ICT-2011.5.6 ICT solutions for Governance and Policy Modelling
FP7-ICT-2011 Coordination Action (CA) project

Final Report on Knowledge Assets in Portal and Final Grand Challenges (D 4.3)

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Editors:	Maria A. Wimmer, Dragana Majstorovic (UKL)
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Abstract:	This report documents the final results of developing knowledge assets and the grand challenges of research in ICT-supported public governance and policy modelling. The first part summarises the work performed in work package 4, including the further development of the glossary terms, progress of comparative analyses towards book chapters and enriching the knowledge portal with knowledge assets. The second part documents the work to develop grand challenges of research in the field. This includes the presentation of the grand challenges, the process to develop grand challenges, and finally recommendations on how to address these grand challenges.

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ABBREVIATIONS AND ACRONYMS

Abbreviation	Description
CERTH	Centre for Research and Technology Hellas, Greece
COMPASS	Centre of Methods and Policy Application in the Social Sciences, The University of Auckland, New Zealand
DoW	Description of Work
EUAK	EA European Academy of Technology and Innovation Assessment GmbH, Germany
ICT	Information and Communication Technologies
INNOVA	Innova spa, Italy
ITMO	Saint Petersburg National Research University of Information Technologies Mechanics and Optics, Russian Federation
IS	Information Systems
KhNU	Khmelnitsky National University, Ukraine
MRSU	Moskow Regional State University, Russian Federation
PUC-PR	Associacao Paranaense de Cultura, Brazil
RG	Rijksuniversiteit Groningen, Netherlands
R&D	Research and Development
RTD	Research and Technological Development
SUNY	The Research Foundation of State University of New York, United States of America
TU Delft	Delft University of Technology, Netherlands
TUK	Technical University Kosice, Slovakia
UBRUN	Brunel University London, United Kingdom
UCDNUID	University College Dublin, National University of Ireland, Dublin, Ireland
UKL	University of Koblenz-Landau, Germany
ULAVAL	Université LAVAL, Canada
UNU-IIST	United Nations University - International Institute Software Technology
UTS	University of Technology Sydney, Australia
VOLTERRA	Volterra Partners LLP, United Kingdom
VUB	Vrije Universiteit Brussel, Belgium
WP	Work Package

1. INTRODUCTION

The overall objective of work package 4 (Knowledge base) is to "*identify and respond to developing global research, practice and innovation challenges in the field of digital governance and policy modelling. It analyses and compares the international and multi-disciplinary digital governance and policy modelling research and practice landscape to facilitate the development of RTD agendas and roadmaps to govern the direction and future evolution of the community. The work allows eGovPoliNet to put together the research and practice teams and thematic networks to respond to evolving challenges and therewith establishes a comprehensive knowledge base*"[1]. The major activities of the past two working periods have focused on the establishment of a comprehensive knowledge base including a glossary of terms and a comparative analysis of relevant theories, concepts, models and solutions of ICT supported governance and policy modelling, and the development of visionary scenarios for ICT supported governance and policy modelling[2]. In the third period, the focus was on drawing conclusions from these research results by developing grand challenges of research, which can be used for future reference within and outside the eGovPoliNet community.

In particular, task 4.5 (Grand challenges for ICT solutions for Governance and Policy modelling) notes the following objectives and suggested methods[3]:

- Identification of existing gaps and development of a coherent set of necessary research themes to achieve desired developments of policy modelling practice in the field (as identified in the visionary scenarios of task 4.4). Means to achieve this are online and offline activities such as workshops, working meetings, online discussions and consultations in work packages 3 and 4.
- Analysis of weaknesses in specific state-of-the-art technological domains as identified by the previous tasks 4.1 - 4.4 performed through desk-based reviews and comparative analyses.
- Building consensus in terms of future R&D demands in the field of ICT for governance and policy modelling and assessing the originality and nature of the identified grand challenges. Again, this aim is operationalised through a set of discussions in virtual and physical meetings, involving project partners as well as external experts and a web-based consultation to assess the originality and nature of the proposed grand challenges.
- Policy recommendations, which will draw paths for future evolution. These were derived by discussions in physical and virtual meetings as well as through online consultations with experts over the LinkedIn group and wider policy modelling community.

The five grand challenges of research on ICT-supported public governance and policy modelling developed in the project's work package 4 are as follows (including brief outlines):

- **Data and information characteristics and use.** The data dimension of policy modelling reports significant challenges for data providers, analysts, and consumers. While existing and new data sources offer great opportunities to explore and understand both the context and possible effects of policy choices, many issues that have tremendous impact on the trustworthiness and reliability of policy models arise with this topic; for example, the quality of data, provenance information, or empirical validity. All these issues demand multidisciplinary research that investigates data characteristics and use in public policy modelling from different angles.
- **Modelling and simulation.** Using computer simulations in examining, explaining and predicting social processes and relationships as well as measuring the possible impact of policies in an innovative manner has become an important part of policy making. However, current paradigms of policy modelling using simulation models are constrained by their particular focus. Unifying

[1] Cf. Description of Work (DoW) of eGovPoliNet, objectives of Work Package 4, p. 14 (internal document)

[2] See technical reports D 4.1 and D 4.2 (available online under http://www.policy-community.eu/results/technical-reports-and-publications/public-deliverables) (last access: 26/01/2015)

[3] Cf. Description of Work (DoW) of eGovPoliNet, objectives of Work Package 4, p. 14-15 (internal document)

different modelling theories under an umbrella of comprehensive policy modelling platforms is an urgent research need.

- **Citizen and stakeholder engagement.** The demand for citizen and stakeholder engagement ought to become one of the most important imperatives of the modern world. This grand challenge puts forward a number of issues and gaps in the process of citizen and stakeholder engagement, such as trust and manipulation, challenge of policy making to provide satisfactory decisions for the entire population and all social groups as well as strategies to overcome the issues.
- **Government capabilities and legitimacy.** This grand challenge encompasses two interrelated concerns: the legitimacy of government in the eyes of the governed and the capabilities of government to carry out actions that respond to the expectations of citizens and other stakeholders.
- **Translating research results into policy actions and support.** A significant gap exists between research on ICT-supported public governance and policy modelling and the practise of public policy making. A big amount of work is carried out in academia, leading to great findings. However, translating these research findings into concrete policy actions in practices is hampered by a number of barriers that lay in systemic aspects, disciplinary foci as well as motivation and benefit for engaging with "the other side".

Deliverable D 4.3 sums up the main achievements of work package 4, namely:

- Finalising the definition of glossary terms for policy modelling to ensure a common ground of understanding across distinct disciplines
- Finalising selected comparative analyses of thematic areas to advance them to become book chapters for the book on policy modelling prepared in work package 3
- Adding further knowledge assets to the knowledge portal
- Analysing the visionary scenarios developed in period 2 and prepare relevant inputs for the grand challenges development
- Developing grand challenges of research for ICT-supported governance and policy modelling
- Deriving recommendations for policy actors and researchers in regards to how to tackle the grand challenges

The remainder of the document is as follows: The next chapter sums up the continuous work in work package 4, including the finalisation of the glossary, the preparation of selected comparative analyses to become chapters of the book on policy modelling, and the extension of the knowledge portal with new knowledge assets. The chapter contains both, the performance of work within period 3 as well as a summary of the final status of these knowledge assets that are handed over to the sustainable community.

The remaining chapters focus on the development of grand challenges, which was a key focus of work package 4 in the third period:

- Chapter 3 sets grounds for a common understanding of what grand challenges are and documents the methodical path of the grand challenges development.
- Chapter 4 documents the results of the scenario analysis. This chapter identifies key issues that need to be researched, grouped into ten research challenges.
- Chapter 5 reports the results of the grand challenges development: The initial version identified three grand challenges. These initial grand challenges base extensively on the scenario analysis. Subsequently, revisions by project partners and a discussion in a workshop with external experts led to the revision of the initial version and to the extension to five grand challenges. An online consultation provided feedback on the grand challenges. All these results are documented in the chapter.
- Chapter 6 provides recommendations to policy actors with the aim to tackle the grand challenges in future initiatives in a successful manner.

The last chapter (7) concludes this deliverable with reflections of the achievements of works in period three as well as the overall achievement of work package 4.

2. WORK PERFORMED IN PERIOD 3 AND FINAL STATUS

This chapter sums up the continued work performed in work package 4 and documents the final status of knowledge assets developed over the whole project lifetime. The chapter contains the following subsections:

- glossary development in subsection 2.1
- advancing selected comparative analyses towards contributions as book chapters (see subsection 2.2
- collaboration with work package 3 on the book project (see subsection 2.3)
- updating the visionary scenarios (subsection 2.4)
- adding further knowledge assets to the knowledge portal (subsection 2.5)

The work on analysing the visionary scenarios and developing grand challenges is documented in separate chapters (cf. chapters 4 to 6).

2.1. GLOSSARY DEVELOPMENT

During the third period, the eGovPoliNet partners continued to specify, review, vote for, and publish in total 69 glossary terms. Also, four terms that were "not assigned" in the second period, were assigned for the development and published at the knowledge portal. The methods and template for developing glossary terms as documented in Deliverable D 4.2[4] have been applied again. Hence, this section only documents the outcomes of the work. The following glossary terms were elaborated, voted on and published in the third period:

- Agent-based Modelling
- Agenda Setting Theory
- Artificial Model Data
- Behavioural change
- Business Process
- Community
- Conceptual Model
- Conceptual Modelling
- Complex System
- Complexity Theory
- Declarative Model
- Design Thinking
- Discipline
- Dynamic Adaptation
- Dynamic System
- Economic Theories
- Evidence
- Game Theory
- Forecasting
- Formal Method
- Formal Model
- Formal Modelling
- Graph Theory
- Hypothesis
- Institutional Choice Theory
- Innovation Network
- Institutional Model
- IT Governance
- Linear Program
- Linear Programming
- Macroeconomic models
- Macro-Simulation
- Mathematical Model
- Mathematical Modelling
- Mathematical Programming
- Micro-Simulation
- Method
- Methodology
- Modelling
- Networked Governance
- Network Governance School (NWG)
- Network Theory
- Normative Model
- Open Data
- Open Government
- Open Linked Data
- Policy Informatics
- Policy Lifecycle
- Policy Model
- Policy Modelling
- Policy Network Analysis (PNA)
- Public Governance
- Public Value Management
- Rational Choice Theory
- Semantic Technologies
- Simulation Model
- Social Media
- Social Network
- Social Network Analysis
- Stakeholder
- Structural Change

[4] See technical report D 4.2 available online under http://www.policy-community.eu/results/technical-reports-and-publications/public-deliverables/d-4.2-synthesis-report-of-knowledge-assets-including-visions/view (last access 26/01/2015)

- System Dynamics
- Technology
- Tool
- Traceability
- Verification
- Web 2.0
- Web 3.0
- Wicked Problem

In total, eGovPoliNet developed 90 terms relevant to the field of public governance and policy modelling. The glossary is available under http://www.policy-community.eu/results/glossary.
As explained already in D 4.2, the contributions of partners have been monitored over the project lifetime. Figure 1 indicates the engagement of partners in developing glossary terms in the third period of the project (only terms that have been published at the knowledge portal are counted). The subsequent

Table 1 indicates the total number of published glossary terms that partners have elaborated over the project lifetime. Values indicated with .5 indicate that two different partners have collaborated in developing a glossary term. Accordingly, each partner is assigned a 0.5 value for the term. The table also indicates the disciplinary focus of institutions and the countries partners come from. These aspects are further analysed to extract disciplinary collaboration.

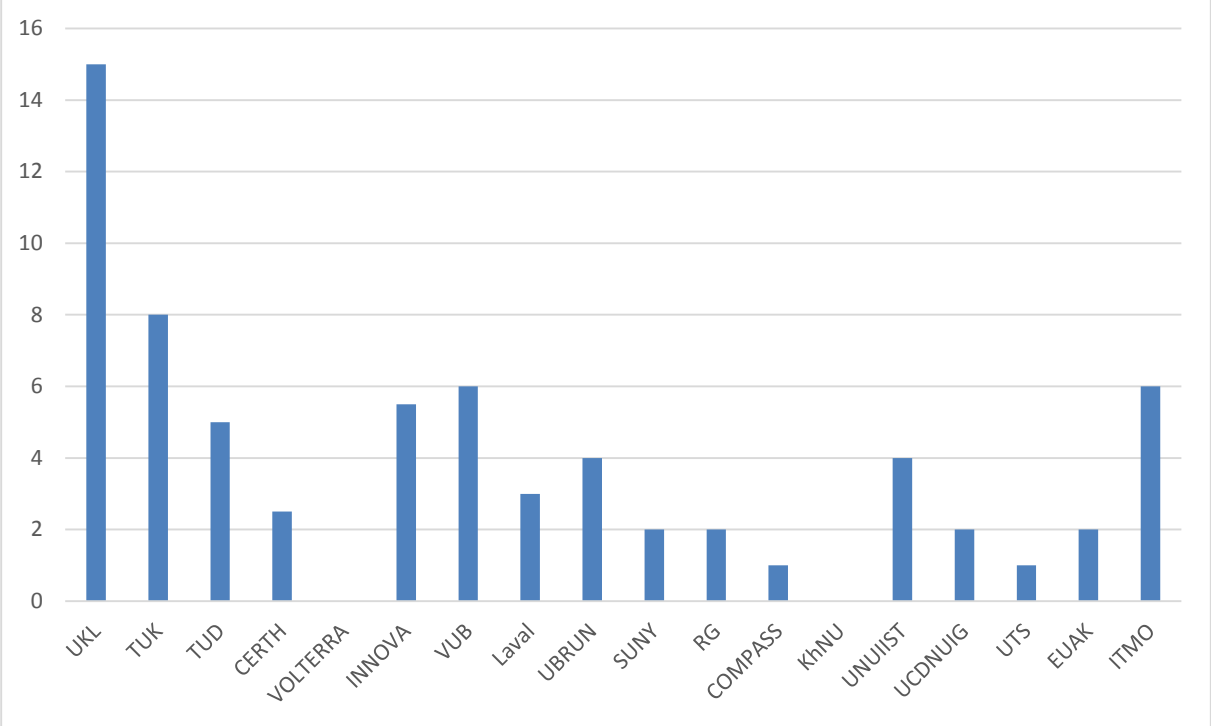

Figure 1: Overview of partners' engagement in developing glossary terms in the third period

Table 1: The partners' engagement in the glossary development over the project lifetime as well as disciplinary focus of institutions and countries involved

Partner	**Country**	**Disciplinary focus of organisations**	**Number of glossary terms**
1 – UKL	Germany	E-Government & E-Participation; Information Systems	20
2 – TUK	Slovakia	Economics	9
3 – TUD	The Netherlands	E-Government; Information Systems	6,5
4 – CERTH	Greece	E-Government & E-Participation; Information Systems	3,5
5 – VOLTERRA	UK	Policy Consulting	0
6 – INNOVA	Italy	Technology Transfer and Exploitation	7,5
7 – VUB	Belgium	Public Administration Science	11
8 – ULAVAL	Canada	Information Systems	3
9 – UBRUN	United Kingdom	Information Systems	4
10 – CTG/SUNY	USA	E-Government; Public Administration Science	2
11 – RG	The Netherlands	Social complexity studies	2,5
12 COMPASS	New Zealand	Sociology of Health and Well-Being	1
13 – KhNU	Ukraine	Organisation and Management	0
15 – UNU-EGOV	China	Information Systems; E-Government	9
18 – UTS	New Zealand	Information Systems; Management and Leadership	1
19 – EUAK	Germany	Technology Assessment	4
20 – ITMO	Russian Federation	E-Government	6

To demonstrate the contributions from different academic disciplines, Table 2 provides an overview of contributions to the glossary terms by respective disciplines. Disciplines involved were information systems, computer science, complexity science, sociology, social sciences, e-government & e-participation, public administration sciences, economics, and organisational and management sciences. As some partners argue that they can be affiliated with different disciplines, the numbers contain double assignments. However, a maximum of two main disciplines were counted per partner.

Table 2: Interdisciplinary collaboration in the Glossary development

Disciplines	Number of terms per discipline*
Information systems	34
Computer science	6,5
Complexity science	2,5
Sociology	1
Social sciences	4
E-government & E-participation	59
Public administration sciences	2
Economics	9
Organisational and management sciences	34,5

*****Some of the researchers participating in the glossary development are interdisciplinary in their work. However, no more than two main disciplines per person were considered in this analysis.

2.2. ADVANCING SELECTED COMPARATIVE ANALYSES TO BOOK CHAPTERS

During the second period, nine comparative analysis were performed[5] with thematic focus on theories, frameworks, simulation models, conceptual and domain models, tools and technologies, projects, cases and stakeholder engagement.

In the third period, four comparative analyses were further advanced and developed to become chapters of the eGovPoliNet book "Policy Practice and Digital Science — Integrating Complex Systems, Social Simulation and Public Administration in Policy Research" to be published by Springer Verlag in the series "Public Administration and Information Technology" edited by Chris Reddick[6]. The following comparative analyses were selected:

- *Comparative analysis of simulation models* was advanced by the authors Dragana Majstorovic, Maria A. Wimmer (both UKL), Roy Lay-Yee, Peter Davis (both COMPASS) and Petra Ahrweiler (EUAK) to become chapter 6 with the title "Peculiarities and Value-Add of Simulation Models of Distinct Modelling Approaches Supporting Policy Making: A Comparative Analysis"
- *Comparative analysis emerging tools and technologies supporting policy modelling* was advanced by the authors Eleni Kamateri, Eleni Panopoulou, Efthimios Tambouris, Konstantinos Tarabanis (all CERTH), Adegboyega Ojo, Deirdre Lee (both DERI – external, academia), and David Price (Thoughtgraph Ltd – external, ICT industry) to become chapter 7 with the title "A Comparative Analysis of Tools and Technologies for Policy Making"
- *Comparative analysis of stakeholder engagement in policy development* was advanced by the authors Natalie Helbig, Sharon Dawes (both CTG), Zamira Dzhusupova (UNU-IIST), Bram Klievink (TUDelft) and Catherine G. Mkude (UKL) to become chapter 9 with the title "Stakeholder Engagement in Policy Development: Observations and Lessons from International Experience"

[5] See technical report D 4.2 available online under http://www.policy-community.eu/results/technical-reports-and-publications/public-deliverables/d-4.2-synthesis-report-of-knowledge-assets-including-visions/view (last access 26/01/2015)

[6] See the announcement of the book on Springer Verlag's website: http://www.springer.com/new+%26+forthcoming+titles+%28default%29/book/978-3-319-12783-5 (last access 30/01/2015)

- *Comparative analysis of projects / cases implementing policy* was advanced by the authors Dominik Bär, Maria A. Wimmer (both UKL), Jozef Glova (TUK), Anastasia Papazafeiropoulou and Laurence Brooks (both UBRUN) to become chapter 15 with the title "Analysis of Five Policy Cases in the Field of Energy Policy"

Table 3 presents an overview of partners' engagement in the development of the nine comparative analyses (white papers) and advancements towards book chapters. The total results from the sum of book chapters plus further white papers that did not materialise into a book chapter (cf. D 4.2 for details of comparative analyses and the white papers).

Table 3: Overview of engagement of partners in comparative analyses (white papers) and book chapters

Partner	Book chapters	White papers	Total comparative analyses
UKL	4	1	5
TUK	1		1
TUD	2		2
CERTH	1	1	2
VOLTERRA			
INNOVA			
VUB		2	2
ULAVAL		1	1
UBRUN	1		1
CTG	1		1
RG	2		2
COMPASS	2		2
KhNU			
UNU-IIST	1		1
UTS			
EUAK	2		2
ITMO	1		1

The performance of comparative analyses was analysed already in deliverable D 4.2[7]. A publication by (Majstorovic & Wimmer, A Collaborative Approach to Study Policy Modelling Research and Practice from Different Disciplines, 2014)[8] further synthesised the cross-disciplinary collaboration. It also extracted experiences and lessons learnt from the collaboration.

[7] Technical report D 4.2 is available online under http://www.policy-community.eu/results/technical-reports-and-publications/public-deliverables (last access: 30/01/2015)

[8] For further details see http://www.policy-community.eu/results/technical-reports-and-publications/papers/document.2014-08-27.5003654677 and download available as open access from http://www.booksonline.iospress.nl/Extern/EnterBookSeriesBook.aspx?ISBN=978-1-61499-428-2

2.3. COLLABORATING WITH WORK PACKAGE 3 ON THE BOOK PROJECT

The book "Policy Practice and Digital Science — Integrating Complex Systems, Social Simulation and Public Administration in Policy Research" edited by Marijn Janssen, Maria A. Wimmer and Ameneh Deljoo is the first comprehensive book in which the various developments and disciplines are covered from the complete policy making perspective. The book covers a wide range of aspects for social and professional networking and multidisciplinary constituency building along the axes of technology, participative processes, governance, policy modelling, social simulation and visualisation as well as comparisons between them. Finally, public administration, policy analyses, information systems, complex systems and computer science disciplines are also examined in this book.

The book consists of 19 chapters, which are organised in five sections and prepared by 54 authors. eGovPoliNet partners authored 10 chapters together with the members of the wider policy community, while further 9 chapters were developed by other members of the policy community[9]. The cover of the book is shown in Figure 2.

Figure 2: The book cover

The table of contents of the book is as follows:

- Preface by the Project Officer, Athanassios Chrissafis, European Commission
- Introduction to Policy Making in the Digital Age, by Marijn Janssen and Maria A. Wimmer (Chapter 1)
- Foundations
    - Chapter 2: Educating Public Administrators and Policy Analysts in the Era of Informatics, by Chris Koliba and Asim Zia
    - Chapter 3: The Quality of Social Simulation: An Example from Research Policy Modelling, by Petra Ahrweiler and Nigel Gilbert
    - Chapter 4: Policy Making and Modelling in a Complex World, by Wander Jager and Bruce Edmonds
    - Chapter 5: From Building a Model to Adaptive Robust Decision-Making Using Systems Modelling, by Erik Pruyt
    - Chapter 6: Peculiarities and Value-Add of Simulation Models of Distinct Modelling

[9] For more details on the Social Network Analysis of the book see technical report D 3.3.

Approaches Supporting Policy Making: A Comparative Analysis, by Dragana Majstorovic, Maria A. Wimmer, Roy Lay-Yee, Peter Davis and Petra Ahrweiler

- Chapter 7: A Comparative Analysis of Tools and Technologies for Policy Makin, by Eleni Kamateri, Eleni Panopoulou, Efthimios Tambouris, Konstantinos Tarabanis, Adegboyega Ojo, Deirdre Lee, David Price

- Social Aspects, Stakeholders and Values
  - Chapter 8: Value Sensitive Design of Complex Product Systems, by Andreas Ligtvoet, Geerten van de Kaa, Theo Fens, Cees van Beers, Paulien Herder and Jeroen van den Hoven
  - Chapter 9: Stakeholder Engagement in Policy Development: Observations and Lessons from International Experience, by Natalie Helbig, Sharon Dawes, Zamira Dzhusupova, Bram Klievink and Catherine G. Mkude
  - Chapter 10: Values in Computational Models Revalued: The Influence of Designing Computational Models on Public Decision-Making Processes, by Rebecca Moody and Lasse Gerrits
  - Chapter 11: The Psychological Drivers of Bureaucracy: Protecting the Societal Goals of an Organization, by Tjeerd Andringa
  - Chapter 12: Active and Passive Crowdsourcing in Government, by Euripidis Loukis and Yannis Charalabidis

- Policy, Collaboration and Games
  - Chapter 13: Management of Complex Systems: Towards Agent-Based Gaming for Policy, by Wander Jager and Gerben van der Vegt
  - Chapter 14: The Role of Micro-Simulation in the Development of Public Policy, by Roy Lay-Yee and Gerry Cotterell
  - Chapter 15: Visual Decision Support for 378 Policy-Making—Advancing Policy Analysis with Visualization, by Tobias Ruppert, Jens Dambruch, Michel Krämer, Tina Balke, Marco Gavanelli, Stefano Bragaglia, Federico Chesani, Michela Milano and Jörn Kohlhammer

- Applications and Practices
  - Chapter 16: Analysis of Five Policy Cases in the Field of Energy Policy, by Dominik Bär, Maria A. Wimmer, Jozef Glova, Anastasia Papazafeiropoulou and Laurence Brooks
  - Chapter 17: Challenges to Policy-Making in Developing Countries and the Roles of Emerging Tools, Methods and Instruments—Experiences from Saint Petersburg, by Lyudmila Bershadskaya, Andrei Chugunov and Dmitrii Trutnev
  - Chapter 18: Sustainable Urban Development, Governance and Policy: A Comparative Overview of EU Policies and Projects, by Diego Navarra, Simona Milio, and Isabel Canto de Loura
  - Chapter 19: E-participation, Simulation Exercise and Leadership Training in Nigeria: Bridging the Digital Divide, by Tanko Ahmed

Complementary information and the social network analysis of the book are provided in deliverable D 3.3.

2.4. REVISING SCENARIOS FOR FUTURE VISIONS OF ICT SOLUTIONS FOR GOVERNANCE AND POLICY MODELLING

In the second period, project partners developed visionary scenarios of ICT solutions for governance and policy modelling as documented in deliverable D 4.2[10]. At the end of the second period, six consolidated scenarios were published at the knowledge portal, and the wider community was asked to comment the scenarios. In the third period, the final scenarios have been slightly revised and updated for the inclusion in the knowledge portal – taking into account the comments received. The final six scenarios are[11]:

1. **Using air quality monitoring data to track and improve public health.** This scenario describes how ICT can be used to help governments and communities improve and assure public health. It focuses on exploring real-time data and providing added-value services to citizens. The key is networking data and providing it to users according to their needs.
2. **Policy decision-making using intelligent simulations and exploiting open and big data sources.** The scenario stresses the need for integrated and combined approaches of social and formal simulation to better inform policy decision-making therewith including approaches of data science, and wider stakeholder engagement. It suggests freely accessible technology platforms that offer different tools and building blocks for quickly and easily building simulation models.
3. **Public/private innovation policy scenario.** This scenario brings forward visions on how to make the process of drug development less expensive, safer, less dominated by big pharmaceutical players, more integrated, and more successful in reducing the time-to-market. New governance models and a change of paradigm to involve citizens proactively thereby exploiting the potentials of ICT are proposed.
4. **Optimising emergency response.** This scenario describes how real-time simulations and mobile networks can be used in the future to organise personalised evacuations and other emergency responses to properly and promptly assess emergencies, thus increasing the effectiveness of the emergency response teams and reducing the impact on the affected population.
5. **Using smart and mobile ICT for developing governance and policy.** Many technology companies are currently developing mobile and wearable devices. It is expected that in the future, such devices become increasingly available, affordable and used in everyday life. This scenario describes how mobile and wearable devices together with the development of Internet of Things can become powerful tools for supporting automatic data collection and mobile participation in the future.
6. **Information warfare impact on developing governance and policy modelling.** Together with the technology development in governance and policy modelling and governmental provision of open and transparent strategy, the threats of this new approach were discovered, especially information warfare threats from external or internal interferences. This scenario describes challenges with respect to appropriate decision-making processes that will be open and transparent and at the same time protect against information warfare threats.

Overall, the scenarios present visions of possible interactions between governments and their stakeholders as well as potential usage of ICT solutions for governance and policy modelling in the years to come. They are based on current perspectives, technological trends and pace of development in the field of public governance and policy modelling.

[10] See technical report D 4.2 available online under http://www.policy-community.eu/results/technical-reports-and-publications/public-deliverables (last access: 30/01/2015)

[11] The final scenarios are available from http://www.policy-community.eu/results/scenarios/

In eGovPoliNet, the scenarios were used as a starting point for the development of grand challenges. The analysis of the future scenarios enabled the project partners to identify research gaps and to develop grand challenges of policy research as will be detailed in chapter 4. A publication by (Majstorovic & Wimmer, Future Scenarios of ICT Solutions for Governance and Policy Modelling, 2014) documents an earlier status of scenario analysis in eGovPoliNet.

To demonstrate the collaboration across different disciplines, Table 4 provides an overview of the disciplinary focus of the partners involved in the development the final six scenarios.

Table 4: Interdisciplinary collaboration in the development of the final six scenarios

Disciplines	SC 1	SC 2	SC 3	SC 4	SC 5	SC 6	Total
Information systems	1	2	1		1		5
Computer science					1	1	2
Social sciences			1				1
E-government & E-participation		2	1	2	1	1	7
Public administration sciences	1						1
Organisational and management sciences				1		1	2

2.5. ADDING KNOWLEDGE RESOURCES TO THE KNOWLEDGE PORTAL

The knowledge portal of eGovPoliNet is a web-based repository containing state-of-the-art knowledge and references to knowledge assets in the field of ICT for governance and policy modelling (cf. Deliverable D 2.2[12] and D 2.3). It helps users to enable access to expertise between knowledge domains, by classifying and categorising existing assets of knowledge on ICT solutions for governance and policy modelling.

In the third period, in total 116 knowledge items were added to the portal in the following categories: publications, technical reports, grand challenges, presentations, and glossary. Table 5 provides an overview of the contents added.

Table 5: Knowledge assets added to the eGovPoliNet knowledge portal during the third period of the project

Publications		
1	Title	Policy Practice and Digital Science—Integrating Complex Systems, Social Simulation and Public Administration in Policy Research
	Authors	Marijn Janssen, Maria A. Wimmer, Ameneh Deljoo (Eds)
	Reference	M. Janssen, M. A. Wimmer, & A. Deljoo (Eds.) (2015) *Policy Practice and Digital Science – Integrating Complex Systems, Social Simulation and Public Administration in Policy Research* (Series: Public Administration and Information Technology). Berlin et al: Springer Verlag
2	Title	Analysis of Five Policy Cases in the Field of Energy Policy

[12] See technical report D 2.2 available online under http://www.policy-community.eu/results/technical-reports-and-publications/public-deliverables (last access: 30/01/2015)

	Authors	Dominik Bär, Maria A. Wimmer, Jozef Glova, Anastasia Papazafeiropoulou, Laurence Brooks
	Reference	Bär, D., Wimmer, M. A., Glova, J., Papazafeiropoulou, A., & Brooks, L. (2015). Analysis of Five Policy Cases in the Field of Energy Policy. In: M. Janssen, M. A. Wimmer, & A. Deljoo, *Policy Practice and Digital Science – Integrating Complex Systems, Social Simulation and Public Administration in Policy Research* (Series: Public Administration and Information Technology). Berlin et al: Springer Verlag
3	Title	Stakeholder engagement in policy development: Observations and lessons from international experience
	Authors	Natalie Helbig, Sharon Dawes, Zamira Dzhusupova, Bram Klievink, Catherine Gerald Mkude
	Reference	Helbig, N., Dawes, S. S, Dzhusupova, Z., Klievink, B., & Mkude, S. G. (2015). Stakeholder engagement in policy development: Observations and lessons from international experience. In: M. Janssen, M. A. Wimmer, & A. Deljoo, *Policy Practice and Digital Science – Integrating Complex Systems, Social Simulation and Public Administration in Policy Research* (Series: Public Administration and Information Technology). Berlin et al: Springer Verlag
4	Title	Comparative Analysis of Emerging Tools and Technologies Supporting Policy Modelling
	Authors	Eleni Kamateri, Eleni Panopoulou, Efthimios Tambouris, Konstantinos Tarabanis, Adegboyega Ojo, Deirdre Lee, David Price
	Reference	Kamateri, E., Panopoulou, E., Tambouris, E., Tarabanis, K., Ojo, A., Lee, D. & Price, D. (2015). Comparative Analysis of Emerging Tools and Technologies Supporting Policy Modelling. In: M. Janssen, M. A. Wimmer, & A. Deljoo, *Policy Practice and Digital Science – Integrating Complex Systems, Social Simulation and Public Administration in Policy Research* (Series: Public Administration and Information Technology). Berlin et al: Springer Verlag
5	Title	Features and Added Value of Simulation Models Using Different Modelling Approaches Supporting Policy-Making: A Comparative Analysis
	Authors	Dragana Majstorovic, Maria A. Wimmer, Roy Lay-Yee, Peter Davis, Petra Ahrweiler
	Reference	Majstorovic, D., Wimmer, M. A., Lay-Yee, R., Davis, P., & Ahrweiler, P. (2015). Features and Added Value of Simulation Models Using Different Modelling Approaches Supporting Policy-Making: A Comparative Analysis. In: M. Janssen, M. A. Wimmer, & A. Deljoo, *Policy Practice and Digital Science – Integrating Complex Systems, Social Simulation and Public Administration in Policy Research* (Series: Public Administration and Information Technology). Berlin et al: Springer Verlag
6	Title	State Stability: a Governance Analysis Framework for Arab Spring Countries
	Authors	Karim Hamza
	Reference	Hamza, K. 2014. State Stability: a Governance Analysis Framework for Arab Spring Countries. In Proceedings of the 8th International Conference on Theory and Practice of Electronic Governance (ICEGOV2014), 27-30 October 2014, Guimaraes, Portugal. ACM Press
7	Title	Future Scenarios of ICT Solutions for Governance and Policy Modelling

	Authors	Dragana Majstorovic and Maria A. Wimmer
	Reference	Majstorovic, D. and Wimmer, M. A. 2014. Future Scenarios of ICT Solutions for Governance and Policy Modelling. In Proceedings of the 8th International Conference on Theory and Practice of Electronic Governance (ICEGOV2014), 27-30 October 2014, Guimaraes, Portugal. ACM Press
8	Title	A Collaborative Approach to Study Policy Modelling Research and Practice from Different Disciplines
	Authors	Dragana Majstorovic and Maria A. Wimmer
	Reference	Majstorovic, D. and Wimmer, M. A. 2014. A Collaborative Approach to Study Policy Modelling Research and Practice from Different Disciplines. In Janssen et. Al (Eds.). Electronic Government and Electronic Participation. Joint Proceedings of Ongoing Research, Posters, Workshop and Projects of IFIP EGOV and ePart 2014. Innovation and the Public Sector nr. 21, IOS Press, Amsterdam, pp. 153-162
9	Title	Strategic Implementation Framework for Smart City in Developing Countries - The Case of Egypt
	Authors	Karim Hamza
	Reference	Hamza, K. (2015). Strategic Implementation Framework for Smart City in Developing Countries - The Case of Egypt. In J. R. Gil-Garcia, T. A. Pardo & T. Nam, *Smarter as the New Urban Agenda: A Comprehensive View of the 21st Century City*. Springer
10	Title	On Publishing Linked Open Government Data
	Authors	Evangelos Kalampokis, Efthimios Tambouris and Konstantinos Tarabanis
	Reference	Evangelos Kalampokis, Efthimios Tambouris, Konstantinos Tarabanis (2013) On Publishing Linked Open Government Data. Proceedings of the 17th Panhellenic Conference on Informatics, pp. 25-32, DOI: 10.1145/2491845.2491869
11	Title	A domain model for online community building and collaboration in eGovernment and policy modelling
	Authors	Eleni Kaliva, Eleni Panopoulou, Efthimios Tambouris and Konstantinos Tarabanis
	Reference	Eleni Kaliva, Eleni Panopoulou, Efthimios Tambouris, Konstantinos Tarabanis, (2013)A domain model for online community building and collaboration in eGovernment and policy modelling, Transforming Government: People, Process and Policy, Vol. 7 Iss: 1, pp.109 - 136
12	Title	Introduction to Policy Making in the Digital Age
	Authors	Marijn Janssen and Maria A. Wimmer
	Reference	M. Janssen and M. A. Wimmer (2015) Introduction to Policy Making in the Digital Age, In: M. Janssen, M. A. Wimmer, & A. Deljoo, Policy Practice and Digital Science – Integrating Complex Systems, Social Simulation and Public Administration in Policy Research (Series: Public Administration and Information Technology). Berlin et al: Springer Verlag
13	Title	Educating Public Administrators and Policy Analysts in the Era of Informatics
	Authors	Chris Koliba and Asim Zia
	Reference	C. Koliba and A. Zia (2015) Educating Public Administrators and Policy Analysts in the Era of Informatics, In: M. Janssen, M. A. Wimmer, & A. Deljoo, Policy

		Practice and Digital Science – Integrating Complex Systems, Social Simulation and Public Administration in Policy Research (Series: Public Administration and Information Technology). Berlin et al: Springer Verlag
14	Title	The Quality of Social Simulation: An Example from Research Policy Modelling
	Authors	Petra Ahrweiler and Nigel Gilbert
	Reference	P. Ahrweiler and N. Gilbert (2015) The Quality of Social Simulation: An Example from Research Policy Modelling, In: M. Janssen, M. A. Wimmer, & A. Deljoo, *Policy Practice and Digital Science – Integrating Complex Systems, Social Simulation and Public Administration in Policy Research* (Series: Public Administration and Information Technology). Berlin et al: Springer Verlag
15	Title	Policy Making and Modelling in a Complex World
	Authors	Wander Jager and Bruce Edmonds
	Reference	W. Jager and B. Edmonds (2015) Policy Making and Modelling in a Complex World, In: M. Janssen, M. A. Wimmer, & A. Deljoo, *Policy Practice and Digital Science – Integrating Complex Systems, Social Simulation and Public Administration in Policy Research* (Series: Public Administration and Information Technology). Berlin et al: Springer Verlag
16	Title	From Building a Model to Adaptive Robust Decision-Making Using Systems Modelling
	Authors	Erik Pruyt
	Reference	E. Pruyt (2015) From Building a Model to Adaptive Robust Decision-Making Using Systems Modelling, In: M. Janssen, M. A. Wimmer, & A. Deljoo, *Policy Practice and Digital Science – Integrating Complex Systems, Social Simulation and Public Administration in Policy Research* (Series: Public Administration and Information Technology). Berlin et al: Springer Verlag
17	Title	Value Sensitive Design of Complex Product Systems
	Authors	Andreas Ligtvoet, Geerten van de Kaa, Theo Fens, Cees van Beers, Paulien Herder and Jeroen van den Hoven
	Reference	A. Ligtvoet, G. van de Kaa, T. Fens, C. van Beers, P. Herder and J. van den Hoven (2015) Value Sensitive Design of Complex Product Systems, In: M. Janssen, M. A. Wimmer, & A. Deljoo, *Policy Practice and Digital Science – Integrating Complex Systems, Social Simulation and Public Administration in Policy Research* (Series: Public Administration and Information Technology). Berlin et al: Springer Verlag
18	Title	Values in Computational Models Revalued: The Influence of Designing Computational Models on Public Decision-Making Processes
	Authors	Rebecca Moody and Lasse Gerrits
	Reference	R. Moody and L. Gerrits (2015) Values in Computational Models Revalued: The Influence of Designing Computational Models on Public Decision-Making Processes, In: M. Janssen, M. A. Wimmer, & A. Deljoo, *Policy Practice and Digital Science – Integrating Complex Systems, Social Simulation and Public Administration in Policy Research* (Series: Public Administration and Information Technology). Berlin et al: Springer Verlag
19	Title	The Psychological Drivers of Bureaucracy: Protecting the Societal Goals of an Organization

	Authors	Tjeerd Andringa
	Reference	T. Andringa (2015) The Psychological Drivers of Bureaucracy: Protecting the Societal Goals of an Organization, In: M. Janssen, M. A. Wimmer, & A. Deljoo, *Policy Practice and Digital Science – Integrating Complex Systems, Social Simulation and Public Administration in Policy Research* (Series: Public Administration and Information Technology). Berlin et al: Springer Verlag
20	Title	Active and Passive Crowdsourcing in Government
	Authors	Euripidis Loukis and Yannis Charalabidis
	Reference	E. Loukis and Y. Charalabidis (2015) Active and Passive Crowdsourcing in Government, In: M. Janssen, M. A. Wimmer, & A. Deljoo, *Policy Practice and Digital Science – Integrating Complex Systems, Social Simulation and Public Administration in Policy Research* (Series: Public Administration and Information Technology). Berlin et al: Springer Verlag
21	Title	Management of Complex Systems: Towards Agent-Based Gaming for Policy
	Authors	Wander Jager and Gerben van der Vegt
	Reference	W. Jager and G. van der Vegt (2015) Management of Complex Systems: Towards Agent-Based Gaming for Policy, In: M. Janssen, M. A. Wimmer, & A. Deljoo, *Policy Practice and Digital Science – Integrating Complex Systems, Social Simulation and Public Administration in Policy Research* (Series: Public Administration and Information Technology). Berlin et al: Springer Verlag
22	Title	The Role of Micro-Simulation in the Development of Public Policy
	Authors	Roy Lay-Yee and Gerry Cotterell
	Reference	R. Lay-Yee and G. Cotterell (2015) The Role of Micro-Simulation in the Development of Public Policy, In: M. Janssen, M. A. Wimmer, & A. Deljoo, *Policy Practice and Digital Science – Integrating Complex Systems, Social Simulation and Public Administration in Policy Research* (Series: Public Administration and Information Technology). Berlin et al: Springer Verlag
23	Title	Visual Decision Support for 378 Policy-Making—Advancing Policy Analysis with Visualization
	Authors	Tobias Ruppert, Jens Dambruch, Michel Krämer, Tina Balke, Marco Gavanelli, Stefano Bragaglia, Federico Chesani, Michela Milano and Jörn Kohlhammer
	Reference	T. Ruppert, J. Dambruch, M. Krämer, T. Balke, M. Gavanelli, S. Bragaglia, F. Chesani, M. Milano and J. Kohlhammer (2015). Visual Decision Support for 378 Policy-Making—Advancing Policy Analysis with Visualization. In: M. Janssen, M. A. Wimmer, & A. Deljoo, *Policy Practice and Digital Science – Integrating Complex Systems, Social Simulation and Public Administration in Policy Research* (Series: Public Administration and Information Technology). Berlin et al: Springer Verlag
24	Title	Challenges to Policy-Making in Developing Countries and the Roles of Emerging Tools, Methods and Instruments—Experiences from Saint Petersburg
	Authors	Lyudmila Bershadskaya, Andrei Chugunov and Dmitrii Trutnev
	Reference	L. Bershadskaya, A. Chugunov and D. Trutnev (2015) Challenges to Policy-Making in Developing Countries and the Roles of Emerging Tools, Methods and Instruments—Experiences from Saint Petersburg. In: M. Janssen, M. A. Wimmer, & A. Deljoo, *Policy Practice and Digital Science – Integrating Complex Systems,*

		Social Simulation and Public Administration in Policy Research (Series: Public Administration and Information Technology). Berlin et al: Springer Verlag
25	Title	Sustainable Urban Development, Governance and Policy: A Comparative Overview of EU Policies and Projects
	Authors	Diego Navarra, Simona Milio, and Isabel Canto de Loura
	Reference	D. Navarra, S. Milio, and I. Canto de Loura (2015) Sustainable Urban Development, Governance and Policy: A Comparative Overview of EU Policies and Projects. In: M. Janssen, M. A. Wimmer, & A. Deljoo, *Policy Practice and Digital Science – Integrating Complex Systems, Social Simulation and Public Administration in Policy Research* (Series: Public Administration and Information Technology). Berlin et al: Springer Verlag
26	Title	E-participation, Simulation Exercise and Leadership Training in Nigeria: Bridging the Digital Divide
	Authors	Tanko Ahmed
	Reference	T. Ahmed (2015) E-participation, Simulation Exercise and Leadership Training in Nigeria: Bridging the Digital Divide. In: M. Janssen, M. A. Wimmer, & A. Deljoo, *Policy Practice and Digital Science – Integrating Complex Systems, Social Simulation and Public Administration in Policy Research* (Series: Public Administration and Information Technology). Berlin et al: Springer Verlag
Technical reports		
27	D 1.2. Final community building strategy	
28	D 2.2 eGovPoliNet portal including advanced functions for community and constituency building (version 2: final version of D 2.1)	
29	D 2.3 Final sustainable eGovPoliNet portal	
30	D 3.2 Community and Constituency Building Report Year 2	
31	D 3.3 Final Community and Constituency Building Report	
32	D 4.2 Synthesis Report of Knowledge Assets, including Visions	
33	D 4.3 Final report on knowledge assets in portal and final grand challenges	
34	D 5.2 Dissemination Report year 2, including initial business and exploitation plan	
35	D 5.3 Final Dissemination report, including business and exploitation plan for sustaining eGovPoliNet	
Grand challenges		
36	Grand challenge 1 - Data and information characteristics and use	
37	Grand challenge 2 - Modelling and simulation	
38	Grand challenge 3 - Citizen and stakeholder engagement	
39	Grand challenge 4 - Government capabilities and legitimacy	
40	Grand challenge 5 - Translating research results into policy actions and support	
Presentations		
41	Cross-disciplinary collaboration in public policy modelling: international experiences and future directions	

42	A Collaborative Approach to Study Policy Modelling Research and Practice from Different Disciplines
43	Future Scenarios of ICT Solutions for Governance and Policy Modelling
44	Cross-disciplinary collaboration in policy modelling: International experiences from the eGovPoliNet community
45	eGovPoliNet: Modelling public policy and tools for stronger civic engagement
46	Policy Innovation and Digital Science Track Along ICEGOV 2014
47	Introductory presentation for "Policy Innovation and Digital Science" track along ICEGOV 2014

Glossary

48	Agent-based Modelling	**49**	Agenda Setting Theory
50	Artificial Model Data	**51**	Behavioural change
52	Business Process	**53**	Community
54	Conceptual Model	**55**	Conceptual Modelling
56	Complex System	**57**	Complexity Theory
58	Declarative Model	**59**	Design Thinking
60	Discipline	**61**	Dynamic Adaptation
62	Dynamic System	**63**	Economic Theories
64	Evidence	**65**	Game Theory
66	Forecasting	**67**	Formal Method
68	Formal Model	**69**	Formal Modelling
70	Graph Theory	**71**	Hypothesis
72	Institutional Choice Theory	**73**	Innovation Network
74	Institutional Model	**75**	IT Governance
76	Linear Program	**77**	Linear Programming
78	Macroeconomic models	**79**	Macro-Simulation
80	Mathematical Model	**81**	Mathematical Modelling
82	Mathematical Programming	**83**	Micro-Simulation
84	Method	**85**	Methodology
86	Modelling	**87**	Networked Governance
88	Network Governance School (NWG)	**89**	Network Theory
90	Normative Model	**91**	Open Data
92	Open Government	**93**	Open Linked Data
94	Policy Informatics	**95**	Policy Lifecycle
96	Policy Model	**97**	Policy Modelling
98	Policy Network Analysis (PNA)	**99**	Public Governance
100	Public Value Management	**101**	Rational Choice Theory
102	Semantic Technologies	**103**	Simulation Model
104	Social Media	**105**	Social Network

106	Social Network Analysis	**107**	Stakeholder
108	Structural Change	**109**	System Dynamics
110	Technology	**111**	Tool
112	Traceability	**113**	Verification
114	Web 2.0	**115**	Web 3.0
116	Wicked problem		

Beyond the work of CROSSOVER, eGovPoliNet added in total 171 knowledge items to the portal. Table 6 provides an overview of the content added to the portal by eGovPoliNet.

Table 6: An overview of knowledge assets added to the portal by eGovPoliNet

Category	**Number of knowledge assets added to the portal**
Conference publications & Book chapters	31
Individuals	13
White papers of comparative analyses	9
Visionary scenarios	6
Glossary terms	90
Technical reports	9
Grand challenges of research	5
Presentations	7
Projects	1

3. BASIC UNDERSTANDING OF GRAND CHALLENGES AND METHOD FOR DERIVING GRAND CHALLENGES

This chapter first provides an understanding of grand challenges and subsequently documents the method applied to the scenario analysis and the development of grand challenges. The subsequent chapters present the results of scenario analysis (chapter 4), the grand challenges (chapter 5) and recommendations to target groups for how to tackle these grand challenges (chapter 6).

3.1. WHAT ARE GRAND CHALLENGES?

The National Science Foundation (NSF) of the USA defines grand challenges as „fundamental problems of science and engineering, with broad applications, whose solutions would be enabled by high-performance computing (HPC) resources …" and which „cannot be solved by advances in HPC alone: they also require extraordinary breakthroughs in computational models, algorithms, data and visualization technologies, software and collaborative organizations uniting diverse disciplines"[13]. Meyer argues that grand challenges should "mobilise a significant part of the community, on a key unsolved issue, for a decade or so, with ambitious goals that can in principle be attained, but not without special effort, resources and dedication" (Meyer, 2003).

The project partners agree that dealing with grand challenges needs the combined efforts of various social and technical disciplines, such as electronic government, information systems, complex systems, public administration & policy research, social simulation and computer science.

3.2. METHOD FOR THE DEVELOPMENT OF GRAND CHALLENGES

The objectives of work package 4 include the development of grand challenges of research in the field. The work description suggests to embark on the inputs from the visionary scenarios to draw research needs and develop grand challenges of research. Following this, the process of developing grand challenges is outlined in Figure 3. The process started with the inputs from the scenario development, i.e. the six final scenarios. After the second period of the project, the work package 4 leader UKL started to identify major aspects of the scenarios relevant for the research field. In doing so, the method of scenario analysis as suggested by (Janssen M. , et al., 2007) was followed. This method identified three key dimensions with a high impact on technology developments (environment, attitude toward government, and scope of government activities) and with a dichotomy of two possible opposite values per dimension in order to categorise and analyse visionary scenarios in technology road-mapping (Janssen M. , et al., 2007). This approach was customised to the field of policy making as follows (adopted from (Janssen, van der Duin, & Wimmer, Methodology for scenario building, 2007), p. 26 and (Janssen, Wimmer, Bicking, & Wagenaar, 2007):

- *The environment* can be stable or disruptive. A stable environment is characterised by a high satisfaction of the citizens and by economic growth. A disruptive environment is unstable and is characterised by corruption, crimes and a large social divide.
- *The attitude toward government* is characterised by either trust or distrust. In the former, the policy decision-making is transparent and citizens believe that the government is fair, while the latter presents an atmosphere lacking good governance principles such as openness and transparency and consequently citizens distrust governments as a whole and/or their decisions.
- *The scope of government activities* is either all-inclusive (governments provide a wide range of services) or reduced to only cover core services and functions (governments rely to a large extent on the private and civil sectors for service provision and they intervene only where necessary,

[13] NSF - http://www.nsf.gov/cise/aci/taskforces/TaskForceReport_GrandChallenges.pdf (last access: 30/01/2015)

i.e. governments only act where the scope of decision-making falls into the core responsibility of the public sector).

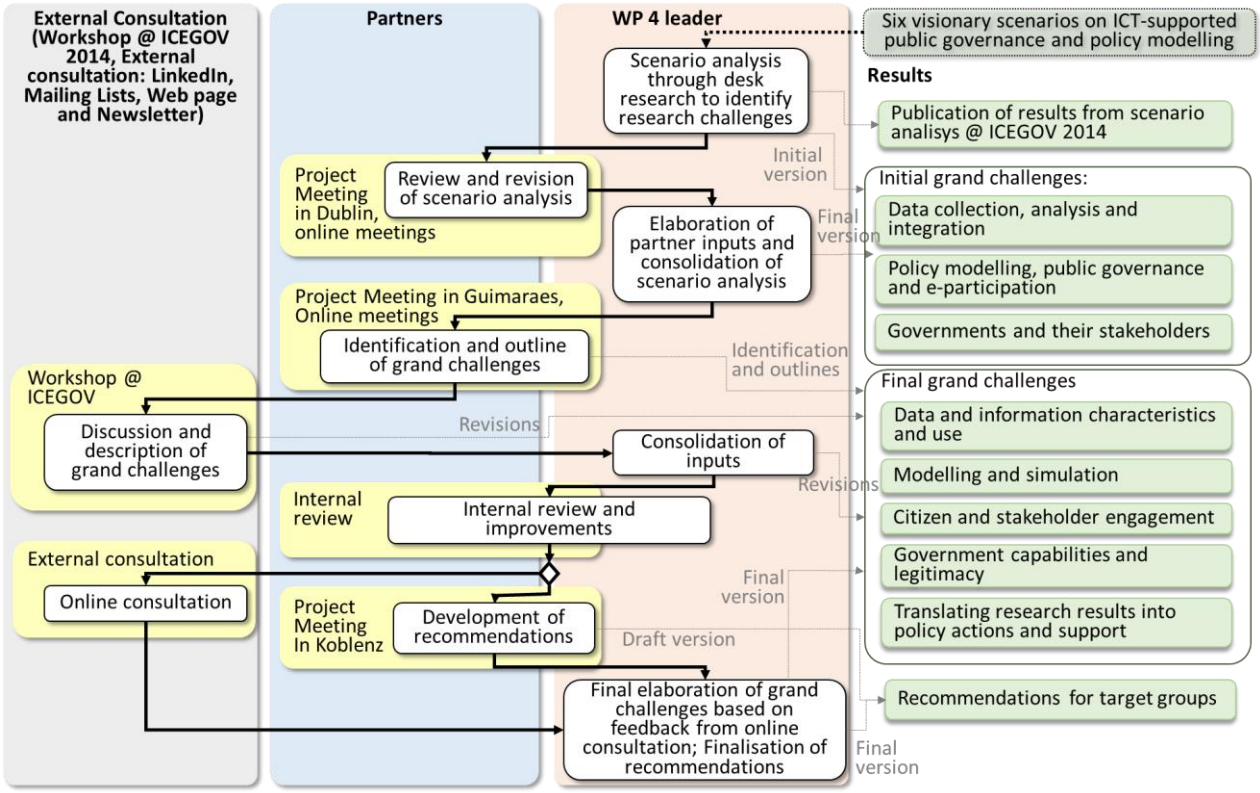

Figure 3: eGovPoliNet's process to develop grand challenges of research

Besides these three core dimensions, four further dimensions were used to categorise the issues from the analysis. These were in principle already used to guide the scenario development in the second period[14], but were slightly revised and complemented with key questions to guide the discussions and analysis as follows:

- Social and contextual environment
  - How will the data be used?
  - What kind of data will feed into policy decision-making and policy modelling?
  - How networked will actors and tools be?
  - How well will social aspects be considered?
- Governments and their stakeholders, and citizen engagement
  - Who are the key actors in policy making?
  - What are the particular services for policy modelling?
  - What kinds of interaction take place between actors for service consumption, service delivery and policy decision-making?
  - How intensively are the stakeholders included in policy modelling?
- ICT standards and tools

[14] See technical report D 4.2, p. 10, available online under http://www.policy-community.eu/results/technical-reports-and-publications/public-deliverables (last access: 26/01/2015)

  - What tools are used for the engagement in policy making?
  - In which ways do governments and their stakeholders use ICT tools?
  - What tools are used for policy modelling and for governance?
  - How much interconnectedness and integration is achieved?
  - How much are innovative and new tools and technologies explored?
- Benefits of ICT solution
  - What are the benefits of using ICT solutions in policy modelling and governance?
  - How will ICT solutions in governance and policy making contribute to implement good governance principles?
  - Who will benefit the most?

Based on the three core dimensions and the four particular dimensions as described above, each scenario was analysed to identify relevant research needs and gaps of current research. The research needs derived from this analysis were grouped into three categories as indicated in Figure 3. Subsequently, the scenario analysis was discussed among the project partners in offline and online meetings, in particular in the project meeting in Dublin in September 2014. Project partners provided feedback and suggestions for revisions of the issues identified along the scenario analysis, which were subsequently incorporated in the results of the scenario analysis. Chapter 4 documents the final results of this scenario analysis, which served as key input for the subsequent formulation of grand challenges. An earlier version of the results is published in (Majstorovic & Wimmer, Future Scenarios of ICT Solutions for Governance and Policy Modelling, 2014).

The results of the scenario analysis was the starting point for the development of grand challenges of research in the field of public governance and policy modelling. Initial work on grand challenges was performed in the project meeting in Dublin in September 2014. In group works, partners analysed the six scenarios and identified research gaps. These were subsequently consolidated into three initial grand challenges. Key work of formulating grand challenges was then carried out along the project meeting in Guimaraes (Portugal) and the external consultation along a workshop @ ICEGOV 2014 end of October 2014. The workshop with project partners discussed the results of the scenario analysis and reflected the meaning of grand challenges of research. In plenary discussion, the three categories of research needs identified in the scenario analysis were reviewed and discussed. The result of the discussion among project partners was the identification of five grand challenges of research as indicated in Figure 3. Four of the five grand challenges were also characterised with key research questions (grand challenge "Translating research results into policy actions and support" was not described due to time constraints). It was agreed that the five grand challenges would be exposed to group discussions with external experts along the workshop scheduled for ICEGOV 2014 the subsequent day, and that the grand challenge not yet detailed would in any case be discussed in a group. In the workshop with external experts, four groups were formed to discuss and characterise the grand challenges of research identified the day before. Again, four groups were formed to discuss the grand challenges. This time grand challenge "Data and information characteristics and use" was not discussed.

After the meetings in Guimaraes, UKL consolidated the results and internal discussions and reviews of project partners followed, which refined and completed the grand challenges of research for the online consultation. To ensure a common way of description, the grand challenges of research were outlined along the following aspects:

- A brief abstract motivating the grand challenge, and the underlying gaps grounding the grand challenge
- The challenges to be faced and formulated along a set of research questions
- Innovations and wider impact expected when tackling the research demands

By mid January 2015, the work package leader prepared the online consultation as indicated in Figure 3 by

- publishing the final draft descriptions of the grand challenges on the project website: http://www.policy-community.eu/results/grand-challenges-of-research/
- Preparing the explanations for the online consultation and the meaning of the grand challenges
- Preparing an online questionnaire
- Announcing the invitation to the online consultation in LinkedIn groups (Policy Making 2.0[15] and EGOV researcher community[16]) and in various Mailing Lists such as: PIN-L@LISTSERV.ALBANY.EDU, EGOV list, SEWORLD, WI@aifb (german-focused), DGSNA (facebook), SIMSOC@JISCMAIL.AC.UK;
  Partners also sent the invitation to their closed community networks.
- Publishing a newsletter with the invitation to the online consultation

The online consultation with experts was enabled through different means as follows:

- Filling in the online questionnaire, which contained a rating of the importance of each of the grand challenges and a set of structured questions. The questionnaire and invitation text is provided in Annex I: Questionnaire for the online consultation.
- Discussing and "liking" each of the grand challenges in the LinkedIn group Policy Modelling 2.0
- Commenting the grand challenges on the web page

In February 2015, the results of the online consultation were analysed. The results of the grand challenges development - including interim versions, final version, and inputs from the online consultation - are documented in chapter 5.

The last step of the grand challenges development was to derive recommendations for policy actors in regards to how to tackle the grand challenges of research – see indication in Figure 3. The main inputs for the recommendations were gathered along the project meeting in Koblenz in mind January 2015. Two groups discussed recommendations, which were subsequently presented and discussed in the plenary. Furthermore, inputs were sought from the online consultation. I.e. a post in the LinkedIn group invited experts to suggest recommendations, and the online questionnaire asked for recommendations. The recommendations were consolidated by the work package leader and are documented in chapter 6.

4. SCENARIO ANALYSIS: IDENTIFYING CHALLENGES AND GAPS OF RESEARCH

Following the process as described for the scenario analysis in section 3.2, Table 7 through Table 12 document the analysis of the six visionary scenarios eGovPoliNet partners developed in period 2. The description of the scenario analysis follows the approach suggested and is done along the three core dimensions and four further dimension. The objective of this analysis was to identify major aspects relevant for future research on ICT-supported governance and policy modelling and to well ground the grand challenges of research that will be developed next.

[15] See https://www.linkedin.com/groups/Policy-Making-20-4165795 (last access: 30/01/2015)

[16] See https://www.linkedin.com/groups?home=&gid=166290 (last access: 30/01/2015)

Table 7: Analysis of Scenario 1 - Using air quality monitoring data to track and improve public health

Values of core dimensions		
Environment	Attitude toward government	Government scope
Stable	Trust	all-inclusive
Key issues along further dimensions		
Social and contextual environment	ICT standards and tools	
Data from all relevant sources feed a central database Crowd sourcing is employed to collect data Central database is freely accessible to citizens to connect and use the data Data is integrated into the best estimates, aggregated and correlated at different levels, updated hourly and rated with respect to reliability of the sources Transparency is high	Policy consultations Open government data analysis Visualisation tools Big data analysis tools Simulation models Pollution standards Data protection protocols User-centric services Extensive provision of free cloud services for the population Services are embedded into various mobile and ubiquitous devices	
Governments and their stakeholders	Benefits of the ICT solutions	
Scientists and policy researchers Community health advocates Educational institutions Regional and national governmental agencies Citizens	Support in scientific studies Forecast short-term health threats Predictions of climate changes Policy analysis Urban and regional planning Health care services ICT support provides benefit to all stakeholders	

Table 8: Analysis of Scenario 2 - Policy decision-making using intelligent simulations and exploiting open and big data sources

Values of core dimensions		
Environment	Attitude toward government	Government scope
Stable	trust	all-inclusive
Key issues along further dimensions		
Social and contextual environment	ICT standards and tools	
Combined social and formal simulations Citizens develop their own simulations to participate in policy decisions Opinions from social media integrated in simulation models Open government data feed simulation models Big data analytics	Tools for overcoming information overload Tools for collecting opinions from social media Big data analytics tools E-participation tools Comprehensive simulation platforms combining tools supporting distinct modelling paradigms Platforms for the exchange of data	

Participation platforms enable interaction and collaboration Openness and transparency	Building blocks for quick simulation building Visualisation tools Tools for the analysis of open government data Tools for the analysis of unstructured data and subjective opinions (e.g. based on text mining) Tools for the integration of open government data in simulation models
Governments and their stakeholders	Benefits of the ICT solutions
Personalised interaction between government and citizens Evidence-driven communication between stakeholders NGOs Citizens Crowds and swarm intelligence Private companies Governmental institutions	Transparent decision-making process Stakeholders involved in policy decision-making Stakeholders better informed about policy options Building capacity of stakeholders to engage in policy making process Stakeholders have better understanding of policies Alternative choices of policy making become more reliable Complexity of system dynamics become manageable Combination of distinct simulation modelling paradigms help to better understand complex social policy processes

Table 9: Analysis of scenario 3 – Public-private innovation policy scenario

Values of core dimensions		
Environment	Attitude toward government	Government scope
Stable	trust	all-inclusive
Key issues along further dimensions		
Social and contextual environment		ICT standards and tools
High government investments in education and research Citizens engaged in new drug development Innovations origin in research Government stimulates quick adoption of innovations Governments provide open government and big data Government organises policy agencies for science, technology and innovation at regional levels Agent-based simulations used to evaluate business risks for new companies Government provides start-up budget for a new company Universities offer resources to a new company Transparency is high		Crowd sourcing to collect, analyse & develop relevant data Tools for big data analysis Open access database for new research findings E-voting and e-participation Knowledge-based systems for technology and innovation management Tools for marketing research and patent search Crowd funding and systems for business plan preparation for innovation companies Integrated ICT support for the development of young innovation companies Business intelligence tools
Governments and their stakeholders		Benefits of the ICT solutions
Public-private partnerships Universities and research institutions Citizens		New drug development is less expensive, safer, less dominated by big companies, integrated into society Reduced time-to-market of a new drug

Government policy agencies Health advocates Health experts Politicians	A stream of innovative solutions to health problems Proper supervision and control before drugs are released for widespread use and the market

Table 10: Analysis of scenario 4 - Optimising emergency response

Values of core dimensions		
Environment	Attitude toward government	Government scope
Stable	trust	all-inclusive
Key issues along further dimensions		
Social and contextual environment		ICT standards and tools
Simulation models are used for insights on expected behaviour of stakeholders Simulation models integrate previous experiences in similar emergency situations Real-time simulation models used for responding to emergencies Personalised evacuation instructions Crowd sourcing Automatic discovery of new emergencies Transparency is high		Universal wireless networks Sector-specific regulations Tools for automated discovery of emergencies Networked ICT systems Geographic information syst. Mobile network services, especially positioning and communication Tools for integration of current information in simulation Simulation models for trainings Real-time simulation models Tools for analysis of open government data and for integration thereof in simulation models
Governments and their stakeholders		Benefits of the ICT solutions
Citizens Emergency teams such as police, fire departments, medical services, rescue services, coastguard Local government authorities		Decreased impact of emergency situations on human life and on goods Increased effectiveness of emergency response teams and of recovery efforts Individualisation of emergency procedures

Table 11: Analysis of scenario 5 - Using smart and mobile ICT for developing governance and policy

Values of core dimensions		
Environment	Attitude toward government	Government scope
stable	trust	all-inclusive
Key issues along further dimensions		
Social and contextual environment		ICT standards and tools
New wearable technologies integrated into daily life No digital and social divide Citizens engaged in data collection using swarm intelligence Online networks connected and “intelligent”		Massive use of implanted/ ubiquitous and wearable devices Dealing with automatically generated data from wearable devices

Individual and community inputs to policy making Citizens engaged in policy decision-making through ICT Wearable technologies provide new norms for citizen engagement in policy decision process Mobility is fully supported Transparency is improved	Tools for open government data and big data analytics Serious games tools for people to take various roles E-participation and e-voting tools Internet of things fully spread Massive use of web 3.0 and web 4.0 Internet of Things
Governments and their stakeholders	Benefits of the ICT solutions
Citizens Local governmental institutions Companies that develop new technologies Research institutions, especially technology institutes and technology innovation centres Anytime anywhere citizen engagement	Citizens involved in different kinds of decision-making processes and urban planning, with the decision at the hands of citizens Lowering participation threshold Citizens have impact on policy decisions Local governments focused on issues that are most important for citizens Improved decision-making process

Table 12: Analysis of scenario 6 - Information warfare impact on developing governance and policy modelling

Values of core dimensions		
Environment	Attitude toward government	Government scope
Stable	trust	all-inclusive
Key issues along further dimensions		
Social and contextual environment	ICT standards and tools	
International relationships with cooperation between governments of different countries are critical Data protection a big issue Security vs. openness to be resolved Privacy vs. security to be resolved Political pressure by abusing information and technology tools used by governance and policy-makers Governance and policy modelling technologies become the information backbone of governments Non-military approaches in data and information protection Increased resources devoted to cyber forensics	Tools preventing from e-crimes and e-terrorism, Cyber forensics tools Monitoring technologies Information and knowledge management Security standards Information warfare strategy Safeguarding tools emerging from the information warfare strategy Legal regulations and appropriate policies crucial Sponsor research, development, and standard creation in computer network defence Allies networks to discover joint threats through artificial intelligence and early detection systems Tools for raising awareness among citizens how to protect themselves and report violation, Tools for Social Network Analysis and for serious games	
Governments and their stakeholders	Benefits of the ICT solutions	
Internal stakeholders (within the boundaries of a country): pressure groups, political parties, private sector, citizens External stakeholders: other countries, multinational businesses, worldwide operating organisations	Safety and reliability of information Privacy protection Assurance of services Increased attention in developing models that can assess government conditions, evaluate the influence of	

Interactions between stakeholders inside and outside the government Departments of international affairs Role of the government and regulative environment	stakeholders on service provision and security mechanisms and provide early warnings

As can be noted from the above analysis, all six scenarios were formulated with a positive attitude towards governments, i.e. the three core dimensions' values are the same for all six scenarios, namely:

- Environment: stable
- Attitude toward Government: trust
- Scope of Government activities: all-inclusive

Based on the initial desk-based scenario analysis of the work package leader, the project partners discussed the scenario analysis in a physical meeting in Dublin in September 2014 (see also next section). In plenary discussions, partners provided feedback and suggestions for revisions of the issues identified along the scenario analysis, which was subsequently incorporated. The content of the tables above covers the updated analysis results. The results of the initial analysis performed by UKL are published in (Majstorovic & Wimmer, Future Scenarios of ICT Solutions for Governance and Policy Modelling, 2014).

The next step was to derive grand challenges from this analysis (see next chapter).

5. GRAND CHALLENGES OF RESEARCH

The process of elaborating grand challenges as presented in Figure 3 indicates in the next step after scenario analysis a gap analysis of research by project partners. This was done along the project meeting in Dublin in September 2014. Next, these inputs were synthesised and a first set of grand challenges was identified (see section 5.1), which were further reviewed and extended along the Guimaraes meeting and workshop with external experts in October 2014 (see sections 5.2 and 5.3). The work package leader finally consolidated these inputs and with the help of partners, the final draft of grand challenges was developed, which was exposed to an online consultation with external experts in January 2015. Based on the input of this online consultation, the final grand challenges were derived, which are documented in section 5.5.

5.1. RESULTS OF ANALYSIS BY PARTNERS: THREE INITIAL GRAND CHALLENGES

During the Dublin meeting in September 2014, groups of eGovPoliNet partners were organised to formulate gaps in current research that lead to grand challenges. The starting point for the discussion were the six final scenarios and the initial scenario analysis. The key question driving the discussion was: which aspects of the scenarios are not (or not sufficiently) covered yet by current research.

Along the group discussions, partners identified in total 48 gaps. These indications of gaps were further analysed by the partners during the Dublin meeting. Through further analysis by desk work, UKL structured the identified gaps until the next technical meeting in October 2014 and grouped them into three grand challenges that seemed to emerge from the scenario analysis, namely:

- Data collection, analysis and integration
- Policy modelling, public governance and e-participation
- Governments and their stakeholders

Within these three main groups, ten challenges of research were derived from the scenario analysis. Table 13 through Table 15 show ten research challenges identified by eGovPoliNet partners, which are

grouped along the three initial grand challenges of research. The third column presents the indication of where (in which scenario) partners found that need.

Table 13: Research challenges identified in data collection, analysis and integration

Data collection, analysis and integration in public governance and policy modelling		
No.	**Indications of research challenges and gaps**	**Emerging from scenario**
1 Quality of data		
1.1	Sensors not working properly and their technological limitations	1, 6
1.2	Certification of data sources (trust)	1
1.3	Data provenance	1
1.4	Data manipulation	1,3
1.5	Storing of data	1,3
1.6	Mechanisms for ensuring data quality, ownership and reliability of data	1,3
1.7	Reliable geographic landscape	4
2 Data sharing and usage		
2.1	Linking data because they are heterogeneous	1
2.2	How can ordinary citizens who are not data scientist make sense out of the vast amount of data	1
2.3	Creating of a large database with data containing all trials and experiments conducted ever	3
2.4	Public/private interaction, e.g. whether phone companies are willing to share information, such as where people physically are, their behaviour, etc.	4
3 Big data and open data		
3.1	Creation of a big data source	1
3.2	Feeding big data/open data into simulation models	2
4 Information overload		
4.1	How to prevent information overload	6
4.2	Explore technological facilities for information distribution so that the right information is provided in the right time	6

Table 14: Research challenges identified in policy modelling, public governance and e-participation

Policy modelling, public governance and e-participation		
No.	**Indications of research challenges and gaps**	**Emerging from scenario**
5 Simulation models		
5.1	Development of easy to manipulate models	3
5.2	Integration of various types of simulation approaches in simulation platforms	3
5.3	Using of simulations instead of trials on animals and humans	3
5.4	DNA simulations and effects of different diseases and possible cures	3
5.5	Correct interpretation of simulation outcomes (avoiding wrong interpretation)	3
5.6	Usage of visualisation tools in the most effective way to understand results of simulation models	2

5.7	How to test simulation systems whether they will work properly in the real situation	4
5.8	How big data/open data and the vast amount of information can be integrated into technology platforms and effectively used to develop reliable simulation models	2, 4
6 E-participation		
6.1	Engaging people in policy modelling	2
6.2	Capacities of people to use and understand complex policy models	2
6.3	Supporting/encouraging E-participation	5
6.4	Lowering the threshold for ordinary citizens to participate (visualisation, interpretation support etc.)	1,3
7 Public governance and collaboration		
7.1	Governance/business models (dealing with power)	1,3
7.2	Collaborations across different disciplines to be supported	2
7.3	Cross agency/organisational communication	4
7.4	Which methods can be used and combined in policy decision-making process	2
7.5	Policy modelling platforms that integrate different approaches to policy modelling	2
8 Information and communication technology		
8.1	How smart/mobile technologies can really contribute towards policy development	5
8.2	Making decisions about developments of new buildings in a city by walking around the virtual landscape	5
8.3	Over-dependency on technology - what happens when it stops working, i.e. 'technology betrayal'	5
8.4	Which technology platforms, modelling paradigms and theories can support models to provide security mechanisms	6
8.5	Better understanding of how information threatening systems work	6

Table 15: Research challenges identified in governments and their stakeholders

Governments and their stakeholders		
No.	**Indications of research challenges and gaps**	**Emerging from scenario**
9 Government's role		
9.1	Ensuring trust	1
9.2	Dealing with fragmented government since governments are geographically organised. Often no agreements between states/countries about borderless problems such as pollution	1
9.3	Organising public-private governance models for governing public and private parties.	3
9.4	Dealing with the power of organisations	3
8.5	Defining the obligations of a government concerning quality of data and open access to data	1
9.6	Creating a sustainable business model to promote opening and usage of data	1
10 Privacy protection		

10.1	Understand the right balance between secrecy of decision-making and transparency. How much secrecy of a strategy decision-making can be kept while there is demands for openness? If everything is transparent before data are used for decisions making, then it brings danger for governments and public governance might become not operable.	6
10.2	Understand how much opening is reasonable and how much protection is necessary in order not to be too much vulnerable for information attacks	6
10.3	Define how much personal information should be collected/shared. How to address the issue of trust: naivety of giving personal data and thinking they will not be used	5, 6
10.4	Which legal and technical frameworks can be provided in order to enable exploitation of data and technologies in supporting struggle against e-crime while ensuring privacy	6
10.5	Intellectual property, privacy issues, ethical issue	1, 3

The next step in developing grand challenges was the involvement of partners and of experts from a wider community of academia and practice during a project meeting and workshop at ICEGOV 2014[17]. The next section documents the results of the project meeting, while section 5.3 documents the inputs gathered from the workshop with external experts.

5.2. FIRST REFINEMENT RESULTING IN FIVE GRAND CHALLENGES OF RESEARCH

In the technical meeting of project partners along ICEGOV 2014 at the end of October 2014, discussions were organised to further elaborate the analysis and to synthesise results presented in the previous Section (see Section 5.2). First, the notion of "grand challenge" was discussed and the understanding, as presented in Section 3.1, was agreed upon. Subsequently, the three initial grand challenges extracted by UKL from the synthesis of first inputs as presented in chapter 4 were discussed, and these were reorganised into the following five grand challenges (indicating in brackets the changes made in regards to the initial work presented in the previous chapter):

- **Data and information characteristics and use** *(renaming initial grand challenge "Data collection, analysis and integration")*
- **Modelling and simulation** *(splitting this grand challenge and the next one from the initial grand challenge named "Policy modelling, public governance and e-participation")*
- **Citizen and stakeholder engagement** *(splitting this grand challenge and the previous one from the initial grand challenge named "Policy modelling, public governance and e-participation", and adding the participatory aspects from the initial grand challenge "Governments and their stakeholders")*
- **Government capabilities and legitimacy** *(renaming initial grand challenge "Governments and their stakeholders" and removing the stakeholder engagement aspects that belong to the previous new grand challenge)*
- **Translating research results into policy actions and support** *(added as a new grand challenge)*

Strong interrelationships are naturally apparent among these grand challenges as they are addressing complex social problems. Advancing policy making requires breakthrough developments in all areas. The use of big and open data as well as blended modelling techniques needs to be accompanied by good user interfaces to lower the engagement threshold. It also requires developing necessary capabilities and regulative frameworks as well as support for easily interpreting the results. The participants also emphasised that policy making rests on different preconditions and cultures of politics and civic

[17] See www.icegov.org (last access: 30/01/2015)

engagement in different countries, something that need to be taken into consideration when implantation of these challenges is taking place.

In a next step, key aspects of the first four grand challenges were discussed among project partners in the technical meeting. The last grand challenge was not discussed at the technical meeting due to time constraints. It was, however, agreed to discuss it along the subsequent workshop with a wider expert group (cf. report in Section 5.3). The synthesis of the initial results reassigned and revised research gaps, resulting in the following research needs per grand challenge (formulated as research questions):

Grand challenge "Data and information characteristics and use"

- How to ensure a good data quality (as evidence and input to policy models as well as simulation results) and how to identify and convey data weaknesses to users
- How to support data sharing and usage in a way that adds value to the policy development process and does not open or exacerbate potential risks of misuse and fraud
- How to exploit and integrate concepts and solutions of big data and open data into policy modelling approaches, and how to ensure effective data integration across multiple sources
- How to protect stakeholders from information overload while at the same time ensuring the provision of the right quantity and quality of data.
- How to ensure trust in the data being used as input to inform a policy model as well as trust in the data and results generated from simulation models in public policy making
- How to ensure the right level of data protection so that privacy of individuals, integrity of organisations, or confidentiality of sensitive and/or secret data is provided; what is the right level of data protection
- How to ensure information security so that data is neither misused nor manipulated by unauthorised third parties; This demands an understanding of the vulnerability of too much openness and transparency, i.e. for understanding how much openness is reasonable and how much protection is necessary in order not to be too vulnerable to information attacks
- How to support, encourage, and ensure effectiveness and efficiency of data and information use

Grand challenge "Modelling and simulation"

- How to integrate various types of simulation approaches and platforms to offer more powerful simulation environments that are capable of capturing distinct dynamics and aspects of a social problem / public policy; the underlying assumption is that existing simulation paradigms focus on particular aspects of a policy problem, while neglecting others; a hypothesis is that a combination of simulation paradigms would enable more reliable assessments and predictions
- How to test simulation systems to be reliable in real situations (there is a strong relationship with grand challenge "Translating research results into policy actions and support" to turn research on policy modelling into practice)
- How to effectively support the communication function about what models tell us given the complexity of public policies; including how to best visualise policy models and results of simulation runs to make them quickly and easily understandable for end users
- How to make simulation models usable for end users without compromising the complexity of the problems (social and others) being modelled
- How can big data/open data and the vast amount of information be integrated into simulation platforms and effectively used to develop reliable and valid simulation models
- How can modelling and simulation procedures (the application of simulation paradigms, the use of the supporting ICT tools, and the interpretation of simulation results towards easily

understandable communications for end users) become more effective and efficient

- How to reduce the risks of misuse of simulation models; including what kinds of misuse of simulation could be assumed
- How to effectively explore crowdsourcing for policy modelling and simulation
- How to effectively involve stakeholders (including end users) into policy modelling and simulation initiatives (strongly related to grand challenge "Citizen and stakeholder engagement")

Grand challenge "Citizen and stakeholder engagement"

- How to improve the engagement of citizens and stakeholders in policy development
- How to develop the capacities of citizens and other stakeholders to understand, interpret and use complex policy models and simulation results
- How to create better understanding of the social and political challenges of engaging different cultures in policy development
- How to ensure a high level of trust among the actors in policy development; for example, tackling the naivety of giving personal data and thinking these will not be used
- How to improve collaboration between citizens, other stakeholders and governments in policy development
- How to effectively and efficiently explore the potentials of innovative ICT in citizen and stakeholder engagement

Grand challenge "Government capabilities and legitimacy"

- How to improve collaboration between governments and private and civil sector actors in policy development
- How to improve the capability of government to satisfy demands for data quality and open access to data by different users; and therewith creating a sustainable business model to promote opening and usage of data (with a strong link to grand challenge "Data and information characteristics and use")
- How to understand the dynamics and potential conflicts among confidentiality, secrecy and transparency in government decision-making; What are the potential risks involved, for example, to what extent can strategic decision-making be kept secret, while there are demands for openness? If everything is transparent before data are used for decision-making, then what is the danger for governments and public governance that policies might not be implemented
- How to ensure and improve trust in government; including 1) defining how much personal information should be collected/shared, and 2) how to address the issue of trust: (cf. also grand challenge "Citizen and stakeholder engagement")
- How to ensure the protection of privacy, confidentiality and intellectual property; which legal and technical frameworks can be provided in order to enable exploitation of data and technologies in supporting the struggle against e-crime while ensuring privacy and other rights such as intellectual property, and ethical values of cultures in general

The "How to" questions along the five grand challenges demand research in different directions such as:

- Developing and providing underlying theories and models to support understanding and explanations of phenomena and their interdependencies or causal relations
- Developing and providing concepts, methods and paradigms to deal with the challenges embodied in the questions in a sophisticated and effective, scientifically grounded systematic way that is also actionable in practice

- Providing best practice cases to demonstrate good solutions and examples of how and where solutions work effectively and efficiently
- Providing empirical studies to prove applicability and usefulness as well as distinctiveness of theories, concepts and examples
- Providing rationales for the value added and wider impact of such theories, concepts and examples

5.3. SECOND REFINEMENT OF GRAND CHALLENGES WITH EXTERNAL EXPERTS

The second refinement of grand challenges of research was performed through the workshop along ICEGOV 2014. Participants of the workshop formed four groups of 5-7 people. Each group selected a grand challenge to discuss (grand challenge "Data and information characteristics and use" was not discussed), a rapporteur who was taking notes during the discussion and a speaker for the short presentation of findings after the group works. The discussions lasted approx. 40 minutes. The groups were asked to keep the discussions around the following aspects of consideration:

- Identify gaps in existing research on ICT supported governance and policy modelling and argue what challenges emerge from these gaps
- Discuss how the gaps and challenges could be overcome in terms of what would need to be changed and what innovations would be needed

In short presentations at the end of the workshop, the results of each group were presented and discussed with the experts participating in other groups. The results of the four group discussions are summarised in the following:

Grand challenge "Modelling and simulation"

The blending of different models provides more insight into the effects of prospective policies. This requires that the different models are integrated and as much evidence (empirical data, open and big data, stakeholder views and positions, etc.) is used to inform the models. Creating valid and reliable models is one of the key issues. The group stressed that the results of policy modelling and simulation can allow for the following two kinds of support:

- Citizens can have tools that allow them to provide their opinion on a daily basis with regard to decisions of policy-makers. The challenge in this regards lies more at cultural and adoption level of using these kinds of tools by citizens.
- Policy-makers can measure the impacts of their decisions. In this context, there are at least three challenges:
  - how to model a policy decision,
  - how to model its execution context, and
  - how to model and measure its impacts.

Grand challenge "Citizen and stakeholder engagement"

In general, more difficult and comprehensive models are less easy to use. Nevertheless, citizen engagement requires lowering the complexity to increase the use threshold and the ability to understand and interpret the models within a short time frame. The group identified the following gaps (the focus was rather on e-participation in general than on citizen and stakeholder engagement in public policy modelling):

- Trust and manipulation: This gap includes lack of general engagement of citizens and stakeholders in politics and on existing e-participation platforms.
- Inclusion and Digital Divide: This gap considers biased opinions, imbalance in participation since some individuals can dominate discussions, bridging the total divide, lack of useful

content and lack of facilitation (engagement of government).

- Disjointedness / disconnectedness of argumentations between the experts' opinions and wider stakeholder discussions.
- Weak relevance of e-participation and lack of customisation for context: Relevant form and granularity of information are necessary for particular groups of citizens, as well as adequate interpretations of results and visualisation tools.
- Lack of impact and real results: Existing isolated legacy systems and procedures are impediments to the successful implementation of e-participation applications
- Interpretation: understanding of the models and interpretation of the results advances the understanding. Interpretation is often error-prone and needs an in-depth understanding.

The group suggested the following innovation needs:

- Government should: 1) provide immediate feedback; 2) discuss relevant issues with relevant stakeholders and civil society; 3) facilitate open access to relevant data as well as to the policy modelling process, as much as possible; 4) ensure that free infrastructure is available; 5) provide a multilevel presentation layer (embracing citizens' diversity).
- The following principles should be applied: 1) Intermediation; 2) Customisation; 3) Relevant data visualisation and simplification; 4) Localization and contextualised presentation; 5) Accessibility and fun factor; 6) Participatory design for stakeholders; 7) Citizen collaboration in policy making; 8) Legal inclusion of e-participation in policy making; 9) Ranking of e-participation activities; and 10) Interoperability for e-participation.

Grand challenge "Government capabilities and legitimacy"

Governments are, on the one hand, confronted with an ever increasing pace of technology developments. They often have not the knowledge and ability to integrate these innovations in their processes and ICT solution landscapes. On the other hand, expects from public, private and civic arenas exist that can help governments to use the new opportunities. The group worked with the assumption that capabilities and legitimacy overlap. On this basis, the group identified the following gaps:

- Noticeable shift from public to private sector: This tendency is increasing and bringing high risk, not so much from the commercial side, but rather from the side of usage. The downside of this shift is that the business model practised by some vendors is designed to deliver services at no cost where the cost is covered by advertisements. These services collect information for personal profiles to allow more efficient advertisements than most of the competitors. The model is highly effective, and can erode democracy and hamper European business initiatives in the following ways:
    - Reduction of the watch-dog capability of media. The newspapers revenue drop from advertisements can cause a decline in the number of journalists able to pursue long-term investigations. Important voices will be silenced and freelance journalists will need to focus more on selling their articles.
    - Limitations in access to information. Search engines and the underlying search algorithms are designed with a specific purpose of promoting certain results. This bias of particular interest-promoting delivery of results may prevent citizens from finding counter arguments and opposing opinions in political discussions.
    - Market barrier for other business models. Companies not using the model with personally profiled advertisements may not be able to provide services at no cost. This may be an insurmountable obstacle for SMEs to enter the market even with very innovative products.
    - Transformation. The development of new capabilities takes time and is often based on experiences resulting in transformation of the policy making.

- A data privacy issue has to be resolved, since big private companies collect and own more information than governments, which gives them the possibility of monitoring governments and their activities. An example of such a big company is Google. To avoid loss of control from the side of governments, it has to be controlled how private companies use the information they collect. This issue of data protection brings forward another issue, the question of authority, since in modern complex worlds the following principle applies: the owner of information holds the power.
- Weak understanding of available information from governments. An example is the Swiss government where municipalities complained that children spend too much water in schools. A university designed dashboard showing that, for example, energy usage in the municipality is much higher than water consumption in schools.
- Governments generally follow the pace of technology development without questioning it. This issue brings forward technological legitimacy issues as well as an important question to answer what do technologies change in political situations and in public governance.

Grand challenge "Translating research results into policy actions and support"

Research often cannot be translated into practices in a one-to-one manner. The group identified a number of gaps in translating research results into policy actions and support, confirming that there is a big gap between research and policy practice. The following gaps were identified:

- Principle of "lost before translation": the traditional stereotype understanding is that practice is usually not interested in research papers, while research is not usually published in a way that facilitates operationalization of research findings.
- Principle of "lost in translation": research and practice don't succeed to collaborate as they do not speak the same language. Three groups to be targeted with distinct communication and writing style were identified that need to be satisfied: Academic publishers and Universities (well elaborated and scientifically grounded rigorous publications) – Policy-makers (management summaries and policy briefs; to be clear, convincing, interesting and short) – Policy practitioners (actionable reports, guidance, documentation and evidence of practical results)
- Government actors such as Ministries in some countries consider research activities and research results to be "very specific" and not actionable or not a priority in their areas of work.
- Practitioners do not recognise the value of research findings as assets.
- The transformation process from research and innovation trials to real practice is not effective.
- Risk-averseness of policy-makers towards innovation and creativity: risking that research findings might not be positive from the government point of view.
- Reaching professors: practitioners might be hesitant to contact a professor.
- Fostering different levels of construction and interest: research papers and publishing channels vs. practitioner interests.
- Diversity of disciplines in policy making hampers collaboration – again distinct languages, but also different approaches and expectations of performance.
- Structural problem of academia: researchers are expected to teach and to deliver academic papers. There is a lack of incentives for doing work with practitioners.
- Lack of understanding, working towards, and appreciating a wider impact of ICT supported policy modelling into society.
- Dealing with information overload – how to ensure the most accurate and timely information is available.
- Value propositions of distinct actors don't match.
- If findings of research are simplified into management summaries or actionable descriptions, they are no more considered to be of high quality in research.

- Problems identified may be related to structure, to governance or some to content

The group made some suggestions of change needed, but these are not exhaustive to respond to the gaps identified:

- Introducing intermediaries (for example, editors who can translate academic speech into practitioner and/or layperson speech) and thereby ensuring that policy-makers, policy operators, intermediaries and researchers work together.
- Changing cultures and reducing the stereotyping of distinct groups – policy-makers are able to read research papers and are interested in research results, while researchers have an interest in results and application of research in practice as well as in challenges of policy practice that can be resolved with research methods.
- Need for a change in the system to give more appreciation to publications that are more practice oriented, to count for the career paths of academia.
- High costs of access to publications – move more to open access.

On the basis of the inputs from the project meeting and the expert consultation in Guimaraes in October 2014, final drafts of grand challenges were developed, which were subsequently exposed to a wider online consultation. The feedback of the wider online consultation is documented in the next section. The final version of the grand challenges is reported in section 5.5.

5.4. FEEDBACK FROM ONLINE CONSULTATION

5.4.1. Means used to reach out to experts

The grand challenges have been exposed to an online review and discussion with experts, involving LinkedIn groups and a Facebook group, mailing lists run by relevant communities, an announcement on the homepage, the newsletter nr. 6, and a news entry of the eGovPoliNet portal[18].

For the online consultation, a questionnaire was developed to provide an assessment of the importance and relevance of the five grand challenges of research specified, and with a possibility to suggest further grand challenges in a structured way. It contained eleven questions, structured in four parts:

- Part 1 asked the respondent to rate the five grand challenges (Q 1) and to suggest revisions / improvements of the texts developed (Q 2). A respondent could choose those grand challenges on which he or she was willing to provide improvements / revisions. For each grand challenge selected, three text fields were provided for suggesting revisions: one for the abstract (max. 3000 characters), one for the research questions (max. 4000 characters) and one for potential impacts (max. 3000 characters). The text fields were optional, so a user could also decide to only fill in one field.
- Part 2 asked respondents to add up to two new grand challenges (Q 3) if they felt we missed important ones. Depending on the selection, the user was directed to the next question (either to the next part or to one or two dialogues where a respondent was able to insert new grand challenge(s). In the second case, the respondent was asked to provide a name for the grand challenge and to fill in the descriptions of abstract, research questions and potential impact. If a grand challenge was added, all fields were required.
- Part 3 asked respondents about recommendations for tackling the grand challenges (Q 4), about any indications for best practice developments (Q 5), and about whether respondents were

[18] See http://www.policy-community.eu/ (last access: 30/01/2015)

planning to tackle any of the grand challenges of research in their own professional activities (Q 6).

- Part 4 asked respondents about some demographic data (Q 7 through Q 11). Question 11 was optional and asked for name and email. If respondents provided these data, they were assured that this data is only used for getting back to the respondent in case specific questions regarding the respondent's input were asked. The respondent was in this case also promised to be proactively informed when the final results of the consultation will have been compiled.

The questionnaire was set up to enable anonymous data entries. It was activated on 19th January and was closed by mid February 2015. The questionnaire is attached in Annex I: Questionnaire for the online consultation, together with the welcome invitation message.

The LinkedIn group Policy Making 2.0[19] was on the one hand invited via a general post on the group's discussion board as shown in Figure 4. On the other hand, each grand challenge was posted and group members could comment the grand challenges directly in the group's posts. The invitation to comment the grand challenges of research as shown in Figure 4 was also posted on the discussion board of the LinkedIn group "EGOV researcher community"[20] as well as in the Facebook group of the Digital Government Society[21] as shown in Figure 5. The full text posted in the Facebook and LinkedIn groups is available in Annex II: Posts in Social Networks.

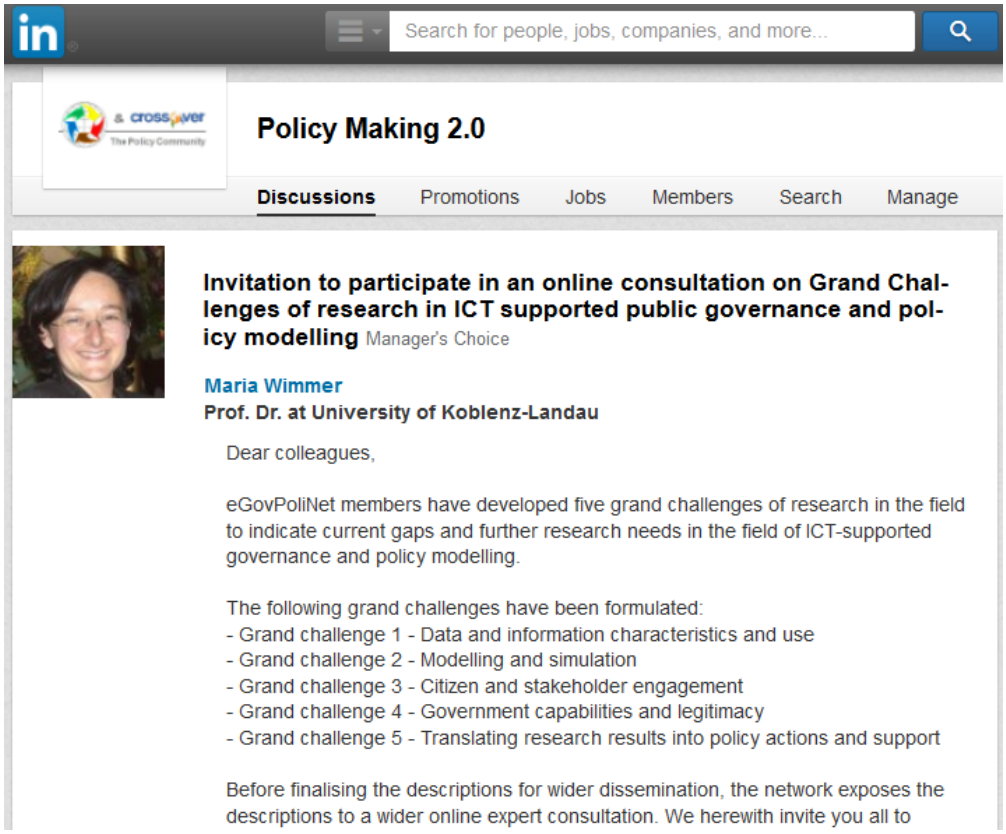

Figure 4: Screenshot of the LinkedIn general post to invite experts in the online consultation

[19] See https://www.linkedin.com/groups/Policy-Making-20-4165795 (last access: 30/01/2015)

[20] See https://www.linkedin.com/groups?home=&gid=166290 (last access: 30/01/2015)

[21] See https://www.facebook.com/groups/dgsna/permalink/862190640469376/ (last access: 28/02/2015)

Figure 5: Screenshot of the post to invite the Digital Government Society group members in Facebook to the online consultation

Invitations to comment grand challenges were posted to different mailing lists maintained by relevant communities of ICT supported governance and policy modelling. An overview of these mailing lists as well as the community targeted and the approximate number of members of the mailing list is shown in Table 16.

Table 16: Overview of mailing lists to which the invitation to the online consultation was posted

Mailing list address	Community reached	Approx. number of members
PIN-L@LISTSERV.ALBANY.EDU	Public administration sciences and policy research	Approx. 200, strongly US-based
egov-list@u.washington.edu	e-government and e-participation	Several thousands, worldwide
seworld@sigsoft.org	Information systems (more engineering focused)	Several hundreds, worldwide
wi@aifb.uni-karlsruhe.de	Information systems research	Several thousands, German-focused
SIMSOC@JISCMAIL.AC.UK	Social simulation community	Several hundreds, worldwide

Several partners also sent the invitation to their closed community networks via personal mails. Finally, a newsletter was released in January 2015 with an invitation to the online consultation, and the online consultation was announced prominently at the homepage.

5.4.2. Summary of results of the online consultation

The rest of this section reflects the results of the online consultation via online survey, commenting grand challenges online, and discussions and "likes" in the LinkedIn group Policy Making 2.0. First, the synthesis of the feedback from the online survey[22] is documented along the four parts of the questionnaire:

Part 1 – Rating the five grand challenges and providing suggestions for improvement: Based on the understanding of the concept of "grand challenges", participants were asked to rate each grand challenge on whether it is in their opinion a grand challenge (see Table 17 for the results).

Table 17: Rating the grand challenges (1 = not agree that this is a grand challenge … 5 = fully agree that this is a grand challenge) – 4 responses

Grand Challenges Respondent-ID	Data and information characteristics and use	Modelling and Simulation	Citizen and Stakeholder engagement	Government capabilities and legitimacy	Translating research results into policy actions and support
1	4	5	5	5	4
2	5	3	4	4	5
3	3	4	5	3	5
4	1	2	4	3	2
Average	**3,25**	**3.5**	**4.5**	**3.75**	**4**

As Table 17 shows, the results are diverging on some grand challenges. While two experts perceived grand challenge "Data and information characteristics and use" as important, another expert did not consider at all that this would be a grand challenge. A similar result can be observed for grand challenge "Modelling and Simulation". The experts are more in agreement with "Citizen and Stakeholder engagement" and "Government capabilities and legitimacy" being grand challenges. On "Translating research results into policy actions and support", three experts agree that this is a grand challenge, while one expert does rather not agree with this.

None of the respondents using the questionnaire provided suggestions for improving the texts of the grand challenges as was asked for in question 2.

Part 2 – suggesting new grand challenges: One respondent (respondent-ID # 4) suggested two additional grand challenges, arguing also that the five grand challenges defined would be less relevant than the two additional challenges. The following entries were provided by this respondent:

- ***Name of Grand Challenge: "Performance"***
  - *Brief abstract motivating, and underlying gaps grounding the grand challenge.* Using ICT to improve the performance of government. Making decisions quicker, better founded and well linked to other decision-making.

[22] It was made available through http://www.policy-community.eu/results/grand-challenges-of-research/ (last access 26/02/2015)

- *Challenges to be faced, formulated along a set of research questions.* Identify technical and governmental possibilities. Combine what can be done with what should be done.
- *Innovations and wider impact expected when tackling the research demands.* This implies market and process innovations.

- ***Quality of governance***
  - *Brief abstract motivating, and underlying gaps grounding the grand challenge.* Using ICT, mainly text analysis tools, to improve the quality of decision-making.
  - *Challenges to be faced, formulated along a set of research questions.* Which aspects of the quality of policy making can be measured by using text analysis.
  - *Innovations and wider impact expected when tackling the research demands.* While the technology exists, the implementation of the technology in this field is brand new. If it succeeds, the technology can be used to measure the quality of policy (making) objectively, not just by human readers in the current demographic but subjective setting.

Part 3 – recommendations and other forward looking questions: Two respondents provided suggestions of recommendations (to policy-makers, funding agencies or similar high-level stakeholders) to address the five (or more) grand challenges. The following three recommendations were put forward by the respondents:

- "Develop a test bed in which the technology can be used to demonstrate that the public can be engaged. For example, cell phones can be used to document holes in the roads, leaking facets, public bathrooms not working, etc.
- Voting online (if a bank can transfer money online, why people cannot vote online?). This would greatly reduce the cost of asking people what they want and show to people that the technology can work.
- Seek ways to use ICT not anymore to automate "handwork" but to "automate" brainwork."

Two respondents provided suggestions on how we might best develop and distribute 'best practice' as derived from the current grand challenges to support and enable all parties to share knowledge and progress the policy making field:

- "Lower government costs and people will come looking for solutions.
- First identify the needs for possible outcomes in practice. If there is a need, the distribution of "best practice" is easy."

One participant is planning to tackle in his/her work grand challenges of research on ICT for governance and policy modelling.

Part 4 - Demographics: The online questionnaire was filled in by four participants that rated the grand challenges and further elaborated the questionnaire. Of the four that filled the questionnaire, two remained anonymous, and the other two indicated that one is a researcher and the other from the private sector.

On the knowledge portal, the following comments on the grand challenge descriptions were received (provided by four different experts):

- *Feedback on "Modelling and simulation":* The respondent argued that integrated policy modelling is researched for polio for more than a decade. The respondent argued that this "involves both multiple analytical disciplines and a wide range of stakeholders with full consideration of variability, uncertainty, and time." In the view of the respondent, "policy modelling is typically motivated by the need to address subject-specific policy questions, so the work happening in different policy domains (e.g. global health, climate change) would need to be considered."

- *Feedback 1 on "Citizen and stakeholder engagement":* The respondent argued that this is the most important grand challenge. Without resolving this grand challenge, the others cannot be solved either. The respondent further argues that topic, culture, social class, the temporal and spatial scale of the issue are all important.
- *Feedback 2 on "Citizen and stakeholder engagement" and feedback on "Government capabilities and legitimacy":* The respondent stated that he checked these two grand challenges and he argued "I think you have addressed the issues well."
- *Feedback on "Translating research results into policy actions and support":* The respondent argues that this is "a very challenging area and very promising as well, if only researchers also exploit, along with multi-disciplinary research, both qualitative and quantitative research methods to capture adequately the complex environment organisations operate in and thus increase transferability from academia to practice".

The LinkedIn threads resulted in the following suggestions for consideration:

- *Feedback on the general invitation*[23]*:* The respondent argued that in his view "the grand challenges are all well thought and well articulated". The respondent had a suggestion to add the following research question to grand challenge *"Translating research results into policy actions and support":* "How to improve the mass media's ability to utilise experts/expertise and to make evidence-based criticisms/defending, or arguments/counter-arguments, on public policies." The respondent argues that, "given the growing populist mood, the press is and will be wielding its influence on what it broadcasts and publishes about in democracies". The respondent also argued that "translating research results into policy is not just a research utilisation issue, but also an issue of democratic learning in society".
- *Feedback 1 on "Citizen and stakeholder engagement"*[24]*:* The respondent argued that a balance between the engaged and the not-engaged should be considered, in the following way:
    - "the representativeness of the engaged people,
    - in case of serious lack of representativeness, policy advocacy by public officials for the under-represented,
    - the qualifications for public officials, i.e., a serious re-examination of the current practice of selecting public officials
    - to what extent the public and stakeholders should be pushed to get engaged"
- *Feedback 2 on "Citizen and stakeholder engagement"*[25]: One respondent argued: "While being in support of citizen and stakeholder participation in decision-making on public policies, we have to emphasise the need to design proper methods and procedures by which this is realised:
    - In the modern context of globalisation, policy-making has become very complex and difficult. Policy-making depends upon C + R, where C stands for consensus by the citizens and stakeholders and R stands for rationality (according to the participant). New policies or changes in substantive policies need to be accepted by the people. People will not automatically accept all policies, particularly policies that reduce public services and their incomes or inconveniences of them in their day-to-day work. In addition, every policy affects some stakeholders favourably and others unfavourably. One way is to involve all citizens and stakeholders directly in designing policies. This is possible only in small countries/communities. Even Switzerland, the country that introduced many reforms in this area, is increasingly reducing the scope of direct

[23] https://www.linkedin.com/groups/Invitation-participate-in-online-consultation-4165795.S.5962931335877128194?trk=group_item_detail-b-show_lks-cmt&goback=.gmr_4165795.gmp_4165795 (last access: 28/02/2015)

[24] https://www.linkedin.com/groups/LinkedIn-consultation-on-grand-challenge-4165795.S.5962935047622266884?trk=group_item_detail-b-show_lks-cmt (last access: 28/02/2015)

[25] Ibid.

participation. Though technology development has made direct participation feasible, the need for quicker decision-making, the problems becoming more complex and the need to educate all citizens in policy process and the rationale behind policy change, scope of direct participation is becoming less. We are living in the era of representative democracy with periodical elections of representatives who have the role and responsibility to bring the needs and problems of their constituents to the notice of policy-makers and get redress.

- Direct participation also assumes good education and experience on the part of citizens to contribute effectively to the policy process. While direct participation in policy-making could be encouraged at the local level, instruments of representative democracy should be used at the regional and national level. Occasionally, very crucial issues like joining or leaving the EU as a Member can be subjected to a Referendum, otherwise normal ongoing policy making cannot be subjected to a constant process of consultation. A more fruitful approach could be to improving transparency and accountability of policy makers and policy process."

- *Feedback 3 on "Citizen and stakeholder engagement"*[26]: This respondent reported about his experiences with prototyping a new approach to innovative town planning. He is interested in metrics to measure success of such engagement processes and he argues "that innovation tends to come from the variety (breadth) of community feedback, rather than the volume of participation"
- *Feedback 4 on "Citizen and stakeholder engagement"*[27]: This respondent argued that "stakeholders should be enabled to participate in their own terms, simply by documenting their own objectives. Intermediary services should perform the necessary mappings to government objectives. No knowledge of government bureaucratic structures or policy formulation time-lines should be required." The respondent also suggested the policy texts and actual performance plans to be made available "in machine-readable format, with clearly specified stakeholder roles and performance indicators. Documenting performer roles and performance metrics in open, standard, machine-readable format will enable value-added intermediary services to inform stakeholders of: a) responsibilities ascribed to them, and b) the levels of performance expected."

No discussion was received on the other grand challenges or on suggesting recommendations for how to tackle the grand challenges formulated.

In LinkedIn, the experts could also "like" the descriptions, indicating agreement and support of a description of a topic being a grand challenge. Table 18 shows the "likes" received on the posts in the LinkedIn group.

The following résumé of the online consultation can be drawn:

- The invitation to the online consultation of experts has been widely spread, counting the number of members in the LinkedIn groups (Policy Modelling 2.0 and EGOV researcher community) and via the mailing lists.
- The number of experts engaging with us online in reviewing the grand challenges developed was very limited.
- The rating of grand challenges is not helpful as experts may have distinct perceptions, depending on their backgrounds and interests.

[26] Ibid.

[27] Ibid.

Table 18: Overview of "likes" received per grand challenge in the LinkedIn group

Posts on LinkedIn	Number of "likes" in LinkedIn posts (not counting Likes of partners
Grand Challenge "Data and information characteristics and use"	0
Grand Challenge "Modelling and Simulation"	0
Grand Challenge "Citizen and Stakeholder engagement"	7
Grand Challenge "Government capabilities and legitimacy"	1
Grand Challenge "Translating research results into policy actions and support"	2
Policy recommendations	2
Invitation to online discussion thread	1 on Dragana's post 3 on Maria's post

- The comments received on the grand challenges were in helpful and were integrated in the final versions of grand challenges as documented in section 5.5 below. In part, the comments were representing own views of aspects already covered, i.e. supporting and enriching the formulations already existing.
- The two "new grand challenges" have been incorporated into the existing grand challenges as much as was reasonable, i.e. performance is related to grand challenges, and the quality of governance seems from the descriptions rather technically focused and somehow related to "Data characteristics and use" and to "Modelling and simulation".
- From the recommendations put forward, mainly the first was conveyed into the recommendations of the project. The indications how to best develop and distribute best practice were also reflected in the recommendations.

Based on the feedback received, the next section introduces the final grand challenges.

5.5. FINAL VERSION OF GRAND CHALLENGES OF RESEARCH

As described in Figure 3, the development of the grand challenges consisted of a set of activities. This section documents the final version of the five grand challenges developed. Each grand challenge is outlined along:

- a brief abstract motivating the grand challenge, and the underlying gaps grounding the grand challenge,
- the challenges to be faced and formulated along a set of research questions, and
- innovations and wider impact expected when tackling the research demands

The next five subsections provide these descriptions of the grand challenges.

5.5.1. Grand challenge "Data and information characteristics and use"

Brief abstract motivating, and underlying gaps, grounding the grand challenge

The data dimension of policy modelling presents significant challenges for data providers, analysts, and consumers, while existing and new data sources also offer an under-appreciated opportunity to explore and understand both the context and possible effects of policy choices. Reliable and trustworthy public policy making is extensively dependent on the underlying data informing policy models. The quality of data, provenance information, empirical validity and other characteristics of data have tremendous impact on the trustworthiness and reliability of policy models. Also, ownership and license models of data, openness, accessibility and interoperability of data, data privacy, and protection of data against misuse and violent attacks are aspects that need to be reflected when using data in public policy making. Yet, ensuring an adequate level of data quality for a given purpose or understanding distinct data characteristics and transforming them into suitable formats and quality for a given instance of policy modelling remain difficult and costly goals.

The many new sources of government data offer potential value but this value will be realised only if government information policies and practices are better aligned with the needs of policy-oriented data users. In turn, data and policy analysts must treat information critically in the policy analysis process. While extensive research on big data, open data, text and opinion mining, and similar topics is already carried out, the use of data (both, qualitative and quantitative) and of advanced methods and concepts of data analysis are still not well integrated into policy modelling initiatives. Many questions of appropriate data quality, reliability of data, performance improvement and prevention from information overload are still unanswered. Methods for improvement such as metadata and feedback mechanisms seem useful, but questions remain about how these should be defined and implemented and at what cost. Also, the performance of government to making decisions quicker and better founded needs to be better understood. All these issues demand multidisciplinary research that investigates data characteristics and use in public policy modelling from different angles.

Challenges to be faced, formulated along a set of research questions

The following challenges demand extensive and complementary research in the domain of ICT-supported public governance and policy modelling:

- How to support data sharing and usage in a way that adds value to the policy development process and does not open potential risks of misuse and fraud
- How to exploit and integrate concepts and solutions of big data and open data into policy modelling approaches, and how to ensure effective data integration
- How to ensure good data quality (as evidence and input to policy models as well as in regards to simulation results); and how can flaws in data sources be recognised, categorised, and evaluated; How can this evaluation be meaningfully reflected in the presentation and consideration of analytical results? How can data be interpreted?
- How to ensure the right balance between useful and sufficient information provision to enable and encourage stakeholder participation in policy making (preventing from information overload while at the same time ensuring the provision of the right quantity and quality of data); and how to ensure effectiveness and efficiency of data and information use
- How to ensure trust in the data being used as input to inform a policy model as well as trust in the data and results generated from simulation models in public policy making
- What information policies and data management practices will help make government information more useful and usable for policy analysis and modelling and to support quicker decision-making?

- How to ensure the right level of data protection so that privacy of individuals, integrity of organisations or confidentiality of sensitive and/or secret data is provided; what is the right level of data protection
- How to ensure information security so that data is neither misused nor manipulated by unauthorised third parties; This also demands understanding the vulnerability of too much openness and transparency, i.e. for understanding how much openness is reasonable and how much protection is necessary in order to not to be too vulnerable to information attacks
- How to measure the performance of government and impact of investments in big data and open data infrastructures to legitimise the government investments and to improve equal access and social inclusion; and how to sustain the investments in such technical infrastructures

Innovations and wider impact expected when tackling the research demands

Innovations tackling the aforementioned challenges of research can help to achieve better data quality and better integration of data in the development and testing of public policy models. A more effective use of available data and information in public policy modelling can lead to process innovation, to more reliable and trustworthy policy making and to better performance of government. Appropriate and innovative methods and tools for information analysis and visualisation have great potential to facilitate collaborative policy making, and enable more diverse user groups to engage in policy development and monitoring. A better integration of new approaches to data analysis and visualisation into the development of public policy modelling will contribute to better appreciation and representation of complexity and can achieve more reliable and trustworthy policy models. Accordingly, better-informed, better founded and quicker decision-making will be possible.

5.5.2. Grand challenge "Modelling and simulation"

Brief abstract motivating, and underlying gaps grounding the grand challenge

Using computer simulations in examining, explaining and predicting social processes and relationships as well as measuring the possible impact of policies in an innovative way (e.g. by also involving open and big data, innovative visualisation, serious games, and other new technical and/or social innovations into the simulations) has become an important part of policy making. The recent focus of research on ICT-supported public governance and policy modelling spurred by the European Commission's funding programs in framework programme 7[28] and horizon 2020[29] has brought much attention to the field. Yet, along eGovPoliNet's activities, we still see the need for extensive research in the field, especially to overcome drawbacks of silo approaches. The complexity encompassed with modelling public policies demands for different - often distinct - political, economic, social and technical disciplines to work together to leverage the benefits of different approaches to understanding policy problems and designing innovative policy responses. However, traditional fragmentation among disciplines still keeps researchers within their own disciplines to develop silo-approaches. In order to fully address policy modelling challenges, researchers need to bring together their knowledge and share their expertise within a multidisciplinary collaboration and to integrate advancements from different fields of research (cf. (Majstorovic & Wimmer, A Collaborative Approach to Study Policy Modelling Research and Practice from Different Disciplines, 2014)).

Current paradigms of policy modelling using simulation models however are constrained by their particular focus. Real-world systems and social processes are complex and require the consideration of

[28] See: http://cordis.europa.eu/fp7/ict/programme/challenge7-governance_en.html (last access: 30/01/2015) for call 4, http://cordis.europa.eu/fp7/ict/programme/challenge5_en.html (last access: 30/01/2015) for call 11

[29] See http://ec.europa.eu/programmes/horizon2020/ (last access: 30/01/2015)

parameters at different levels: macro-level, micro-level as well as social behaviour and interconnections between actors. Accordingly, applying one singular approach to modelling a real-world problem is constrained by the particular modelling approach it focuses on. For example, a system dynamics model may lack precision and social interactions because the missing factors are not accounted for by the methodology. While meeting the appropriate level of detail included in a model's description is essential, the success of a simulation model depends in part on striking the right balance between complexity and simplicity. Further, we see a growing need for integrating and combining different modelling paradigms to accommodate the diverse aspects to be considered in complex policy contexts. Unifying different modelling theories under an umbrella of comprehensive policy modelling platforms is an urgent research need. Such research should put forward a meta-model of how individual simulation paradigms can be combined, and suggestions of "clever" junctions of individual smaller (and self-contained) simulation models dedicated to individual aspects to be modelled (see (Majstorovic D. , Wimmer, Lay-Yee, Davis, & Ahrweiler, 2015), and it should incorporate ties to related policies to better understand interdependencies among distinct decision-making procedures. Multidisciplinary research needs to be strengthened and more intensely focused in policy research. Best practices of international and multidisciplinary research need to be shared more extensively. eGovPoliNet has made a start, yet further initiatives need to follow to sustain the work.

Challenges to be faced, formulated along a set of research questions

The following research questions express this grand challenge and demand extensive and complementary research in the domain of ICT supported public governance and policy modelling:

- How to integrate various types of simulation approaches and platforms to offer more powerful simulation environments that are capable of capturing distinct dynamics and aspects of a social problem / public policy; the underlying assumption is that existing simulation paradigms focus on particular aspects of a policy problem, while neglecting others; a hypothesis is that a combination of simulation paradigms would enable more reliable assessments and predictions
- How to test simulation systems to be valid and reliable for predicting real situations (strong relationship with the grand challenge "Translating research results into policy actions and support" to turn research on policy modelling into practice)
- How to effectively support the communication function about what models tell us given the complexity of public policies; including how to best visualise policy models and the results of simulation runs to make them quickly and easily understandable for end users
- How to make simulation models usable for end users without compromising the complexity of the problems (social and others) being modelled, and through providing insight into the mechanisms of the modelling and simulation approaches
- How can big data/open data and the vast amount of information be integrated into simulation platforms and effectively used to develop reliable simulation models
- How can modelling and simulation procedures (the application of simulation paradigms, the use of the supporting ICT tools, and the interpretation of simulation results towards easily understandable communications for end users) become more effective and efficient, and how to link decision-making across distinct policy domains that influence each other
- How to reduce the risks of misuse of simulation models; including what kinds of misuse of simulation could be assumed
- How to effectively explore crowdsourcing for policy modelling and simulation
- How to effectively involve stakeholders (including end users) into policy modelling and simulation initiatives and how to overcome existing challenge of cultures that resist adopting such innovative, comprehensive and collaborative policy and simulation solutions (strongly related to the grand challenge "Citizen and stakeholder engagement")

- How to discover and identify best practices of multidisciplinary research that explores innovative ICT in different policy domains; how to transfer experiences of multidisciplinary collaborations into distinct policy domains.

Innovations and wider impact expected when tackling the research demands

The expected innovations and wider impact of this grand challenge are manifold. First of all, better support with more reliable and trustworthy policy and simulation models and with models of higher quality provides an important ground for better policy decision-making.

Citizens and other stakeholders will be enabled to more actively engage in policy modelling processes and to more easily understand complex policy models and simulation results. Also, they will be enabled to provide their opinions with regard to decisions of policy-makers. Also policy-makers can more easily assess and measure the impacts of their decisions.

The blending of different simulation models provides more insight into the effects of prospective policies. This requires that the different models are integrated and as much evidence (empirical (qualitative and quantitative) data, open and big data, stakeholder views and positions, etc.) as possible is used to inform the models. Creating valid and reliable models that also indicate links to related decision-making is one of the key impact expected when tackling the research demands.

Innovations expected are integrated policy modelling and simulation platforms that are easily manageable and usable and that enable crowds to engage in exploring simulations of complex policy domains. Advancements in multidisciplinary research (triggered also by sharing existing good practices of multidisciplinary policy research such as global health, climate change) will facilitate the integration of different tools, methods and concepts of distinct simulation paradigms. The use of complex tools will make policy decision-making more explorative in terms of testing hypotheses and on this basis making better-informed and more reliable decisions, which in turn leads also to improved performance of government.

5.5.3. Grand challenge "Citizen and stakeholder engagement"

Brief abstract motivating, and underlying gaps grounding the grand challenge

The modern world is facing global challenges while at the same time becoming strongly interconnected, dynamic and complex in nature. The demand for citizen and stakeholder engagement ought to become one of the most important imperatives of the modern world. However, a number of issues and gaps can be detected in the process of citizen and stakeholder engagement, the first and the foremost being trust and manipulation issues. At the same time, there is a challenge of policy making to provide satisfactory decisions for the entire population and all social groups, those representing the majority of people as well as those representing the minority. Related to the previous issue is inclusion and the digital divide, which considers biased opinions of individuals and certain imbalances in participation where some stakeholders dominate discussions.

Lack of engagement of citizens on existing collaboration and decision platforms as well as general lack of engagement in policy modelling and public governance can be observed. Citizens and other stakeholders often do not believe that policy decisions are made in a fair way and they may have doubts that their opinions count in the process of decision-making. The problem is further extended by disconnectedness of arguments and opinions in discussions between experts and the wider stakeholder population as well as by disparities among stakeholders based on cultural and language differences, due to the highly interconnected modern world where people often leave their home countries to live in another country.

Challenges to be faced, formulated along a set of research questions

The following research questions were formulated to give guidance for policy officials and stakeholders in collaborative endeavours of policy making and indicate important directions for further scientific research and development in the field of policy modelling:

- How to improve the engagement of citizens and other stakeholders in policy development, thereby embarking on new means supporting engagement such as the use of social media; how to ensure an adequate balance between the engaged and those not engaged in order to ensure representativeness; what means could be explored to represent the opinions of those under-represented in participation endeavours (e.g. policy advocacy); could engagement of the general public be pushed through enforcement
- How to develop the capacities of citizens and other stakeholders to understand, to interpret and use complex policy models and simulation results; how to implement the necessary education of citizens that is required to make rational decisions when they are directly involved in deciding on policy choices; how to enable stakeholders to participate in their own terms, e.g. simply by documenting their own objectives, instead of having to learn the tools and modes of engagement envisaged by the governments – how could intermediary services map stakeholder inputs to government objectives in an unbiased way (excluding governments at this point because of the separate grand challenge "Government capabilities and legitimacy")
- How to create better understanding of the social, cultural and political challenges of engaging different cultures and social classes in policy development
- How to ensure a high level of trust among the actors in policy development
- How to improve collaboration among citizens, other stakeholders and governments in policy development
- How to effectively and efficiently explore the potentials of innovative ICTs in citizen and stakeholder engagement
- How to effectively use tools based on information and communication technologies as a mediator to bridge differences among stakeholders based on social, cultural and language barriers, as well as on temporal and spatial differences
- How to design engagement processes that ensure a proper balance between reaching consensus among citizens and policy stakeholders, and that are in support of the underlying rationality for a certain policy decision that is probably not favourable for certain citizens
- How to ensure a proper balance of citizen engagement in representative democracy models;
- How to improve transparency and accountability of policy makers and policy process so that citizen engagement remains manageable (especially in large societies) and trust in government is improved
- How to measure success and impact of engagement processes; what metrics to apply in regards to measuring engagement processes where innovation comes from the variety (breadth) of community feedback, rather than the volume of participation

Innovations and wider impact expected when tackling the research demands

Following the pace of rapid complex social changes, public governance activities should be shifted in a way to actively involve citizens and other stakeholders in all stages of policy making process and public governance. The process of stakeholder engagement in public governance and policy modelling creates opportunities for citizens and stakeholders to envision future development, clarify their policy preferences, gather information on policy choices and actively participate in final decisions. Likewise, appropriate methods and tools supported by innovative ICT foster successful collaboration of different stakeholders in public governance and policy making. Increased transparency and accountability of

policy decisions and policy makers increases trust of the citizens and keeps the engagement process (also for large societies) at a manageable level.

Public governance officials can ensure relevance and real impact of citizen's participation in policy modelling processes, customisation for context of relevant forms and granularity of information for particular groups of citizens, as well as adequate interpretations of results and visualisation tools. Appropriate mechanisms for bridging the digital divide in policy modelling enable citizens and other stakeholders to be more connected in order to avoid isolated social groups, while overcoming limited resources and communication barriers.

5.5.4. Grand challenge "Government capabilities and legitimacy"

Brief abstract motivating, and underlying gaps grounding the grand challenge

This grand challenge encompasses two interrelated concerns: the legitimacy of government in the eyes of the governed and the capabilities of government to carry out actions that respond to the expectations of citizens and other stakeholders.

A legitimate government is tightly connected to public governance processes as well as participation and engagement of stakeholders in policy modelling, since no government is legitimate unless it enjoys the consent of the governed. A legitimate government exercises the powers that emerge from this consensual process. It protects the rights of citizens and organisations while setting the boundaries for acceptable private action. A capable government successfully manages internal functions and public services and assures the effectiveness and security of public processes as well as political, economic and social developments. Legitimacy and capability together make government stable, trustworthy, and resilient in periods of crisis. They also lay the foundation for efficient and cost-effective public services responsive to the needs of different stakeholders, and for effective performance of government internally and good governance in the interplay with its constituency.

In recent years, rapid technological development and a general shift of traditionally governmental functions to the private sector can be observed. These trends have implications for both legitimacy and capability. While government collects much personal data and provides services directly, many public services are delivered by private actors or by some combination of government, private, and civic organisations. At the same time, private companies are amassing enormous amounts of personal information through commercial transactions and via social media and internet-based access to information. Personal profiles created in this way are subject to security breaches in both private and public sectors. The security of systems and records is constantly under cyber-attacks. On the service side, many new technologies have emerged that can make services more accessible, transparent and efficient. Social media as well as the provision of open government data via respective open data portals offer new avenues for public discourse and policy analysis. New forms of data management and analysis can improve policy formulation and evaluation and new cross-sector relationships can produce social innovation and social governance. Yet, government is seldom capable of taking full advantage of these developments. It tends to be a technology follower and has difficulty absorbing innovative tools and techniques into legacy processes and systems. The performance of government is becoming more unstable. Similarly, approaches to social innovation and social governance are still very seldom seen in public service provision and public policy making.

Challenges to be faced and formulated along a set of research questions

The following research questions were formulated to give guidance for policy officials and stakeholders in collaborative endeavours of policy making and indicate important directions for further scientific research and development in the field of policy modelling:

- How to ensure and improve trust in government; including 1) how to improve and diversify

public discourse regarding policy problems so that decisions and choices are seen as legitimate to all stakeholders, and 2) defining how much personal information should be collected/shared and how it should be protected from misuse (cf. also grand challenge "Citizen and stakeholder engagement")

- How to ensure the protection of privacy, confidentiality and intellectual property;
- How to understand the dynamics and potential conflicts among confidentiality, secrecy and transparency in government decision-making; how much secrecy is appropriate for strategic decision-making, while there are demands for openness? If everything is transparent before data are used for decisions making, then there is a risk that decisions about public governance may not be implemented
- How to improve collaboration between governments and private and civil sector actors in policy development as well as assuring accountability among all these diverse actors in complex service systems; How to support and enable social innovation and social governance;
- How to improve the performance of government in making decisions quicker, better founded and well integrated and aligned with the different decisions to be made across policy domains
- How to improve the capability of government to satisfy demands for open access to good quality data for different uses; How to provide policy data and policy plans in machine-readable formats, which also contain stakeholder roles, and performance plans and indicators to enable value-added intermediary services to inform stakeholders of: a) responsibilities ascribed to them, and b) the levels of performance expected; How to most effectively explore technology (e.g. for text analysis) to enable measuring the quality and accountability of decision-making in policy contexts in an objective way (all with a strong link to grand challenge "Data and information characteristics and use")
- What legal and technical frameworks can be provided to enable exploitation of data and technologies in supporting the struggle against cybercrime while ensuring democratic values and personal liberties

Innovations and wider impact expected when tackling the research demands

Innovations tackling the aforementioned challenges of research can help achieve better understanding of the interplay between legitimacy and capability, as well as more effective means of achieving both. For example, more effective tools and methods of public discourse and consultation can improve policy making processes and policy outcomes. Appropriate methods and tools can enhance the watchdog function of the media and encourage citizens and other stakeholders to engage with counter arguments and opposing opinions in policy discussions. Increased transparency and trust in government can help motivating civic and private sector actors to engage more in activities of public concern therewith better realising social innovation and social governance.

A more effective means of collaboration between government and the private sector on topics such as the usage of data, intermediary services for mapping citizen inputs with government objectives as well as regulating how private companies use information they collect, can help avoid loss of legitimate government control and strengthen personal privacy protections. The provision of policy data, plans and metrics in machine-readable formats, documenting also the performer roles and performance metrics in open, standard, machine-readable format will enable value-added intermediary services to inform stakeholders of: a) responsibilities ascribed to them, and b) the levels of performance expected.

Research can help develop mechanisms and programs to ensure the protection of privacy, confidentiality and intellectual property and educate stakeholders about protection of personal data as well as about how much personal information should be shared under what circumstances. Better means of assuring transparency and accountability in service delivery systems, which enhance both trust and legitimacy, as well as contribute to effectiveness and efficiency. In general, research on this challenge can help

produce a public sector infrastructure including both legal and technical frameworks that can improve legitimate and capable adoption of new technologies and management and exploitation of big and open data for both service and security.

5.5.5. Grand challenge "Translating research results into policy actions and support"

Brief abstract motivating, and underlying gaps grounding the grand challenge

eGovPoliNet has identified a significant gap between research on ICT-supported public governance and policy modelling and the practise of public policy making. A structural problem of academia (phenomenon of "lost before translation") hinders researchers' engagement with policy practice since academia is expected to teach, conduct research and to deliver the results in scientific papers. Accordingly, in many cases a lack of incentives exists for researchers to engage with practitioners in translating research findings into practice. On the other hand, practitioners often do not recognise the value of research findings as assets that may help them overcome policy problems. The value propositions of the distinct actors do not match. Another gap is that these actors usually do not speak the same language (phenomenon of "lost in translation") and do not use the same publishing channels: while researchers need to write well-grounded rigorous publications to get their work published in scientific publication outlets, policy-makers need short management summaries in a different language and through channels to reach out to their constituency. Policy operators and citizens need to be served with yet another way of presenting research results and policy outcomes. Different levels of construction and interest have to be fostered: research papers and publishing channels vs. practitioner interests and media channels. Yet, who acts as translator? In addition, risk-averseness of policy-makers towards untested innovation and creativity potentially bringing negative results can prevent investments in innovative research.

Ineffective transformation processes from ground-breaking innovation research to application and marketization in practice represent another gap in this grand challenge. Many valuable innovations and findings of research remain within the academic discipline and end up in bookshelves without further consideration of being translated into practical use. Moreover, sometimes the added value of findings in one discipline need to be detected by another discipline before bringing the value of the findings to society. More multidisciplinary research, and research conducted in collaboration with practice, needs to be furthered in policy making research to spur collaboration for better translating research findings into actionable policy practices.

Challenges to be faced, formulated along a set of research questions

The following set of research questions indicates challenges that need to be addressed in this grand challenge to make a more effective, efficacious and efficient translation of scientific results from research to policy practice possible (and vice versa, to better convey research challenges of policy practice into the academic world):

- How to transform research results into practical use in everyday policy decision-making; how to overcome the phenomenon of "lost before translation" and strengthen collaboration among research and policy practice in order to diffuse scientific findings into policy practice and to bring back needs of research and insights from policy practice into scientific research. The added value of collaborations across academia and policy practice needs to be made more explicit and recognition of knowledge transfer from academia to policy practice needs to become a recognised and valuable part of academic career development
- How to overcome the phenomenon of "lost in translation" between research and practice, i.e. how to facilitate collaboration through a common language (or intermediaries serving as "translators") and through joint communication channels. Three actor groups have to be

targeted with distinct communication channels and writing style: Academic publishers and Universities (who need to write well elaborated and scientifically grounded rigorous publications, which are not necessarily targeted to the practice community) – Policy-makers (who need management summaries and policy briefs as their time is often very limited; such policy briefs must be clear, convincing, interesting and short to be accepted by policy-makers) – Policy practitioners (who need actionable reports, guidance, documentation and evidence of practical results)

- How to improve the mass media's ability to utilise experts/expertise and to make evidence-based criticisms/defending, or arguments/counter-arguments, on public policies; given the growing populist mood, the press is and will be wielding its influence on what it broadcasts and publishes about in democracies. Translating research results into policy is not just a research utilisation issue, but also an issue of democratic learning in society – how can democratic learning in society be supported to become more effective and faster
- How to make the transformation process from research and innovation trials to real practice more effective and how to measure the wider impact of collaborative policy modelling efforts in both academia and policy practice; how to sustain the use of research and innovation projects' outcomes over time (in both worlds)
- How to reduce the risk-averseness of policy-makers towards innovation and creativity and how to turn the perception of research findings that might not be positive into insights that bring value to policy-makers
- How to overcome the stereotype perception of single-disciplinary research focus being the only successful path for academic careers. Currently, diversity of disciplines in policy making hampers collaboration, yet we need to change this stereotype perception and foster more multidisciplinary research, supported by overcoming diversities in languages, approaches and expectations of performance
- How to support a better understanding of policy practice and society that collaboration and ICT-supported policy modelling can have a positive impact on policy practice, government performance and society and their attitudes of working together in policy development and assessment. This process of transition needs to be accompanied by academic research; accordingly, the value propositions of the distinct actors need to be fulfilled

The challenges identified above are of different natures such as related to structure, to governance and to content. All of these challenges need to be dealt with to better translate research findings into policy practice.

Innovations and wider impact expected when tackling the research demands

Overcoming deficiencies of translating innovative research into policy practice will add public and economic value in regards to policy modelling to societies. Better appreciation of academic researchers working in collaboration with practitioners will spur a new wave of research driven innovation and bring appreciation to researchers of this type for their academic career.

A changed culture of researchers and practitioners, in which both speak a common language and appreciate contributions of the other side, facilitates collaboration and enables better translation of research findings into practice. The mass media plays an important role in communicating complex policy results to the wider citizenship and hence contributes to democratic learning in society.

Also, the appreciation of multidisciplinary research enables a new generation of multidisciplinary thinkers to grow, and this group brings forward many new innovations that build on research theories and methods from different disciplinary grounds, combining qualitative and quantitative research methods and the constructive approaches of ICT research to capture adequately the complex environment organisations operate in on policy domains and thus increasing transferability from

academia to policy practice. This approach fosters a better handling of social problems and hence more reliable and trustworthy policy modelling results in both, academic and practice outlets.

5.6. PARTNERS' COLLABORATION ACROSS DISCIPLINES IN THE GRAND CHALLENGES DEVELOPMENT

To demonstrate the collaboration across different disciplines, Table 19 provides an overview of the disciplinary focus of the partners' institutions involved in the development of grand challenges. The analysis is divided into engagement in the identification of research challenges and gaps in the workshop in Dublin, refinement of research challenges into grand challenges of research in workshops in Portugal, as well as further consolidation of grand challenges of research through internal reviews. Scientific disciplines involved in the development of grand challenges of research were information systems, computer science, e-government, e-participation, public administration sciences, and organisational and management sciences.

Table 19: The partners' engagement in the development of grand challenges of research and recommendations as well as disciplinary focus of institutions and countries the authors come from

Partner	**Country**	**Disciplinary focus of organisations**	**Research challenges / gaps (Dublin)**	**Refinement (Portugal)**	**Consolidation and internal review**	**Recommen-dations (Koblenz)**
1 – UKL	Germany	E-Government & E-Participation; Information Systems	✓	✓	✓	✓
2 - TUK	Slovakia	Economics				✓
3 – TUD	The Netherlands	E-Government; Information Systems	✓	✓	✓	✓
4 – CERTH	Greece	E-Government & E-Participation; Information Systems	✓			✓
5 – VOLTERRA	UK	Policy Consulting				
6 – INNOVA	Italy	Technology Transfer and Exploitation	✓		✓	
7 – VUB	Belgium	Public Administration Science		✓	✓	✓
8 – ULAVAL	Canada	Information Systems		✓	✓	
9 – UBRUN	United Kingdom	Information Systems	✓		✓	✓
10 – CTG / SUNY	USA	E-Government; Public Administration Science	✓	✓	✓	✓
11 – RG	The Netherlands	Social complexity studies				
12 - COMPASS	New Zealand	Sociology of Health and Well-Being				

13 – KhNU	Ukraine	Organisation and Management				✓
15 – UNU-IIST	China	Information Systems; E-Government	✓	✓		
18 – UTS	New Zealand	Information Systems; Management and Leadership	✓			
19 – EUAK	Germany	Technology Assessment				✓
20 – ITMO	Russian Federation	E-Government	✓	✓		✓

6. RECOMMENDATIONS FOR POLICY ACTORS AND RESEARCHERS

After the grand challenges have been formulated, the final step in the process according to Figure 3 was to derive a set of recommendations for different policy actors and the academic community. The recommendations suggest principles and means that provide a favourable environment to successfully tackle the grand challenges of research on ICT-supported governance and policy modelling in the future. The recommendations were identified by the project partners in group discussions in the project meeting in Koblenz by mid-January 2015. The target policy actors that eGovPoliNet aims to address with its recommendations are: Funding bodies, Policy makers, Research community, and Practice community.

The recommendations to different target actors must not be seen in isolation per group. Instead, they may be considered as different sides of the same coin. For example, the recommendation to improve communication among research and practice demands the right "translation" of what should be communicated to the other side. Also, the willingness of academia to collaborate with practitioners and vice versa needs to be motivated. Accordingly, the benefits of what the involvement of academia can bring to practice and vice versa needs to be made more explicit. Fostering more intense collaboration among research and practice for the purpose to better translate research results into policy practice demands potentially for a "cultural exchange" and the willingness to understanding the other side.

Table 20 documents the recommendations of eGovPoliNet to the relevant actors. Columns 2 to 5 indicate which target actor is addressed by a recommendation. The last set of columns assigns each recommendation to thematic clusters, which were suggested along the project meeting in Koblenz in January 2015. The thematic clusters are: Communication & exchange, Policy formulation, Education, Understanding, Collaboration / involvement, and Translation. These thematic clusters indicate what kind of recommendation is given, resp. in which direction the recommendation should bring forward improvements and contributions to resolve the grand challenges. The recommendations listed in Table 20 have no specific order. They are sorted somehow along related topics.

Table 20: Recommendations of eGovPoliNet partners to target actors and along thematic clusters in order to successfully tackle the grand challenges of research formulated

	Target actors				Thematic clusters					
Recommendations to target actors	**Funding bodies**	**Policy makers**	**Research community**	**Practice community**	**Communication & Exchange**	**Policy Formulation**	**Education**	**Understanding**	**Collaboration / Involvement**	**Translation**
Ensure and enable multidisciplinary project settings to address grand challenges from distinct points of view, involving also a stronger support of the cycle of learning/understanding and innovation, both based on theory building.	x		x			x			x	x
Engage in the SIGs and collaborate across disciplines to address aspects brought forward in the grand challenges	x	x	x	x	x		x	x	x	x
Foster and support the investigation of longer-term research problems; Focus on hype themes lacks negligence of long-term research problems	x		x						x	x
Tackle policy challenges not in isolation but in a multidisciplinary nature. Along with this, strengthen the interdisciplinary nature of project set-ups and base on previous	x	x	x	x	x	x			x	x

experiences when establishing projects in order not to reinvent the wheel										
Adopt a co-creation approach in forming research agendas.	x					x			x	
Incorporate or set up funding programmes to foster the grand challenges developed by eGovPoliNet, both at national and international levels.	x					x			x	x
Offer a variety of funding models to financially support collaborative discussions and training of research and practice in the field. Dependence on EU support is not reliable.	x								x	x
Address fragmentation issues in policy making by demanding (a more extensive) collaboration among the policy makers themselves and with academia	x	x	x	x	x	x		x	x	x
Support research and practice collaboration that contributes to achieving policy decisions that are based on well-informed assessment of policy options and on the consent of with relevant stakeholders. Transparency of underlying rationales of decisions is crucial	x	x	x	x	x	x	x	x	x	x
Involve stakeholders on a broader basis to address research challenges and to produce more relevant solutions, particularly involving policy makers, policy operators and researchers in co-creative policy-making processes that engage wider stakeholder groups	x	x	x	x	x	x	x	x	x	x
Search for and identify best practices of innovative and collaborative multidisciplinary policy making around the globe and continue the activities of community building and research exchange across disciplines as was started in eGovPoliNet	x	x	x	x	x		x	x	x	x
Provide customised applications and tools that can easily be used in policy making by the public, at best as open services	x		x	x		x		x	x	x
Demand that modellers make their techniques, data, assumptions, and results transparent and understandable.	x	x	x	x	x	x		x		x
Trigger a change in the traditional culture of policy making practice to become more research oriented and to foster the use of innovative ICT tools in policy making	x	x	x	x	x	x	x	x	x	x
Invest in research into the efficacy of different kinds of modelling and different combinations of modelling techniques for different classes of policy problems.	x	x	x		x	x		x	x	x
Aggregate research findings (and the work) of projects and researchers in a way that these findings can be easily picked by the policy makers	x	x	x	x	x		x	x		x
Along research, invest also in activities that will make the processes and results of modelling understandable by policy makers, government professionals and a lay audience	x		x		x			x		x
Motivate young researchers to tackle aspects of grand challenges	x	x	x	x			x	x	x	x
Ensure that research findings and policy developments protect personal data and privacy if these are used in policy making processes	x	x	x	x	x	x			x	
Develop test beds that demonstrate that the engagement of stakeholders in policy discourses through online means adds value to legitimacy, accountability and trustworthiness of policy decisions, and public service provision	x		x	x	x	x	x	x	x	x

Collaborate with academia and extend policy making through the support of policy models and analysis of data to reach better data quality and use and to achieve more informed policy decisions. The collaboration between academia and policy practice can be of high value, so the capacities and competencies of academia should be better used to get to better policies		x	x	x		x		x	x	x
Incorporate multi-disciplinary experiences in academic training in the relevant curricula and training programs		x	x	x			x	x		
Researchers to be active and entrepreneurs, looking up new funding models to financially support collaborative discussions and training		x	x	x	x				x	x
Policy consultation representatives to join forces with academia (e.g. collaboration venture) in looking into the impacts of policy research and consultancy recommendations.		x	x	x		x		x	x	x
Establish a database that settles and oversees the quality in policy consultancy, including a certification of policy modelling experts of consultation and academic professionals		x	x	x	x		x	x	x	x
Evaluate the effectiveness of policy choices, the models, and other kinds of analysis that supported them by well-grounded research paradigms		x	x	x		x		x	x	
Ensure a proper translation of research findings to innovation and to the practice of policy development.		x	x	x	x			x		x
Take into account the cultural and geographical context of stakeholders to develop policies that matter to them		x	x	x	x	x	x	x	x	x
Engage in comparative analyses to contribute with findings documented in publications		x	x	x	x		x	x	x	x
Incorporate data-intensive research experiences in academic training of public administration and policy professionals		x	x	x			x	x		
Train professionals to mediate the modelling world and the policy world at a higher level.		x	x	x	x					x
Provide education to policy makers (e.g. online education and shorter programmes) on simulation and modelling.		x	x				x	x		x
Educate and train students who may work in the area of ICT for governance and policy modelling to better present their work in the 'known and used' social media when they are active in their professional area.			x	x	x		x	x		x
Learn to communicate about policy models in the vocabularies of practitioners, policy makers, and the public in their own vocabularies			x		x			x		x
Place career value on multi-disciplinary work and on evaluation research as well as on new discoveries			x				x			
Train public administration students to be well-informed consumers of policy analysis, including different kinds of models and data analytics			x	x			x	x		
Policy consultation to invest in knowledge and research				x		x		x	x	x
Marketers to develop a co-creation environment that enables citizens to engage with specialists in policy discussions				x	x	x		x	x	x
Marketers to look for business opportunities to have educational progress on ways to involve more stakeholders in policy discussions				x	x	x	x	x		

7. CONCLUDING REMARKS

The overall aim of work package 4 was to develop a base of knowledge assets relevant to the community of ICT supported governance and policy modelling. In phase three of the project, key knowledge resources have been further developed such as glossary terms and comparative analyses that were improved towards chapters of the eGovPoliNet book. Also, the visionary scenarios of phase two were slightly updated and formed the key input for developing grand challenges through a thorough qualitative analysis of the visionary scenarios.

A major milestone in phase three was the formulation of grand challenges of research on ICT-supported policy modelling and public governance. Five such grand challenges were developed through a collaborative process, involving partners and external experts in several steps. This deliverable documents the process steps and intermediate as well as final results of the grand challenges. The last part of this activity was to formulate recommendations for key policy actors for how to tackle the grand challenges of research reported in this deliverable.

The deliverable at hand documents in a first part the work performed towards generating further knowledge assets for the knowledge portal. This is done on two levels: i) the work performed in the third period of the project as well as ii) the summary of the knowledge assets developed in the project. The second part of the deliverable documents the process, methods and results of the grand challenges development and the recommendations towards key target actors to tackle the grand challenges successfully.

The work performed in work package 4 has laid a good ground to support an emerging community of ICT supported governance and policy modelling. It relates in many respects to works performed in other work packages and documented in deliverables D 1.2 for the sustained community strategy (the knowledge assets in the knowledge portal as well as the book and the grand challenges of research represent key value assets for the policy community), D 3.3 for continuing and extending community activities across disciplines along the grand challenges of research, and D 5.3 for founding the business and exploitation plans of partners. The knowledge portal (cf. D 2.3) with the knowledge assets as introduced in this deliverable are key assets for the policy community to sustain over the time period.

Along with the final grand challenges, the recommendations to policy actors will be distributed and spread widely in order to create awareness and achieve lasting impact by contributing to future collaborations and findings leading to solutions for the grand challenges. Doing so, the established SIGs and communities will be engaged to spread the word and to diffuse the grand challenges.

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ANNEX I: QUESTIONNAIRE FOR THE ONLINE CONSULTATION

Survey along the consultation on "Grand Challenges of Research in ICT Supported Policy Modelling and Public Governance"

7.1. WELCOME MESSAGE:

Dear colleague,

We herewith kindly invite you to provide us with your assessment of the five grand challenges of research developed for the field of "ICT supported public governance and policy modelling". The questionnaire offers a structured way of providing your feedback and it enables you to develop further grand challenges in the field that the project members might not have thought of. It contains eleven questions structured in four parts:

- Part 1 asks you to rate the five grand challenges (Q 1) and to suggest revisions / improvements of the texts developed (Q 2). You can select those grand challenges on which you are willing to provide improvements / revisions. For each grand challenge you selected for suggesting revisions, you are provided with three text fields: one for the abstract (max. 3000 characters), one for the research questions (max. 4000 characters) and one for potential impacts (max. 3000 characters). For each grand challenge selected, you may provide revisions to each field or just to one or two of them. For example, if you would like to add one key research question to grand challenge 3, then select this grand challenge in question 2 and proceed. You will then get to the dialogue with the three fields. Just indicate in the second field that you suggest to add a research question and specify the research question to add.
- Part 2 asks you if you would like to add more grand challenges (Q 3). A maximum of two new grand challenges can be added per user. Depending on your selection, you will be directed to the next question (if you choose none to add) or to one or two dialogues where you are able to insert your new grand challenge(s). You will be asked to provide a name for the grand challenge and to fill in the descriptions of abstract, research questions and potential impact. All fields are obligatory.
- Part 3 asks you about policy recommendations for tackling the grand challenges (Q 4), about any indications for best practice developments (Q 5), and about whether you are planning to tackle any of the grand challenges of research in your own professional activities (Q 6)
- Part 4 asks you about some demographic data (Q 7 through Q 11). Question 11 is optional and asks for your name and email. If you will provide it to us, this data is only used for getting back to you if we have specific questions regarding your input. We will then also be able to inform you proactively when the final results of the consultation have been compiled.

The questionnaire is set up to enable anonymous data entries. If you provide your name and email, we herewith assure anonymity of data analysis and we will not relate your name to the questionnaire responses along the analysis and results generation of the online consultation.

Please note that the survey is protected from misuse of automatic bots with a captcha feature. We kindly ask for your understanding of using this minimum security feature and for not being annoyed having to insert it on the different pages. It is NOT possible to save your data entries before finishing the survey. While filling in the questionnaire, it is possible to navigate the pages of the survey backwards using the browser navigation feature. However, we kindly ask you to be cautious with this feature in order not to lose the data already entered. Navigating back and then forth demands re-entering the new captcha indications on pages already filled in.

For your convenience, we herewith repeat our understanding of "grand challenges", which are according to NSF fundamental problems which „*require extraordinary breakthroughs in computational models, algorithms, data and visualization technologies, software and collaborative organizations uniting diverse disciplines*". Meyer (2003) argues that they "*mobilise a significant part of the community, on a key unsolved issue, for a decade or so, with ambitious goals that can in principle be attained, but not without special effort, resources and dedication*". The community we envision includes both social and technical disciplines.

The survey will be closed by January 31, 2015. Many thanks for your most valuable contributions in advance!

The eGovPoliNet project members.

7.2. QUESTIONNAIRE:
Assessing the grand challenges of research - Part 1

Q 1) Based on the understanding of the concept of "grand challenges", please rate for each grand challenge formulated, whether it is in your opinion a grand challenge:

(1 = I don't agree that this is a grand challenge. 5 = I fully agree that this is a grand challenge.)

Question	1	2	3	4	5
Grand challenge 1 - Data and information characteristics and use (Required)	○	○	○	○	○
Grand challenge 2 - Modelling and simulation (Required)	○	○	○	○	○
Grand challenge 3 - Citizen and stakeholder engagement (Required)	○	○	○	○	○
Grand challenge 4 - Government capabilities and legitimacy (Required)	○	○	○	○	○
Grand challenge 5 - Translating research results into policy actions and support (Required)	○	○	○	○	○

Q 2) Please provide for any grand challenge your suggestions for extending, improving and/or revising the current text:

First, please select the grand challenge(s), for which you want to suggest changes:

- Grand challenge 1 - Data and information characteristics and use
- Grand challenge 2 - Modelling and simulation
- Grand challenge 3 - Citizen and stakeholder engagement
- Grand challenge 4 - Government capabilities and legitimacy
- Grand challenge 5 - Translating research results into policy actions and support

(Filter: dependent on what selection is made in Q 2)

Please provide for grand challenge 1 - "Data and information characteristics" your suggestions for extending, improving and/or revising ...

Q 2.1.1) ... the abstract, and the underlying gaps grounding the grand challenge:

(text field, max. 3000 characters)

Q 2.1.2) ... the research questions formulated to express the research needs and challenges:

(text field, max. 4000 characters)

Q 2.1.3) ... the innovations and wider impact expected when tackling the grand challenge:

(text field, max. 3000 characters)

Please provide for grand challenge 2 - "Modelling and simulation" your suggestions for extending, improving and/or revising ...

Q 2.2.1) ... the abstract, and the underlying gaps grounding the grand challenge:

(text field, max. 3000 characters)

Q 2.2.2) ... the research questions formulated to express the research needs and challenges:

(text field, max. 4000 characters)

Q 2.2.3) ... the innovations and wider impact expected when tackling the grand challenge:

(text field, max. 3000 characters)

Please provide for grand challenge 3 - "Citizen and stakeholder engagement" your suggestions for extending, improving and/or revising ...

Q 2.3.1) ... the abstract, and the underlying gaps grounding the grand challenge:
(text field, max. 3000 characters)
Q 2.3.2) ... the research questions formulated to express the research needs and challenges:
(text field, max. 4000 characters)
Q 2.3.3) ... the innovations and wider impact expected when tackling the grand challenge:
(text field, max. 3000 characters)

Please provide for grand challenge 4 - "Government capabilities and legitimacy" your suggestions for extending, improving and/or revising ...
Q 2.4.1) ... the abstract, and the underlying gaps grounding the grand challenge:
(text field, max. 3000 characters)
Q 2.4.2) ... the research questions formulated to express the research needs and challenges:
(text field, max. 4000 characters)
Q 2.4.3) ... the innovations and wider impact expected when tackling the grand challenge:
(text field, max. 3000 characters)

Please provide for grand challenge 5 - "Translating research results into policy actions and support" your suggestions for extending, improving and/or revising ...
Q 2.5.1) ... the abstract, and the underlying gaps grounding the grand challenge:
(text field, max. 3000 characters)
Q 2.5.2) ... the research questions formulated to express the research needs and challenges:
(text field, max. 4000 characters)
Q 2.5.3) ... the innovations and wider impact expected when tackling the grand challenge:
(text field, max. 3000 characters)

Grand Challenges of Research Survey Part 2

Q 3) If you suggest an additional grand challenge, please provide a description along the format for the existing grand challenges: (Required)

First, select how many additional grand challenges you want to suggest.

- None
- 1
- 2

(Filter: dependent on what choice is selected in Q 3)

For suggesting an additional grand challenge, please provide a description along the format for the existing grand challenges (if 1 or 2 is selected, the respective text fields per new grand challenge are required:
Q 3.1.1) Grand challenge name: (text field, required)
Q 3.1.2) The abstract, and the underlying gaps grounding the grand challenge: (text field, required)
Q 3.1.3) The research questions formulated to express the research needs and challenges: (text field, required)
Q 3.1.4) The innovations and wider impact expected when tackling the grand challenge: (text field, required)

Q 3.2.1) Grand challenge name: (text field, required)
Q 3.2.2) The abstract, and the underlying gaps grounding the grand challenge: (text field, required)
Q 3.2.3) The research questions formulated to express the research needs and challenges: (text field, required)
Q 3.2.4) The innovations and wider impact expected when tackling the grand challenge: (text field, required)

Grand Challenges of Research Survey - Part 3

Q 4) Please provide us with your suggestions of policy recommendations (to policy makers, funding agencies or similar high-level stakeholders) to address the five (or more) grand challenges: (text field, required)

Q 5) How might we best distribute 'best practice' cases that will potentially emerge from the current grand challenges to support and enable all parties to share knowledge and progress the policy making field? (Text field, Required). Please provide us with your considerations and suggestions.

Q 6) Are you planning to tackle one (or more) of the grand challenges of research in ICT supported governance and policy modelling in your professional (research and/or practical) activities? (Required)

- Yes
- Probably
- No

Grand Challenges of Research Survey - Part 4

Please provide us with some demographic data:

Q 7) Which professional group are you belonging to? (Required)

- Researcher
- Practitioner in policy making and policy operations from the public sector
- Strategic decision maker such as policy maker, representative of funding agency, etc.
- Student in the area (incl. doctoral student)
- Private sector: Policy consulting area
- Private sector: ICT development and/or service provider
- Non-government organisation
- Other - Please specify: (text field)

Q 8) What discipline are you mainly affiliated with? (Required)

- Computer science
- Information systems
- E-government and e-participation
- Social simulation
- Social sciences and humanities (except social simulation)
- Political science
- Psychology
- Communications and media research (incl. journalism)
- Economics
- Business administration
- Public administration and policy research
- Other - Please specify: (text field)

Q 9) What Nationality are you? (selection from ISO list, Required)

Q 10) What age are you approximately? (Required)

- under 30
- 30 - 49
- 50 - before retirement
- retired

Q 11) Name and email (optional)

In case we have any question or need for clarification, are you willing to provide us with your name and e-mail so we can contact you in this case? If so, please provide us with your name and e-mail (separated by a comma, max 200 characters): (text field)

ANNEX II: POSTS IN SOCIAL NETWORKS

Heading: Invitation to participate in an online consultation on Grand Challenges of research in ICT supported public governance and policy modelling

Dear colleagues,

eGovPoliNet members (www.policy-community.eu) have developed five grand challenges of research in the field to indicate current gaps and further research needs in the field of ICT-supported public governance and policy modelling.

The following grand challenges have been formulated:

- Grand challenge 1 - Data and information characteristics and use
- Grand challenge 2 - Modelling and simulation
- Grand challenge 3 - Citizen and stakeholder engagement
- Grand challenge 4 - Government capabilities and legitimacy
- Grand challenge 5 - Translating research results into policy actions and support

Before finalising the descriptions for wider dissemination, the network exposes the descriptions to a wider online expert consultation. We herewith invite you all to participate in this online consultation and to engage with us in assessing and improving the draft descriptions. As the grand challenges will be accompanied by policy recommendations for funding bodies, policy makers as well as the research and practice community actors in the field, we furthermore invite you to put forward your considerations of what policy recommendations should be formulated and directed to whom.

We kindly ask you to review the above grand challenge descriptions and provide us with your feedback, which you can do in the following ways:

- by adding your comments underneath each of the grand challenge descriptions on the page http://www.policy-community.eu/news-events/results/grand-challenges-of-research
- by filling in an online questionnaire with eleven questions, which allows you also to develop up to two additional grand challenges if you feel that key aspects are not covered in the five grand challenges above (in that case, please consider the understanding of grand challenges provided above). The questionnaire is reachable via http://www.policy-community.eu/news-events/results/grand-challenges-of-research
- by engaging in the discussion we also convey over our LinkedIn group "Policy Making 2.0" https://www.linkedin.com/groups?gid=4165795.

The project members and I as project coordinator are very grateful for your most valuable contributions! We very much hope that you find this kind of open discussion of value.

With kind regards,

Maria Wimmer