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Gap Analysis Methodology for Identifying Future Ict Related eGovernment Research Topics – Case of "Ontology and Semantic Web" in the Context of eGovernment

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Gap analysis methodology for identifying future ICT related eGovernment research topics – case of "ontology and semantic web" in the context of eGovernment

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Abstract

Modern ICT enables governments all over the world to improve their operation in order to become more efficient and effective. Despite of all possible benefits of using modern ICT, governments still struggle with the problems of inefficiency of their operation. eGovernment is being discussed in many contexts. Expectations of research and implementation in this field were high. However, many investments have not met the visions and reached the maturity aimed at. What are the deficiencies of current developments in eGovernment? What is the role of research in advancing the field? In an European Commission - funded project, eGovRTD2020, eGovernment research is being investigated in terms of current state of play and future needs of eGovernment research based on visionary scenarios of governments using modern ICT in 2020 for their service provision and interaction with their constituency (citizens, companies, other governments, etc.). To understand the future needs of eGovernment research, a structured methodology of analyzing the gaps of current research in respect to the future needs has been developed. This paper presents the gap analysis methodology with the example of identified gap and future research theme "semantic web and ontology in the context of eGovernment".

Keywords: eGovernment, gap analysis, future research, storylines, semantic web and ontology

1 Introduction

Today, Information Society forces not only the business sector, but also governments all over the world to improve their operation in order to become

more efficient and effective. Modern ICT heavily impacts and shapes Government activities in order to enable governments to cooperate with society, citizens, businesses and with other government agencies within countries and across borders in a more efficient and effective way.

The use of modern ICT enables innovative performance of business processes, integration of back-office systems among public (and private) sector, and provision of fully customized and personalized electronic services to customers - other public agencies, businesses and citizens. However, despite of all possible benefits of using modern ICT, governments still struggle with the problems of rigid, ineffective business processes due to insufficient use of ICT. Some exemplary problems are that information systems are still fragmented or that business processes are not properly with the modern ICT. Governments' cooperation with other government agencies and with society (citizens and businesses) is inefficient and bureaucratic in many cases. Fully customized and personalized electronic services are still a vision far beyond reality. However, full electronic collaboration without the necessity of physical contact is a path not to underestimate for certain electronic services even in the public sector.

Many strategic documents and initiatives have been launched in order to achieve more efficient government at the European level. One of the key documents is the Lisbon agenda (Lisbon strategy 2000), whose main goal is to make Europe the most dynamic and competitive knowledge-based economy by 2010 with improving citizens' quality of life, supporting single markets, and reducing administrative burden on enterprises (UK Ministerial eGovernment Conference 2005). For achieving its goals many other strategic initiatives have been launched as for example the i2010 initiative (European Commission 2005) and its predecessors eEurope 2005 (eEurope 2005) and eEurope 2002.

The goals of these documents were the basic guideline underlying the 5th and 6th Framework Programs of IST (Information Society Technologies). Within the 5th Framework Program, the EC funded eGovernment projects related to a 'user-friendly information society' (IST 2002). The research priorities of the 6th Framework Program of IST addressed research priorities with the labels "ICT research for innovative Government" and "Strengthening the Integration of the ICT research effort in an Enlarged Europe" (IST 2005). Other programs related to the i2010 strategy and the eEurope Action Plans are for example the MODINIS program (MODINIS 2005), Interchange of Data (IDA) and Interoperable Delivery of Pan-European eGovernment Services to Public Administrations, Business and Citizens (IDABC) programs (IDABC 2005) and eTEN (Trans-European Networks) (eTEN).

As it can be realized, a great deal of research is already going on in eGovernment related research. Consequently, the further needs of eGovernment research have to be identified. To gather a comprehensive understanding of future eGovernment research, a profound analysis of the deficiencies of current research in respect to future needs is required. Within the eGovRTD2020 project, such an analysis of gaps in current eGovernment research was carried out.

This paper first introduces the overall methodology of the roadmapping project eGovRTD2020, which aims at identifying a) future research themes for eGovernment, and b) measures to implement these research topics. The main focus of this contribution is the eGOVRTD2020 gap analysis methodology, which aim at identifying needed eGovernment research actions towards future scenarios, considering society, ICT and governmental environment in 2020. Identified eGovernment research themes can be seen as valuable input to strategic decision-makers responsible for eGovernment research programs.

This paper presents an example of gap analysis for identified gap and future research theme "semantic web and ontology in the context of eGovernment".

2 The eGOVRTD2020 project

eGOVRTD2020 gap analysis was carried out within the eGovRTD2020, specific support action under the sixth framework program of IST, co-financed by the European Commission. The project methodology can be presented into five main steps (cf. as well Bicking, Janssen and Wimmer, 2006) (Figure 1):

- Identify and compare current eGovernment research and eGovernment strategies (D.1.1 State of Play report)
- Develop future scenarios of innovative Governments in 2020 using modern ICT (D. 2.1. Scenarios report - Including regional workshops report)
- Identify and validate gaps between the state of play in eGovernment research and future needs of eGovernment research emerging in the scenarios 2020 (D. 3.1. Gap analysis Report).
- Define research themes and actions, as well as recommendations to governments, stakeholders, ICT providers, and society in order to streamline wanted evolutions of the future scenarios and to avoid unwanted trends (workshops with regional eGovernment experts resulting to Roadmapping report).
- Undertake actions to create a common awareness and to prepare the actors to take actions needed.

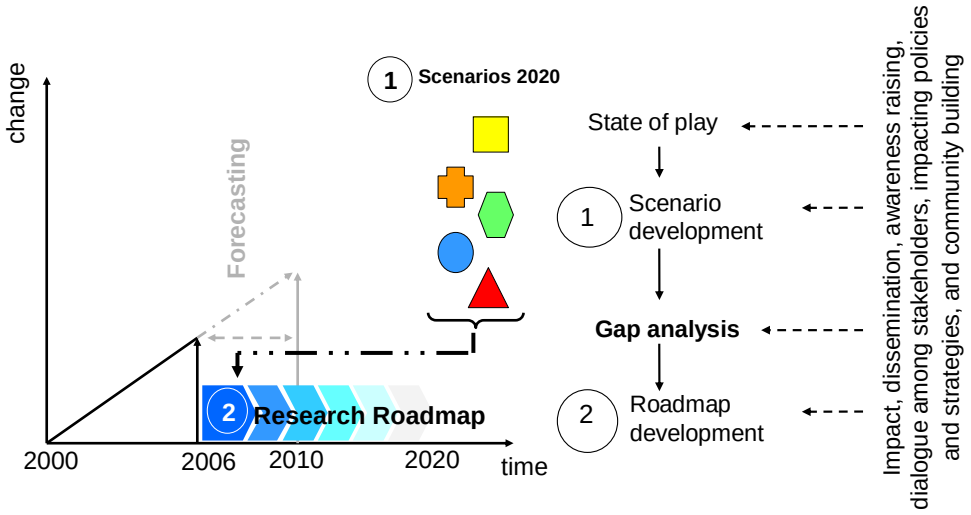

Figure 1: eGovRTD2020 overall methodology to develop an eGovernment research roadmap for innovative Governments in 2020

This paper focuses on step 3, the results of the gap analysis activity (D3.1 Gap analysis report). The major focus of the gap analysis was to identify gaps in current research and to recommend the key future research directions for eGovernment in 2020 in order to achieve wanted aspects of future scenarios and to avoid unwanted ones.

3 Gap analysis in eGovRTD2020

Gap analysis is carried out in many contexts and for various purposes. To understand and study gaps, a well defined structured approach is required. In general, a gap expresses a mismatch between issues of consideration. In the understanding of eGovRTD2020, gaps may refer to an issue of research that is currently being considered (existing in the state of play) but in a way, which does not meet the needs emerging in the future scenarios. A gap may also refer to an issue that is not addressed at all by current investigations of eGovernment research.

Further on to the definitions provided above, in the context of eGovRTD2020, a gap is defined as:

- either a mismatch between the issues (dimensions or topics of interest) in the state of play and the issues extracted from the future scenarios ,
- or a lack of current research of issues identified in the scenarios.

To analyze gaps, the holistic reference framework of eGovRTD2020 (**Error! Reference source not found.**2, Bicking and Wimmer, 2006) was used as the baseline for investigating the aspects of interest in gap analysis.

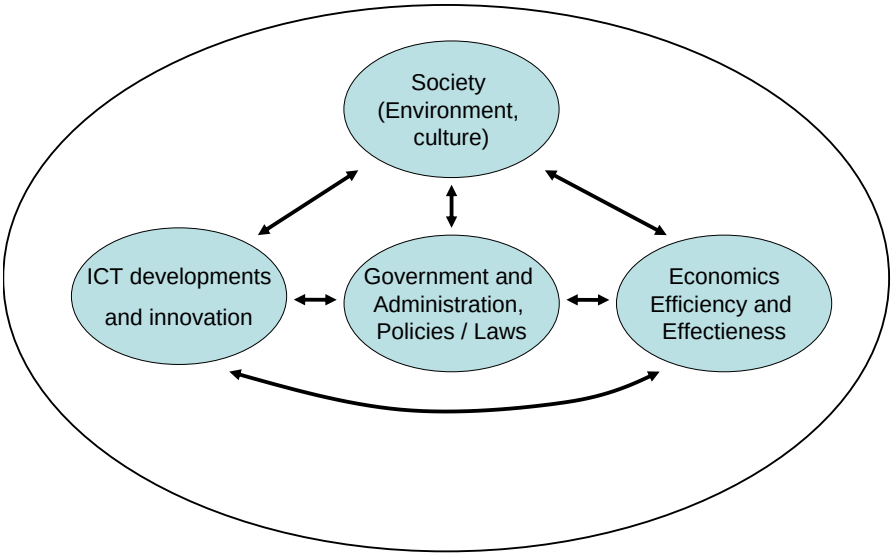

Figure 2: Holistic reference framework of eGovRTD2020 – key research areas and their interconnections as core categories of investigations for the gaps

As shown in **Error! Reference source not found.**2, the gaps can be grouped along the four main aspects (research areas) forming government activities, i.e.:

- Governments themselves
- Society including citizens, market, business, environment, cultures, etc.
- ICT and innovative technical developments
- Economics including modernization aspects, public value, cost/benefit assessments, etc. (this category is not considered in its own, instead, it is to be understood in its interrelation with the other categories mentioned before)

and their interconnections:

- Government & ICT (how governments are using ICT for their activities and services within governments and in the interaction among governments)
- Governments & Society (how governments interact with society, i.e. services to the society)
- Government & Economics (how governments try to fulfill their tasks in an effective and efficient way, securing value for money, carrying out cost/benefit analyses, doing modernization based on pressure to safe costs)
- Government & Economics & ICT (how government reaches more efficiency and effectiveness through the use of ICT; modernization through ICT; focus is within governments and among governments)
- Governments & Society & Economics (how government reaches more efficiency and effectiveness in interacting with its constituency through organizational change and modernization; this category focuses on efficiency gains without using ICT)
- Government & Society & ICT & Economics (how government reaches more efficiency and effectiveness through the use of ICT when interacting with its

constituency; modernization of interactions with society through ICT; focus thereby is the external side of government, i.e. interaction with society).

The focus of eGovRTD2020 is on eGovernment research and future research themes in this field. Consequently, some categories have been more important than others (e.g. the last item listed), some even resulted in negligence due to minor relevance to eGovernment research (e.g the categories Society & ICT or Society & ICT and Economics).

3.1 eGOVRTD 2020 Gap analysis methodology outline

Investigation of relevant literature has uncovered several gap analysis related methodologies, such as:

- *Soft systems methodology (SSM).* The SSM is an approach to investigate problem situations of the real world (Checkland and Scholes, 1990:18). Soft problems are difficult to define as they have a large social and political component. "When we think of soft problems, we don't think of problems but of problem situations. We know that things are not working the way we want them to and we want to find out why and see if there is anything we can do about it" (Hicks et all 1991; Lenart and Hribar 2004, p. 226). SSM was developed by Peter Checkland for the purpose of dealing with problems of this type.

For the eGovRTD2020 gap analysis methodology, the SSM was used as a basic reference.

- *SWOT analysis methodology.* SWOT Analysis is a strategic planning tool used to evaluate the Strengths, Weaknesses, Opportunities, and Threats involved in a project or in a business venture or in any other situation requiring a decision. Strengths and weaknesses are internal to an organization. Opportunities and threats relate to external factors (Mindtools 2006, Tutor2U 2006). The required first step in SWOT analysis is a definition of the desired end state or objective1. The objective must be explicit and approved by all participants in the SWOT analysis process. Once the objective has been identified, SWOTs are discovered and listed.

SWOT analysis is important for clarifying and evaluating the importance and relevance of problems and gaps in eGovRTD2020.

- *ITPOSMO methodology.* ITPOSMO stands for: Information, Technology, Processes, Objectives and values, Staffing and skills, Management systems and structures, and Other resources, time and money. It is a commonly used gap analysis methodology in the field of eGovernment projects developed by Heeks (Heeks 1999, Heeks 2001, Heeks 2003). Heeks states that these seven dimensions are necessary and sufficient to provide an understanding of design-reality gaps in eGovernment projects. eGovernment success and failure depend on the size of

1 Synonyms for "objectives" in SWOT analysis terminology are "desired end states", "plans", "policies", "goals", "strategies", "tactics" and "actions".

gaps that exist between current realities and the design of an eGovernment project (Heeks 1999, Heeks 2003).

The ITPOSMO methodology is the closest meeting the needs for the eGovRTD2020 gap analysis. Consequently, it was the fundamental basis adapted for the gap analysis and roadmapping aims of eGovRTD2020.

The commonality of the introduced gap analysis methodologies is that these intend to identify and validate the difference between a current state of affairs and a future state. Thereby, the object of analysis can be classified as a problem (Checkland 1999, 316; Možina et all 2002, 619; Lenart and Hribar 2004) or as a gap (Heeks 2003).

Nevertheless, the above mentioned methodologies do not fully support the aims of gap analysis in the context of eGovRTD2020 projects. Therefore a revised methodology fitting the needs of gap analysis in eGovernment research has been developed. It is being introduced in the next section.

3.2 Development of eGOVRTD2020 gap analysis methodology

The eGovRTD2020 gap analysis methodology is based on above introduced related methodologies. However, it is specifically developed to identify the gaps and needs of future research in eGovernment, comprising of the following four steps (see figure 3):

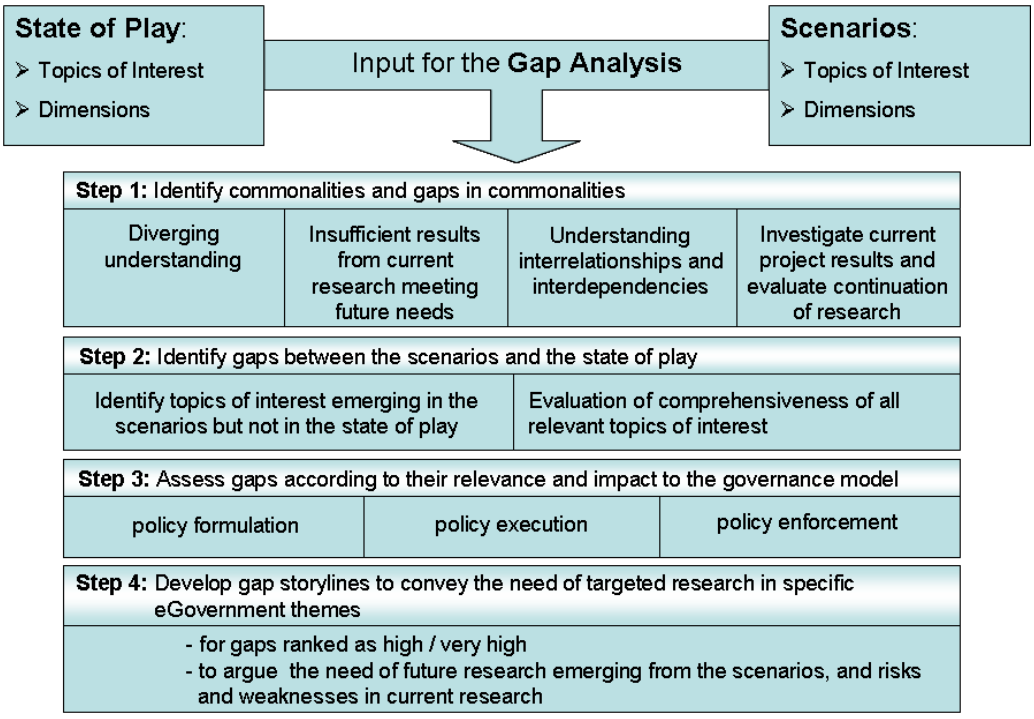

Figure 3: Gap analysis methodology for eGovRTD2020

- *Step 1 – Identification of commonalities where current research will not meet the future demands or where research needs to be continued to meet the future needs.*

- *Step 2 - Identification of dimensions and topics of interest, which are not mentioned in the state of play but emerged in the visionary scenarios for 2020.*

To investigate the gaps in current research, the state of play of current eGovernment research and the possible future scenarios of governments and society in 2020 were the main inputs.
In both activities, issues of current research and of future needs of research were extracted. These issues comprise dimensions and topics of interest that have been analyzed, compared and assessed.

- *Step 3 – Gap assessment according to impact and relevance towards the eGovernance model.*

The gaps identified in steps 1 and 2 were evaluated according to their relevance and impact to the eGovernance model shown in **Error! Reference source not found.**4. In public administration sciences, the core activities of state and public administration are defined as the following three (Gisler 2003, Lenk and Traunmüller 1999, Wimmer et al 2001):

– Policy formulation: definition of policies, strategic decision-making, formulation of laws, issues of constitutions of states, etc.
– Policy Execution: implementing the policies formulated, i.e. intervention in society and market, regulations, execution of laws, etc. The core business of operative action in governments and public administration.
– Observation of society and market: in order to be able to formulate laws and strategic decisions as well as to intervene properly in society, market and environment, governments need to collect data and information on the actors and their behavior.

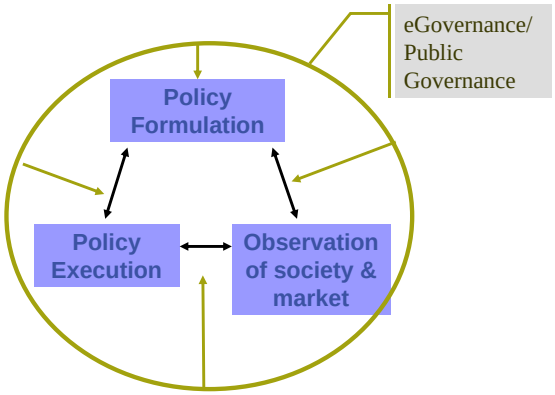

Figure 4: eGovernance model - criteria for gap assessment (adapted from Gisler 2003).

These three activities can only be executed on the basis of a proper governance model (also called public governance – **Error! Reference source not found.**4). The overall public governance model was the basis for the gap assessment in eGovRTD2020. Consequently, the gaps identified in steps 1 and 2 were assessed

in terms of very high, high, middle, low, no relevance and/or impact to this governance model.

- *Step 4 – Gap storyline development to convey the need of targeted research in specific eGovernment themes.*

For gaps, which were assessed as having a very high impact and/or relevance to the governance model, gap storylines were developed. The storylines were aimed at giving a deeper understanding of future scenarios and the risks and weaknesses in current research. Storylines have been defined as being a coherent collection of issues (dimensions and topics of interest) within one category including a problem, a goal and potential solutions in the future. Gap storylines may enlarge issues of scenarios with new aspects to make them internally complete and consistent. In developing gap storylines, some dimensions identified in the state of play or in the scenario building exercise may also appear as solutions. Storylines were used later in the roadmapping process for the formulation of 13 e-government research themes with action plan for their application and execution.

3.3 eGOVRTD Gap analysis results – exemplification

In the following subsections, the example of identified eGovRTD2020 research gap description, with gap assessment and storylines is described. Starting with the identified »Ontology and Semantic web« research gap description. As presented research gap has been assessed as very high relevant/important to the above introduced e-governance model, storyline addressing this issues have been further developed.

3.3.1 A gap description for the case "ontology and semantic web" in the eGovernment context"

In the gap analysis phase of eGovRTD2020, a number of gaps have been elicited and described using a template as introduced in Table 1. The table presents an example of gap description for the case "ontology and semantic web in the eGovernment context".

<table>
<tr><td colspan="4">Issues from State of play and future Scenarios</td></tr>
<tr><td colspan="2">Scenarios</td><td colspan="2">State of Play</td></tr>
<tr><td>Dim</td><td>Topics of Interest</td><td>Dim</td><td>Topics of Interest</td></tr>
<tr><td rowspan="4">Ontology and Semantic web</td><td>ICT as mediator (not only for syntax and semantic interoperability but also to bridge cultures)</td><td rowspan="4">eGovernment as a research discipline of its own</td><td rowspan="4">Trans-disciplinary approaches aiming at reducing the gap between humanist and technologist perspective in: intelligent agents, semantic web, broadband communication, ubiquitous computing</td></tr>
<tr><td>Semantic web technologies</td></tr>
<tr><td>Ontology</td></tr>
<tr><td>Translation technologies</td></tr>
</table>

	Multilingual problems in Central eGovernment services
Commonality	
Currently, the European Commission supports several research projects in the FP 6 focusing on providing semantic interoperability among eGovernment (eGov) services across organizational, regional and linguistic borders. In spite of the fact that there are some projects dealing with ontology and semantic web already in place, there are still many issues to be addressed in further research.	
Gap	
A Common European eGovernment ontology and an agreed European eGovernment glossary are not established. Common specifications for semantic interoperability are claimed as being needed, for instance through a regular eGovernment service terminology and service information model. In regard to globalization, a need for, and likely a successful development of automatic translation machines will progress, which will help to bridge the gap between people speaking different languages. To assure this, more research is needed in this field. Trans-disciplinary approaches aimed at reducing the gap between the humanist and technologist perspectives in intelligent agents, semantic web, ontologies, broadband communication, and ubiquitous computing, are needed.	
Gap assessment: Very high relevance / importance	

Table 1: Gap "Ontology and Semantic web"

In the following, the example of gap related storyline of the gap analysis activity within eGovRTD2020 is introduced for the purpose to exemplify the methodology.

3.3.2 Gap storyline for the case "Ontology and semantic web in the eGovernment context"

In the context of eGovRTD2020, the gaps ranked as very high in terms of impact and / or relevance to the eGovernance cycle needed to be conveyed in an expressive way to the experts in the roadmapping workshops. Gap storylines seemed to be a proper means.

The gap storylines have been described in a template comprising of: a brief gap description, the storyline describing the future potential, risks, and needs of research, and links to the gaps and scenarios embodied in the gap storyline.

Table 2 presents gap storyline to demonstrate the concept. The full range of gap storylines developed within eGovRTD2020 is available in the final deliverable D 3.12.

2 Available as D 3.1 at the project website www.egovrtd2020.org

Gap dimension: "Ontology and Semantic web"
Gap description: Common European eGovernment ontology and agreed European eGovernment glossary are not established. The issues of interoperability still remains open.
Storyline: According to workshop's scenarios, following vision relating to "Ontology and Semantic web" dimension can be defined: There is ICT used as mediator to not only for syntax and semantic interoperability but also to bridge cultures. Government becomes the orchestrator, as technology for ensuring interoperability at the technical, syntactical, semantic and cultural levels is developed. Semantic interoperability between EU countries and between EU, central and local levels of government is accomplished and automatic workflow management is possible, involving all kinds of agencies at all levels of government. Semantic networks and interoperability support widespread ICT usage. Semantic interoperability is and will be a challenge (and important) not only across languages but across domains of practice - even in the same country different professions cannot communicate accurately because their terms of art are not understood by "outsiders" even when the outsiders use the same words. Semantic interoperability is understanding the meaning, which requires also being able to interpret what the other one is saying, i.e. inference mechanisms to reason about the impact. On the other hand ontologies will help to develop common understandings and semantic technologies will facilitate linking up organizational, semantic and technical levels of understanding and execution of services. In order to achieve common European eGovernment on Common European eGovernment ontology and agreed European eGovernment glossary are not established. Common specifications for semantic interoperability are claimed in as being needed for instance through a regular eGovernment service terminology and service information model. In regard to globalization, a need and likely a successful development of automatic translation machines will progress, which will help to bridge the distance between people speaking different languages. For assuring this, more research is needed to be focused on this field. Providing semantic interoperability among eGovernment services across organizational, regional and linguistic borders is important step towards common European eGovernment ontology and European eGovernment glossary. Furthermore, development programs and researches should be also focused on developing translation machines in order to bridge language barriers.
Gap issues: Translation technologies, Multilingual problems in Central eGovernment services, ICT as mediator (not only for syntax and semantic interoperability but also to bridge cultures)

Table 2: Gap Storyline "Ontology and Semantic web"

4 Conclusions

In this contribution, we introduced a method to analyze gaps of current research in the field of eGovernment and to identify key topics of future research in the field. The methodology was developed in the course of an European Commission - funded project, eGovRTD2020. The concept bases on well-known methodologies such as the SSM, SWOT analysis and the ITPOSMO method. However, it goes beyond sole analysis of weaknesses and deficiencies. Instead, the eGovRTD2020 gap analysis methodology investigates challenges and deficiencies of current research in respect to future needs, it assesses the relevance and impact of these weaknesses in respect to a specific objective or conceptual framework, and it links the gaps with future needs, visions and potential research to address the gaps through the gap storylines.

All together in the eGovRTD2020 77 research gaps were identified by gap analysis in step 1 and 32 research gaps were identified in step 2. All the gaps were clustered in the 12 categories. Gaps, assessed as very high relevant/important to the eGovernance model were further on grouped and interlinked in the storylines, which aim to describe the key aspects of the gap followed by potential research and development methodologies and solutions.

The gap analysis methodology of eGovRTD2020 is a part of a broader methodological framework to strategic planning, which can be applied in diverse contexts. Crucial points to apply the methodology are:

- to have a good understanding of the current situation in the context and of the future(s) aimed at in that respect;
- to investigate the environment of consideration in a broader perspective: key aspects and their interrelations (a holistic view);
- to base on a clear assessment framework;
- to support the analysis with qualitative methods of data analysis and extraction.

In eGovRTD2020 project, the next stage is roadmapping eGovernment research. Thereby the gap analysis and the gap storylines as exemplified in this contribution are key inputs for the experts to discuss future research needs and measures to implement the research. In this paper only one example is presented. All project results can be obtained from the project web site: http://www.eGovRTD2020.org.

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