by definition, cannot be observed for units not involved in the project. In other words, evaluators cannot know what would have been the behaviour of a *treated* unit in the absence of treatment. Similarly, we have no counterfactuals for the *non-treated* unit (those not involved in the program). This is a well-known problem in policy evaluation analysis (see e.g. Rubin, 1975; 1978; 1980; 1986), which has been overcome using several methods. What is common to all these 'alternative' approaches is that they attempt to identify or create the most appropriate control group (Khandker, Koolwal & Samad, 2010) in order to overcome the two main obstacles in the estimation of counterfactual:

- The 'selection bias', which consists of the fact that target population differs from counterfactual population due to pre-intervention features. A solution is the introduction of an identification hypothesis stating that pre-intervention variables are sufficient to 'reconstruct' the control group of non-beneficiaries (counterfactual).
- The presence of spontaneous dynamics, due to the fact that target population differs from control population for the trend of the result variable. A solution is the introduction of an identification hypothesis to take in consideration the spontaneous dynamics of the result variable trend.

There are basically five main counterfactual impact assessment methodologies:

- **Randomised Controlled Trials:** A solution can be found in case of randomized processes (this happens when the possibility to take part to a project is made available to people on the basis of a random process). In this situation we do not expect structural differences between those who are treated (and receive support) and those who are not, so that we can use the non-supported subjects as a control group for comparison with the former group.
- **Difference-in-Difference (DID):** The impact of a policy on an outcome can be estimated by computing a double difference, one over time (before and after the treatment) and one across subjects (between treated and non treated). This simple method requires only aggregate data on the outcome variable, and at least 3 observations in time: two observations before and 1 observation after. Unfortunately the difference in difference method implies that the trend in treatments and comparisons are the same. With only four points of observation on means we do not know if this assumption is correct. However, with two additional pre-intervention data points the parallelism assumption becomes testable.

- **Regression Discontinuity Design (RDD):** One solution that has been proposed in the literature is the use of so called "regression discontinuity design". This method can be applied to situations in which it is possible to identify a clear cut-off level for treatment access and in which treatment status is based on observable characteristics. In this case the cut-off is defined by the eligibility rules of the project so that the treatment group is made up by people that just satisfy these criteria (and hence have access to the project), whereas the control group is composed of people that are just below the cut-off level and do not have access to the project. In such a circumstance it is reasonable to assume that the control group and the treated groups are very similar against most criteria, and that the small difference in the variables guaranteeing access to treatment are not sufficient to justify a different value of the outcome variable, so that a difference in the latter can be entirely attributed to treatment.
- **Instrumental Variables and Natural Experiments:** This category is relevant when the exposure to the policy is to a certain degree determined by an external force which does not affect the outcome of the policy directly, but only indirectly, through its influence on the exposure. Angrist & Krueger (2001) define this situation as natural experiment, i.e. "where the forces of nature or government policy have conspired to produce an environment somewhat akin to a randomized experiment."
- **Matching:** The most common matching method is the propensity score matching. This approach is based on the premise that, for each unit that has been treated, it is possible to find at least one non-treated unit that is "close" enough to the treated counterpart. In this context "close" means that it exhibits a value for the propensity score very similar (if not identical) to the one observed for the treated unit. The propensity score is defined as the conditional probability of receiving the treatment and is usually estimated using logit or probit regressions. After having computed the propensity scores for all the firms in the dataset, it is possible to use this value to match firms in the treated group with at least one firm in the control group. There are various techniques for undertaking this matching process. Some use replacement while others do not, and some use more complex definitions of distance, but the logic in all these approaches is very similar - find a close match for the treated unit within the group of untreated, using the values for the propensity scores. This approach works well if the evaluator has access to a representative sample of the underlying population and can control for all the variables determining the treatment status (the so called "selection on observables" assumption); otherwise the process can be bedevilled with the selection bias issue.
- **Challenges and Research Gaps:** In evaluation of Policy Making 2.0 are primarily given by the fact that often we are not facing a natural experiments situation, as the treatment exposure is not mandatory and depends upon some selection process that needs to be controlled. Moreover often it is not clear which is the treated unit. For example a policy making tool implemented in the Internet can affect many groups of people from different countries, and anyway it is very difficult to obtain data on the untreated. On the other hand often the same units are treated with different policies and initiatives. Sometimes the treated

unit is an entire country: this makes it impossible to apply methodologies such as randomized control trials or matching, and finally there is the need to develop new sets of indicators used for assessing the impact.

SOLUTIONS AND RECOMMENDATIONS: POLICY-MAKING 2.0 BETWEEN HYPE AND REALITY

In this final section, we bring together the findings of the different sections and put policy-making 2.0 in perspective of long term improvement of public decision making. A first question to be addressed is to what extent the research challenges relate to a specific challenge in policy-making, as described in section 3 and illustrated in the figure below. As we can see, the described research challenges capture all the main needs of policy-makers, and in particular the capacity to detect problems early and to leverage the collective intelligence in policy-making.

In view of this analysis, the next step is to relate each of the research challenges in the policy-making cycle. Each research challenge is in fact relevant for one or more of the specific tasks, not for all. Figure 5 illustrates this relationship. In each of the phases of the cycle, for each of the tasks, we can identify the potential impact of the research challenges described.

Figure 4. Relation between policy-making needs and research challenges

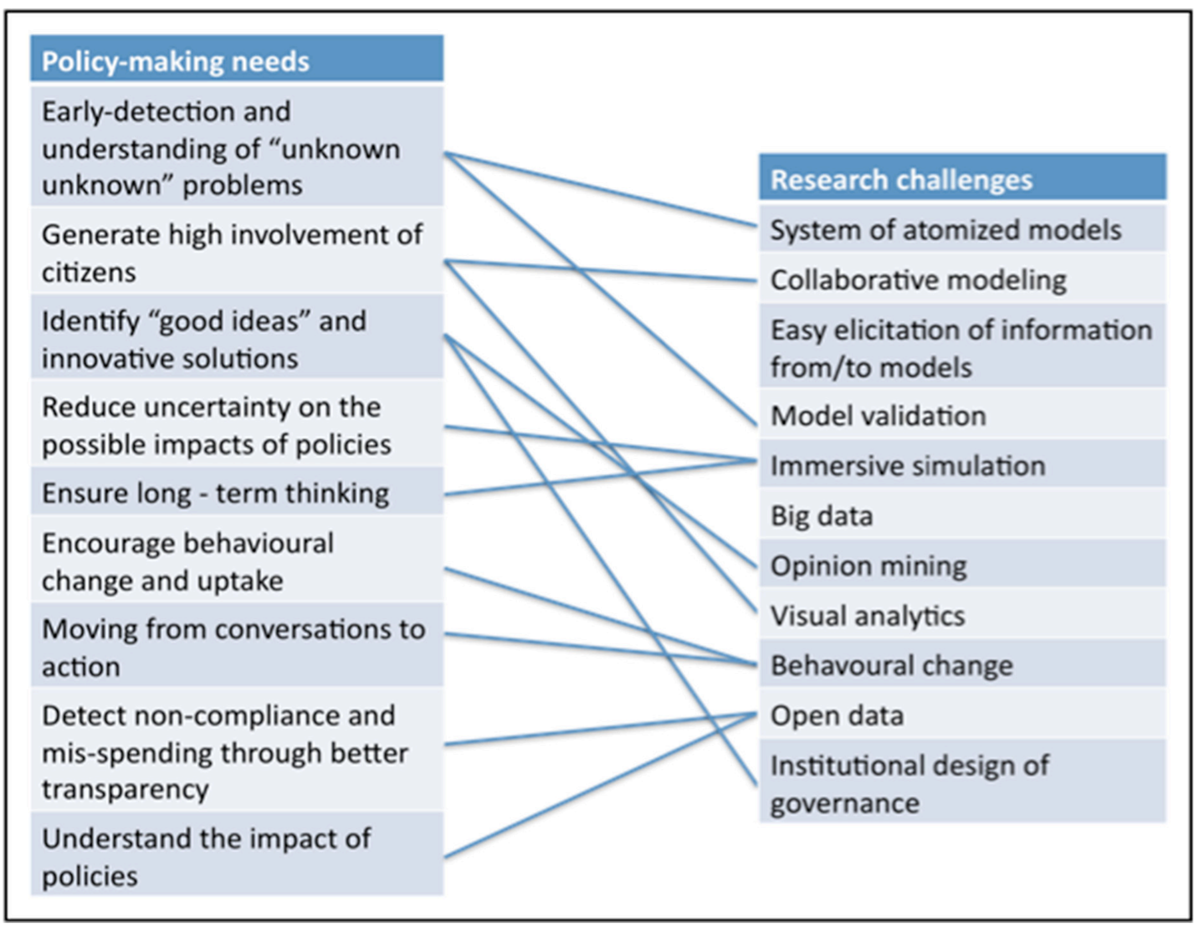
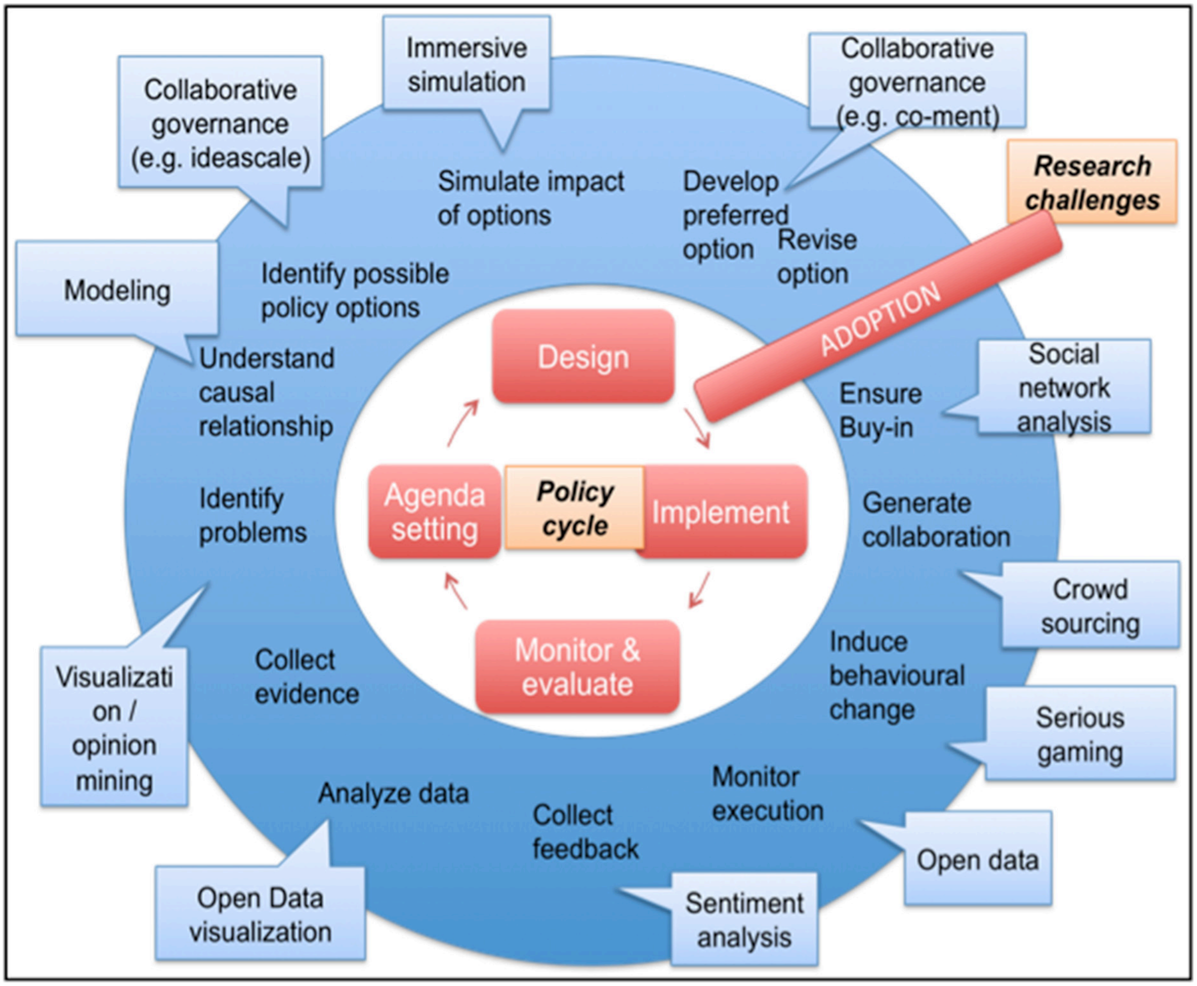


Figure 5. The policy making 2.0 cycle



The policy cycle starts with the *agenda setting phase,* where the problem is identified and analysed. In this section, visualization and opinion mining can help to identify the problems at an early stage. Advanced modeling techniques are then used to untangle the casual relationships behind the problem, understanding the causal roots that need to be addressed by policy. Once the problem is clearly spelled out, we move to the *policy design phase,* where collaborative solutions are useful to identify the widest range of options, by leveraging collective intelligence. In order to facilitate the choice of the most effective option, immersive simulations support decision-makers by taking into account unexpected impacts and relationships. Collaborative governance enables then to develop further and fine-tune the most effective option, for example through commentable documents. Once the option is developed and adopted, we enter into *policy implementation.* In this phase, it is crucial to ensure awareness, buy-in and collaboration from the widest range of stakeholders: social network analysis, crowdsourcing and serious gaming are useful to deliver this. Already during this implementation, we move into the *monitoring and evaluation*. Open data allow stakeholders and decision makers to better monitor execution; together with sentiment analysis, they can be used to evaluate the impact of the policy, also through advanced visualization techniques. In summary, our vision for 2030 embodies a radically different context for policy-making 2.0. On policy modeling and simulation, thanks to standardisation and reusability of models and tools, system thinking and modeling applied to policy impact assessment has become pervasive throughout government activities, and is no longer limited to high-profile regulation. Model building and simulation is carried out directly by the responsible civil servants, collaborating with different domain experts and colleagues from other departments. Visual dynamic interfaces allow users to directly manipulate the simulation parameters and the underlying model. Policy modeling software becomes productized and engineered, and is delivered as-a-service, through the cloud, bundled with added-value services and multidisciplinary support including mathematical, physics, economic, social, policy and domain-specific scientific support. Cloud-based interoperability standards ensure full reusability and modularity of models across platforms and software. System policy models are dynamically built, validated and adjusted taking into account massive dataset of heterogeneous data with different degrees of validity, including sensor-based structured data and citizens-generated unstructured opinions and comments. By integrating top-down and bottom-up agent based approaches, the models are able to better explain human behaviour and to anticipate possible tipping points and domino effects. On collaborative governance, policy-making leverages collective intelligence and collective action. It accounts for *the greater policentricity of our governance system*. While traditional tools are designed for the public decision-makers, these research challenges are more *symmetric* by nature, in order to engage stakeholders all through the phases of the policy-making cycle. Thanks to visualisation and design, it is able to reach out to new stakeholders and lower the barriers to entry in the policy discussions. Policy-making 2.0 is not only designed to be more effective, but also more participatory.

CONCLUSION AND FUTURE RESEARCH

This document described at length the specific opportunities of policy-making technology, and identified the technological bottlenecks that we need to overcome over the next years if we want to grasp the opportunities of Policy-Making 2.0. The research challenges identified so far are not just a simple collection of research issues, but also an integrated bundle of innovative solutions that together can lead to a paradigm shift in policy-making. Yet it does not fail us that the main bottlenecks to achieving this vision are not technological. The reason why policy-making is not already as open and evidence-based as it could be, lies less in the limitation of the technology than on the concrete needs and limitations of human behaviour. This is a lesson we learnt from many years of studies on the impact of ICT, for example on e-government. Regardless of the technological tools at your disposal, the key barriers to change lie with cultural and organisational issues. We cannot claim to propose a more human centric policy making, that takes into account the complexity of human behaviour, and then fail to recognize the humanity of policy-makers. Policy-makers are agents, and as such are self-interested and driven by an own agenda. They are human, and therefore not perfectly rational and atomised. Citizens are human, and not that interested in public policy. It would therefore be foolish to expect that the simple availability of the technology will suddenly free policy-making from politicking, corruption, personal interests or simple incompetence. It is not within the scope of this roadmap to develop generic policy recommendations for improving policy-making as such, yet we cannot treat non-technological factors as a simple black box: technological tools have to take into account the concrete problems of policy-making. We propose that policy-making 2.0 is not a panacea for better government, yet it is not neutral to power relationships that enable such problems as corruption and incompetence to emerge. In other words, these are not "just tools" that can be used for good or bad: they provide the opportunity to re-frame the system of check and balances that determine the likelihood of good or bad policy-making. More open data, more transparent models, more visually accountable policy measures can facilitate the uncovering of corruption, personal interests and incompetence. The emphasis on usability and openness of modeling is opening up policy-making to a wider range of stakeholders. The availability of different simulated future scenarios enhances the accountability of today's decision of policy makers. There will always be room for malpractice and greed in policy-making 2.0 as well as in any human activities. This is however not an argument to give up on improving the available methods. Raising the barriers to malpractice, and lowering the barrier to good practice, is an achievable goal worth pursuing.

ADDITIONAL READING MATERIAL

As additional reading material we can suggest, apart from CROSSOVER, the following projects:

- eGovRTD2020 (Wimmer et al., 2007), a European Commission co-funded project, which investigated the future research on e-government driven by changing circumstances and the evolution of technology. This project consisted of an analysis of the state of play, a scenario-building, a gap analysis and a roadmapping activity.
- CROSSROADS, aimed at elaborating a roadmap for ICT research in the field of governance and policy modeling, in order to identify emerging technologies, new governance models and novel application scenarios in the area of participation, electronic governance and policy modeling, leading to the structuring of a beyond the state-of-the-art research agenda, fully embraced by research and practice communities.

Moreover there are some examples of counterfactual impact evaluation applied to open government for assessing the validity of claims for transparency and participation:

- Zhang (2012) ran a pilot field experiment in Kenya to explore how variation in the content of an information campaign can impact political behaviour in villages. The experiment involved two interventions. The first provided a Constituency Development Fund (CDF) report card, which detailed the budgets of all the CDF projects allocated funding in the constituency for that fiscal year, to see if villagers respond to unaccounted for money in locally visible projects. The second intervention, based upon the mixed findings in the literature as to how information can enable citizens to take action couples the report card with a public participation flyer, to see if information about legal rights and *decision* making processes is necessary for citizens to use the report card to take action.
- Olken (2010) ran an experiment in which 49 Indonesian villages were randomly assigned to choose development projects through either direct *election* based plebiscites or through *representative* based meetings. In villages where plebiscites were performed, there has been a dramatic

> increase in satisfaction among villagers, in knowledge about the project, in greater perceived benefits, and a higher reported willingness to contribute. Moreover we have that changing the political mechanism had much smaller effects on the actual projects selected, with some evidence that plebiscites resulted in projects chosen by women being located in poorer areas. According to the outcomes of the study, satisfaction and *legitimacy* are substantially increased *by direct* participation.

Some other important references are “The CROSSOVER Research Roadmap” (CROSSOVER 2013), “Policy Making 2.0: Unleashing the power of big data for open governance” (Mureddu et al., 2013), and “A New Roadmap for Next-Generation Policy-Making” (Misuraca et al., 2012).

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KEY TERMS AND DEFINITIONS

Counterfactual Impact Evaluation: Set of methodologies attempting to identify or create the most appropriate control group in order to overcome the two main obstacles in the estimation of counterfactual, which are: the 'selection bias', which consists of the fact that the target population differs from the control population due to pre-intervention features; the presence of spontaneous dynamics, due to the fact that the target population differs from the control population for the trend of the result variable.

Policy Making 2.0: Refers to a set of methodologies and technological solutions aimed at innovating policymaking. Its scope goes well beyond the focus on decision making notion typical of eParticipation, and encompasses all phases of the policy cycle. The main goal is limited to improving the quality of policies, not of making them more consensual or representative.

Research Challenges: They represent the endeavours to be tackled by researchers and practitioners towards the definition of the future policy making. In our framework, the research challenges have the following characteristics: user-driven and demand-driven, highly multidisciplinary, with particular involvement of non-technological disciplines, not clearly divided between research and innovation, and finally serendipitously innovative.

Research Roadmap: A strategic planning approach to identify the actions and funding decisions needed to boost technological development and innovation. It provides a means of depicting the link between the current, emerging and potential technologies that governments may choose to exploit, and the long term situational opportunities to which it could apply them.

The Policy Making 2.0 Cycle: A new framework for analysis the development of policies. In the inner layer the phases of the policy cycle are outlined: agenda setting phase, design phase, policy implementation, and monitoring and evaluation. In the intermediate layer are presented the tasks of the policy maker, while in the outer layer the tools that the policy maker can use.

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Index

S

T

U

V

W