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Scientific foundations training and entrepreneurship activities in the domain of ICT-enabled Governance

Government 3.0 Roadmap

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Document description:	This task focuses on the definition of the roadmap of the Government 3.0 Scientific area. This task will identify the gaps concerning the missing knowledge from the

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	current training curricula and it will provide input in WP3. The roadmap will also identify current and future fields of interest and research in the domain of collaborative government. It will describe the further development of and integration of ICT in all aspects of governance and citizenship. Based on the roadmap, the consortium will identify topics that suit research projects that can be conducted with participation of students. Close collaboration with businesses and public agencies ensures that research can have practical impact and thus contribute to entrepreneurship and thus this task will provide input in WP5.

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Document History

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		Jon Matthew Switters, Francesco Mureddu (LC)	Project analysis: Service Co-creation, Once-Only Principle, Service Modules, CAPS
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Executive Summary

The current report details the roadmapping activities within the Work Package 2 of the Gov 3.0 project. It describes the methodology that has been used to develop the roadmap and the results of the application of the methodology.

The methodology described in this report is based on the previous roadmapping projects, led by the partners, including eGovRTD2020 and OCOPOMO projects. The methodology has been adjusted and adapted to the specific needs of the Gov 3.0 project. The Roadmap has been developed based on the identified research and training needs, elaborated with the help of the future scenario technique and the analysis of the projects.

Results presented in the report include the identified projects that involve the disruptive technologies of Government 3.0, possible future scenarios that exemplify the implementation of these technologies in the public service and research and training needs, arising during the implementation. These inputs were used to develop the Government 3.0 Roadmap, detailing the specific steps for the effective implementation of disruptive technologies in digital government. Roadmap concerns various stakeholders relevant to the implementation of these new technologies in government and can be used as a guidance for addressing effectively the arising research and training needs.

The developed roadmap will be used in the WP3 and WP4 of the project for the development of the learning materials both for the Joint Master Program and the MOOC.

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2. LIST OF TERMS AND ABBREVIATIONS

Term/Abbreviation	Definition
AI	Artificial Intelligence
AR	Augmented Reality
BC	Blockchain
BOLD	Big Open Linked Data
CAPs	Community Awareness Platforms
DUK	Danube University Krems (Austria)
EC	The European Commission
eIDAS	electronic IDentification, Authentication and trust Services
FP7	7th Framework Programme
G2B	Government to business
G2C	Government to citizen
G2G	Government to government
GS	Gaming-based Simulation
ICT	Information and Communication Technologies
IoT	Internet of Things
ISA	Interoperability Program for European Public Administration
LC	Lisbon Council (Belgium)
ML	Machine Learning
NEGZ	Das Nationale E-Government Kompetenzzentrum (Germany)
NLP	Natural Language Processing
OOP	Once Only Principle
P2P	Peer-to-peer
PwC	PricewaterhouseCoopers (Greece)
RDF	Resource Description Framework
RDFS	Resource Description Framework Schema
RQ	Research Question
SA	Sentiment Analysis
SC	Smart City
SiLo	Singular Logic (Cyprus)

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SPARQL	SPARQL Protocol and RDF Query Language
TOOP	The Once-Only Principle Project
UAEGEAN	University of the AEGEAN (Greece)
UiA	University of Agder (Norway)
UNU	United Nations University (Portugal)
URI	Uniform Resource Identifier
VR	Virtual Reality
WP	Work Package

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3. INTRODUCTION

1.1 Purpose and Scope

This report is the outcome of the second work package of the Gov 3.0 project. Work package 2 intends to set the research and knowledge roadmap of the area of Government 3.0. The main objectives of this WP are the following:

- To monitor research developments in the area of eGovernment.
- To coordinate research on categorization and structure of different scientific ecosystems so as to perform analysis and categorisation of eGovernment scientific research areas.
- To update and set up Future Research Directions (roadmap) and find the gaps of existing curricula.

The Roadmap is an essential deliverable of the Gov 3.0 project that guides the development of the following work packages, most notably the curriculum developed in WP3.

1.2 Approach for Work Package and Relation to other Work Packages and Deliverables

In WP2, the deliverables of WP1 (T1.1. Baseline Research and T.1.2. Electronic Governance training programmes worldwide) are used as an input to develop a list of specific actions necessary to address the research and training needs in the emerging domain of Government 3.0. This task will identify the gaps concerning the missing knowledge from the current training curricula and will be used for the development of the training courses and joint-master programme in WP3.

Deliverable 1.1 (Report for Electronic Governance research and practice worldwide) of the project produced the following definition of Government 3.0:

> *Government 3.0 refers to the use of disruptive technologies (AI, ML, IoT, NLP, VR, AR and big data technologies) in combination with established information and communication technologies (distributed technologies for data storage and service delivery) and the wisdom of crowd (crowdsourcing and co-creation) towards data-driven and evidence-based decision and policy making and provision of relevant smart customised public services for decision support of citizens and enterprises.*

Government 3.0 qualitatively differs from the previous e-Government generations in its main goal (societal problem-solving), method (data-driven decision making, smart governance) and the area of application (including international level). The proposed definition of Government 3.0 provides a clear link between the use of big open linked data, cloud computing and the new disruptive technologies that, when combined with citizen-input from crowdsourcing and co-creation of services, can significantly improve the quality of governmental decisions, providing evidence-based and data-driven decision making. This definition shifts the focus from collaboration with citizens (as in Government 2.0) to the societal problem-solving, using large volumes of data collected from various sources.

The purpose of the roadmap is to identify the future steps needed to appropriately address the emerging new generation of Government 3.0. This includes, (1) the identification of the research and training needs in the emergent domain, (2) outlining the specific steps needed to be taken to address the needs and challenges of Government 3.0, and (3) formulating the recommendations for the stakeholders for adequately implementing the disruptive technologies in the public sector.

Based on the roadmap, the consortium will identify topics that suit research projects that can be conducted with participation of students. Close collaboration with businesses and public agencies ensures that research can have practical impact and thus contribute to entrepreneurship and thus this task will provide input in WP5. The overview of the relations between different work packages is presented in Figure 1.

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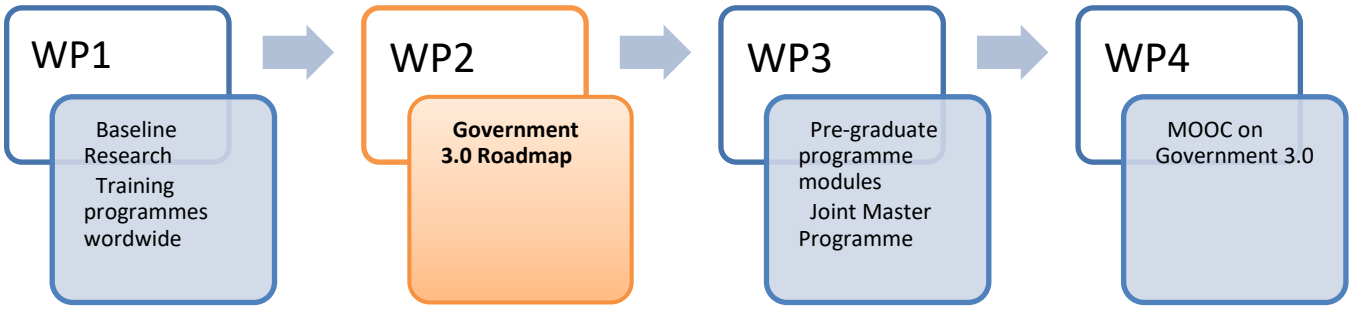

Figure 1. Relationship between work packages in Gov 3.0 project

1.3 Methodology

A research and knowledge roadmap of Government 3.0 will be maintained, updated and enriched taking into account new technological developments and also new needs in the public sector. The roadmap is an ongoing process and the final version of the deliverable is to be produced at M24 to ensure that it contains the most accurate and useful data available for the later work packages.

There are two sources for the identification of the research and training needs used to develop the roadmap of Government 3.0 (section 3): the analysis of existing projects, active or completed in the European Union (described in 1.3.1) and the opinion of experts collected during the future scenario workshops (section 1.3.2).

In the context of the report, a "research need" is a gap identified by relevant stakeholders as important and if addressed will help to resolve a specific real-world problem (Chang, Carey, Kato, Guise, & Sanders, 2012). A "training need" is a gap in the existing training curricula (either formal or vocational), which when addressed allows the recipients of training to manage effectively a specific real-world problem. A "problem" in both of the definitions refers to the implementation of the disruptive technology in public service as illustrated in the scenarios (section 1.3.2).

1.3.1 Project analysis

First step in identification of the training needs relevant to the technologies and technological trends associated with Government 3.0 is the analysis of active and completed European projects involving the application of ICTs for public service provisioning. The list of calls used in the analysis is provided in Table 1.

Table 1. Calls used for search of relevant projects

Project call	Funding body	# of projects
Horizon 2020	European Commission	119
FP7-ICT	European Commission	35
ICT-10-2015	European Commission	2
ERC-2017-ADG	European Commission	3
CIP-ICT-PSP	European Commission	4
CEF Programme	European Commission	1
Other	Various	23

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The projects are studied to determine their place on the Government 1.0/2.0/3.0 generation continuum. Relevant projects along the technologies and trends, described in section 2 are classified and analysed in order to extract the associated research and training needs.

1.3.2 Future scenarios

Scenario building is a widely utilized method to represent possible future situations. This technique is used in public sector, academia and business (Ratcliffe, 2000). The objective of creating the future scenarios is to gain different viewpoints and perspectives of a topic area to understand better the future and possible directions of the field's evolution (Janssen et al., 2007).

Scenarios are the narratives created to explore multiple variants of the possible future developments in a specific area or domain (Johnson et al., 2012). They typically describe the future state of affairs and the path from the present to that state (Ratcliffe, 2000), focussing on the activities of the stakeholders involved in the situations of interest (Carroll, 1999). The aim of the scenarios is to improve the understanding of the specific situation and serve as an instrument for the better decision-making (Ratcliffe, 2000; Ringland, 2002). Scenarios can provide different viewpoints and perspectives of a topic area to understand better the future and possible directions of the field's evolution (Janssen et al., 2007). Scenarios are particularly useful for tackling complex problems with high levels of uncertainty, because, unlike forecasts that suggest the most probable way the situation develops (Berkhout, Hertin, & Jordan, 2002), scenarios encourage to look into multiple possible developments with different degrees of probability (Bohensky, Reyers, & Van Jaarsveld, 2006; Peterson, Cumming, & Carpenter, 2003).

There have been a number of studies, where future scenarios have been used in the context of digitalisation and ICT. The methodologies used in these projects are described below. In the project eGovRTD2020 (Xiaofeng & Wimmer, 2007), scenarios were developed in several regional workshops with the participation of the government experts. For this, the following four-step methodology was used (first two steps take place in the regional workshops, last two steps take place in an internal synthesis) (Xiaofeng & Wimmer, 2007):

1. Scenario building based on a holistic approach.
2. Extraction of issues from scenarios and classification in respect to their probability and impact on future e-government.
3. Validation of the workshop results and consolidation of aspects, extraction of three key dimensions.
4. Synthesis of results into final alternative scenarios.

In this project, scenarios were created during the workshop sessions, which limited the stakeholders who were able to participate in workshops. Building scenarios during the workshop demanded that the participating experts had holistic knowledge of e-government context (Xiaofeng & Wimmer, 2007).

In the OCOPOMO project (Wimmer & Bicking, 2011), scenario building was used for the development of collaborative scenarios for policy modelling. The aim of OCOPOMO was to present different types of scenarios using e-participation tools to reflect several positions, beliefs and conditions of stakeholders in a policy area. Several stakeholder groups were involved in the project to develop, discuss and collaborate on different scenarios in the political context (Wimmer & Bicking, 2011). Similar to eGovRTD2020, stakeholder groups of a specific policy context in the OCOPOMO project were required to create scenarios online. Unlike the former, OCOPOMO scenario building was not following a semi-formalized format, the experts created two types of scenarios. First, stakeholder groups generated evidence-based user-driven scenarios. Then, the model-based scenarios serving as a visualization were created and communicated to the stakeholders (Wimmer & Bicking, 2011). In this project, the scenario building involved the stakeholders of a particular political context who developed scenarios during a group session (narrative or visual, both online).

CROSSROAD project (Bicking & Wimmer, 2011) used roadmapping and scenario methodology to identify new technologies, new governance models and for policy modelling. In this context, CROSSROAD used the desk research methodology and

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developed a taxonomy to define research topics in ICT. The developed taxonomy was used as a basis for the scenario building (Bicking & Wimmer, 2011). Along the project's timeline, CROSSROAD defined a scenario description framework to present a number of different ICT-scenarios in 2030. The framework presented the key impacts, influencing the future research in ICT. Scenarios were developed as a narrative description to present possible forecasts in selected key areas of ICT for governance and policy modelling. Scenario storyboards were presented to describe some possible real-life situations, which show how stakeholders (like citizen or policymaker) would act within the scenario. The difference between the OPOCOMO and CROSSROAD scenario methodologies is that in the latter a more general framework is designed to describe the European society in 2030 (Misuraca et al., 2010).

In contrast to these initiatives, the methodology we applied to identify research and training needs in Government 3.0 focused the efforts of the experts on the discussion of the implications of the scenarios by developing the scenarios beforehand and devoting the workshops exclusively to the discussion/evaluation stage of future scenario technique. The proposed scenario methodology described below is based on a modified operational roadmapping methodology (Xiaofeng & Wimmer, 2007): The future scenarios were created and then offered to the range of experts, who would provide their input and help identify the relevant needs for each technology or trend.

The developed scenarios are designed to cover the majority of the disruptive technologies and concepts associated with Government 3.0. The described implementations include Smart Cities, Cloud Computing, IoT, AR, VR, Blockchain, Big Data, eID, AI, Machine Learning, and Natural Language Processing. Some technologies and concepts are mentioned in more than one scenario.

For the use in the workshops, the scenarios are written in a narrative form and are depicted using a diagram (presented in a form of a poster). The description of a scenario is divided in three sections. The first part of the scenario describes the present state of the situation. This includes the environment of the situation and the current use of the technology in the area of the scenario. In addition, the problems with the status quo are listed. In the second part the vision is described, how the future could look like with the use of the disruptive technology in the domain. The last part explains the benefits of the new technology for this scenario. The scenario diagram shows the interaction between the main actors and technologies (enablers) involved at each step. The diagrams focus on the exchange of information between the parties.

The scenario diagram shows the interaction between the main actors and technologies (enablers) involved at each step. The diagrams focus on the exchange of information between the parties. Visual representation of a complex story significantly improves the understanding of it by the audience (Gemino & Parker, 2009; Stiller, Freitag, Zinnbauer, & Freitag, 2009). Accompanying the scenario with visual cues allows to explain the scenario quickly and also ensures that the audience is able to see the whole scenario all the time, when suggesting and discussing specific research and training needs without the need to refer continuously to the scenario text. Practically, the diagrams are printed as a poster of a size appropriate to the audience and room size.

At the workshops, scenarios were presented to the groups of experts (both from academia and public sector), who in a workshop setting provide input on the viability of such applications of the technologies in the field, and on associated research and training needs. The collected information was then used to draft the research roadmap and recommendations. The final roadmap is a synthesis of the steps concerning the individual disruptive technologies and trends in the Government setting.

Three workshops were conducted as a part of the roadmapping research. All the workshops used similar approach and structure and used future scenarios as a basis for the discussion of research and training needs. Future scenarios envisioned the use of specific disruptive technologies (identified in deliverable T.1.1) in the public service. The structure and the content of each of the three workshops are presented in the following sections.

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1.3.2.1 Workshop 1: Samos Summit (July 4, 2018, Samos, Greece)

For this workshop three scenarios were developed by the WP2 leader (NEGZ). The scenarios showed possible ways to implement different disruptive technologies in public sector, among those identified during WP1 research. The scenarios were then presented to the experts participating in the workshop and discussed with the aim to identify research and training/curriculum needs in relations to the specific scenario and Government 3.0 in general. Scenarios were discussed in groups and presented by each of the three groups moderators orally and visually as posters. Workshop participants suggested research and training needs relevant for the particular scenario.

In this workshop following three scenarios (dealing with specific disruptive technologies) were discussed:

1. Smart city pollution monitoring (Smart Cities, Cloud Computing, IoT)
2. Using IoT to monitor soil erosion and degradation (IoT, Cloud Computing, AI)
3. Virtual reality and augmented reality for emergency management (VR, AR)

The workshop was planned with a following timeline:

1. Introduction (15')
2. Group Work (1 hr)
    2.1. General discussion of the scenario. Possible improvements or changes.
    2.2. Discussion of the particular aspects of the scenario: stakeholders, technological enablers, data issues, barriers, legal issues to be addressed, timeline for possible implementation.
    2.3. Identification of the research needs for the achievement of the scenario. Prioritisation of needs (green/yellow/orange).
    2.4. Identification of the training/curriculum needs for the achievement of the scenario. Prioritisation of needs (green/yellow/orange).
    2.5. Summarizing, wrapping-up by the moderator.
3. Presentation of the scenarios (30') by one representation from each group. General discussion.
4. Summary of the discussion. Closing the workshop. (15')

Steps 2.1 and 2.2 were used to familiarize the audience with the content of the scenario, while during 2.3 and 2.4 the input for the roadmapping activities was collected. Technically, the discussions were organised around posters depicting the processes in the scenarios. Workshop participants used post-it notes of different colours (corresponding to the priority of a need, green – relatively minor need, yellow – average, orange – important need) to note a specific research or training need. The priority of a specific need had to be agreed by the whole group before it was recorded.

The audience of the first workshop on roadmapping consisted of both the participants of the Samos 2018 Summit and the International Summer School on Government 3.0. Gov 3.0 project partners were the initiators of this workshop and participated as well. In general, the participants covered the whole quadruple helix (academia, business, public sector, NGOs) but the percentage of the academic participants reached 60%.

The participants in the workshop were divided into three groups, each group discussing one of the three scenarios. Moderators assured that the groups were composed of people from as diverse backgrounds as possible: i.e. participants from the same university/organisation were always assigned to different groups. At the end, the groups consisted of 5-7 members plus a moderator, who would first present the scenario and then steer the discussion and make notes. One of the group members (but not the moderator) consequently presented the results of the discussion to the whole audience of the workshop and answer questions.

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1.3.2.2 Workshop 2: EGOV-CeDEM-ePart 2018 Conference (September 3, 2018, Krems, Austria)

For the second workshop three scenarios were developed by the WP2 leader (NEGZ). The workshop used similar approach, the three scenarios were discussed by the experts in groups with the aim to identify research and training/curriculum needs in relations to the specific scenario and Government 3.0 in general. Scenarios were presented by the group moderators orally and visually as posters. The timeline of this workshop differed from the first workshop, because of the time allocation in the conference programme.

In the workshop 2, following three scenarios (dealing with specific disruptive technologies) were discussed:

4. Blockchain for storing refugee information (blockchain)
5. Intelligent citizen portals connected across Europe using chatbot interface for easy inter-action with citizens (AI, eID, Once Only Principle)
6. Gamification in social care (gamification, cloud computing)

The workshop was planned with a following timeline:

1. Introduction (15')
2. Group Work (50')
    2.1. General discussion of the scenario. Possible improvements or changes.
    2.2. Discussion of the particular aspects of the scenario: stakeholders, technological enablers, data issues, barriers, legal issues to be addressed, timeline for possible implementation.
    2.3. Identification of the research needs for the achievement of the scenario. Prioritisation of needs (green/yellow/orange).
    2.4. Identification of the training/curriculum needs for the achievement of the scenario. Prioritisation of needs (green/yellow/orange).
    2.5. Summarizing, wrapping-up by the moderator.
3. Presentation of the scenarios (15') by one representation from each group. General discussion.
4. Summary of the discussion. Closing the workshop. (10')

Technically, the discussions were organised around posters depicting the processes in the scenarios. Workshop participants used post-it notes of different colours (corresponding to the priority of a need, green – relatively minor need, yellow – average, orange – important need) to note a specific research or training need. The priority of a specific need had to be agreed by the whole group. Again, the priority of a specific need had to be agreed by the whole group before it was recorded.

The audience of the EGOV-CeDEM-ePart workshop on roadmapping consisted of 28 participants from 17 different countries from Europe, Asia, North and South America. Most of the participants (21) represented the higher educational institutions, 4 came from other research institutions, 3 represented governments. Moderators of the workshop assured that the discussion groups were composed of people from as diverse backgrounds as possible. During the discussion, notes were made by the moderators, which together with identified research and training needs were used for developing this report.

1.3.2.3 Workshop 3: NEGZ Herbstaggung Conference (November 22, 2018, Berlin, Germany)

For the third workshop three scenarios were used. All of the scenarios used, where developed by the WP2 leader (NEGZ). The regional annual event organised by NEGZ attracted experts from Germany and adjacent countries. Organisationally, the workshop used similar approach, the three scenarios were discussed by the experts in groups with the aim to identify research and training/curriculum needs in relation to the specific scenario example and Government 3.0 in general. Scenarios were presented by the group moderators orally and visually as posters. The language of this workshop was German, and the scenario texts were translated by the scenario creators, posters were presented in English.

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Out of the three scenarios used in this workshop, two were re-used and the third one was developed specifically for this workshop. In this workshop following three scenarios (dealing with specific disruptive technologies) were discussed:

1. Smart city pollution monitoring (Smart Cities, Cloud Computing, IoT)
2. Intelligent citizen portals connected across Europe using chatbot interface for easy inter-action with citizens (AI, eID, Once Only Principle)
3. Using predictive policing to prevent property crimes (AI, Machine Learning, IoT)

The workshop used the same timeline as the Workshop 2 (see 1.3.2.2). Again, the workshop participants used post-it notes of different colours to indicate a specific research or training need. The priority of a specific need had to be agreed by the whole group. The audience of the NEGZ-Herbstaggung-workshop consisted of 19 participants representing three different countries (Germany, Austria and Turkey). Involved experts represented research institutions (7), public institutions (5) and private businesses (5). During the discussion, notes were made by the moderators, which together with identified research and training needs were used for developing this report.

1.4 Structure of the Deliverable

This report is divided into four sections. The present section (section 1) deals with the scope, methodology and structure of the deliverable. Second section presents the analysis of the groups of connected disruptive technologies, previously identified in WP1 (Task 1.1). For each technology at first a short introduction is provided (subsection 1), the relevant projects on the European level are described and systemized (subsection 2), possible future scenario of the use of the technology/-ies is presented and analysed (subsection 3), identified research and training needs are discussed in subsection 4, while the recommendations are given in the concluding subsection 5. The analysis described in the second section of the deliverable is used to create the Government 3.0 roadmap, presented in section 3, where specific roadmap steps are described in detail. Finally, section 4 contains conclusions, briefly summarising the report and explaining how the findings of this work package can be used in the WP3.

1.5 Note on the future versions of the document

As the present document is the first draft of the deliverable, some significant portions are missing. In the final deliverable, recommendations, research and training needs and roadmap will be significantly expanded to include findings from the detailed scenario and project analysis. Section 3 (The Roadmap) will be also significantly reworked to mirror the new findings described in Section 2. While the current document reflects the progress in the analysis of the research needs in the field of Government 3.0, it is not a complete work and should be treated for what it is, a draft.

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2. Disruptive technologies in Government 3.0

2.1 Big Data

2.1.1 Introduction

2.1.2 Project analysis

2.1.3 Future scenario

2.1.4 Research Needs and Training Needs

2.1.5 Recommendations

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2.2 Internet of Things

2.2.1 Introduction

Gubbi et al. (2013) define the Internet of things as

> "Interconnection of sensing and actuating devices providing the ability to share information across platforms through a unified framework, developing a common operating picture for enabling innovative applications. This is achieved by seamless, large scale sensing, data analytics and information representation using cutting edge ubiquitous sensing and cloud computing." (p. 4)

This definition captures the three "visions" of the IoT realisation as described by Atzori et al. (2010): internet-oriented (middleware), things-oriented (sensors) and semantic-oriented (knowledge). It also underlines the intrinsic connections of the IoT to the other concepts relevant for defining Government 3.0: cloud computing, sensors, (big) data analytics and smart cities. Brous and Janssen conducted a systematic review of benefits IoT can bring the e-Government (Brous & Janssen, 2015b) and impediments for the use of the IoT in e-Government sector (Brous & Janssen, 2015a). They mention that in 2015 (Brous & Janssen, 2015b) there have been zero results when searching for "benefits", "Internet of things" and "e-Government" in the academic databases of Scopus, IEEE and JSTOR. Looking at the government-related IoT research in the 2015-2018 time period, we note the increasing interest in the use of IoT for public service provision. A total of 19 relevant research items were identified for this timeframe. The majority of the analysed articles deal with smart cities application of the IoT or related urban computing concept (10 of 19 articles).

The IoT is often used as a supporting technology which aids in the realisation of smart city and smart healthcare paradigms. Recent case studies include IoT-enabled smart transportation projects in the US (Le Dantec, Watkins, Clark, & Mynatt, 2015), IoT for road and water management in the Netherlands (Brous & Janssen, 2015b, 2015a), the use of IoT for smart cities in China (Song, Cai, Chahine, & Li, 2017; Zhang, Zhang, & Wang, 2017) and review of IBM supported IoT projects (Scuotto, Ferraris, & Bresciani, 2016). Non-academic reports include survey research by Accenture (Terry Hemken & Gray, 2016) and report by Delloite (Maissin, Ronan, & Colin, 2015). Both articles dealt with the realisation of IoT in developed countries of Europe, North America and Asia.

Brous and Janssen (2015b) identified the benefits brought by IoT to e-Government on different levels. On strategic level data collected with IoT can aid long-term planning, improve forecasting and trend analysis. Large amounts of IoT data can be also made open to the public improving government transparency and leading to better accountability and reduced government waste (Castro, 2008). On the tactical level, IoT can improve medium-term planning and maintenance of public services, thus leading to overall cost reduction (Brous & Janssen, 2015b). On the operational level data collected in real-time enables greater flexibility of service provision: thus leading to improved efficiency and effectiveness (Andrews, 2015).

At the same time, the application of the IoT to the e-Government is associated with some inevitable challenges: security, privacy, data ownership and sharing of the collected information (Scarfo, 2014).

Security and privacy are the main challenges on the strategic level: in some cases (especially in health care) IoT may collect sensitive data about the individuals. Unauthorized access to such data by the third parties due to the insufficient security of the system or inappropriate sharing may lead to dire consequences (Nath & Som, 2017; Scarfo, 2014). As the data collected with IoT is meant to be processed, analysed and possibly combined with different datasets, there is a requirement of strong data governance and appropriately designed legal framework (Scarfo, 2014; Sicari, Rizzardi, Grieco, & Coen-Porisini, 2015; Weber, 2015).

On the tactical level, there is also an issue with public sector's readiness for the IoT. Research conducted by Accenture (Terry Hemken & Gray, 2016) identified a number of challenges associated with the adoption of IoT in public sector. These are legacy systems, lack of leadership support and lack of internal skills or ability to hire. Implementation of IoT is a resource intensive and expensive undertaking (Yazici, 2014). While many public administrations choose to implement IoT (usually as

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a part of a smart city initiative), such efforts often end up very costly and inefficient due to the insufficient agility of the organisation and lack of personnel able to support the system (Clarke, Dunbrack, & Webber, 2017).

Finally on operational level, effective implementation of IoT requires the willingness of participants to be part of the system and share their data (Fan, Wang, Zhang, & Lin, 2013; Nam & Pardo, 2014). To ensure citizen support of the IoT in public services, government needs to effectively communicate the benefits and risks of the IoT, addressing in particular the privacy concerns through appropriate legal regulation (Andrews, 2015; Nugroho & Haryani, 2016).

2.2.2 Project analysis

2.2.3 Future scenario

In order to identify research and training needs related to the IoT technologies, a future scenario was developed, describing a possible use of these technologies by the public sector actors. The scenario was presented and discussed at the Samos Summit Roadmapping workshop.

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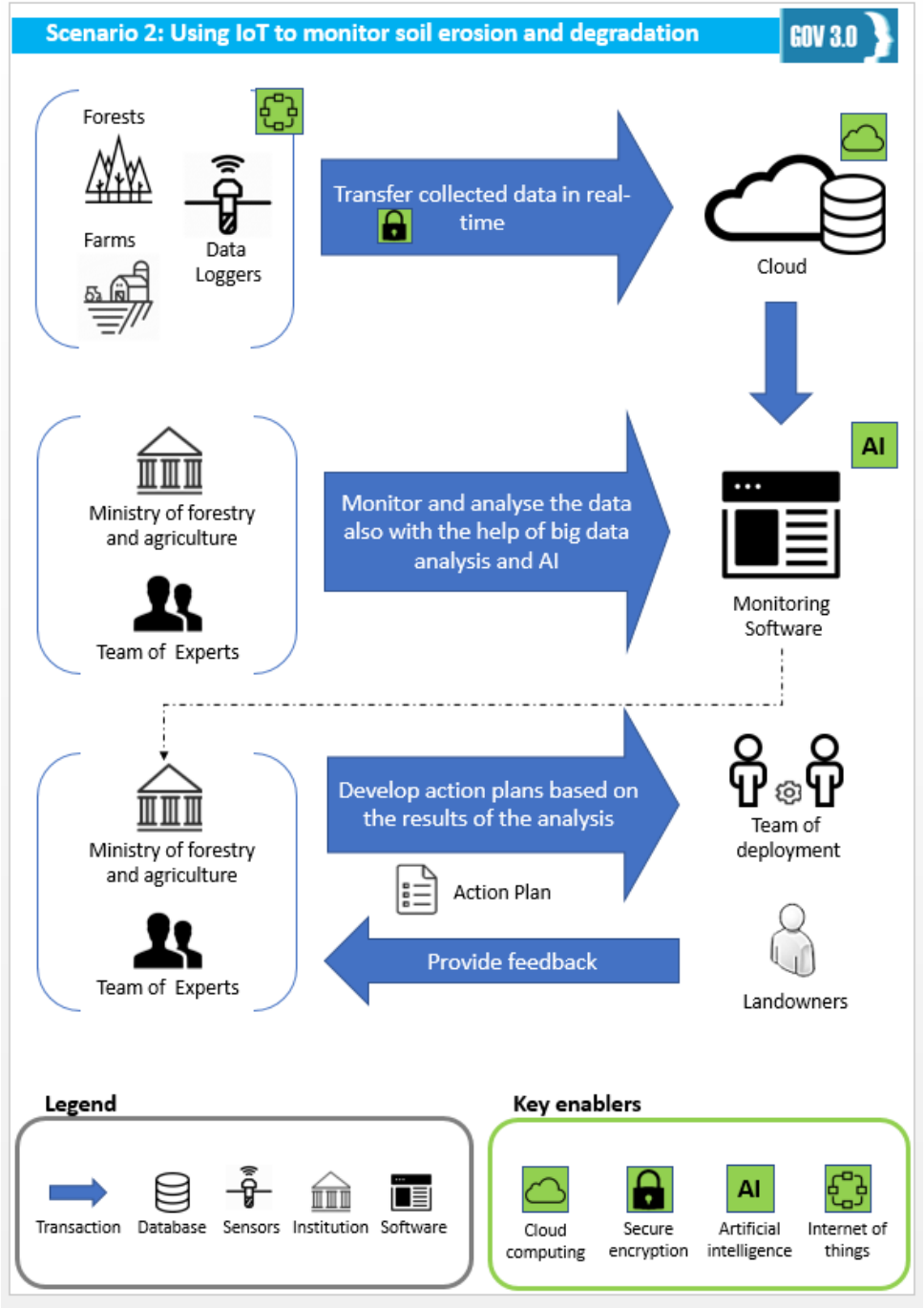

Figure 2 Future Scenario "Using IoT to monitor soil erosion and degradation"

Scenario 2 (Figure 1) "Using IoT to monitor soil erosion and degradation" describes possible application of IoT for soil monitoring. In this scenario, sensors, data loggers and other IoT devices are used to collect the data on the quality of soils in different areas (both farmlands and forests). The devices collect data at specified intervals recording the levels of carbon (C), nitrogen (N) and phosphorus (P), as well as pH levels. These data are then transmitted and analysed automatically (using AI technology, machine learning). The output of the analysis is subsequently used by the government officials and experts to formulate action plans and mid- and long-term strategy for dealing with issues connected to erosion and degradation of the land. Full text of the scenario is provided in Table 2.

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Table 2. Future scenario "Using IoT to monitor soil erosion and degradation"

Soil erosion and degradation is one of the most important environmental threats we are posed to nowadays. Soil erosion is the process of detachment or weathering away of the soil particles from the ground which can be caused by various factors. In addition to erosion, compaction, loss of soil structure, nutrient degradation, and soil salinity are also other forms of soil degradation. Soil erosion is a result of natural factors like wind and water, climate change, deforestation and as well as extensive farming, such as heavy tillage. Major harvest that reduce soil fertility and lead to degraded land include the production of some of the most used products, such as coffee, cotton, corn, palm oil, rice, tea, tobacco, and wheat. Soil degradation is a problem that affects both developing countries, whose economies are based mainly on agriculture, as well as developed countries as a result of industrial agriculture. The current rates of soil degradation are unsustainable. And nearly 1000 years are needed to restore 3 cm of the topsoil, so the best strategy is prevention. To prevent the soil degradation, the properties of soil should be continuously monitored. A remote system is implemented to keep track of the conditions of soil moisture and mineral holding capacity. The system collects data at specified intervals from points of interest on the network through data loggers, about the levels of carbon (C), nitrogen (N) and phosphorus (P), as well as pH levels. This data is then transmitted via internet in real time to the software application of the ministry of agriculture and forestry. Since we don't deal with any personal or sensitive data, there is no need to take extra measures for data privacy. However, the transfer of data should be reliable, since data loss can result in false assumptions that can harm decision making. The received data is analysed from a team of experts in forestry, agriculture and geology. The software application also provides the possibility to use big data analysis techniques and Artificial Intelligence to automatically perform analysis of the data. When the levels of the measured data reach threshold points, the team of experts decides on restoration techniques and action plans will be developed. This system will be implemented both in forests and private farming lands. In the cases, where forests are affected from soil erosion, the intervention plans will be further on deployed from the ministry of forestry and agriculture. For farming lands, the action plan must be first discussed with farmers and then revised based on their feedback. After it has been agreed upon a final plan, the farmers have to take actions accordingly and are the ones in charge. Through the implementation of this system, the monitoring of forests and farmlands are now easier for the government. It also reduces the costs compared to manual monitoring. The interventions are made before the actual erosion or degradation happens, which better preserves the soil. The benefits of it are enriched lands, better crop yields, good financial returns, and a balanced environment.

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2.2.4 Research Needs and Training Needs

Training needs included the use of modelling and AI tools, data analysis tools, cost-benefit analysis and public sector innovation management. Training needs with assigned lower priority included project management and data science as well as digital transformation and security.

Research needs

In the scenario, research needs identified during the workshop included big, open and linked data research, machine learning and policy-making based on data. More practical aspects that need more research include cost-benefit analysis of the use of IoT, base layer measurement, water/earth evaluation and research on the issues of maintenance and sustainability of sensors. Similarly, to the first scenario there is a necessity to standardize the input from the sensors to ensure data quality. In this scenario there is also a particular need for cross-discipline research, specifically in the areas of health, agriculture and international environmental legislation. Finally, experts suggested that scenario can be improved by implementing other technologies like AI for decision-making, optical recognition for advanced sensing and blockchain for data storage.

To assure the effectiveness of the implementation the placement of data loggers is essential. Data loggers, while providing a solution to a problem, also contribute to another problem, as they create pollution. Hence, their placement should be researched and analysed to be able to create effective implementation and optimise it to its maximum. The data security and ownership aspect also need to be researched. In the case of public spaces, it doesn't create an issue, but there are many questions raised for the monitoring of farming lands. As this is private property, the concern raised is to whom belongs this data, to the property owner or to the government? If the studies show that it should be considered as private data, then this would affect to some degree the scenario implementation. The data transfer and processing should be done according to data privacy and safety regulations. Based on the degree of the implementation of the scenario these actions need to comply to either country specific legislations or international law enforcement. This also brings us to the next point of research which are legal frameworks that need to be developed to support the implementation of the scenario. This is crucial especially regarding territories that are shared among different states. For instance, the Bavarian forest extends further to Czech Republic and Austria. Changes might be needed in both local levels from the governments of each country, as well as in the European Union level.

A crucial part of Government 3.0 is the use of ICT for automatic decision making. In the scenario, the use of AI technologies is mentioned as a way that would help the team of experts to analyse the gathered data. The solution can be extended further and make use of AI to develop the action plans automatically and the experts would only audit them. This extension would increase the affinity of the scenario to the concept of eGovernment 3.0 services. An emerging research area would therefore be studying how the tools and technologies of AI can be used to develop the automatic action plans. It is very important to conduct responsible research, to be able to draw a line between when automatic decisions are made and when human intervention is necessary.

Training needs

For the scenario to be fully operational and effective, the people who are involved in it need to be trained. The needs change based on the operational level and involvement, which can be categorised in the following groups:

- Team of experts - for this stakeholder group training in data science and big data analysis is very important, so they can build action plans easier, faster and more effectively. And in the case of scenario extension to use AI for the creation of the plans, they must also be trained in modelling and AI tools, so that they have the necessary knowledge to perform a full audit of the plans.
- Team of deployment - being responsible for the implementation of data loggers in the terrain and their maintenance, requires knowledge of IoT devices and cloud computing.

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- Landowners - can be represented from one person, who is the farmer, or companies. They are in control for the implementation and maintenance of the data loggers in their private properties. Therefore, they also need to be trained in IoT devices and cloud computing.
- Students - new study modules can be integrated in the already existing courses, to provide students of agriculture with knowledge about data loggers and IoT devices in general, as well as cloud computing. The curricula of geodetic engineering courses need to be extended with modules that equip students with good skills in big data analysis, as well as modelling and AI tools, as they are going to be the future experts. Presenting the students to the monitoring system of the ministry, can be offered as a joint module for both students of geodetic engineering and students of public policy.

Apart from the specific training needs mentioned above, the ministry of forestry and agriculture will have to change the current running processes to adapt to the digital transformation, and training in public sector innovation will be crucial to help maintain the day-to-day business intact. This training is especially important for those who carry out managing responsibilities.

2.2.5 Recommendations

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2.3 Smart City Government

2.3.1 Introduction

Dameri and Benevolo, (2016) define smart cities (SC) as

> "a recent but emerging phenomenon, aiming at using high technology and especially information and communications technology (ICT) to implement better living conditions in large metropolises, to involve citizens in city government, and to support sustainable economic development and city attractiveness. The final goal is to improve the quality of city life for all stakeholders." (p. 1)

In a more technical perspective, Costa and Santos (2016) state that

> "Smart Cities are known for their human dynamics, which makes recurrent use of permanently connected devices, frequently known as Internet of Things (IoT). Consequently, since these new cities generate a vast volume of data with significant variety and velocity, they have the potential to be one of the richest and challenging systems to generate Big Data and to benefit from its adequate storage, processing, analysis and public availability." (p. 1247)

Smart city is also defined as innovative (not necessarily but mainly ICT-based) solutions that enhance urban living in terms of people, governance, economy, mobility, environment and living (Anthopolous & Reddick, 2016).

According to Muthulakshmi, Lalitha and Uma (2017), the progression of technologies such as big data and IoT has played an imperative role in operationalizing smart city initiatives (Muthulakshmi, Lalitha & Uma, 2017). The integration of the smart city and big data concepts allow it the development of smart city applications that will help to reach sustainability, better resilience, effective governance, enhanced quality of life, and intelligent management of smart city resources (Al Nuaumi et al., 2015).

Al Nuaimi et al. (2015) review the applications of big data to support smart cities, in which big data analytics can provide deeper insights and better decision-making practices, as the "process of collecting, organizing and analysing large sets of data to discover patterns and other useful information" (Muthulakshmi, Lalitha and Uma, 2017, p. 105). Cloud computing can also provide the needed large computational and storage facilities to support smart city big data management and applications (Al Nuaimi et al., 2015).

The relation between smart city development and IoT projects is very clear (Alamsyah, Susanto & Chou, 2016). According to Jin et al. (2014), utilizing ICTs, such as IoT, to provide adequate services and infrastructure in the urban centres presents "an opportunity for the development of smart cities, where city management and citizens are given access to a wealth of real time information about the urban environment upon which to base decisions, actions and future planning" (p. 1). The same is analysed by Mali and Kanwade (2016) in which based in IoT, "smart city government, management and local people are provided with access to various real-time information about the environment and local objects on which automatic decisions, actions are planned" (p. 1). Thus, according to Kubler et al. (2016), IoT is playing a new role in making the world smarter and more interconnected, although is still one of the main challenges that faces today's smart city movement.

Regarding governance aspects, smart city government rests on the implementation of a model of smart governance (Scholl & AlAwadhi, 2016b). According to Dameri and Benevolo (2016), "an SC vision requires a well-conceived governance framework, capable of both integrating all of the political, social, and economic aspects of a city and managing the investments required to produce the best returns in terms of public value and benefits" (Dameri & Benevolo, 2016, p.693). According to Scholl and AlAwadhi (2016b), AlAwadhi and Scholl (2016) suggest that smart governance is a foundational aspect to create smart cities. The main success factors in smart-city initiatives are "reshaping administrative structures and process across multiple local government agencies and departments" as well as "stakeholder involvement in governance" (AlAwadhi and Scholl, 2016). Scholl and AlAwadhi (2016b) affirm that creating a collaborative governance model is an important success factor considering the multi-jurisdictional smart-city initiatives. The influence of the governance and the

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new public management discourses on smart cities discourse was identified by Przeybilovicz et al. (2018), especially regarding to the “new urbanism” themes such as quality of life, the compact city and the consumption of fewer resources.

Al Nuaimi et al. (2015, p. 12) conclude that a smart city will “improve governance, enhance the economic standing of the city, improve the quality of life of its citizens, and help create environmentally friendly and sustainable infrastructures”. And that the perspectives of a smart city include the “intensive use of ICT and next generation information technology, the integration of the physical and social components of the city via the use of ICT, implementing advanced monitoring and control tools and applications to enhance efficiency and quality, and improving the infrastructures to support better quality of life and higher sustainability” (Al Nuaimi et al., 2015, p. 12).

Last, but not least, other reviews address a variety of perspectives that are participation-based and citizen oriented, including a critical view from the rise of the corporate smart city (Hollands, 2015), a multi-stakeholder co-creation analysis in smart city management (Mayangsari & Novani, 2015) and the adoption of smart community services with focus on IT acceptance (Li et al., 2018).

2.3.2 Project analysis

2.3.3 Future scenario

In order to identify research and training needs related to the Smart City concept, a future scenario was developed, describing a possible implementation of some technologies associated with smart cities. The scenario was presented and discussed at the Samos Summit Roadmapping workshop.

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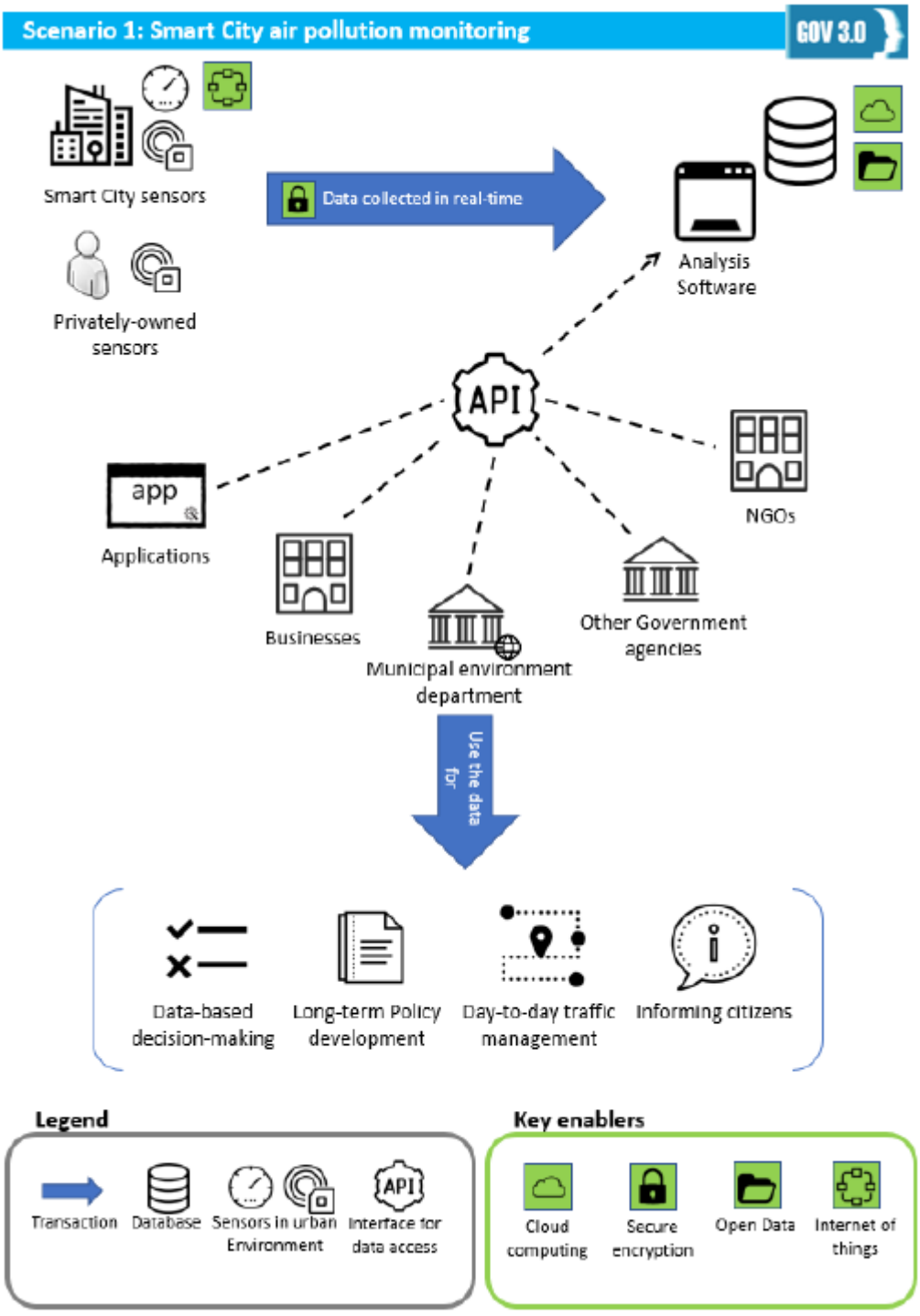

Figure 3. Scenario "Smart city air pollution monitoring"

Scenario 1 (Figure 3. Scenario "Smart city air pollution monitoring"Figure 3) “Smart City air pollution monitoring” describes possible use of sensors in the smart city context to provide an API, available openly to organisation and businesses (e.g. mobile application developers) to create innovative services based on the pollution monitoring. Full text of the scenario is provided in Table 3.

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Table 3. Future scenario "Smart city air pollution monitoring"

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The world's population is increasing, and the most people are moving to cities for a better quality of life. The urban life turns out to be difficult because there is a lot of traffic in the city. The heavy traffic in the cities causes pollution of the air and the quality of the air decreases. Cars emit toxic gases such as carbon dioxide, nitrogen oxides, sulphur dioxide and soot particles. These can lead to serious health problems, such as headaches, dizziness, irritated respiratory tract and even to respiratory arrest or cancer. The increased pollution also is a contributor to climate change. In order to protect the population, the data on pleasure pollution have to be disclosed and made available to people. In addition, these data are evaluated in order to pronounce possible driving bans or to prevent them by redirecting the traffic.

At the moment the data of the air pollution in Germany are provided by the Ministerial of environment on the Internet. In big cities there are about two to three stations whose data are provided online. However, these stations are not always on busy roads or in the city centre with large crowds. The daily average, a median hourly rate or the daily maximum value of the air pollution is made available in the internet. The air pollutant values of ozone, particulate matter, sulphur dioxide, nitrogen oxide and carbon monoxide are displayed. In rural areas, there is no data about air measuring stations.

In the future, the cities will be equipped with several measuring stations and are connected to a big database. These measuring stations are integrated on busy roads into lanterns or guiding posts. In addition, the number of cars at this location is counted to measure the traffic density. Furthermore, private measuring stations of companies or citizens are bounded to the database. This data is provided to the citizen in real time in the form of a mobile app (open data). Every hour, the data of the air pollutants in all metropolitan areas of a city are collected, updated and displayed in the app on a city map. It is compared in which area of the city the pollution is very strong and which is very low. This gives the citizens a recommendation which places they should avoid or which ways they should prefer. Furthermore, different data of the users are collected. The location of the user with the time is localized and which search transitions he made or which measurement station the user has called. These data are collected without personal reference. With the help of this data, the usefulness of this app is being measured. The data is compered whether the citizens have avoided the searched measuring station or visited this place.

The citizen app is connected through an API connection to other web applications. For example, the data is displayed on the city's home page or in applications for allergy sufferers. Thus, the topic of air pollution is brought into the consciousness of the citizens

Also, in rural areas, measuring stations are set up and connected to the municipal measuring stations. The data form the rural measuring stations and municipal measuring stations are compered. Citizens can show how much better the air in rural areas is.

The citizen app aims to reduce urban pollution and increase people's living standards, as well as prevent diseases and stop the climate change. By providing information on environmental pollution in the city, people should be more sensitive to the issue and aware of the extent of pollution in their city. With the data of pleasure pollution, the citizens should no longer drives

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these places by car but switch to more environmentally friendly means of transport, such as the tram, bike or for short distances on foot. Or they should completely avoid these places to protect their health.

2.3.4 Research Needs and Training Needs

In the smart city scenario, the main identified research needs are related to the data quality and accuracy and automatic and autonomous decision-making. Other areas where more research is necessary are standardization of collected data (so that less time is spent on post-processing the collected data), standardization of hardware devices (sensors are produced now by a great number of different manufacturers and the quality standards are very different, so the accuracy and interoperability suffers), interoperability more generally (the way sensors interact with each other and the system) and data modelling (the data collected is used to model air quality data in the city, so it is necessary to understand the rules of how the system will behave based on the collected data). Suggested training needs included decision systems modelling, open data collection and aggregation, data quality and data analysis. Separately, experts suggested that “training the trainers” is an important training need for the practical implementation of the system, as well as training the individual users to use the sensors.

2.3.5 Recommendations

2.4 AI and Machine Learning

2.4.1 Introduction

2.4.2 Project analysis

2.4.3 Future scenario

The scenario "Intelligent citizen portals connected across Europe using chatbot interface for easy interaction with citizens" details a possible use of AI and machine learning coupled with natural language processing technology, realizing a chatbot interface for better cross-border public services.

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Table 4. Future scenario "Intelligent citizen portals connected across Europe using chatbot interface for easy interaction with citizens"

Relocating to another country or similar action involving two or more different countries often carry high administrative burden. Citizens not only have to organize many documents over a short period of time, but also have to consider the different regulations of their home vs. destination country. In the future, the use of intelligent citizen portals with chatbot interface simplifies the organisation of complicated procedures involving authorities in multiple countries. A citizen uses a smartphone to contact the government chatbot and requests help with the process. The citizen can send messages written in natural language without the need to use specific commands. A chatbot then processes the text using Natural Language Processing and AI to understand the meaning of the request and provides relevant answer. In a further future, a chatbot can even process the voice commands and provide answers. The chatbot acts as an interface connecting a citizen to the intelligent portal. The portal is designed in a way to interoperate with other portals and databases across Europe. If eID is used by the citizen, the portal application can then use it to access the relevant information across borders (according to the Once-Only Principle). The application can also identify the missing information required for the relocation of the citizen and ask necessary questions to gather this information. Furthermore, the intelligent portal can automatically complete foreign forms and help with understanding the specific terms, providing assistance through the conversation with a chatbot. Based on the Once-only principle, AI, NLP and the intelligent citizen portal, relocating abroad (and other similar cross-border formalities) is no longer a complicated matter for the citizen and for public authorities.

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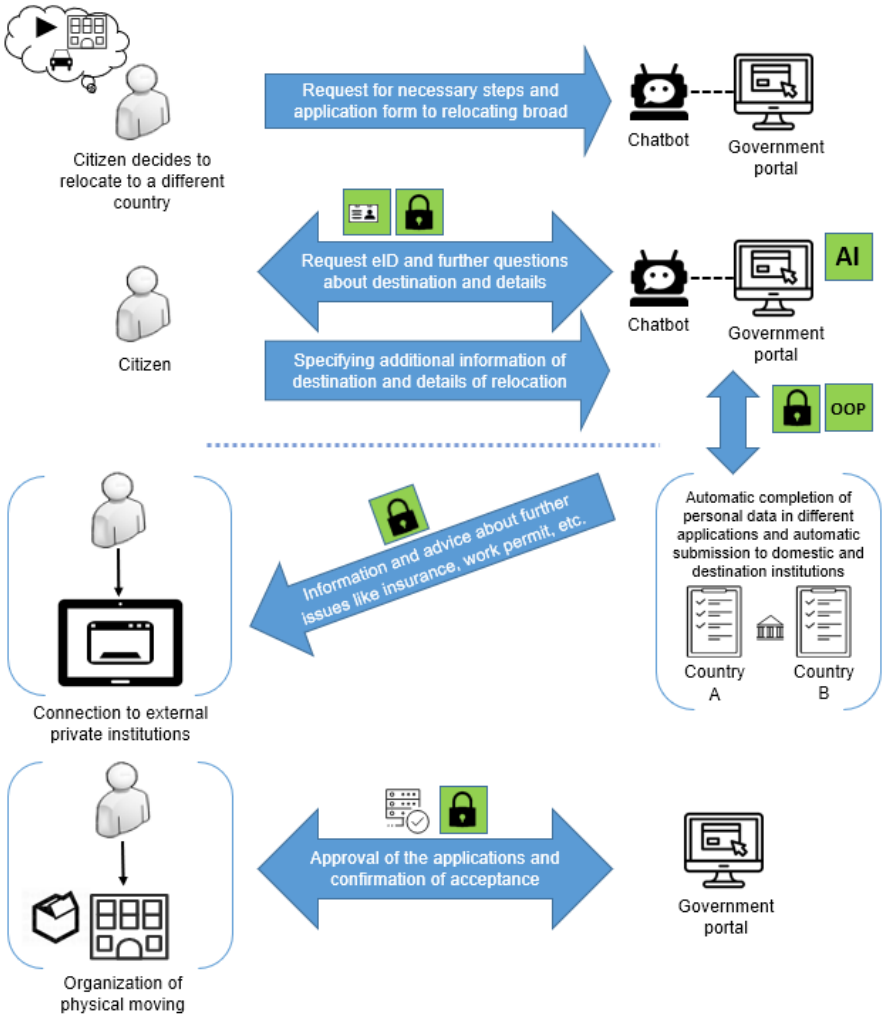

Figure 4. Scenario "Intelligent citizen portals connected across Europe using chatbot interface for effective interaction with citizens"

2.4.4 Research Needs and Training Needs

2.4.5 Recommendations

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2.5 Augmented and Virtual Reality

2.5.1 Introduction

2.5.2 Project analysis

2.5.3 Future scenario

Table 5. Future scenario "Virtual Reality and Augmented Reality for Emergency Management"

In case of emergency, people in public buildings (e.g. schools, hospitals) have to be rescued fast and efficiently. Possible emergencies include fires, earthquakes, floods, other natural disasters, terrorist attacks. In Germany, all employees in public buildings must participate in advanced trainings. Those trainings take place at least once a year and the participants learn how to implement first aid measures and how to handle the alarm equipment and fire extinguisher. Additionally, public buildings are required to perform fire drills or evacuation drills, which will take place at least once a year. In some cases, the fire brigade and police officers are called in for support.
In the future, the public employees are able to translate the learned theoretical foundations into practice through using virtual reality. The whole public building is displayed in virtual reality simulation, where different crisis scenarios could be played out. While the instructions are currently only theory-based, with the help of virtual reality the employees can experience and train the evacuation in a practical setting. To achieve a realistic surrounding and higher plausibility and immersion, multiple human senses are addressed. The VR glasses could display dense smoke in the public buildings and corridors in case of an alarm. Additionally, the sense of smell could be stimulated through artificial fragrances, the sound of the fire, sirens or voices of other people could be recorded, and radiant heaters could be used to stimulate the aural and temperature sensation. The employee's behaviour and the interactions between the employees and with other persons who are in the building (e.g. patients) will be recorded and analysed by special consultants from fire and police force. The data have to be anonymized to achieve data protection and also data security must be ensured. Those specialists will give improvement proposals to the employees. Thus, they can implement them in the next training which takes place twice a year. It is also possible to include situations when something does not go "according to the book", for example if there are missing or injured people. If there is such an emergency in the reality, those who participated in the virtual reality training may react better. They might be calmer because he has already experienced such a situation several times.
Augmented reality in turn is implemented to aid the public employees in case of real emergency situations. The employees wear AR glasses which will be connected to helpers outside the building. The AR glasses are endued with a GPS transmitter to determine and transmit the exact position. Those GPS coordinates are sent to the coordinators at emergency services, thus they know the exact position and are able to navigate the employees using a map or a building plan. They can also use external databases to get more information about certain important aspects for the situation (e.g. piping, electrical wiring, etc.). Furthermore, the coordinators can receive data from sensors placed in different areas of the building (such sensor may sense heat for example near a specific exit). This allows the helper to determine the fastest and safest way out

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of the public building. More efficient than just voice support, the helper will send the exit route to the employee's AR device and the glasses display it. Thus, the employees will evacuate the building fast and secure.

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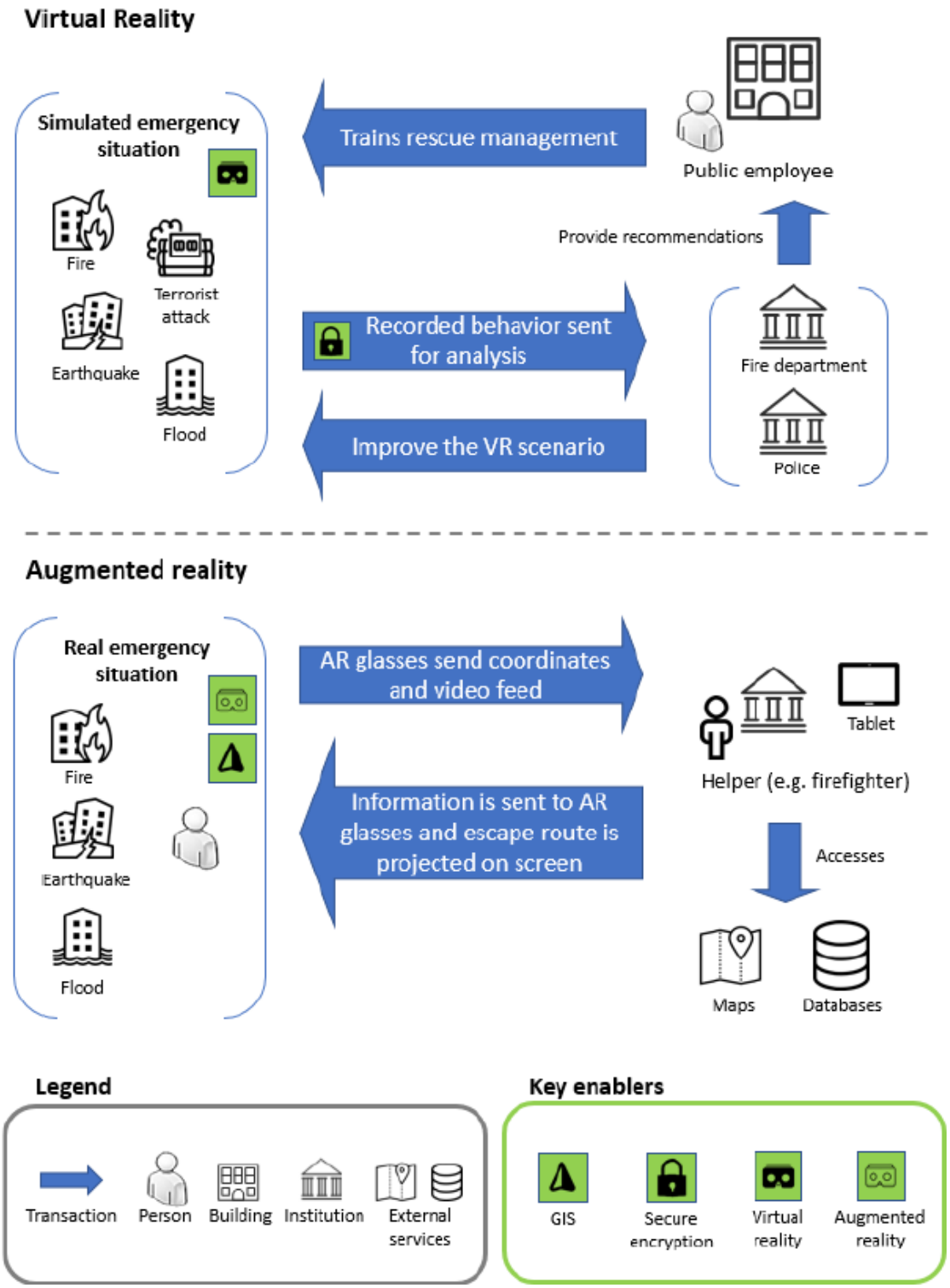

Figure 5. Scenario "Virtual Reality and Augmented Reality for Rescue Management"

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2.5.4 Research Needs and Training Needs

2.5.5 Recommendations

2.6 Open and Linked Data

2.6.1 Introduction

2.6.2 Project analysis

Table 6. Identified projects involving Open and Linked Data technologies

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Project Call	Project Title	Status	Duration (in years)	Technologies used	Type	Identified research needs	Identified Training Needs
FP7-ICT-2009-4	Road Map for Radical innovations in European Transport Services - International cooperation aspects	Finished	0.7	Open Data	Exploratory research	Further integration and data quality projects	N/A
FP7-ICT-2009-5	LOD Around The Clock	finished	2	Open Data, Linked Data, Big Data	Pilot	N/A	N/A
FP7-ICT-2009-5	PlanetData	finished	4	Open Data, Big data, Linked data, Co-Creation	Pilot	N/A	N/A
FP7-ICT-2009-5	LOD2 - Creating Knowledge out of Interlinked Data	finished	4	Open Data, Linked Data, Big Data	Pilot	Improve coherence and quality of data published on the web; close the performance gap between relational and RDF data management; establish trust on the Linked Data Web; lower generally the entrance barrier for data publishers and users.	N/A
FP7-ICT-2011-EU-Brazil	EU-Brazil Open Data and Cloud Computing e-Infrastructure for Biodiversity	finished	2.3	Open Data, Cloud computing		case study	N/A
FP7-ICT-2011-7	Semantic Tools for Carbon Reduction in Urban Planning	finished	3.2	Open Data	case study	N/A	N/A
FP7-ICT-2011-SME-DCL	Commercially empowered Linked Open Data Ecosystems in Research	finished	2	Open Data, Linked Data		proof of concept	Mining facts and their integration into LOD repositories and light-weight ontologies.
FP7-ICT-2011-SME-DCL	Educational curriculum for the usage of Linked Data	finished	2	Linked Data	curriculum development	N/A	N/A
H2020-EU.1.4.1.3.	Open Access Infrastructure for Research in Europe 2020	finished	3.5	Linked Data, Open Data, Natural Language Processing	Pilot	N/A	N/A

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H2020-EU.3.1.	COllaborative Management Platform for detection and Analyses of (Re-)emerging and foodborne outbreaks in Europe	ongoing	5	Linked Data	N/A	N/A	N/A
H2020-EU.2.1.1.4.	European Data Science Academy	finished	3	Big data, linked data, open data	Pilot	need of innovative data management services, creating a demand for Data Scientists possessing skills and detailed knowledge in this area.	Data science
H2020-EU.2.1.1.4.	Open Data INcubator for Europe	finished	2.5	Open Data	Pilot	support the formation process of innovative open data-driven services and business ideas	N/A
H2020-EU.2.1.1.4.	Aquaculture Smart and Open Data Analytics as a Service	finished	2	Open Data	pilot	global knowledge access and data exchanges between aquaculture companies and its related stakeholders	enhance innovation capacity to the aquaculture sector
H2020-EU.2.1.1.4.	Modelling the European data economy	finished	3	Linked Data, Open Data, Big Data		Proof of concept	N/A
H2020-EU.3.6.	A neW concept of pubLic administration based on citizen co-created mobile urban services	finished	3	Co-Creation, Open Data		Pilot	Recognising that governments can no longer be the single providers of public services, ICT-enabled open and collaborative government is vital to deliver 'more from less'. To achieve this, it is necessary to empower stakeholders by giving them incentives to take a more active role in the delivery of public services.
H2020-EU.3.6.	Your Data Stories	finished	3	Linked Data, Big Data, Open Data	Pilot	N/A	N/A
H2020-EU.1.4.1.3.	Engaging the EGI Community towards an Open Science Commons	finished	2.5	Open Data, Big data, cloud computing		Pilot	Making sense of complexity Powering EU research
H2020-EU.2.1.1.	Breakthrough gene expression search engine for cost reduction and significantly increased use of open data in drug discovery.	finished	0.5	Open Data	Proof of concept	N/A	N/A
H2020-EU.3.6.	Mobile Age	ongoing	3	Open Data, Customised / Personalised Public Services, Co-creation		Pilot	Senior citizens do not normally share the same level of connectivity to the Internet as younger generations, and while government agencies are increasingly providing their services through digital platforms, these risks excluding senior citizens from the design and use of such services.

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H2020-EU.3.6.	smart services for calculated impact assessment in open governance	ongoing	3	Open Data, co-creation, smart city government,		Pilot	In the most cases it is only raw dump of data. It is hard for laymen to interpret the data sets, yet even impossible to determine if the content is useable as mostly no meta-information is given
H2020-EU.2.1.1.	SELECT for Cities (Standardized, open, data-driven, service-oriented, user-centric pLatform Enabling large-scale Co-creation, Testing validation of IoE services for Cities)	ongoing	4	Open Data, co-creation, smart city government,		Pilot	The extension of the Internet to the physical spaces and objects is a massive opportunity for new services and business for example in the areas of logistics, transport, environment, security and wellbeing.
H2020-EU.2.1.1.	Empowering citizens to make meaningful use of open data	finished	2.5	Open Data	proof of concept	empowering citizens to seize the opportunities offered by the availability of open data to address needs related to social sustainability.	Open Data skills, awareness
H2020-EU.1.3.2.	Effective Governance of Open Spatial data	finished	2	Open Data	N/A	N/A	N/A
H2020-EU.1.1.	Poetry Standardization and Linked Open Data	ongoing	5	Open Data, Linked Data		pilot	Digital gap among traditional cultural assets and the growing world of data.
H2020-EU.3.6.	dEUdil: Building on open data as a new business model in the business information industry	finished	2	Open Data, Linked Data		N/A	N/A
H2020-EU.2.1.6.3.	Stimulating wider uptake of Copernicus Services by making them available as linked open data	finished	2		N/A	N/A	N/A
H2020-EU.1.3.2.	Linked Irish Traditional Music Project	ongoing	2		N/A	N/A	N/A
H2020-EU.1.4.1.3.	OpenAIRE Advancing Open Scholarship	ongoing	3		N/A	N/A	N/A
H2020-EU.1.4.1.2.	European Lexicographic Infrastructure	ongoing	4		N/A	N/A	N/A
H2020-EU.2.1.1.	Ecosystem for Services based on integrated Cross-sectorial Data Streams from multiple Cyber Physical Products and Open Data Sources	ongoing	3		N/A	N/A	N/A
H2020-EU.3.6.2.2.	Co-Creating Misinformation-Resilient Societies	ongoing	3		N/A	N/A	N/A
H2020-EU.3.	Building the world's largest Application Programming Interface (API) for law, Vizlegal will change how legal information is utilised and understood by the legal industry.	ongoing	0.5		N/A	N/A	N/A
ICT-2009.7.3	Open Collaboration in Policy Modelling	finished	2		N/A	N/A	N/A

2.6.3 Future scenario

2.6.4 Research Needs and Training Needs

2.6.5 Recommendations

2.7 Cloud Computing

2.7.1 Introduction

2.7.2 Project analysis

Table 7. Identified projects involving Cloud Computing Technology

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Acronym	Project Title	Status	Duration (in years)	Technologies used	Type	Identified research needs	Identified Training Needs
CLOUDWATCH2	Think Cloud Services for Government, Business Research	Finished	2	Cloud Computing		N/A	Training on legal aspects addressing increasingly common consumer concerns. Security and privacy certifications and attestations. Guidance to cloud service customers, cloud service providers and policy makers in their evaluation of suitable security and privacy certification schemes for cloud services. Standards and certification in order to understand if and how certification can increase the level of trust in the cloud computing business model.
C4E	Cloud for Europe	Finished	4	Cloud Computing		Pre-commercial procurement (PCP) for services that are identified as missing or need to be adopted for Governments use	N/A
PRISMACLOUD	PRIvacy and Security MAintaining services in the CLOUD	Finished	3	Cloud Computing		There exist no satisfactory approaches to adequately protect the data during its lifetime in the cloud.	Security
CLIPS	CLoud approach for Innovation in Public Services	Finished	2	Cloud Computing		N/A	Privacy control
OpenI	Open-Source, Web-Based, Framework for Integrating Applications with Social Media Services and Personal Cloudlets	Finished	3	Cloud Computing		N/A	N/A

INDIGO-DataCloud	INtegrating Distributed data Infrastructures for Global ExplOitation	Finished	3	Cloud Computing		N/A	PAAS and SAAS platforms
DEPENDABLECLOUD	Towards the dependable cloud: Building the foundations for tomorrow's dependable cloud computing	Finished	5	Cloud Computing		N/A	N/A
HOLA CLOUD	Effective collaboration for European RD and Innovation in software, services and Cloud computing: Knowledge discovery and Roadmapping	Finished	2	Cloud Computing		N/A	N/A
PaaSword	A Holistic Data Privacy and Security by Design Platform-as-a-Service Framework Introducing Distributed Encrypted Persistence in Cloud-based Applications	Finished	3	Cloud Computing		N/A	N/A
SEED	Speeding "Every European Digital"	Finished	2	Cloud Computing		N/A	N/A
SUNFISH	SecUre iNFormation SHaring in federated heterogeneous private clouds	Finished	3	Cloud Computing		There is a lack of infrastructure and technology allowing public sector players federate their clouds	N/A
Broker@Cloud	ENABLING CONTINUOUS QUALITY ASSURANCE AND OPTIMIZATION IN FUTURE ENTERPRISE CLOUD SERVICE BROKERS	Finished	3	Cloud Computing		N/A	N/A
FUPOL	Future Policy Modeling	Finished	4	Cloud Computing		N/A	N/A
Helix Nebula	Helix Nebula - The Science Cloud	Finished	2	Cloud Computing		N/A	N/A
EOSCpilot	The European Open Science Cloud for Research Pilot Project.	Ongoing	2	Cloud Computing		N/A	N/A
AppHub	AppHub, the European Open Source Marketplace	Finished	2	Cloud Computing		The need for a common platform for facilitating the dissemination of open source software	N/A
Cydar PaaS	Disrupting the real-time medical imaging market, and accelerating innovation, with cloud Platform as a Service (PaaS)	Finished	1	Cloud Computing		N/A	N/A
PASSIVE	Policy-Assessed system-level Security of Sensitive Information processing in Virtualised Environments	Finished	2	Cloud Computing		N/A	N/A
e-ScienceTalk	e-ScienceTalk: Supporting Grid and High-Performance Computing reporting across Europe	Finished	3	Cloud Computing			N/A
CloudWATCH	A European cloud observatory supporting cloud policies, standard profiles and services	Finished	2	Cloud Computing		N/A	N/A
CONTRAIL	Open Computing Infrastructures for Elastic Services	Finished	3	Cloud Computing		N/A	N/A

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GODINO	GOVERNING DIGITAL INFORMATION: Users' control and sovereignty over unpublicized digital information in the European Union	Finished	2	Cloud Computing		N/A	N/A
CO3	Digital Disruptive Technologies to Co-create, Co-produce and Co-manage Open Public Services along with Citizens	Ongoing	3	Cloud Computing		N/A	N/A
QualiChain	Decentralised Qualifications' Verification and Management for Learner Empowerment, Education Reengineering and Public Sector Transformation	Ongoing	3	Cloud Computing		N/A	N/A
LEADS	LEADS: Large-Scale Elastic Architecture for Data as a Service	Finished	3	Cloud Computing		N/A	N/A
FoodSMART	Shaping Smarter Consumer Behaviour and Food Choice	Finished	4	Cloud Computing		N/A	N/A
PQCRYPTO	Post-quantum cryptography for long-term security	Finished	3	Cloud Computing		Online banking, e-commerce, telemedicine, mobile communication, and cloud computing depend fundamentally on the security of the underlying cryptographic algorithms. Public-key algorithms are particularly crucial since they provide digital signatures and establish secure communication without requiring in-person meetings. Cryptography.	Post-quantum cryptography
ProBOS	Protection Beyond Operating System - Development of the next generation cyber security solution	Finished	2	Cloud Computing		Security	Security
ICE-WISH	Demonstrating through Intelligent Control (smart metering, wireless technology, cloud computing, and user-oriented display information), Energy and Water wastage reductions in European Social Housing	Finished	4	Cloud Computing		N/A	N/A
Cloudspaces	CloudSpaces: Open Service Platform for the Next Generation of Personal Clouds	Finished	3	Cloud Computing		N/A	N/A
ETICA	Ethical Issues of Emerging ICT Applications	Finished	2	Cloud Computing		N/A	N/A

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2.7.3 Future scenario

2.7.4 Research Needs and Training Needs

2.7.5 Recommendations

2.8 Service Co-creation, Once-Only Principle, Service Modules, CAPS

2.8.1 Introduction

2.8.2 Project analysis

Table 8. Identified projects involving Service Co-creation, Once-Only Principle, Service Modules, CAPS

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Project Call	Acronym	Project Title	Status	Duration (in years)	Technologies used	Type	Identified research needs	Identified Training Needs
H2020-EU.3.6.3	Co-VAL	Understanding value co-creation in public services for transforming European public administrations	ongoing	3	Co-creation	Case studies	New governance models, skills to use disruptive technologies	Participation of citizens in service creation/delivery
H2020-EU.3.6.3	COGOV	Co-Production and Co Governance: Strategic Management, Public Value and Co Creation in the Renewal of Public Agencies across Europe	ongoing	3	Co-creation	Case studies	Public Value Creation models, used in combination with Co Creation and Co Governance ideas, in turn combined with Digital Era Governance inspirations with their possible implications for more participatory approaches to e-government.	Participation of citizens in service creation/delivery
H2020-EU.3.6.3	TROPICO	Transforming into Open, Innovative and Collaborative Governments	ongoing	3	Co-creation	Case studies	Use of ICT for collaboration	Participation of citizens in service creation/delivery
H2020-EU.3.6.2.2	Big Policy Canvas	Big Policy Canvas - Needs, Trends and ICT Tools for Advanced Data-Driven Public Sector	ongoing	2	Big data	N/A	See roadmap	See knowledge base
FP7-ICT-2011-7	CROSSOVER	Bridging Communities for Next Generation Policy-Making	finished	2	Big data, open data, visualization	N/A	See roadmap	See knowledge repository
H2020-SC6-CO-CREATION-2016-2	SCOOP4C	Stakeholders community for once-only principle: Reducing administrative burden for citizens	ongoing	2.5	Once Only			
H2020-SC6-CO-CREATION-2016-2	TOOP	The Once Only Principle Project	ongoing	3.25	Once Only			
H2020-ICT-2015	PROFIT	Promoting Financial Awareness and Stability	finished	3	Community Awareness Platforms			
H2020-ICT-2015	hackAIR	Collective awareness platform for outdoor air pollution	finished	3	Community Awareness Platforms			
H2020-ICT-2015	netCommons	Network infrastructure as commons	finished	3	Community Awareness Platforms			

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H2020-ICT-2015	OpenMaker	Harnessing the power of Digital Social Platforms to shake up makers and manufacturing entrepreneurs towards a European Open Manufacturing ecosystem	finished	2.5	Community Awareness Platforms			
H2020-ICT-2015	ChainReact	Making Supplier Networks Transparent, Understandable and Responsive	finished	3	Community Awareness Platforms			
H2020-ICT-2015	MAZI	A DIY networking toolkit for location-based collective awareness	finished	3	Community Awareness Platforms			
H2020-ICT-2015	SavingFood	An innovative solution to tackle food waste through the collaborative power of ICT networks	finished	2.33	Community Awareness Platforms			
H2020-ICT-2015	SOCRATIC	SOcial CReATive IntelligenCe Platform for achieving Global Sustainability Goals	finished	2.08	Community Awareness Platforms			
ICT-10-2015	POWER	Political and sOcial awareness on Water EnviRonmental challenges	ongoing	4	Community Awareness Platforms			
H2020-ICT-2015	OPENCARE	Open Participatory Engagement in Collective Awareness for REdesign of Care Services	finished	2	Community Awareness Platforms			
H2020-ICT-2015	MAKE-IT	Understanding Collective Awareness Platforms with the Maker Movement	finished	2	Community Awareness Platforms			
H2020-ICT-2015	ChiC	Creating high impact for CAPS	finished	2.5	Community Awareness Platforms			
H2020-ICT-2015	PIE News	POVERTY, INCOME, AND EMPLOYMENT NEWS	ongoing	3	Community Awareness Platforms			
H2020-ICT-2015	DSI4EU	Digital Social Innovation for Europe	finished	1.33	Community Awareness Platforms			
H2020-ICT-2015	CROWD4ROADS	CROWD sensing and ride sharing FOR ROAD Sustainability	finished	3	Community Awareness Platforms			
H2020-ICT-201	CAPTOR	Collective Awareness Platform for Tropospheric Ozone Pollution	finished	3	Community Awareness Platforms			

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H2020-ICT-2015	STARS4ALL	A Collective Awareness Platform for Promoting Dark Skies in Europe	finished	3	Community Awareness Platforms			
H2020-ICT-2015	NEXTLEAP	NEXTLEAP	finished	3	Community Awareness Platforms			
ICT-10-2015	EMPATIA	Enabling Multichannel PArticipation Through ICT Adaptations	finished	2.25	Community Awareness Platforms			
H2020-ICT-2015	Open4Citizens	Empowering citizens to make meaningful use of open data	finished	2.5	Community Awareness Platforms			
H2020-ICT-2015	Making Sense	Making Sense	finished	2 .17	Community Awareness Platforms			
H2020-ICT-2015	ASSET	Instant Gratification for Collective Awareness and Sustainable Consumerism	finished	2.5	Community Awareness Platforms			
H2020-ICT-2015 DOPPIO	POWER	Political and sOcial awareness on Water EnviRonmental challenges			Community Awareness Platforms			
H2020-SC6-CO-CREATION-2016-3	DESIGNSCAPES	Building Capacity for Design enabled Innovation in Urban Environments	ongoing	4	Co-creation			
H2020-MG-2014 _TwoStages	MASAI	MOBILITY BASED ON AGGREGATION OF SERVICES AND APPLICATIONS INTEGRATION	finished	3	Service modules			
N/A	DRAGON	Integrated Service Engineering Demonstrator	finished	2	Service modules			
H2020-ICT-2014-1	AEGLE	AEGLE – An analytics framework for integrated and personalized healthcare services in Europe	finished	3.5	Service modules			
H2020-EINFRA-2017	EOSC-hub	Integrating and managing services for the European Open Science Cloud	ongoing	3	Service modules			
FP6-2005-SPACE-1	HUMBOLDT	Development of a framework for data harmonisation and service integration	finished	4.5	Service modules			
N/A	MULTIMED	Functional Service Integration in Support of Professional User Groups	finished	3	Service modules			
H2020-SC1-2016-CNECT	MIDAS	Meaningful Integration of Data, Analytics and Services	ongoing	3.33	Service modules			

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FP7-ICT-2007-1	OASIS	Open Architecture for Accessible Services Integration and Standardisation	finished	4	Service modules			
H2020-SC5-2016-TwoStage	CLARITY	Integrated Climate Adaptation Service Tools for Improving Resilience Measure Efficiency	ongoing	3	Service modules			
H2020-SC6-CULT-COOP-2017-one-stage	REACH	Re-designing access to CH for a wider participation in preservation, (re)use and management of European culture	ongoing	3	Co-creation			
H2020-SC6-CO-CREATION-2017	CUTLER	Coastal Urban developmenT through the LEnses of Resiliency	ongoing	3	Co-creation			
H2020-SC6-CO-CREATION-2017	Co-Inform	Co-Creating Misinformation-Resilient Societies	ongoing	3	Co-creation			
H2020-SC6-CULT-COOP-2016	CITADEL	Empowering Citizens to TrAnsform European PubLic Administrations	ongoing	3	Co-creation			
H2020-SC6-CULT-COOP-2016	ENLARGE	ENLARGE – Energizes for Local Administrations: Renovate Governance in Europe	finished	2	Co-creation			
H2020-SC6-CULT-COOP-2017-two-stage	CultureLabs	Culture Labs: recipes for social innovation	ongoing	3	Co-creation			
H2020-SC6-CO-CREATION-2017	SoCaTel	A multi-stakeholder co-creation platform for better access to long-term care services	ongoing	3	Co-creation			
H2020-SC6-CO-CREATION-2017	PoliVisu	Policy Development based on Advanced Geospatial Data Analytics and Visualisation	ongoing	3	Co-creation			
H2020-SC6-TRANSFORMATIONS-2018	gE.CO Living Lab	Generative European Commons Living Lab	ongoing	3	Co-creation			
H2020-SC6-TRANSFOR	QualiChain	Decentralised Qualifications' Verification and Management for Learner Empowerment, Education Reengineering and Public Sector Transformation	ongoing	3	Co-creation			

MATIONS-2018								
H2020-SC6-TRANSFORMATIONS-2018	CO3	Digital Disruptive Technologies to Co-create, Co-produce and Co-manage Open Public Services along with Citizens	ongoing	3	Co-creation			
H2020-SC6-GOVERNANCE-2018	WAI-Guide	Authoritative Implementation Guidance and International Cooperation to Support Training, Awareness Raising, and Capacity Building	ongoing	3	Community Awareness Platforms			

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2.8.3 Future scenario

2.8.4 Research Needs and Training Needs

2.8.5 Recommendations

2.9 Policy Informatics/ Analytics

2.9.1 Introduction

2.9.2 Project analysis

2.9.3 Future scenario

2.9.4 Research Needs and Training Needs

2.9.5 Recommendations

2.10 Gamification, Gaming-based Simulation, Policy Modelling

2.10.1 Introduction

2.10.2 Project analysis

Table 9. Identified projects involving Gamification, Gaming-based Simulation, Policy Modelling

Project Call	Acronym	Project Title	Status	Duration (in years)	Technologies used	Type	Identified research needs	Identified Training Needs
H2020-EU.2.1.1.4.	No One Left Behind	No One Left Behind	finished	2.5	Gaming based simulation	large scale implementation	N/A	N/A
H2020-EU.3.7.6., H2020-EU.3.7.1	REDALERT	Real-time Early Detection and Alert System for Online Terrorist Content based on Natural Language Processing, Social Network Analysis, Artificial Intelligence and Complex Event Processing	ongoing	3	NLP, Data Mining, AI, Data Analytics, Open Data, Big Data	pilot	Further analysis to the predictive analytics tools, Regulation	N/A
H2020-EU.1.4.1.1.	PARTHENOS	Pooling Activities, Resources and Tools for Heritage E-research Networking, Optimization and Synergies	ongoing	5	policy modelling, open data, interoperability	large scale implementation	N/A	N/A
H2020-EU.3.3.7.	EURECA	Datacenter EURECA Project	finished	3	policy modelling	large scale implementation	N/A	N/A
H2020-EU.1.1.	CALCULUS	Commonsense and Anticipation enriched Learning of Continuous representations sUpporting Language UnderStanding	ongoing	5	AI, NLP, Machine Learning	pilot	Further investigation on human-machine interaction	N/A
H2020-EU.2.1.1.4.	ProsocialLearn	ProsocialLearn - Gamification of Prosocial Learning for Increased Youth Inclusion and Academic Achievement	finished	3	Gaming based simulation	pilot	N/A	N/A
H2020-EU.2.1.1.	GABLE	GAmification for a BEtter Life	ongoing	3	gamification, machine learning, mobile services	pilot	Image Processing	N/A
H2020-EU.2.1.1.	GamECAR	Gamification of EcoDriving Behaviours through Intelligent Management of dynamic car and driver information	finished	1	gamification	pilot	N/A	N/A
H2020-EU.2.1.1.	Gaming Horizons	Gaming Horizons	finished	2	gamification, policy modelling	pilot	N/A	N/A
FP7-ICT-2013-10	SIMPOL	Financial Systems Simulation and Policy Modelling	finished	4	policy modelling	large scale implementation	N/A	N/A
FP7-ICT-2013-10	INSIGHT	Innovative Policy Modelling and Governance Tools for Sustainable Post-Crisis Urban Development	finished	3	Policy Modelling, open data, big data, smart cities		pilot	N/A
H2020-SFS-2017-1	SUPREMA	SUpport for Policy RElevant Modelling of Agriculture	ongoing	2	Policy modelling, Big Data, Linked Data	large scale implementation	Interoperability, Big Data, Linked Data,	N/A

							societal challenges, policy modelling	
H2020-EU.3.1.6.	FRESHER	FoResight and Modelling for European HEalth Policy and Regulation	finished	2	policy modelling, big data	large scale implementation	List of alternative policy options for policymakers according to different scenarios	N/A
FP7-SSH-2007-1	MONFISPOL	Modeling and Implementation of Optimal Fiscal and Monetary Policy Algorithms in Multi-Country Econometric Models	finished	3	policy modelling	pilot	N/A	N/A
H2020-EU.2.1.1.	GATES	Applying GAming TEchnologies for training professionals in Smart Farming	ongoing	2	gaming-based simulation	pilot	N/A	N/A
FP7-PEOPLE-2007-4-2-IIF	AFEG	Assessment Frameworks for Epistemic Games	finished	1	gaming-based simulation	proof of concept	N/A	N/A
H2020-EU.2.1.1.4.	3D Tune-In	3D-games for TUNing and lEarnINg about hearing aids	finished	3	gaming based simulation, gamification	pilot	N/A	N/A
H2020-EU.3.3.1.	TRIBE	TRaIning Behaviours towards Energy efficiency: Play it!	finished	3	gaming based simulation, big data	pilot	Analysis of users' behaviours to develop a tool for all type of users, technical/ economical/ social barriers for the implementation of EE users	N/A
FP7-SEC-2013-1	LEILA	Law Enforcement Intelligence Learning Application	finished	2	gaming based simulation, big data, decision making, AR	user-centred approach	N/A	N/A
FP7-2011-NMP-ICT-FoF	VISTRA	Virtual Simulation and Training of Assembly and Service Processes in Digital Factories	finished	3	gaming based simulation	Described as a small to medium scale implementation	N/A	N/A

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FP7-SEC-2011-1	CRISMA	Modelling crisis management for improved action and preparedness	finished	3	policy modelling, gaming-based simulation	large scale implementation	N/A	N/A
FP7-ICT-2011-7	CROSSOVER	Bridging Communities for Next Generation Policy-Making	finished	2	policy modelling	N/A	N/A	N/A
FP7-COH-2007-2.2-OMC-NET	CIA4OPM	Optimising the policy mix by the development of a common methodology for the assessment of (socio-) economic impacts of RTDI public funding	finished	2	policy modelling	large scale implementation	N/A	N/A
H2020-EU.3.3.7.	PUBLENEF	Supporting PUBLic Authorities for Implementing Energy Efficiency Policies	finished	3	policy modelling,	large scale implementation	N/A	N/A
FP7-ICT-2011-7	ePolicy	Engineering the POlicy-making LIfe CYcle	finished	3	policy modelling, opinion mining, e-participation	pilot	N/A	
FP7-ICT-2013-10	Consensus	Multi-Objective Decision Making Tools through Citizen Engagement	finished	3	policy modelling	N/A	N/A	N/A
FP7-PEOPLE-2013-CIG	RISK	Risk-Sensitive Policy Making for Populations	finished	4	policy modelling, big data	N/A	Risk analysis	N/A
FP7-HEALTH-2011	REPOPA	REsearch into POlicy to enhance Physical Activity	finished	5	Policy modelling, Big Data, Linked Data	pilot	N/A	N/A
FP7-SCIENCE-IN-SOCIETY-2010-1	EPOCH	Ethics in Public Policy Making: The Case of Human Enhancement	finished	2	Policy making, Big Data	large scale implementation	Ethical issues followed by disruptive technologies concerning the policy making	N/A
FP7-SST-2008-TREN-1	2DECIDE	Toolkit for sustainable decision making in ITS deployment	finished	2	Policy making, Big Data, open data, interoperability	proof of concept	N/A	N/A
H2020-ICT-2016-1	GAPARS	Gamification of participatory science for training and education purposes	ongoing	2	gamification, gaming-based simulation, Cloud computing, Big Data, AR	pilot		N/A
H2020-EU.2.1.1.	INLIFE	Incubate a New Learning and Inspiration Framework for Education	finished	2	Gamification, IoT, VR	large scale implementation	How the Virtual Reality strengthens the infusion of gamification into non-leisure contexts,	N/A

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H2020-EU.3.3.7.	WaterWatt	Improvement of energy efficiency in industrial water circuits using gamification for online self-assessment, benchmarking and economic decision support	ongoing	3	Gamification,	pilot	Awareness: How to be achieved, How the use of a gaming approach can improve the energy efficiency	N/A
H2020-EU.2.1.1.4.	RAGE	Realising an Applied Gaming Eco-system	finished	4	Gamification, Gaming based simulation	large scale implementation	N/A	N/A
FP7-ICT-2013-10	EU Community	EU Community	finished	3	policy modelling, text mining, social media	pilot	N/A	N/A

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2.10.3Future scenario

2.10.4Research Needs and Training Needs

2.10.5Recommendations

2.11 Natural Language Processing

2.11.1Introduction

2.11.2Project analysis

Table 10. Identified projects involving Natural Language Processing

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Project Call	Acronym	Project Title	Status	Duration (in years)	Technologies used	Type	Identified research needs	Identified Training Needs
IC-INTAS, 1993	N/A	Natural language processing: creation of linguistic resources and pilot applications	finished	1	NLP	N/A	Creation of a broader basis for the construction of linguistic resources (lexicon and grammar coverage); construct of a few demonstration prototypes for promising application areas	N/A
ERC-2009-AdG	GRAMPLUS	Grammar-Based Robust Natural Language Processing	finished	5	NLP, Machine Learning	pilot	N/A	N/A
FP7-PEOPLE-2007-2-1-IEF	JOINTSTRUCTUREDPRED	Machine Learning Methods for Complex Outputs and Their Application to Natural Language Processing and Computational Biology	finished	1	NLP, machine Learning	N/A	N/A	N/A
H2020-EU.1.1.	NLPRO	Natural Language Programming: Turning Text into Executable Code	ongoing	5	NLP, Text mining	pilot	Robotics, cognitive computing	N/A
H2020-SEC-2016-2017-1	LETS-CROWD	Law Enforcement agencies human factor methods and Toolkit for the Security and protection of CROWDs in mass gatherings	ongoing	2	policy making/modelling, AI	pilot	N/A	N/A
FP7-PEOPLE-2009-RG	HELENLP	Heterogeneous Learning for Natural Language Processing	finished	4	NLP, Machine Learning, AI	described as a large-scale implementation	N/A	N/A
H2020-EU.1.1.	SEMANTAX	Form-Independent Semantics for Natural Language Understanding	ongoing	5	NLP, Machine Learning	N/A	N/A	N/A
H2020-EU.1.1.	DeepSPIN	Deep Learning for Structured Prediction in Natural Language Processing	ongoing	5	NLP, Deep Learning, Machine Learning	N/A	Structural complexity of human language, big data, open data	N/A

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2.11.3Future scenario

2.11.4Research Needs and Training Needs

2.11.5Recommendations

2.12 Blockchain

2.12.1Introduction

2.12.2Project analysis

Table 11. Identified projects involving Blockchain technology

Project Call	Acronym	Project Title	Status	Duration of the project	Technologies used	Identified research needs	Identified Training Needs
FP7-ICT-2013-10	D-CENT	Decentralised Citizens ENgagement Technologies	finished	2.5	Blockchain (Freecoin)	Decentralization of the internet	N/A
H2020-EURO-6-2015	SONNETS	SOcietal Needs aNalysis and Emerging Technologies in the public Sector	finished	1.5	Blockchain	Identifying, monitoring and early detection of societal trends that need to be met by specific public sector services. How to timely get aware of emerging technologies and assess their usability for the public sector?	N/A
H2020-EU.3., H2020-EU.2.3., H2020-EU.2.1.	Roksnet	e-Society Interconnections Software	finished	0.25	Blockchain	e-Society data exchange system	N/A
ERC-2017-STG	BLOCKCHAINSOCIETY	The Disrupted Society: mapping the societal effects of blockchain technology diffusion	ongoing	5	Blockchain	(1) build the conceptual and methodological bridges between information law, the study of the self-governance of technological systems via Science and Technology Studies, and the study of collective control efforts of complex socio-technological assemblages via Internet Governance studies; (2) address the most pressing blockchain-specific regulatory challenges via the analysis of emerging policies, and the development of new proposals.	N/A

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H2020-EU.3.6.2.2.	CO3	Digital Disruptive Technologies to Co-create, Co-produce and Co-manage Open Public Services along with Citizens	ongoing	3	Blockchain, augmented reality, geolocated social network, liquid democracy tools and gamification	Business plan ensuring long term sustainability for the PAs on the basis of the metrics applied on the pilots' data	N/A
H2020-MSCA-IF-2017	AnticipatoryLedgers	Anticipatory design and ethical framework for Distributed Ledger Technologies (blockchain or DAG) and applications (smart contracts, IoTs and supply chain)	ongoing	2	Blockchain	Analysis of the "governance crisis" in the emerging DLTs	N/A
H2020-EU.2.1.1.	PTwist	An open platform for plastics lifecycle awareness, monetization, and sustainable innovation	ongoing	2	Blockchain, Gamification, analytics, open source and open data solutions	Plastic reuse	N/A
H2020-EU.2.1.1.	ARTICONF	smART soclal media eCOsytstem in a blockchaiN Federated environment	ongoing	3	Blockchain	Decentralization	N/A
H2020-EU.3.6.2.2.	QualiChain	Decentralised Qualifications' Verification and Management for Learner Empowerment, Education Reengineering and Public Sector Transformation	ongoing	3	Blockchain	Education and employment qualifications management	N/A
ERC-2017-STG	P2PMODELS	Decentralized Blockchain-based Organizations for Bootstrapping the Collaborative Economy	ongoing	5	Blockchain	New generation of self-governed and more economically sustainable peer-to-peer CE communities.	N/A
H2020-EU.2.1.1.	BLOOMEN	Blockchains in the new era of participatory media experience	ongoing	3	Blockchain	N/A	N/A
H2020-ICT-2016-1	MH-MD	My Health - My Data	ongoing	3	Blockchain, eHealth	Issues of data subjects' privacy and data security, isolated, locally hosted patient data repositories, disenfranchisement of patients.	N/A
H2020-EU.3.7.4., H2020-EU.3.7.2.	STOP-IT	Strategic, Tactical, Operational Protection of water Infrastructure against cyber-physical Threats	ongoing	4	Computer vision	Risk management for water infrastructure cyber threats	N/A
H2020-EU.2.1.3., H2020-EU.2.1.5.1.	MARKET4.0	A Multi-Sided Business Platform for Plug and Produce Industrial Product Service Systems	ongoing	3.5	VR/AR, simulations	Mediation between suppliers and customers	N/A

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H2020-EUK-2018	DECENTER	Decentralised technologies for orchestrated cloud-to-edge intelligence	ongoing	3	Artificial intelligence, cloud computing	N/A	N/A
H2020-EUJ-2018	M-Sec	Multi-layered Security technologies to ensure hyper connected smart cities with Blockchain, BigData, Cloud and IoT	ongoing	3	Big data, cloud computing and IoT	Solution for the problem of centralized data collection and processing approach, which introduces several limitations in terms of supported applications and business models that they enable	N/A
H2020-EU.3.7.6., H2020-EU.3.7.1.	TITANIUM	Tools for the Investigation of Transactions in Underground Markets	ongoing	3	Machine-learning, deep neural networks	Investigation and mitigation of illegitimate activities	N/A
H2020-EU.3.7.6., H2020-EU.3.7.1.	ANITA	Advanced tools for fighting oNline Illegal TrAfficking	ongoing	3	Big data analytics, neural networks	Investigation and mitigation of illegitimate activities and traffic	N/A
ERC-2017-ADG	CoHuBiCoL	Counting as a Human Being in the Era of Computational Law	ongoing	5	Artificial intelligence	Legal protection in data-driven and code-driven law	N/A
H2020-EU.3.7.4., H2020-EU.3.7.2.	DEFENDER	Defending the European Energy Infrastructures	ongoing	3	Cyber-Physical Systems, drones	Protection of energy infrastructure	N/A
H2020-ICT-2016-1	DECODE	Decentralised Citizens Owned Data Ecosystem	ongoing	3	Blockchain	Decentralization of citizen's data	N/A
H2020-EU.3.7.6.	PoSeID-on	Protection and control of Secured Information by means of a privacy enhanced Dashboard	ongoing	2.5	Blockchain	Privacy Enhancing Dashboard for personal data protection	N/A
H2020-SMEINST-2-2016-2017	Smart-Trust	Smart Trust: Secure Mobile ID for Trusted Smart Borders	ongoing	2	Blockchain, Biometrics	Border control based on biometrics on the move, which provides freedom of movements to citizens while ensuring their privacy safeguarded according to Privacy by Design principles.	N/A
N/A	N/A	Publicly verified blockchain-based identity credential to residents	finished	N/A	N/A	N/A	N/A

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N/A	N/A	Digital Identity for refugees' services	finished	N/A		N/A	N/A
N/A	N/A	Child trafficking	N/A	N/A	N/A	N/A	N/A
N/A	N/A	Lantmäteriet Land registry	N/A	N/A	N/A	N/A	N/A
N/A	N/A	Land registry	ongoing	N/A	N/A	N/A	N/A
N/A	N/A	Healthcare record	N/A	N/A	N/A	N/A	N/A
N/A	N/A	Bitland for land registry	ongoing	N/A	N/A	N/A	N/A
N/A	N/A	Digital street - HM Land registry	ongoing	N/A	N/A	N/A	N/A
N/A	N/A	The Electronic Health Record (e-Health Record)	finished	N/A	N/A	N/A	N/A
N/A	N/A	CareChain	ongoing	N/A	N/A	N/A	N/A
N/A	N/A	Blockcerts blockchain-based certificates	ongoing	N/A	N/A	N/A	N/A
N/A	N/A	e-Scroll system	ongoing	N/A	N/A	N/A	N/A
N/A	Voatz App	Pilot program for military and other voters living overseas.	finished	N/A	Facial recognition	N/A	N/A

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2.12.3Future scenario

2.12.4Research Needs and Training Needs

2.12.5Recommendations

2.13 eID and eSignature

2.13.1Introduction

2.13.2Project analysis

Table 12. Identified projects involving eID and eSignature

Project Call	Acronym	Project Title	Status	Duration (in years)	Technologies used	Type	Identified research needs	Identified Training Needs
FP7-ICT-2011-8	FUTUREID	Shaping the Future of Electronic Identity	finished	3	e-Identity / e-Signature	pilot	no standardized, trustworthy and ubiquitously usable eID client -complex and costly integration of authentication and identity services -no coherent European trust infrastructure for authentication -privacy threats of real-world authentication solutions -non-technical problems	A gap analysis of existing standards will identify areas of work where FutureID needs to seek coordination.
H2020-DS-2015-1	FutureTrust	Future Trust Services for Trustworthy Global Transactions	ongoing	3	e-Identity / e-Signature, Customised/Personalised Public Services	pilot	Distributed Ledger (e.g. OpenChain) Reputation Based Web of Trust (WoT) aspects of security and global trust validation of electronic signatures long term preservation of signatures remote signatures and mobile signing	N/A
CIP-ICT-PSP-2007-1	STORK	Secure Identity Across Borders Linked (STORK)	finished	3.5	e-Identity / e-Signature	pilot	N/A	N/A
CIP-ICT-PSP-2011-5	STORK 2.0	Secure idenTity acrOss boRders linKed 2.0	finished	3.5	e-Identity / e-Signature	pilot	N/A	N/A
H2020-FCT-2015	ARIES	ReliAble euRopean Identity EcoSystem	ongoing	2.5	e-Identity / e-Signature	proof of concept	Identity ecosystem New technologies, processes and security features for physical and virtual identity management Biometric identity Strengthening the link between physical documents linked to the biometric and the digital (online and also mobile) identity	N/A
CIP-ICT-PSP-2010-4	SSEDIC	Scoping the Single European Digital Identity Community	finished	3	e-Identity / e-Signature	proof of concept	Over the course of the last 3 years, SSEDIC has conducted two large surveys on user attitudes towards eID and use of eIDs [SSE11, SSE12b]. Taking a step back from the results and asking what might be particularly noteworthy characteristics of the respondents to the survey we find that end users are	N/A

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							•Sceptical: expect to see clear benefits from the use of eID technologies •Convenience seeking: use convenient, readily available tools (also in a professional environment) even if they have experienced or are aware of some associated security issues •Internationally oriented: engage in cross-border online commerce and banking transactions •With high expectations: expect their national governments and the EU to take action towards improving the current situation and to ensure cross-border usability of eIDs not only for public but also for private sector applications	
2018 CEF Telecom Call – eIdentification & eSignature (CEF-TC-2018-1)	eID4Spain	Connecting Regional and Local Administrations to the Spanish eIDAS node	ongoing	N/A	e-Identity / e-Signature	large scale impleme ntation	N/A	N/A
2016-EU-IA-0064	eID@Cloud	Integrating the eIdentification in European cloud platforms according to the eIDAS Regulation	ongoing	N/A	e-Identity / e-Signature	large scale impleme ntation	N/A	N/A
FP7-ICT-2009-5	ABC4Trust	Attribute-based Credentials for Trust	finished	4	e-Identity / e-Signature	proof of concept	Identity Management and Overidentification Problem Identity Assurance and the 'Calling Home' problem	N/A
FP7-ICT-2011-8	HINT	Holistic Approaches for Integrity of ICT-Systems	finished	3	e-Identity / e-Signature	proof-of-concept	developing 'integrity checking' of computer parts based on trusted computing technologies.	N/A
FP7-SEC-2013-1	EKSISTENZ	Harmonized framework allowing a sustainable and robust identity for European Citizens	finished	3	e-Identity / e-Signature	proof-of-concept	EKSISTENZ studied, in an interdisciplinary manner, societal, ethical and legal aspects of identity theft; and advised EKSISTENZ in the development of technical tools to secure citizen identity. The current research stands apart from majority of privacy literature that deals with identity	N/A

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							management and biometrics in its close interaction with actual technology design and development. This has allowed us to address the relevant technology choices in a much more detailed manner, and to advise the technology partners in their work.	
CIP-ICT-PSP-2009-3	SEMIRAMIS	Secure Management of Information across multiple Stakeholders	finished	2.8	e-Identity / e-Signature	pilot	SEMIRAMIS will be based on leading edge technologies based on XML derivatives, mainly SAML 2.0 which is largely considered a key technology in the area of federated identity management. SEMIRAMIS will take advantage of the RADIUS (Remote Authentication Dial-In User Service) infrastructure which has been successfully brought into production in the last two years, implemented into an access process based on 802.1X. For achieving data security, a PKI (Public Key Infrastructure) will be used.	N/A
FP7-SEC-2011-1	FIDELITY	Fast and trustworthy Identity Delivery and check with ePassports leveraging Traveler privacy	finished	4	e-Identity / e-Signature	proof of concept	Project members presented studies, guidelines and recommendations for the implementation of privacy-by-design principles, and ethical, legal and sociological requirements in the development of ePassport solutions.	N/A
FP7-SME-2013	HIGHTRUST WALLET	A framework for mobile wallets that provides the security levels QAA1-4 in a TSM architecture supporting the use of e-Identity cards on the mobile phone	finished	2	e-Identity / e-Signature	framework	Team personnel developed a high-security wallet framework potentially compatible with various currently available mobile phone wallet systems. The developments combine a secure software element, improved authentication methods, a wallet server and a Trusted Identity Manager. As a result, the system enables life-cycle management for services at differing security levels.	N/A
SMEInst-13-2016-2017	IDENTITY	Usable Digital Signature	finished	0.5	e-Identity / e-Signature	proof of concept	During this study, we have realised that European SMEs tend to use cloud solutions and we have not found any in the global market (and European) that is	N/A

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							specifically designed for online contracts with cloud signing. The new eIDAS scenario, gives the final push to solutions related to cloud signature solutions. There are companies that offer the signature in the cloud, but rudimentarily. Our proposal makes IDENTITY to evolve, as described in the initial proposal, in order to turn it to the most advanced solution in the market, associated with the signing of online contracts	
H2020-DS-2014-1	CREDENTIAL	Secure Cloud Identity Wallet	finished	3	e-Identity / e-Signature	proof of concept	Significant progress was made regarding the adoption and improvements of CREDENTIAL's core cryptographic primitives, in particular concerning the combination of redactable signatures and proxy re-encryption which was necessary to allow for the privacy-preserving and selective cloud-based sharing of authentic (i.e., signed) data between data owners and receivers. Combined with the overall approach of CREDENTIAL, these findings will in particular become relevant to achieve the goal of data minimization. Also, research regarding the long-term security of proxy re-encryption schemes has led to the first forward-secure such scheme in the literature, which again will contribute to reducing the trust that has to be put into cloud services. Furthermore, we have analysed various existing identity protocols including, e.g., SAML or OpenID Connect which could be extended to support proxy re-encryption. To maximally secure the users' authentication to the cloud, the consortium focused on, and analysed, wide-spread technologies like FIDO.	N/A
N/A	e-Identity	e-Identity- Estonia	finished	N/A	e-Identity / e-Signature	large scale	N/A	N/A

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						implementation		
N/A	NemID	NemID - Denmark	finished	N/A	e-Identity / e-Signature	large scale implementation	N/A	N/A
N/A	ID2020	ID2020 Alliance	ongoing	N/A	e-Identity / e-Signature	N/A	N/A	N/A
N/A	ID4D	Identification for Development	ongoing	N/A	e-Identity / e-Signature	N/A	N/A	N/A

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2.13.3Future scenario

2.13.4Research Needs and Training Needs

2.13.5Recommendations

3. The Roadmap of Government 3.0

3.1 The Roadmap

Based on the analysis conducted in section 2, the roadmap has been developed, formulating a list of specific actions to be realised in order to address the identified needs connected to the developments in the disruptive technologies in the context of Government 3.0. Structurally, the actions are grouped into two roadmaps, one describing actions in research and another concerning actions in education and training.

Government 3.0 Research Roadmap presented in Table 13 describes the research actions connected to the identified research gaps of the Government 3.0 domain. The actions of the roadmap are focused on building up knowledge and addressing research challenges in the field.

Government 3.0 Education and Training Roadmap (Table 14) focuses on the training needs, outlining a number of specific steps needed to properly address them in education and vocational training.

The roadmap actions are presented in Table 13, which includes the following information regarding each step in the roadmap:

- **Key Theme** is a short name of the roadmap action.
- **Description** is the justification of the action and short explanation of the problem the action is addressing.
- **Objective** outlines the aim of the action. What is to be achieved with the completion of the roadmap action.
- **Risks** describe possible issues in the domain of public service in case the roadmap action is not carried out.
- **Actors** indicate who are the stakeholders responsible for the realisation of a particular action.
- **Impact** denotes the implications of the action for the field generally.

***Note**: As it is the first version of this deliverable and some of the chapters within section 2 are still incomplete, the presented roadmaps are also still provisional versions and will be extended when more technologies and concepts are analysed in section 2.*

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Table 13. Government 3.0 Research Roadmap (first draft)

No.	Key theme	Description	Objective	Risks	Actors	Impact
1	Analysis of first implementations	Analysis of cases of first exploitations of disruptive technologies in government.	Better understanding of benefits and negative aspects of the disruptive technologies in public sector, as well as objectives of such implementations.	None	Researchers	Understanding of the benefits and risks of particular technologies, allows to make better decision about the use of disruptive technologies in government.
2	Analysis of the factors affecting adoption of the disruptive technologies	Investigating what are the main barriers and issues, hampering the introduction of disruptive technologies in government. The topic addressed through empirical research where sufficient data from existing adoption/use of the specific disruptive technology can be collected; otherwise, if there has been limited use/adoption of the technology, the theme can be addressed theoretically using previously developed relevant theory (or knowledge from the research of other technologies) or based on views and opinions of experts.	Identification of barriers and challenges connected to the adoption of the new technologies in public service.	Insufficient support of the initiatives by the public.	Researchers	Understanding of the main barriers and challenges affecting the adoption of individual disruptive technologies in government. Conceptual model of technology adoption in government.

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3	Application areas for the disruptive technologies, targeted benefits	Deeper research in the practical application of the disruptive technologies. The topic addressed through empirical research where sufficient data are available, otherwise the theme can be addressed theoretically using previously developed relevant theory or surveying the opinions of experts.	Identification of application areas for disruptive technologies, targeted benefits of their implementation	Missing opportunities: not using disruptive technology, where it could be beneficial.	Researchers	Proper understanding of the areas for the application of technologies
4	Factors affecting the realisation of services based on the disruptive technologies	Research of the factors that influence the realisation of the services implementing the disruptive technologies: both positive and negative factors. The topic addressed through empirical research where sufficient data are available, otherwise the theme can be addressed theoretically using previously developed relevant theory or surveying the opinions of experts.	Identification of factors (positive and negative) affecting the realisation of services based on the disruptive technologies	Implementation of inefficient and ineffective services. Erosion of public trust.	Researchers	Understanding the factors affecting the implementation of disruptive technologies. More efficient and targeted implementation.
5	Negative aspects of the introduction of services based on disruptive technologies	Research of the negative aspects of the use of the disruptive technologies in government. This includes the negative aspects	Identification of possible drawbacks of the implementation of the disruptive technologies and	Introduction of the new technologies may lead to	Researchers, Government institutions	Possibility to minimise the negative aspects of the introduction of the new technologies. Selective

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		affecting the specific domains (e.g., increased costs) as well as society as a whole (e.g. increasing digital divide). Short- and long-term effects are to be considered.	conditions under which such implementations may not be justified.	increased costs and lower service quality.		implementation of the new technologies where they would be most effective.
6	Integration and interoperability issues	Research of integration and interoperability of the technologies is important for making sure that the new systems and technologies interact properly with the existing systems and realise the common standards. This also includes research into the technical interoperability of the IoT devices, especially when the data collected using such devices are used for automated decision making.	Identification/ creation of the standards for specific disruptive technologies in the government services.	Introduction of new technologies may lead to the emergence of a number of conflicting standards.	Researchers, IT service providers	High interoperability among systems results in more effective and efficient services.
7	Automated decision making in government	Research of the implications of the implementation of the automated decision making in government. This includes the issues of efficiency, cost and public acceptance.	Identification of possible processes that can be effectively automated through AI.	Low-level of trust towards AI-based agents. Algorithmic bias.	Researchers, Government institutions, IT service providers	Understanding of how some government decision making processes can be automated without losing public trust in such decisions.

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8	Data governance	Research regarding the best practices and standards for data storage and quality assurance.	Identification of the best practices of data governance.	Improper data governance may lead to significant loss of public support.	Researchers, IT service providers	Data governance standards ensuring protection of public data and potentially reducing costs of data storage and processing.
9	Data ownership, security and privacy	Research of the data regulation and standards for potential sensitive data collected using sensors or through data mining.	Identification of the best practices to ensure ownership, privacy and security of personal data.	Improper handling of sensitive private data may lead to erosion of public trust.	Researchers, Regulatory bodies, Government institutions	A set of regulations to ensure ownership, security and privacy of the data, including the use of anonymised data from multiple sources.
10	Legal frameworks	Research of the possible issues regarding the regulation of the new technologies. The implementation of the disruptive technologies may lead to the new legal issues and require new laws, standards and regulations both on national and international levels.	Identify inadequacies of existing laws when applied to the disruptive technologies. Develop legal frameworks addressing the new legal challenges arising from the application of the disruptive technologies.	Inadequate laws may allow violations of citizen rights.	Regulatory bodies, Government institutions, IT service providers, Researchers	Legal framework for the implementation of services based on the disruptive technologies. Protection of citizen rights both within and across national borders.

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Table 14. Government 3.0 Education and training roadmap (first draft)

No.	Key theme	Description	Objective	Risks	Actors	Impact
1	Development of the new courses on the undergraduate level	Expanding the current study programmes with further modules on the disruptive technologies in public services.	Prepare future researchers and practitioners in e-government domain.	Outdated or irrelevant content may negatively influence the future public officials.	Higher education institutions	Skilled public officials, and decreased need for vocational training.
2	Development of the new study curriculum on the postgraduate level	Creation of the new postgraduate programme focusing on the use of the disruptive technologies in e-government.	Preparation of the future researchers and practitioners in e-government domain.	Government 3.0 is not properly addressed as a new stage in the e-Government development.	Higher education institutions	Proper understanding of specific benefits and challenges of the implementation of the disruptive technologies in government.
3	Vocational training on the application of the disruptive technologies	Public officers need to be familiar with the new disruptive technologies.	Improvement of the professional performance of employees or service providers. Increased productivity and efficiency.	Decreased quality of service because of the insufficient knowledge of the disruptive technologies.	Higher education institutions, Government institutions	Enhanced competence development. Efficient and satisfied employees.
4	End-user training	Training the citizens on how to use the services based on the new technologies.	Capacity building, arming the users with the necessary knowledge to work with the new services.	Low user acceptance, erosion of trust in government institutions.	Government institutions, public bodies	Higher acceptance of the new services, higher rate of adoption.

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3.2 Recommendations

4. Conclusions

5. REFERENCES

Andrews, C. (2015). *The Internet of Things: what IoT means for the public sector*. Retrieved from http://electronicdesign.com/communications/internet-things-needs-firewalls-too

Atzori, L., Iera, A., & Morabito, G. (2010). The Internet of Things: A survey. *Computer Networks*, *54*(15), 2787–2805. http://doi.org/10.1016/j.comnet.2010.05.010

Berkhout, F., Hertin, J., & Jordan, A. (2002). Socio-economic futures in climate change impact assessment: Using scenarios as "learning machines." *Global Environmental Change*. http://doi.org/10.1016/S0959-3780(02)00006-7

Bicking, M., & Wimmer, M. A. (2011). Concept to Integrate Open Collaboration in Technology Roadmapping: Stakeholder Involvement in Strategic E-Government Planning. *Proceedings of the 44th Hawaii International Conference on System Sciences (HICSS-44)*, 1–12.

Bohensky, E. L., Reyers, B., & Van Jaarsveld, A. S. (2006). Conservation in Practice: Future Ecosystem Services in a Southern African River Basin: a Scenario Planning Approach to Uncertainty. *Conservation Biology*, *20*(4), 1051–1061. http://doi.org/10.1111/j.1523-1739.2006.00475.x

Brous, P., & Janssen, M. (2015a). A Systematic Review of Impediments Blocking Internet of Things Adoption by Governments. In M. Janssen, M. Mäntymäki, J. Hidders, B. Klievink, W. Lamersdorf, B. van Loenen, & A. Zuiderwijk (Eds.), *Lecture Notes in Computer Science* (Vol. 9373, pp. 81–94). Cham: Springer International Publishing. http://doi.org/10.1007/978-3-319-25013-7_7

Brous, P., & Janssen, M. (2015b). *Advancing e-Government Using the Internet of Things: A Systematic Review of Benefits*. (E. Tambouris, M. Janssen, H. J. Scholl, M. A. Wimmer, K. Tarabanis, M. Gascó, … P. Parycek, Eds.) (Vol. 9248). Cham: Springer International Publishing. http://doi.org/10.1007/978-3-319-22479-4

Carroll, J. M. (1999). Five Reasons for Scenario-Based Design. In *Proceedings of the 32nd Hawaii International Conference onsystem Sciences* (Vol. 00, pp. 1–11).

Castro, D. (2008). Digital Quality of Life: Government. *SSRN*. http://doi.org/10.2139/ssrn.1285002

Chang, S. M., Carey, T. S., Kato, E. U., Guise, J. M., & Sanders, G. D. (2012). Identifying research needs for improving health care. *Annals of Internal Medicine*. http://doi.org/10.7326/0003-4819-157-6-201209180-00515

Clarke, R. Y., Dunbrack, L., & Webber, A. (2017). *The IoT Imperative in Public Services : Government and Healthcare*.

Fan, P. F., Wang, L. L., Zhang, S. Y., & Lin, T. T. (2013). The Research on the Internet of Things Industry Chain for Barriers and Solutions. *Applied Mechanics and Materials*, *441*, 1030–1035. http://doi.org/10.4028/www.scientific.net/AMM.441.1030

Gemino, A., & Parker, D. (2009). Use case diagrams in support of use case modeling: Deriving understanding from the picture. *Journal of Database Management (JDM)*. http://doi.org/10.4018/jdm.2009010101

Gubbi, J., Buyya, R., Marusic, S., & Palaniswami, M. (2013). Internet of Things (IoT): A vision, architectural elements, and future directions. *Future Generation Computer Systems*, *29*(7), 1645–1660. http://doi.org/10.1016/j.future.2013.01.010

Janssen, M., Van Der Duin, P., Wagenaar, R. W., Dawes, S., Bicking, M., Wimmer, M. A., & Petrauskas, R. (2007). Scenario building for E-Government in 2020: Consolidating the results from regional workshops. *Proceedings of the Annual Hawaii International Conference on System Sciences*, 296–297. http://doi.org/10.1109/HICSS.2007.473

Johnson, K. A., Dana, G., Jordan, N. R., Draeger, K. J., Kapuscinski, A., Schmitt Olabisi, L. K., & Reich, P. B. (2012). Using participatory scenarios to stimulate social learning for collaborative sustainable development. *Ecology and Society*, *17*(2). http://doi.org/10.5751/ES-04780-170209

Le Dantec, C. A., Watkins, K. E., Clark, R., & Mynatt, E. (2015). Cycle Atlanta and OneBusAway: Driving Innovation Through the Data Ecosystems of Civic Computing. In M. Kurosu (Ed.), *Lecture Notes in Computer Science* (Vol. 9171, pp. 327–338). Cham: Springer International Publishing. http://doi.org/10.1007/978-3-319-21006-3_32

Maissin, J. P., Ronan, V. E., & Colin, F. (2015). How will IoT improve public sector services ? *Inside 2015, Special Edition Public Sector*, 156–162. Retrieved from https://www2.deloitte.com/content/dam/Deloitte/lu/Documents/public-sector/lu_en_how-will-iot-improve-public-sector-services_122015.pdf

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Misuraca, G., Broster, D., Centeno, C., Punie, Y., Lampathaki, F., Charalabidis, Y., … Bicking, M. (2010). *Envisioning Digital Europe 2030 : Scenarios for ICT in Future Governance and Policy Modelling*. *Europe*.

Nam, T., & Pardo, T. A. (2014). The changing face of a city government: A case study of Philly311. *Government Information Quarterly*, *31*(SUPPL.1). http://doi.org/10.1016/j.giq.2014.01.002

Nath, S., & Som, S. (2017). Security and Privacy Challenges: Internet of Things. *Indian Journal of Science and Technology*, *10*(3). http://doi.org/10.17485/ijst/2017/v10i3/110642

Nugroho, R. A., & Haryani, T. N. (2016). Generation X and generation Y perception towards Internet of Things in public service: A preliminary study in Indonesia. *2016 22nd Asia-Pacific Conference on Communications (APCC)*, 110–114. http://doi.org/10.1109/APCC.2016.7581443

Peterson, G. D., Cumming, G. S., & Carpenter, S. R. (2003). Scenario planning: A tool for conservation in an uncertain world. *Conservation Biology*. http://doi.org/10.1046/j.1523-1739.2003.01491.x

Ratcliffe, J. (2000). Scenario building: a suitable method for strategic property planning? *Property Management*, *18*(2), 127–144. http://doi.org/10.1108/02637470010328322

Ringland, G. G. (2002). *Scenarios in Public Policy*. Chichester, UK: Wiley.

Scarfo, A. (2014). Internet of things, the smart X enabler. In *Proceedings - 2014 International Conference on Intelligent Networking and Collaborative Systems, IEEE INCoS 2014* (pp. 569–574). http://doi.org/10.1109/INCoS.2014.98

Scuotto, V., Ferraris, A., & Bresciani, S. (2016). Internet of Things: Applications and challenges in smart cities: a case study of IBM smart city projects. *Business Process Management Journal*, *22*(2), 357–367. http://doi.org/10.1108/BPMJ-05-2015-0074

Sicari, S., Rizzardi, A., Grieco, L. A., & Coen-Porisini, A. (2015). Security, privacy and trust in Internet of Things: The road ahead. *Computer Networks*, *76*, 146–164. http://doi.org/10.1016/j.comnet.2014.11.008

Song, T., Cai, J., Chahine, T., & Li, L. (2017). Towards Smart Cities by Internet of Things (IoT)—a Silent Revolution in China. *Journal of the Knowledge Economy*, 1–17. http://doi.org/10.1007/s13132-017-0493-x

Stiller, K. D., Freitag, A., Zinnbauer, P., & Freitag, C. (2009). How pacing of multimedia instructions can influence modality effects: A case of superiority of visual texts. *Australasian Journal of Educational Technology*, *25*(2). http://doi.org/10.14742/ajet.1149

Terry Hemken, & Gray, C. (2016). *Smart move: Emerging technologies make their mark on public service*. Retrieved from https://www.accenture.com/us-en/insight-ps-emerging-technologies?c=psv_psitechfy16_10000001&n=otc_0816

Weber, R. H. (2015). Internet of things: Privacy issues revisited. *Computer Law and Security Review*, *31*(5), 618–627. http://doi.org/10.1016/j.clsr.2015.07.002

Wimmer, M. A., & Bicking, M. (2011). Collaborative Scenario Building For Policy Modelling. In *Conference: tGov 2011*.

Xiaofeng, M., & Wimmer, M. A. (2007). eGovRTD2020 operational roadmapping methodology. In M. A. Codagnone, C.; Wimmer (Ed.), *Roadmapping eGovernment Research: Visions and Measures towards Innovative Governments in 2020* (pp. 31–34). Clusone: MY Print snc di Guerinoni Marco & C.

Yazici, H. J. (2014). An exploratory analysis of hospital perspectives on real time information requirements and perceived benefits of RFID technology for future adoption. *International Journal of Information Management*, *34*(5), 603–621. http://doi.org/10.1016/j.ijinfomgt.2014.04.010

Zhang, J.-C., Zhang, X., & Wang, Z. C. N.-J. A. R. 2017. (2017). Internet of Things for Public Service: Innovative Practice in China. In *Routledge handbook on information technology in government* (pp. 124–136).

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