European Commission

JRC SCIENCE FOR POLICY REPORT

Exploring Digital Government transformation in the EU

Analysis of the state of the art and review of literature

Authors: Egidijus Barcevičius, Guoda Cibaitė, Cristiano Codagnone, Vaida Gineikytė, Luka Klimavičiūtė, Giovanni Liva, Loreta Matulevič, Gianluca Misuraca, Irene Vanini

Editor: Gianluca Misuraca

2019

Joint Research Centre

EUR 29987 EN

This publication is a Science for Policy report by the Joint Research Centre (JRC), the European Commission's science and knowledge service. It aims to provide evidence-based scientific support to the European policymaking process. The scientific output expressed does not imply a policy position of the European Commission. Neither the European Commission nor any person acting on behalf of the Commission is responsible for the use that might be made of this publication. For information on the methodology and quality underlying the data used in this publication for which the source is neither Eurostat nor other Commission services, users should contact the referenced source. The designations employed and the presentation of material on the maps do not imply the expression of any opinion whatsoever on the part of the European Union concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

Contact information
Gianluca Misuraca
Senior Scientist, Digital Government Transformation
European Commission's Joint Research Centre, Digital Economy Unit
Edificio EXPO, Calle Inca Garcilaso, 3 – 41092 Seville, Spain
+34 95-448.87.18
gianluca.misuraca@ec.europa.eu

EU Science Hub
https://ec.europa.eu/jrc

JRC118857

EUR 29987 EN

PDF ISBN 978-92-76-13299-8 ISSN 1831-9424 doi:10.2760/17207

Luxembourg: Publications Office of the European Union, 2019

How to cite this report: Authors: Barcevičius, E., Cibaitė, G., Codagnone, C., Gineikytė, V., Klimavičiūtė, L., Liva, G., Matulevič, L., Misuraca, G., Vanini, I., Editor: Misuraca, G., *Exploring Digital Government transformation in the EU - Analysis of the state of the art and review of literature*, EUR 29987 EN, Publications Office of the European Union, Luxembourg, 2019, ISBN 978-92-76-13299-8, doi:10.2760/17207, JRC118857.

Contents

Abstract

This report presents the findings of the analysis of the state of the art conducted as part of the JRC research on *"Exploring Digital Government Transformation in the EU: understanding public sector innovation in a data-driven society" (DIGIGOV)*, within the framework of the "European Location Interoperability Solutions for eGovernment (ELISE)" Action of the ISA^2 Programme on Interoperability solutions for public administrations, businesses and citizens, coordinated by DIGIT. The results of the review of literature, based on almost 500 academic and grey literature sources, as well as the analysis of digital government policies in the EU Member States provide a synthetic overview of the main themes and topics of the digital government discourse. The report depicts the variety of existing conceptualisations and definitions of the digital government phenomenon, measured and expected effects of the application of more disruptive innovations and emerging technologies in government, as well as key drivers and barriers for transforming the public sector. Overall, the literature review shows that many sources appear overly optimistic with regard to the impact of digital government transformation, although the majority of them are based on normative views or expectations, rather than empirically tested insights. The authors therefore caution that digital government transformation should be researched empirically and with a due differentiation between evidence and hope. In this respect, the report paves the way to in-depth analysis of the effects that can be generated by digital innovation in public sector organisations. A digital transformation that implies the redesign of the tools and methods used in the machinery of government will require in fact a significant change in the institutional frameworks that regulate and help coordinate the governance systems in which such changing processes are implemented.

Foreword

The rapid pace of the digital transformation of society is raising the need for governments to urgently change their *modus operandi*. As the long-standing eGovernment goals of making services and data available online have faded, new strategic directions emerged around an open and collaborative government model, based on the principles of effectiveness, efficiency, collaboration, transparency, participation and sustainability.

We stand at the beginning of a new revolution, powered by the engine of Information and Communication Technologies (ICTs) and there is hope that by harnessing systems analytics, personal and government-held digital data could be transformed into economic value. The "power of data" is also expected to promote more transparent governance processes and make citizens' engagement in policy making more effective, fundamentally changing the way decisions are taken and enabling new forms of digitally-enabled democracy.

New paradigms for the global governance of the future society are likely to emerge in the years to come. These will impinge on consolidated socio-technical trends, such as the diffusion of pervasive, always-on Internet connections, which increase the amount of services and content consumed and produced by users; the 'democratisation' of software and the 'data deluge', which has lowered the need for advanced technical skills while opening up an immense potential for creativity and experimentation; and the increasing expectations and empowerment of citizens no longer willing to accept government services as they are but keen to have the opportunity to contribute shaping the governance architecture of the society they live in.

Indeed, the experimental character of ICT-enabled innovations contributes to the identification of new possible solutions to address individual needs and solve societal challenges. At the same time, new complications and ethical challenges are emerging about how ICTs shall be governed and used. This requires a better understanding of current and future risks and opportunities of the digital transformation of the fabric of society, the possible 'regulatory governance' responses and the management of the dynamic tensions between institutional frameworks and technological change that will emerge, as well as the way individuals and groups interact within the evolving digital landscape. In addition, ICTs also offer a tremendous potential for innovating the way data are gathered and processed, thus paving the way for real-time informed policy-making based on predictive analytics and next generation computational modelling.

However, while it is taken for granted that technological advancements - especially those that have emerged rapidly in the last decade - have revolutionised the way that both every-day and complex activities are realised, regardless of the domain of application and directly linked with the exploitation of emerging technologies, as well as the constantly increasing volume of available data, it is difficult to assert that governments and public sector organisations, in general, are fully exploiting ICT-enabled innovations to meet the needs of citizens or businesses and re-engineer governance systems for improving service delivery and policy-making.

Despite the huge investments made on implementing e-Government during the last thirty years and the clear advancements in the field of public sector modernisation and automation, there is still an urgent demand for transforming the government through adopting a successful disruption paradigm, made possible through the innovative use of ICTs. This paradigmatic shift shall allow governments simultaneously satisfy better the needs of the public sector itself; address the challenges of public sector employees and policy makers; and benefit all citizens and businesses, opening up new innovation directions that will, in turn, put the public sector in the position to play a central and active role in innovation diffusion and technology take-up.

This shift is necessary not only due to the current conditions that call for more cost-efficient solutions and the improvement of effectiveness, efficiency and quality of decisions in the public sector. New concepts that consider the available data (including its structure and topology) and evidence to ensure accurate and meaningful input and feedback to public sector organisations in order to support and establish new types of evidence-informed policy design and implementation are of the utmost importance.

To this end, a multi-disciplinary perspective is required for a better understanding of the impacts of the digital transformation of government and how government shall transform itself to take advantage of the potential of emerging and future digital technologies, while at the same time govern and steer the implications of digital transformation on its own structures, as well as in the relationships with all stakeholders involved in the governance processes and policy-making mechanisms.

For this purpose, the Digital Economy Unit of the Directorate for Growth and Innovation of the European Commission's Joint Research Centre launched in 2018 a new research line on Digital Government transformation as part of the **"European Location Interoperability Solutions for e-Government (ELISE)"** Action of the ISA[2] Programme on Interoperability solutions for public administrations, businesses and citizens.[1]

After many years of implementation of e-Government in policy and practice, and a rich vein of academic and scientific research in the topic across several disciplines, it was timely and urgently needed to systematise and re-conceptualise the overall phenomenon of Digital Government transformation within the scope of Public Sector Innovation and the modernisation of public administrations in the EU, in light of the efforts conducted to enhance the quality of public services in a data-driven society.

Building on results from previous activities on this topic, in December 2018 JRC started a new **research on "Exploring Digital Government Transformation in the EU: understanding public sector innovation in a data-driven society" (DIGIGOV)** to analyse more in-depth the interplay between digital technology and other factors transforming government operations in terms of service delivery, governance processes and policy-making mechanisms.

The ultimate aim is to pave the way to in-depth analysis of the effects that can be generated by digital innovation in public sector organisations, with a specific focus on the social, economic and political impacts they can have on their constituencies. A digital transformation that implies the redesign of the tools and methods used in the machinery of government and public sector at large will require a significant change in the institutional frameworks that regulate and help coordinate the governance systems in which such changing processes are implemented.

In other words, it is necessary to understand the way in which governments and governance systems adapt (or fail to adapt) to the rapid changes that have swept through the digital world. This is instrumental to the need to deal with the social and political tensions that will necessarily result from the profound changes in regulation and organisational structures of the public sector, as well as to respond to the imbalances and contradictions brought by the transformation process itself.

This report of analysis of the state of the art is the result of the first phase of the research and provides an overview of the literature and policy review conducted in collaboration between JRC and the Consortium led by PPMI which is supporting the study, conceptualisation and empirical analysis of the complex phenomenon we labelled as Digital Government transformation.

By analysing almost 500 sources and policy developments in the EU28, this report set the basis for better understanding the intertwined forces that play a role in the digital transformation process, and their dynamics, building on contributions from different academic fields and discourses. In doing so it contributes to the development of a conceptual framework for assessing how ICT-enabled innovation can transform government at different levels, which will be tested and validated by using an experimental approach to case-study research.

The results of the study will finally inform future research and policy recommendations, especially in terms of new approaches to use data for the design and formulation of policies and the co-creation of public services, helping the Commission in proposing future research directions and policy implications for the EU beyond 2030.

Until then, I wish you a pleasant reading,

Gianluca Misuraca

DIGIGOV Scientific and Project Leader for JRC

[1] https://ec.europa.eu/isa2/actions/elise_en

Acknowledgements

This report is the outcome of the first phase of the JRC study on *"Exploring Digital Government Transformation in the EU: understanding public sector innovation in a data-driven society" (DIGIGOV)*, implemented by the research team of the consortium consisting of PPMI, Open Evidence, Rand Europe, Politecnico di Milano and Martel Innovate (Contract No. 936152 A08 LT), with the lead of Egidijus Barcevičius and the scientific direction of Cristiano Codagnone, in collaboration with the D-GOV Team of the JRC Digital Economy Unit (B6), under the scientific and technical coordination of Gianluca Misuraca.

Indeed this report is the result of a collaborative effort as the literature and policy review was conducted through various iterations by a multi-disciplinary team of researchers across Europe and benefited from valuable insights from the DIGIGOV group of recognised experts drawn from a diverse range of academic disciplines and practices, as well as representatives of relevant stakeholders and policy-makers that has been formed to supervise the research, contributing to its design, discussing preliminary findings and validate results.

The approach followed in this part of the research was in fact based mainly on systematic review of literature and analysis of the state of the art of policy and practice in the broad domain of public sector innovation, with specific regard to digital government transformation. The aim however was to inform the development of an original structured conceptual framework for assessing the impacts that can be generated by digital innovation in public sector organisations with a prospective orientation so to capture potential effects of emerging technologies and future developments, with a specific focus on data-driven models of governance and real time evidence-informed policy-making mechanisms.

We are therefore grateful to the about 50 participants in the "*1st Experts & Stakeholders Consultation Workshop on How ICT-enabled innovation can transform EU governance and policy-making"* that took place at JRC in Ispra on 13-14 May 2019, where the results of the literature and policy review have been presented, and a first proposal of a conceptual framework has been debated and further developed through focus groups.

A special mention goes in particular to Vincenzo Aquaro, Judie Attard, Tomasz Janowski, Marijn Janssen and Ines Mergel who provided written contribution to the review of the analysis of the state of the art, as well as colleagues of JRC who contributed to the research management, especially Eckhard Stoermer, Robin Smith, Colin van Noordt, Petra Scudo, Andrea Perego, Sofia Kekempanou and Paula Galnares, among others.

We are also clearly indebted to Natalia Aristimuño Pérez, Head of DIGIT Interoperability Unit and the ISA^2 Programme Manager Georges Lobo, as well as Francesco Pignatelli, ELISE Action Leader at JRC, since without their leadership and commitment this research would have not been possible.

Finally, we are very thankful to the Head of the Digital Economy Unit, Alessandro Annoni, for his guidance, and inspiration, being supportive of the approach proposed and contributing in shaping the research design and the discussion of results in view of the evolving policy orientations at EU and global level, setting the path from Digital government towards Digital Governance.

Authors

Egidijus Barcevičius
Research Director, PPMI

Guoda Cibaitė
Researcher, PPMI

Cristiano Codagnone
Partner, Open Evidence

Vaida Gineikytė
Research Manager, PPMI

Luka Klimavičiūtė
Researcher, PPMI

Giovanni Liva
Researcher, Open Evidence

Loreta Matulevič
Researcher, PPMI

Gianluca Misuraca
Senior Scientist, JRC

Irene Vanini
Researcher, Politecnico di Milano

Executive summary

This report presents a review of the state of the art of digital government research and policy in the European Union. It aims to inform the debate about the current dynamics and potential impacts of digital government. The research team applied a combined approach to collect the relevant sources, which consisted of a systematic literature review, a 'snowball' approach, and additional searches that aimed to add further detail on certain topics. The review of academic literature was complemented by a review of relevant non-academic publications, which is particularly important given that the study focusses on very recent technologies. Further, the team has also carried out a policy review to identify the key government strategies and exemplary initiatives that take advantage of the new technologies.

In this report we first introduce and debate the evolution of the eGovernment discourse (**Chapter 1**). The evolution occurred in four different phases. During the last twenty years this research field has moved from what is sometimes referred-to as eGovernment 1.0—the initial applications of World Wide Web technology in the public sector—to what recent articles call eGovernment 4.0—a transformed citizen-driven government that uses cognitive systems and advanced analytics. In this study we focus on the concept of digital government which covers different phases of open (2.0), smart (3.0) and transformed (4.0) government. Our review shows that alongside the current interest in the broad concept of Artificial Intelligence (AI), there are many national initiatives that draw less cutting-edge technologies. The process of change has been far from linear. The implementation of national policies is not necessarily aligned with the prevailing academic discourses.

Chapter 2 clarifies the terms used in this paper. It firstly focuses on the broad concept of digital transformation in the public sector and discusses what changes could be called 'transformative'. Despite an abundance of literature that uses this term, the transformative element of digital government has never been clearly defined. It is often assumed that an intelligent use of game-changing technologies such as AI will lead to transformation. The most far-reaching transformation cuts across all aspects of government, including internal processes, governance, policy, and service provision. The sources reviewed often associate transformation in government with technology-enabled public sector innovation as a precondition or an actual expression of such transformation. The second part of the chapter, therefore, provides a brief overview of the most recent technologies that drive these innovations.

In **Chapter 3** we review literature concerning the effects of digital transformation on governments. These effects can be relatively minor as, for example, AI being used to respond to simple inquiries and thus giving more time for civil servants to address more complex issues; or paramount, as re-definition of citizenship by drawing on blockchain technologies. We outline both positive effects, like enhanced political participation, and risks including privacy and personal data protection. The effects are discussed in relation to each aspect of government (internal processes, governance, policy, and service provision). We conclude by considering how these aspects changed regarding their: 1) efficiency and productivity; 2) effectiveness and quality; and 3) transparency, accountability, trust and legitimacy.

The literature review helped to identify two important trends. First, many texts discussing digital government transformation are normative, prospective or prescriptive, and there is limited empirical evidence that documents the envisaged impacts. Second, the majority of sources focus more on the positive effects; the introduction of digital innovations is often framed as a positive development in itself, while the lack of innovation is seen as an important problem.

In **Chapter 4** we focus on the drivers, barriers and preconditions for successful digital government transformation. We found that the majority of sources point to similar types of drivers that characterised the first wave of eGovernment literature. On the demand side, economic drivers feature prominently, as the potential efficiency gains are indeed of high importance to the public sector and to the taxpayers. On the supply side, the rapid technological developments and diffusion of electronic devices are identified as important drivers, even though they are not considered sufficient to transform governments on their own. Lastly, the political, social and cultural factors receive a lot of attention, with a particular focus on the expectations of citizens for more transparency and participation in policy-making.

The literature reviewed for this report confirmed that the barriers and preconditions for successful digital government transformation are complex and often not related to ICTs. In fact, the introduction of new technologies by governments is always mediated by organisational, institutional, legal, ethical and social barriers. Digital technologies may transform virtually every process, system and structure of government, resulting in redefinition of responsibilities and work routines of public officials. Nevertheless, they also create issues and trade-offs that merit careful consideration and preparation before a full-blown change is introduced.

Chapter 5 provides a summary review of strategies and initiatives that governments in the EU are using in order to foster or manage the transformational change or indeed bring it under control. We identified a number of strategies of different form and scope. A feeling exists among governments that AI (in the broad sense) will have a major impact on the employment, economy, welfare, competitiveness, and power structures within and among countries, and thus they are directing resources to both the research on AI as well as developing and adopting AI-based applications. A variety of pilot initiatives have been started, many of which take place in cities and regions, because smaller scale, agility and open mindedness of the leaders often allows them to move first and test opportunities offered by the new technologies. A significant policy debate also concerns the ethical, privacy and fairness-related issues. The policy approaches to tackle them are only emerging, with an important role being played by the EU.

Overall, the analysis of the state of the art conducted revealed many sources that appear overly optimistic with regard to digital government transformation, while empirical evidence to show the real and more varied effects is lacking. Such attitude has already been visible in research on eGovernment 1.0 and is now being repeated. We therefore caution that digital government transformation should be researched empirically and with a due differentiation between evidence and expectation.

Building on the analysis of the state of the art conducted by reviewing scientific and grey literature, as well as integrating insights from the policy review of EU Member States, in **Chapter 6** we finally outline a selected number of what we call "policy and research pointers" which are aimed to facilitate ICT-enabled transformation of government through the application of innovative approaches to data governance and digital technologies.

These are anticipated indications of some of the policy and research recommendations that will be elaborated further in the next phases of the research. Clearly the goal is not to be exhaustive, rather be thought-provoking and start promoting the debate on future Digital Government transformation strategies and policy developments at EU and Member States level.

For instance, one of the key areas that we flag is related to employment in the public sector. We found very few sources addressing task routinisation and the impacts of AI on jobs and skills in government. This includes the lack of debate in the eGovernment literature on several policy challenges that are crucial for the "governance of AI", such as the effects of AI and machine learning on, for example, reinforcing inequality and discrimination.

Another important element concerns the need of devising a regulatory framework that remove barriers to data flows, creating frameworks and infrastructures for interoperability and data sharing between the public and private sectors so to build a true European data ecosystem. At the same time it is crucial to understand better the dynamics of platformisation in government, in order to reap the benefits while also avoiding monopolistic or oligopolistic outcomes. This entails exploring new "modes of regulation" to address the implications of digital government transformation on the combination of institutional, normative, cultural, and regulatory components that ensure the functioning of the economy and may alter the very social fabric of our societies.

As a matter of fact the process of digital transformation unfolds in twists and turns, through changing hypes and discourses, via different projects and applications, and is subject to both incremental change and radical innovation. In many EU countries new and innovative technological initiatives coexist with old ones. Thus building human capacity and creating a culture of digital transformation, so to exploit the potential of predictive analytics, data-driven modelling and simulation tools among others, requires also that the vocabulary and methods of complexity theory and analysis are applied to digital government transformation.

The "decalogue" of pointers serves also to inform the conceptualisation and empirical component of the research which will further discuss some of the issues raised through theoretical and empirical analysis. The ten policy and research pointers are in fact instrumental to raise the political debate on the setting up of the Digital Europe Programme and its implementation both at European and national level, including the implications digital government transformation has on regional and local government and society at large.

1 Introduction

This report provides an overview of the findings of the literature review on the most recent developments of digital government research. In this chapter, an introductory account of the evolution of digital government discourse is presented in Section 1.1. Section 1.2 then describes the methodological approach followed, explaining all the steps taken for literature review and providing information on the research questions, the search strings, and a summary of the sources used. It also explains the scope, limitations, and the narrative strategy adopted to summarise the results. Finally, Section 1.3 outlines the structure of this report.

1.1 Development of the digital government discourse

The stereotypical image of a government is of a slow-moving bureaucracy, unwilling or unable to change and years behind the private sector in its use of new technology and new business models. However, the past several decades have been marked by developments challenging this view.

The application of Information and Communication Technologies (ICTs) in and by the governments has become the object of a large research body on the various aspects of their **digital transformation**. The phenomenon has been investigated both by academics as well as international organisations, such as the OECD, the UN, the World Bank and the European Commission (including through funding H2020 research projects on eGovernment and related fields such as for instance, in the area of ICTs for governance and policy modelling[2]).

Digital government transformation has been broadly defined as the process of implementing ICT-enabled government innovations while transforming the organisational structures, documents and the way services are provided[3], as well as the overall policy and governance systems. Digital government relies on the use and reuse of data and analytics to simplify transactions for the citizens, businesses, as well as government agencies. It creates information from data to support and enhance the decision making; it fosters the creation of new, collaborative and more efficient service delivery models[4]. Such transformation reshapes both, the internal processes and service models, as well as relationship between various levels of government and other social and political actors. It may foster effectiveness and efficiency, and lead to outcomes, such as transparency and openness, cost savings, better governance and, eventually, better quality of life for citizens[5]. Nevertheless, as a research field, digital government is in constant evolution[6]. The terms such as digital transformation, innovation, eGovernment have been used in a variety of ways and have evolved over time.

In the late 1990s and early 2000s, a lot of research focused on "eGovernment", characterised by the provision of online services and setting up of government websites and IT systems within public administrations. It is also sometimes referred to as e-Government 1.0—the initial applications of World Wide Web technology in the public sector replacing paper transactions. It aimed at internal process innovation to create a government which works effectively and efficiently. To achieve this, public organisations started investing into ICTs, but the mode of operation itself remained mostly the same; only the medium changed.

In the second half of the 2000s, the discourse shifted to eGovernment 2.0, also sometimes referred to as "open" government, also covered under the concept of "eGovernance". It went hand in hand with Web 2.0 collaborative technologies and aimed at creating an open-source platform in which government, citizens, and innovative companies could interact. It was mostly an external process (governance) innovation, aimed at increasing participation, collaboration and transparency in two-sided exchanges between governments and the public. The government opened-up for bilateral interaction and gained a new role as a provider of open data, web services, and platforms as an infrastructure[7].

---

2 European Commission. (2019). Projects about eGovernment. *European Commission*. Retrieved from https://ec.europa.eu/digital-single-market/en/projects/75991/3520?page=1 and https://cordis.europa.eu/programme/rcn/13624/en

3 Charalabidis, Y., Sarantis, D., & Askounis, D. (2009). Knowledge-driven project management in government transformation. In *Handbook of Research on ICT-Enabled Transformational Government: A Global Perspective* (pp. 213-239). IGI Global.

4 Williams, M., & Valayer, C. (2018). Digital Government Benchmark Study on Digital Government Transformation. *DG Joint Research Centre, European Commission*.

5 Ibid.

6 Alcaide–Muñoz, L., Rodríguez–Bolívar, M. P. et al. (2017). Analysing the scientific evolution of e-Government using a science mapping approach. *Government Information Quarterly* 34, 545–555.

7 Chun, S., Shulman, S., Sandoval, R., & Hovy, E. (2010). Government 2.0: Making connections between citizens, data and government. *Information Polity*, 15(1, 2), 1-9.

More recently, since mid-2010s the literature on ICT-enabled innovations in the public sector speaks about eGovernment 3.0: the "smart" or "intelligent" government[8], powered by innovations related to open and big data, administrative and business process management, Internet of Things (IoT) and blockchain. eGovernment 3.0 was assumed not only to work well and be open to people, but also *think* – with the use of data and artificial intelligence – on better ways to make decisions, solve societal problems, optimise resources and boost citizen well-being and participation. It was also about policy innovation: improving sustainability, affordability and appropriateness of policies[9].

Finally, the most recent articles also introduce the concept of eGovernment 4.0 – a transformed and citizen-driven government, which adapts itself to the needs and expectations of citizens, businesses, non-profit organisations, and other stakeholders, and creates relations and exchanges that are personalised, interactive, and easy to access[10]. The United Nations increasingly sees digital government[11] and specifically eGovernment 4.0[12] as a tool for building effective, inclusive and accountable institutions to support policy making and service delivery for the sustainable development goals (SDGs)[13].

Nonetheless, it must be stressed that the apparent linearity of the account above is a conceptual simplification[14]. In practice, despite of the emerging interest in Artificial Intelligence (AI) and related technologies, as of early 2019, many national Digital Government programmes, contain many priorities and initiatives grounded in what the academic sources would call eGovernment 1.0 or og second generation (or 2.0). The process by which governments have moved towards digitalisation from the late 1990s has been far from linear and the implementation is not necessarily aligned with the academic discourses.

For this reason, **the concept of digital government, although used in various ways by different authors, is intended in our analysis to cover open (2.0), smart (3.0) and transformed (4.0) government** (see the figure below). Digital government requires innovations in all areas: internal processes, governance, service delivery and policies. This way of understanding the digital government is in line with the definition provided by the OECD, according to which digital government refers to the use of digital technologies, as an integrated part of governments' modernisation strategies, to create public value. It relies on a digital government ecosystem comprised of government actors, non-governmental organisations, businesses, citizens' associations and individuals which supports the production of and access to data, services and content through interactions with the government[15].

This definition is applied further in the review of literature and the analysis of the state of the art conducted in this report and it will set the rationale for the next phases of the DIGIGOV research, underpinning the conceptual framework under development and being the basis for the empirical work and case study research.

8 Valle-Cruz, D., & Sandoval-Almazán, R. (2014, June). E-gov 4.0: a literature review towards the new government. In Proceedings of the 15th Annual International Conference on Digital Government Research (pp. 333-334). ACM.

9 Ojo, A., & Millard, J. (Eds.). (2017). Government 3.0–Next Generation Government Technology Infrastructure and Services: Roadmaps, Enabling Technologies & Challenges (Vol. 32). Springer.

10 Viderity. (2018). *The Future of Digital Government*. Retrieved from http://viderity.com/2018/10/09/the-future-of-digital-government/

11 United Nations (n/a), "Digital Government". Public Institutions and Digital Government, Department of Economic and Social Affairs. Retrieved from: https://publicadministration.un.org/en/ict4d

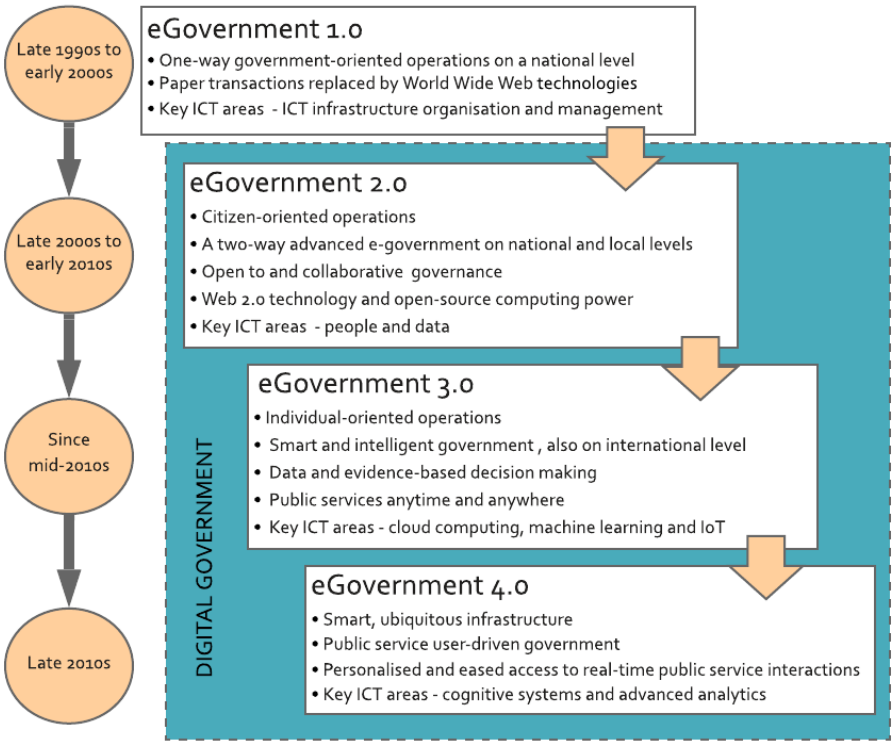
12 Novero, M. (2019), "Beyond digital government: government, governance and digital transformation in the SDG era". E-Government, Digital Cooperation and the Sustainable Development Goals (SDGs). In preparation of the United Nations E-Government Survey 2020. Expert Group Meeting, 1-2 April 2019, New York, NY 10017.

13 United Nations (2018). Resolution adopted by the General Assembly on 26 November 2018 (A/73/L.20 and A/73/L.20/Add.1).

14 Codagnone, C., Misuraca, G., & Savoldelli, A., & Lupiáñez-Villanueva, F. (2015). Institutional isomorphism, policy networks, and the analytical depreciation of measurement indicators: The case of the EU e-Government benchmarking. *Telecommunications Policy*, 39(3-4), 305-319.

15 Organisation for Economic Co-operation and Development, OECD. (2014). Recommendation of the Council on Digital Government Strategies.

FIGURE 1. EVOLUTION OF EGOVERNMENT DISCOURSE



Source: authors' elaboration

1.2 Methodology of the literature review

The literature review aimed to answer the following questions:

- How did the literature on the topic develop in the past decade, especially what concerns the conceptual transition from eGovernment (and its versions 1.0, 2.0, etc.) towards Digital Government? (*Chapter 2*)
- Based on the answers to the previous question and/or on other parameters, what typologies/taxonomies have been developed in the literature to describe the types of innovations and types of change that they are related to? How to identify transformative innovations? (*Chapter 2*)
- What are the effects of Digital Government innovations? What typologies/taxonomies have been developed in the literature to describe them? (*covered in Chapter 3*)
- What are the drivers and objectives leading to the introduction of Digital Government innovations? (*Chapter 4*)
- Which are the barriers or condition of success at the implementation level? (*Chapter 4*)

Answers to these questions, provided further in this report, summarise the relevant findings on digital government transformation across several disciplines. Our account includes the academic studies that explored the ways in which digital technologies and other factors transform the public sector in terms of service delivery, governance processes and policy-making. The review also considers the literature that addresses emerging priorities in the field of public sector innovation and the evolving nature of digital government transformation.

To carry out the review of the state of the art, we conducted extensive research of recent publications to identify and define the different dimensions of digital innovations in governments, their potential impacts, as well as the main technological trends, antecedents, drivers, and barriers.

To this end we applied a combined approach, consisting of several steps:

- The first and core step consisted of a systematic literature review. This included a review of literature published in academic journals using a set of pre-defined research strings. This was complemented by desk research in order to avoid omitting obvious sources either unintentionally or on the basis of an unwitting oversight in the search logic of the search syntax used in the databases.
- Given the variety of concepts and themes covered in this study, both more generic (e.g. digital transformation) and more specific (e.g. particular technologies), we collected additional sources by using targeted search and a "snowball" approach. This constituted the second phase of our literature review.
- At both phases (systematic and targeted), the review of academic literature was complemented by desk research to gather relevant non-academic publications (the "grey" sources), including reports by international organisations, NGOs, private consultancy companies and other authors. This was especially important given that academic time to publication may result in a couple of years lag, while our research focuses on very recent technological trends.

For the systematic part of the literature review, we conducted a preliminary exploratory search of references and a consecutive screening of the most relevant articles on the basis of a number of **keywords** that stem from the research questions presented above. Specifically, we included the following search terms:

> *eGovernment, digital government, digital governance, digital transformation, smart government, public sector innovation, open government, eDemocracy, service delivery, public service, governance, policy-making, policy-cycle, artificial intelligence, AI, automation, blockchain, machine learning, big data, internet of things, open API, algorithm, predictive analytics, modelling, data use, data re-use, data-driven, interoperability, geolocation, geospatial data, online platforms, ICT-enabled participation, citizens engagement, drivers, barriers, impact, technology, efficiency, effectiveness, inclusiveness, privacy*

We constructed Boolean search strings: the combination of keywords and Boolean operators (e.g. "and", "or", "not") that allow us to focus the query and narrow the search to the specific area of interest. Both the search teams and the inclusion/ exclusion criteria were piloted to ensure an optimal calibration. The table below outlines the search strings used in this first phase of the review.

TABLE 1. THE INITIAL SEARCH STRINGS

#	SEARCH STRINGS
1	(eGovernment OR Digital Government OR Digital Governance OR Smart Government OR Open Government) AND (service delivery OR public service OR governance OR policy-making OR policy-cycle) AND (artificial intelligence OR AI OR automation OR blockchain OR machine learning OR big data OR internet of things OR open API OR algorithm OR predictive analytics OR modelling) AND (impact OR effectiveness OR efficiency)
2	(eGovernment OR Digital Government OR Digital Governance OR Smart Government OR Open Government) AND (service delivery OR public service OR governance OR policy-making OR policy-cycle) AND (artificial intelligence OR AI OR automation OR blockchain OR machine learning OR big data OR internet of things OR open API OR algorithm OR predictive analytics OR modelling OR online platform) AND (e-Democracy OR participation OR citizens engagement)
3	(eGovernment OR Digital Government OR Digital Governance OR Smart Government OR Open Government) AND (service delivery OR public service OR governance OR policy-making OR policy-cycle) AND (artificial intelligence OR AI OR automation OR blockchain OR machine learning OR big data OR internet of things OR open API OR algorithm OR predictive analytics OR modelling OR online platform) AND (geolocation OR geospatial data OR location data)

In parallel, the same search strings were applied for the search of **non-academic/grey literature**, conducted using the general-purpose Google search engine.

Meanwhile, for the second phase – the targeted/snowball search – we used a variety keywords specific to the explored questions, technologies and functions of government. We constructed the search strings incrementally, with different sub-strings responsible for different aspects of the search (e.g., *impacts* AND *artificial intelligence* AND *policy making,* and so on).

We used a set of **inclusion and exclusion criteria** to define the thematic scope of literature to be reviewed. The literature that focused exclusively on eGovernment 1.0 was not included in the review at the first stage. However, in some cases, specific articles were used instrumentally to illustrate the development of the research field. We targeted publications from various disciplines, including public administration, political science, economics and sociology. Given the focus of this study on the new technologies, we also found pertinent articles in sources related to computer science and engineering. We included these sources only when they contained some non-technical considerations and policy implications that were relevant for the analysis.

We mostly included studies published in the past ten years (i.e. since 2009). However, we allowed for some exceptions due to the relevance of some articles published more than ten years ago. The inclusion criteria concerning the type and methodological design of the studies were defined broadly so as to include any relevant publication type and source on the issues of interest. Two reviewers independently identified potentially eligible records through title and abstract screening and for selecting studies for final inclusion through full text screening.

In the systematic search, we identified 216 academic articles and then, after applying the exclusion criteria to the titles and abstracts, the number of items was reduced to 112. Then we conducted a more detailed screening by reading full texts and we finally selected 58 academic articles. In parallel, the review of grey literature resulted into the selection of 96 items. These 154 articles were used as an intermediate output. The snowballing/targeted search, conducted by several researchers in parallel, added 168 academic articles and 155 items of grey literature. The total list of reviewed literature therefore includes 477 items. The synthetic review of all the sources retrieved fed into the consistent **analytical narrative** focusing on the main questions listed above, and providing the insights of the authors into the reviewed literature. It is presented in the following chapters of this report.

The methodology applied for the policy review is presented in more detail in Chapter 5.

1.3 Structure and contents

The remainder of this document is structured as follows. Chapter 2 analyses conceptualisations and definitions of the digital government transformation, as they are discussed in the reviewed literature. As part of this analysis we also review most transformative and emerging technologies. Chapter 3 reports on the effects of the newest and more transformative technologies as they emerge from the reviewed sources; the chapter is organised along the four types of innovations identified in Chapter 2 (process innovation, governance innovation, policy innovation, and service innovation). Chapter 4, looks into the drivers and barriers of transformation. Chapter 5 presents a summary of the policy review carried out as part of the broader study. Finally, Chapter 6 introduces the policy and research pointers. These are anticipated indications of some of the policy and research recommendations that will be elaborated further in the next phases of the research which are also instrumental to the political debate on the setting up of the Digital Europe Programme and its implementation both at European and national level, including the implications Digital Government transformation has on regional and local government and the society at large.

2 Digital government transformation

Despite significant interest in digital government transformation in the past years, the definition of what is meant by *transformation* remains varied. We start this section with a thorough overview of the existing eGovernment benchmarks and maturity models to illustrate how the understanding of digital transformation has changed over time. In the second section, we focus more specifically on the broad and fluid concept of transformation, how to identify it, and what changes it should bring to the public sector. Further, building on the reviewed literature, we look into the ICT-enabled innovations in the public sector and their main characteristics. Finally, we overview the most recent and most 'hyped' technologies that are expected to transform governments today, including examples of their applications in the public sector.

2.1 From e-government to digital government: maturity models, benchmarking and definitions

With the growing interest in the digitalisation in public sector in the beginning of the 21st century, a variety of early eGovernment stage models were suggested by international organisations, consulting firms, think tanks and individual researchers. This resulted in a large number of different frameworks, using different perspectives and metaphors.

These models generally assumed that there is an evolution from "simple" to more "complex" forms of e-government, which can be distinguished along a number of dimensions such as technology, organisational form, or type of exchanges between citizens and government. Most models included several stages (concerning accessibility, interaction, transaction and integration) as the phases that governments go through in their digital transformation.

For example, in 2000 the Gartner Group presented a Four Phases of e-Government Model to measure eGovernment initiatives progress and design a road map to constituency service achievement. The first stage was titled presence – when information is provided through a website in passive nature. Second stage was interaction, where basic interactions are offered between citizen/business and government in forms of e-mail contact and interactive feedback forms. Third stage concerned transactions, such as tax payment, license renewals and applying for contract procurement bids. Transformation was the highest stage, in which technologies are mature enough to bring changes that reinvent government's existing process and functions. These transform systems as whole to eGovernance and add value[16].

In 2001, PwC published its five-stage model[17] (Information, Two-way communication, Transaction, Integration, Political participation), largely overlapping with the Gartner Group model. Layne and Lee[18] then developed a very similar and widely applied model of four development changes, involving cataloguing, transactions, vertical integration and horizontal integration. Many similar publications followed the same approach, with a slightly different wording[19]. All of them, nonetheless, focused mostly on eGovernment 1.0, and some features of what is defined eGovernment 2.0 were basically seen as the final stage.

Later (i.e., in the literature published from 2009 onwards – the target period of this review), catching up with the developments of Government 2.0., the focus of maturity models and benchmarks gradually shifted from e-government towards "digital", "smart" or "intelligent" government and governance.

Nonetheless, most of the frameworks for ICT-enabled government transformation published from 2009 to around 2015 have mostly focused on eGovernment rather than digital government (although often these two terms were used interchangeably). For example:

---

16 Baum, C., & Di Maio, A. (2000). Gartner's Four Phases of EGovernment Model. *Gartner*. Retrieved from https://www.gartner.com/doc/317292/gartners-phases-egovernment-model

17 Hiller, J. S., & Bélanger, F. (2001). Privacy strategies for electronic government. *PwC Endowment for the Business of Government*.

18 Layne, K., & Lee, J. (2001). Developing Fully Functional E-Government: A Four Stage Model. *Government Information Quarterly*, 18(2), 12–136.

19 Deloitte Consulting & Deloitte Touche. (2001). *At the Dawn of eGovernment. The Citizen as Customer*; Moon, M. Jae. (2002). The Evolution of E-Government Among Municipalities: Rhetoric or reality? *Public Administration Review* 62(4), 424-433; Hiller, J. S., & Bélanger, F. (2001).

- In 2010, Lee[20] published a comparative synthesis of 12 models developed between 2000 and 2006 and produced own synthetic framework of five stages of eGovernment development. It focused on the dimensions of citizen/service and operation/ technology, and identified five stages: presenting, assimilating, reforming, morphing, and e-governance. Namely e-governance was considered as the main goal and the last stage, defined by citizen involvement in decision making and use of ICTs in process management.
- In 2011, Valdes et al. published the eGovernment Maturity Model (eGov-MM) focusing on four domains: e-government strategy, IT governance, process management, and organisation and people. Based on government's performance in each domain, they were ascribed a maturity level: Initial, Developing, Defined, Managed or Optimising. The highest level meant that the procedures in each domain have reached the level of best practices and have been optimised through the use of ICT, allowing it to work in an integrated manner with other domains.
- The UN biannually publishes its eGovernment development index (EGDI). The index is based on the UN survey. It highlights three dimensions: (i) the scope and quality of online services quantified as the Online Service Index (OSI); (ii) the status of the development of telecommunication infrastructure or the Telecommunication Infrastructure Index (TII); and (iii) the inherent human capital or the Human Capital Index (HCI). High EGDI level indicates high scores on every dimension. As EGDI's scope is global, the index has a very broad scale, and EU countries tend to be at the top, as compared to other regions.
- Capgemini has been producing the eGovernment Benchmark since 2000s. The latest versions of the benchmark assess EU countries based on four dimensions:
- User centricity — the extent to which a service is provided online, its mobile friendliness and its usability.
- Transparency — the extent to which governments are transparent about the process of service delivery, the responsibilities and performance of public organisations and the personal data processed in public services.
- Cross-border mobility — the extent to which users of public services from another European country can use the online services.
- Key enablers — the extent to which technical and organisational pre-conditions for eGovernment service provision are in place.
- The most recent issue of the eGovernment Benchmark provides an additional comparison of countries related to their eGovernment performance. Based on the dimensions of penetration and digitisation, the countries are assigned to one of the four categories: non-consolidated e-government, unexploited e-government, expandable e-government or fruitful e-government. The countries that have achieved the highest stage feature both solid supply of digital services as well as sufficient number of users benefitting from these online services[21].

Compared to their predecessors published in the first decade of the 21st century (which mainly focused on technology in government, electronic government and electronic governance), some of these models include new important aspects, such as user-centricity. Nonetheless, their main focus remained the more traditional notion of e-government (as ICT-enabled transactional service-oriented innovations). The usability of these models in the EU contexts has decreased over the years, not only because they are outdated for a number of digitally advanced countries, but also because of their failure to adequately explain the reality of e-government evolution at different stages. It is not necessarily linear, and authorities, for example, tend to adopt certain e-government features at a later stage even if features of an earlier stage are not adopted at all[22].

Since around 2015, models focusing specifically on what we define as Digital Government have started to emerge. They provide a new look at the dimensions for the transformation in the public sector and aim to foresee the developments beyond what is traditionally understood as eGovernment. The literature increasingly

[20] Lee, J. (2010). 10 year retrospect on stage models of e-Government: A qualitative meta-synthesis. *Government Information Quarterly*, 27(3), 220-230.

[21] Capgemini, Sogeti, IDC, & Politecnico di Milano. (2018). *eGovernment Benchmark 2018. Securing eGovernment for all*.

[22] Rooks, G., Matzat, U., & Sadowski, B. (2017). An empirical test of stage models of e-government development: Evidence from Dutch municipalities. *The Information Society*, 33(4), 215-225.

views digital innovations as something more than their digital bits: technologies drive transformations that go deeper into the public organisations and their relationships with the public. For instance:

- In his article published in 2015, Janowski[23] suggested that Digital Government evolves through the stages of Digitization (Technology in Government), Transformation (Electronic Government), Engagement (Electronic Governance) and Contextualization (Policy-Driven Electronic Governance). Each stage can be explained by pressures on government and how digital innovation is applied to address such pressures. The highest stage denotes the case of policy-driven electronic governance, in which technology affects sectors and communities and leads to transformation which is both internal and external as well as context-specific.
- In 2015, Deloitte presented a digital maturity model, examining the extent to which digital technologies have transformed government's organisations' processes, talent engagement, and citizen service models. Based on five dimensions (strategy, leaderships, workforce development, user focus and culture), the maturity model classifies government organisations as early, developing or maturing[24]. The highest level here means that an organisation is mostly advanced towards the digital transformation.
- OECD, in its report on Digital Government Strategies for Transforming Public Services in the Welfare Areas[25] published in 2016, proposed a three-element path to digital transformation. These elements are digitalisation, e-government and digital government. This path proceeds from focus on efficiency and productivity, in which citizens are passive users, through focus on efficiency and productivity in delivering tailored services to individuals who participate in this process, to focus on openness, transparency, engagement with and trust in government, in which users' role is crucial.
- Finally,[26] in 2018 Gartner conducted a study on Digital Government Benchmark for the JRC, proposing a generic common framework to assess digital transformation of government. It uses several dimensions (drivers, service model, digital system, users, technology, leadership and key metrics) to determine five levels of digital government maturity: e-government, open government, data-centric government, fully transformed government, and smart government as the highest stage of maturity. Building on Gil-Garcia et al, 2014)[27] Smart government is referred to as relying on consolidated information systems and communication networks to develop innovative policies, business models, and technology to address the financial, environmental, and service challenges facing public sector organisations[28].

Most authors of the overviewed models use the notion of '**transformation'** to denote the transition of governments from one stage to another, although its meaning in this context changed over time. This brief overview illustrates how the scholars' understanding of the aims and directions of digital transformation in government evolved, with the final goal becoming increasingly ambitious: from fully integrated web presence (missing out on the issues of political participation and changes in decision-making[29]), to intelligent government in which technology has penetrated and changed all functions at all levels. Transformation is the central theme of this study. Further in this review, therefore, we focus on unpacking this term.

---

23 Janowski, T. (2015). Digital government evolution: From transformation to contextualization. *Government Information Quarterly*, 32(3), 221-236.

24 Eggers, W. D., & Bellman, J. (2015). The journey to government's digital transformation. *Deloitte*.

25 OECD. (2016). Comparative Studies Report: Digital Government Strategies for Transforming Public Services in the Welfare Areas. *OECD Comparative Study*.

26 Di Maio, A., & Howard, R. (2017). Introducing the Gartner Digital Government Maturity Model 2.0. *Gartner*. Retrieved from https://www.gartner.com/doc/3764382/introducing-gartner-digital-government-maturity

27 Gil-Garcia, J. R., Helbig, N., & Ojo, A. (2014). Being smart: Emerging technologies and innovation in the public sector. *Government Information Quarterly*, 31, I1-I8.

28 Williams, M., & Valayer, C. (2018). Digital Government Benchmark Study on Digital Government Transformation. *DG Joint Research Centre, European Commission*.

29 Baum & Di Maio, (2000)

2.2 What is transformation in the context of digital government?

Many of the reviewed sources do not define digital *transformation* explicitly[30]. Nonetheless, analysis of numerous articles on the topics allows to list the main features of this phenomenon.

The term 'transformation' is often used to denote a notable **change, modernisation effort or innovation**, introducing digital technologies in government's business processes, service delivery models and culture, restructuring how the government performs basic functions and governs. However, while some researchers rely on an assumption that transformation will happen through greater use of digital technologies[31], others argue that transformation will not result from "doing things incrementally better, but by doing things **fundamentally differently**"[32]. Therefore, an important element distinguishing transformation from gradual types of change is the **abandonment of analogue operating models** (e.g., manual, paper) in favour of the new digital systems[33]. In many cases, the literature relates digital government transformation to the application of **specific technologies** in government, such as blockchain[34], Internet of Things or artificial intelligence (see Section 2.4).

Digital transformation tends to be seen as a **process**. As illustrated with the overview of maturity models above, the literature often metaphorically compares it to other processes such as 'journey', moving through stages or 'maturing'[35] from the current situation to the higher levels of digitalisation. Transformation can also be seen specifically as the process of moving from traditional government through the initial forms of eGovernment towards the Digital Government[36], which entails introducing the necessary initiatives in making changes deeper in the provision of online services through e-government portals, into the broader business of government itself. The new, 'transformed', technology-based systems should not only be consumer-friendly, strategy-driven, and capable of providing a better experience for those interacting with the government, but, more importantly, should also improve the way the government systems operate.

Some papers apply very specific definitions of transformation in relation to other types of change in government, although it seems that the difference is mostly in the preferred choice of wording. For example, Janowski[37], in the article mentioned above, considered transformation as one of the stages in the Digital Government Evolution Model. Transformation, according to this definition, implies internal government transformation, but does not affect external relationships and is not context-specific (both of these aspects are covered by subsequent stages of engagement and contextualization). Most other authors, however, use a broader definition of transformation, as encompassing change on all these dimensions. Generally, the digital transformation can be defined as both, (1) transformation of **internal processes** and (2) as a transformation of the **relationships between governments and other social and political actors** (institutional transformation)[38], tailored to specific policy areas and needs – basically what Janowski calls contextualisation.

Finally, some authors suggest that the aspect of **public value** is central to evaluation of digital government transformation and related initiatives[39] . This concept covers outcomes, the means used to deliver them, trust and legitimacy, as well as addresses issues such as equity, ethos and accountability.

---

30 SAP. (2017), *Transforming Government for the Digital EraTo Improve Citizens' Lives*; Deloitte. (2018), *Blockchain in Public Sector: Transforming government services through exponential technologies*.

31 OECD Comparative Study (2016). Comparative Studies Report: Digital Government Strategies for Transforming Public Services in the Welfare Areas. *OECD.*

32 SAP. (2017), *Transforming Government for the Digital EraTo Improve Citizens' Lives.*

33 Eggers, W. D., & Bellman, J. (2015). Digital government transformation. The journey to government's digital future. *Deloitte University Press.*

34 Deloitte. (2018), *Blockchain in Public Sector: Transforming government services through exponential technologies.*

35 Ibid.

36 Vlahovic, N., & Vracic, T. (2015). An Overview of E-Government 3.0 Implementation. In *Encyclopedia of Information Science and Technology*, Third Edition (pp. 2700-2708). IGI Global.

37 Janowski, T. (2015). Digital government evolution: From transformation to contextualization. *Government Information Quarterly*, 32(3), 221-236.

38 Luna-Reyes, L. F., & Gil-Garcia, J. R. (2014). Digital government transformation and internet portals: The co-evolution of technology, organizations, and institutions. *Government information quarterly*, 31(4), 545-555.

39 Savoldelli, A., Misuraca, G., & Codagnone, C. (2013). Measuring the Public value of e-Government: The eGEP2. 0 model. *Electronic Journal of e-Government*, 11(1), 373-388; Luna-Reyes, L. F., Picazo-Vela, S. et al. (2016). Creating public value through digital government: lessons on inter-organizational collaboration and information technologies. In *2016 49th Hawaii International Conference on System Sciences (HICSS)* (pp. 2840-2849). IEEE.

Generating public value for citizens through government's services depends on the level of quality with which they are delivered, in terms of access, cost, fairness of provision and satisfaction levels. For example, digital services have the potential to empower citizens and broaden their engagement with governments[40]. By digitising, governments also can provide services that meet the evolving expectations of citizens and businesses, even in a period of tight budgets and complex challenges such as income inequality, geopolitical instability, and aging populations[41]. Increased trust in government – an important theme in digital government research[42] – is also expected to be fostered by digitalisation. These aspects, in turn, have the potential of increasing the **resilience** of the country's social and economic system, among other positive effects.

However, in sum, not that much conclusive empirical evidence exists that may justify the different definitions and documenting positive changes and the digital transformation itself[43]. On the contrary, the promised gains seem to not have been achieved yet[44]. At the same time, scholars also warn about the potential negative effects of digitalisation in the public sector. For example, poor usability of digital government services, preventing universal adoption, may create digital divide, and this is far from the democratic and egalitarian goals of eGovernment[45]; open data initiatives are related to the risk of violating privacy and possible misuse and misinterpretation of data[46], and so on. We will discuss both potentially positive and negative effects of digital transformations, as covered in the recent literature, in Chapter 3.

2.3 Innovations that transform governments

Academic and grey literature refers to digital transformation in a variety of ways. Meanwhile, the sources reviewed offer some useful conceptualisation concerning the **public sector innovations**[47] and their impacts on government. The literature offers several classifications, some of which can be applied to understand digital government transformation. To begin with, all innovations can be defined by several dichotomies.

- **Incremental innovations vs. disruptive innovations.** This dichotomy denotes the degree of novelty and change. The first type means incremental improvements of already existing products, processes or services (making them 'better'). The second type means introduction of completely new products, processes or services that replace the pre-existing ones (making them 'different')[48]. It is important to note that some authors further divide incremental ICT-enabled innovations in public sector into technical and organisational, while transformative innovations – into disruptive and radical, the latter being the highest level of change[49].
- **Top-down innovations vs. bottom-up innovations.** The distinction stems from the types of actors who initiate the process leading to innovations/changes. While 'the top' means governments or institutions higher up in the hierarchy within government, 'the bottom' denotes the society, business or public employees, civil servants and mid-level policy makers who act as change entrepreneurs[50].

---

40 Baig, A., Dua, A., & Riefberg, V. (2014). Putting citizens first: How to improve citizens' experience and satisfaction with government services. *McKinsey Center for Government*.

41 Corydon, B., Ganesan, V., & Lundqvist, M. (2016). Digital by default: A guide to transforming government. *McKinsey Center for Government*.

42 Alzahrani, L., Al-Karaghouli, W., & Weerakkody, V. (2017). Analysing the critical factors influencing trust in e-government adoption from citizens' perspective: A systematic review and a conceptual framework. *International Business Review*, 26(1), 164-175.

43 Luna-Reyes, L. F., & Gil-Garcia, J. R. (2014). Digital government transformation and internet portals: The co-evolution of technology, organizations, and institutions. *Government information quarterly*, 31(4), 545-555.

44 Misuraca, G., Savoldelli, A., & Codagnone, C. (2014). Evaluating e-government: A comprehensive methodological framework to assess policy impacts. In *Government e-Strategic Planning and Management* (pp. 25-47). Springer, New York, NY.

45 Stanziola, E., Espil, M. M. et al. (2006). Hidden negative social effects of poor e-government services design. In *International Conference on Electronic Government* (pp. 150-161). Springer, Berlin, Heidelberg.

46 Zuiderwijk, A., & Janssen, M. (2014). Open data policies, their implementation and impact: A framework for comparison. *Government Information Quarterly*, 31(1), 17-29.

47 Bertot, J. C., Estevez, E., & Janowski, T. (2016). Digital public service innovation: Framework proposal. In *Proceedings of the 9th International Conference on Theory and Practice of Electronic Governance* (pp. 113-122). ACM.

48 Hacklin, F., Raurich, V., & Marxt, C. (2004, October). How incremental innovation becomes disruptive: the case of technology convergence. In *2004 IEEE International Engineering Management* Conference (IEEE Cat. No. 04CH37574) (Vol. 1, pp. 32-36). IEEE.

49 Misuraca, G., & Viscusi, G. (2014, October). Digital governance in the public sector: challenging the policy-maker's innovation dilemma. In *Proceedings of the 8th International Conference on Theory and Practice of Electronic Governance* (pp. 146-154). ACM; Misuraca, G., & Viscusi, G. (2015). Shaping public sector innovation theory: an interpretative framework for ICT-enabled governance innovation. Electronic Commerce Research, 15(3), 303-322.; Misuraca, G., Pasi, G., & Brancati, C. U. (2017). ICT-enabled social innovation. Evidence and prospective. Joint Research Centre, European Commission.

50 Ibid.

Various studies on technological, social, organisational and other types of innovation emphasise that depending on whether an innovation is incremental or disruptive, and top-down or bottom up can significantly affect its development[51], success[52], scaling process[53] and transformative effects[54], among other aspects.

Further, most classifications of innovation in public sector are based on the area in which the innovation is introduced. Building on the broader innovation literature, various authors outline a number of such types of innovation, which we summarise in the table below. Generally, government innovations enabled by digital technologies can be process, policy or service innovations.

TABLE 2. TYPES OF DIGITAL INNOVATIONS IN GOVERNMENT

Type of innovation	Focus	Goal	Incremental	Disruptive	Authors
Internal process (administrative, system, organisational) innovation	Improvement of quality and efficiency of internal and external processes. Creation of new organisational forms, the introduction of new management methods and techniques, new working methods.	To generate a notable increase in productivity or to drive down costs significantly.	Incremental improvements in the process, optimisation, taking the 'waste' out	Radically new processes introduced	Walker, 2014; Damanpour, and Schneider, 2009; Bessant et al, 2010; EY, 2017; Bertot et al, 2016; de Vries et al, 2016
External process (governance) innovation	Creation of new governance methods, involvement of new actors, new patterns of co-creation and interaction.	To address specific societal problems in a collaborative way, involving stakeholders to achieve better policy outcomes.	Incremental changes in governance means and methods	Introduction of completely new governance forms and actors	de Vries et al, 2016; Bertot et al, 2016
Policy innovation	Improvement in identifying the needs of constituents and shortening the time required to develop, test, implement and diffuse a policy.	To make timely decisions regarding policies that affect government employees and citizens.	Improved policies – e.g. at inputs or activities levels	Completely new policies introduced	EY, 2017; Bertot et al, 2016; de Vries et al, 2016
Service (or product) innovation	Creation of new public services or products or improvement of the existing ones.	To find new ways to offer and deliver services to citizens quickly in a manner that is easy to access, use and understand — and to do so in a cost-effectively.	Improved service/ product – faster, simpler, better quality, etc.	Completely new services/ products	Bessant et al, 2010; EY, 2017; Bertot et al, 2016; de Vries et al, 2016; Misuraca & Viscusi, 2014

Source: authors' elaboration

The object of this study concerns all the above-mentioned types of innovation, specifically enabled by **digital technologies**. As these develop and change rapidly, so do their application in government, triggering innovation in different areas, from internal processes to governance, policy and services. For this reason, in the following chapter we review the most relevant current and emerging technologies transforming governments today, depicting both the state of affairs in digital government research and the potential use and impact on governance from a policy and practice perspective.

[51] Saari, E., Lehtonen, M., & Toivonen, M. (2015). Making bottom-up and top-down processes meet in public innovation. *The Service Industries Journal*, 35(6), 325-344.

[52] Gobble, M. M. (2016). Defining disruptive innovation. *Research-Technology Management*, 59(4), 66-71; Neumeier, S. (2017). Social innovation in rural development: identifying the key factors of success. *The geographical journal*, 183(1), 34-46.

[53] Westley, F., & Antadze, N. (2010). Making a difference: Strategies for scaling social innovation for greater impact. *Innovation Journal*, 15(2), 2-19.

[54] Nagy, D., Schuessler, J., & Dubinsky, A. (2016). Defining and identifying disruptive innovations. *Industrial Marketing Management*, 57, 119-126.

2.4 Emerging technologies transforming governments

The application of digital innovations to government's processes, in terms of governance, policy and services reflect the general trends in technology, public administration and government-citizen relationship at a specific time[55]. Some frameworks, such as the Gartner's Hype Cycle (introduced in 1995), illustrate how the technological solutions are adopted by government organisations, from initial enthusiasm through a period of disillusionment to an eventual understanding of the technology's relevance and role in government, as well as its productive use[56]. The Hype Cycle has been applied by a number of scholars to explain digital innovation on government[57] and investigate specific digital government initiatives, such as the open government in the US[58], ICT-enabled modes of government-citizen interaction[59], eGovernment 2.0[60], and cloud computing in eGovernment[61], among others. The most recent (2018) edition of the Hype Cycle for digital government technology[62] refers to AI-based technologies, IoT and Blockchain, among others. Some recent studies focus largely on these technologies as game-changers for government and governance[63].

Further in this section we briefly present a review of most notable technologies associated with digital government transformation in the past years, which are assumed to support governments to:

- Understand citizens better for the design better policies and services;
- Find new solutions to policy challenges;
- Implement their everyday functions and provide services more effectively and efficiently;
- Engage with citizens, businesses and other external stakeholders in new ways to develop new policies, services, delivery models;
- Operate more transparently and accountably, leading to improved government legitimacy.

More specifically, we cover the digital technologies which have been the basis of the recent governance, policy and process innovations across the World and in the EU: **artificial intelligence (in the broad sense), predictive analytics, robotics and automation, IoT, geo-spatial data, blockchain and open government data**. In the following of this report we will focus specifically on these technologies in terms of the antecedents, effects, impacts and related challenges of public sector innovation and transformation.

It is important to stress here what will be developed further in Chapter 4. To enable the move from eGovernment to Digital Government Transformation, as presented in Section 2.1, the application of new emerging technologies is only the starting point but should not be considered in isolation from other factors, from their possible combination, and from their specific characteristics. **Full transformation most likely occur as combination of different technologies and innovations, as the value of digital transformation is less about the tools used in delivery and more about the way in which governments can now engage with their users to gather their insights and design responses to best address their needs, enabled by an increasing ubiquity of affordable personal technology and a wealth of data.**

---

55 Eggers, W. D., & Bellman, J. (2015). Digital government transformation. The journey to government's digital future. Deloitte University Press.

56 Linden, A., & Fenn, J. (2003). Understanding Gartner's hype cycles. Strategic Analysis Report Nº R-20-1971. *Gartner*.

57 Bannister, F., & Connolly, R. (2012). Forward to the past: Lessons for the future of e-government from the story so far. *Information Polity*, 17, 211-226.

58 Linders, D., Wilson, S. C., & Bertot, J. C. (2012). Open government as a vehicle for government transformation. In *Public Sector Transformation through E-Government* (pp. 20-35). Routledge.

59 Schellong, A. (2009). Citizen government interaction: the promise of the E-channel. In *ICTs, citizens and governance: after the hype* (pp. 13-20). IOS Press.

60 Boughzala, I., Janssen, M., & Assar, S. (2015). E-government 2.0: Back to reality, a 2.0 application to vet. In *Case Studies in e-Government 2.0* (pp. 1-14). Springer, Cham.

61 Dash, S., & Pani, S. K. (2016). E-Governance paradigm using cloud infrastructure: benefits and challenges. *Procedia Computer Science*, 85, 843-855.

62 Holgate, R. (2018). Hype Cycle for Digital Government Technology 2018. Gartner. Available at https://www.gartner.com/doc/3884179/hype-cycle-digital-government-technology

63 E.g. Engin, Z., & Treleaven, P. (2019). Algorithmic government: Automating public services and supporting civil servants in using data science technologies. The Computer Journal, 62(3), 448-460. Which mentions most of these technologies.

2.4.1 Artificial intelligence

Artificial intelligence (AI) is a generic, 'umbrella' term that refers to any machine or algorithm that is capable of observing its environment, learning and taking intelligent action based on the knowledge and experience gained. For computers to make useful decisions, they need at least two things: large amounts of relevant data and specific rules on how to use this data. This broad AI definition covers several technologies, including machine learning (algorithms whose performance improve as they are exposed to more data overtime[64]), deep learning, predictive analytics, computer vision and natural language processing, among others.

Although the term 'artificial intelligence' dates from as early as the 1950s, interest in it has intensified in the past decade, driven by unprecedented and continuously increasing amounts of data collected every day through Internet, social media, telecommunications, digital photos, platform economy and IoT (see Section 2.4.4). According to some estimates, in 2017, 2.5 quintillion bytes of data were generated every day. To illustrate how fast the data collection progresses, 90% of all the data in the World available by mid-2018 was generated in the previous two years[65]. While the public sector has been data-intensive by its very nature, these developments opened new opportunities for collecting, combining and processing all kinds of data as a key element driving digital government transformation, towards the 'intelligent government'[66]. Various scholars[67] started looking into what they call the datafication of government. Datafication refers to sensing and the subsequent collecting of all kinds of data in machine-readable data formats. Supported by the new technologies (e.g. IoT), datafication is rapidly becoming a mainstream activity of public organisations. The use of collected data is expected to improve decision- and policymaking especially with the use of AI.

AI, therefore, has also been receiving increasing interest from policy makers. The European Commission expects that AI can significantly improve the lives of EU citizens and bring major benefits to society and economy through better healthcare, more efficient public administration, safer transport, a more competitive industry and sustainable farming[68]. It has launched a number of policy initiatives with the aim to progress in this area, including the communication "Artificial Intelligence for Europe"[69], declaration of cooperation on AI[70], and coordinated action plan on the development of AI in the EU[71], among others. Similarly, OECD has been working on AI analysis and measurement. It has created a policy observatory, and has convened an expert group on AI – all of which are aimed at supporting applications of this technology, including in the public sector[72]. The UN has opened the UNICRI Centre for Artificial Intelligence and Robotics, with the mission to serve as an international resource on matters related to AI and robotics[73].

As a consequence, scholars and consultancy firms have an ever increasing interest in studying AI's application in governments, preconditions of this application (see Chapter 4) and its effects and impacts (see Chapter 3).

---

64 Annoni, A., et al. (2018). Artificial intelligence: A European perspective. *DG Joint Research Centre, European Commission.*

65 Marr, B. (2018). How Much Data Do We Create Every Day? The Mind-Blowing Stats Everyone Should Read. *Forbes.* Retrieved from https://www.forbes.com/sites/bernardmarr/2018/05/21/how-much-data-do-we-create-every-day-the-mind-blowing-stats-everyone-should-read/#485b13a560ba

66 Halaweh, M. (2018). Artificial Intelligence Government (Gov. 3.0): The UAE Leading Model. J*ournal of Artificial Intelligence Research*, 62, 269-272.

67 Janssen, M., Charalabidis, Y., & Krcmar, H. (2017). Open data, information processing and datification of government. In *Proceedings of the 50th Hawaii International Conference on System Sciences*; Marjanovic, O., & Cecez-Kecmanovic, D. (2017). Exploring the tension between transparency and datification effects of open government IS through the lens of Complex Adaptive Systems. *The Journal of Strategic Information Systems*, 26(3), 210-232.

68 European Commission. (2018). Factsheet: Artificial intelligence for Europe. *European Commission.* Retrieved from https://ec.europa.eu/digital-single-market/en/news/factsheet-artificial-intelligence-europe

69 European Commission (2018). Communication 'Artificial Intelligence for Europe' {SWD(2018) 137 final}

70 European Commission. (2018). EU Member States sign up to cooperate on Artificial Intelligence. *European Commission.* Retrieved from https://ec.europa.eu/digital-single-market/en/news/eu-member-states-sign-cooperate-artificial-intelligence

71 European Commission. (2018). Member States and Commission to work together to boost artificial intelligence „made in Europe". *European Commission.* Retrieved from https://ec.europa.eu/digital-single-market/en/news/member-states-and-commission-work-together-boost-artificial-intelligence-made-europe

72 OECD. (n.d.). OECD initiatives on AI. Retrieved from http://www.oecd.org/going-digital/ai/oecd-initiatives-on-ai.htm#policy-observatory

73 UNICRI. (n.d.). UNICRI Centre for Artificial Intelligence and Robotics. Retrieved from http://www.unicri.it/in_focus/on/UNICRI_Centre_Artificial_Robotics

According to a review by Wirtz et al. (2018), literature on AI in government falls under five broad categories: (1) AI government service, (2) working and social environment influenced by AI, (3) public order and law related to AI, (4) AI ethics and (5) AI government policy[74].

A number of recent studies have examined a variety of AI applications in public sector, from models to predict the award prices for public infrastructure projects[75] or the use of city big data as a policy tool for advancing the goals of urban development[76], to AI for medical diagnosis and treatment, to AI's capabilities to transform the government's workforce[77] and many other instances[78] discussed in the further chapters of this report.

Nonetheless, despite the increasing cases of use and evolving discussion on the dangers and benefits of the adoption of AI in the public sector, there is limited empirical evidence of the actual effects[79]. This is unsurprising given that the current AI practices/solutions in the public sector are in the early stages of process automation and predictive analytics[80]. For instance, Mehr[81] classified AI case studies in government into: answering questions, filling out and searching documents, routing requests, translation, and drafting documents – all rather basic tasks. Nevertheless, in further sections we will also present cases on the more sophisticated use of AI that are emerging and being already applied in the public sector.

2.4.2 Behavioural and predictive analytics

Predictive analytics is the process of using data mining, statistics and modelling to make predictions about the future. Along with many other tools, it basically lays at the crossroads of AI and big data: historical data defines a set of parameters, which machines then use to determine what behaviour should be expected in the future. In this sense it is the third phase of data analytics, after descriptive ('what happened?') and diagnostic ('why did it happen?') analytics.

Already widespread in the private sector, predictive analytics offer a range of possibilities for strengthening governments' capacity to manage complex socioeconomic issues. According to a recent report by Bright et al[82], the potential benefits of predictive analytics in government are threefold: it allows to optimise the deployment of scarce resources (e.g., staff spending time where it actually matters); it allows to deliver services to citizens faster and better; and, importantly, it provides the possibility for interventions to occur before problems develop, leading to both, improved outcomes and savings.

The existing cases of use of predictive analytics in governments – at least at an experimental stage – have already been numerous. The application areas vary from public safety (e.g., predicting crime[83]), education and public health[84] (e.g. predicting the spread of diseases), to housing, transportation[85], to defence[86] and fraud detection[87], among others.

---

74 Wirtz, B. W., Weyerer, J. C., & Geyer, C. (2018). Artificial Intelligence and the Public Sector—Applications and Challenges. *International Journal of Public Administration*, 1-20.

75 E.g. Chou, J. S., Lin, C. W. et al. (2015). Optimized artificial intelligence models for predicting project award price. *Automation in Construction*, 54, 106-115.

76 Pan, Y., Tian, Y. et al. (2016). Urban big data and the development of city intelligence. *Engineering*, 2(2), 171-178.

77 Sun, T. Q., & Medaglia, R. (2018). Mapping the challenges of Artificial Intelligence in the public sector: Evidence from public healthcare. *Government Information Quarterly*.

78 United Nations (2018), Technology and Innovation Report 2018. Harnessing Frontier Technologies for Sustainable Development. United Nations Conference on Trade and Development (UNCTAD).

79 Ibid.

80 Tinholt, D., Carrara, W., & van der Linden, N. (2017). Unleashing the potential of Artificial Intelligence in the Public Sector. *Capgemini Consulting*.

81 Mehr. H. (2017). Artificial intelligence for citizen services and government. *Harvard Kennedy School Ash Center for Democratic Governance and Innovation.*

82 Bright, J., Ganesh, B., Seidelin, C. & Vogl, T. (2019). *Data Science for Local Government*. Oxford Internet Institute, University of Oxford.

83 Tomar, L., Guicheney, W., Kyarisiima, H., & Zimani, T. (2016). Big Data in the public sector: Selected applications and lessons learned. Inter-American Development Bank.

84 Qureshi, B. (2014, September). Towards a digital ecosystem for predictive healthcare analytics. In Proceedings of the 6th International Conference on Management of Emergent Digital EcoSystems (pp. 34-41). ACM.

85 Gover, J. (2018). How to Do Data Analytics in Government. Government Technology. Retrieved from https://www.govtech.com/data/How-to-Do-Data-Analytics-in-Government.html

86 Booz Allen Hamilton Inc. (2017), Predictive Analytics Handbook for National Defense.

87 De Fremery, R. (2018), Big Data and Government: How the Public Sector Leverages Data Insights. Hortonworks. Retrieved from https://hortonworks.com/article/big-data-and-government-how-the-public-sector-leverages-data-insights/

Predictive analytics enable tailored interventions (e.g., personalised medicine) and targeted 'nudges' aimed at directing human behaviour (e.g. tax compliance or student attrition)[88]. More generally, it can also be applied in several stages of the policy cycle, moving it closer to the goal of data-driven decision making (see Section 3.3.).

Behavioural and predictive analytics also raise ethical concerns however. These include biases in the historical data, lack of clarity or transparency[89], privacy violations[90], unfairness or discrimination. Furthermore, often the key obstacle for using predictive analytics in public sector is insufficiency of appropriate, high quality data. According to reviewed authors, the necessary preconditions include systemised collection of data, data interoperability solutions[91], new skills to public servants[92], appropriate use of analytics in decision making[93], transparency, as well as specific rules for data protection[94].

2.4.3 Robotics and automation

AI also enables the automation of various aspects of government operations. Robotic process automation (RPA) is one of the most recent trends in digital government, growing in popularity as a way to rapidly automate time-consuming manual processes and services. RPA uses special software to automate routine clerical work, such as data entry into a system. It mimics actions of a person and interacts with applications in the same way that a human would. At the same time, it is expected to reduce human errors, cut operational costs, and allow the staff focus on more high-value tasks[95].

At its current stage, RPA technology is considered to be sufficiently developed, resilient, scalable and reliable to be used in large government organisations[96]. RPA is already being applied in central governments (for benefits calculations, tax calculations, anti-fraud checks, licensing applications processing), local governments (for permit applications, incident reporting, case management, and contract administration); policing (fixed penalty processing, intelligence reporting, crime reporting, firearms licence processing and replacing the need for officers to double key the same information into different systems), health (coding, diagnostics, discharge processing, outpatient clinic outcomes, cashing up) and education (managing admissions and enrolments, student timetabling and estates utilisation, student finance management, course assessment data handling, alumni database maintenance)[97], among other government functions[98].

RPA can be used to implement a variety of tasks. We might find social and conversational robots replacing traditional government service channels[99]. These include chat bots (software agents that focus on written/text language), conversational bots (focusing on spoken language and offering an alternative to telephone interactions), and intelligent agents (integrating chat and conversational bots into one system, like Apple's Siri or Google's Assistant). Such applications, according to some authors, could lead to significant cost savings and service improvements[100]. More specific applications are presented in the analysis of the effects of digital transformation in Chapter 3.

---

88 Gregor, S., & Lee-Archer, B. (2016). The digital nudge in social security administration. International Social Security Review, 69(3-4), 63-83.

89 Bright, J., Ganesh, B., Seidelin, C. & Vogl, T. (2019). Data Science for Local Government. Oxford Internet Institute, University of Oxford.

90 Ekowo, M., & Palmer, I. (2016). The Promise and Peril of Predictive Analytics in Higher Education: A Landscape Analysis. *New America - ERIC*.

91 Amarasingham, R., Patzer, R. E., Huesch, M., Nguyen, N. Q., & Xie, B. (2014). Implementing electronic health care predictive analytics: considerations and challenges. *Health Affairs*, 33(7), 1148-1154.

92 Sutcliffe, D. (2017). What are the barriers to big data analytics in local government? Oxford Internet Institute, The Policy and Internet Blog. Retrieved from http://blogs.oii.ox.ac.uk/policy/what-are-the-barriers-to-big-data-analytics-in-local-government/

93 Bright, J., Ganesh, B., Seidelin, C. & Vogl, T. (2019). Data Science for Local Government. Oxford Internet Institute, University of Oxford.

94 Mantelero, A. (2014). The future of consumer data protection in the EU Re-thinking the "notice and consent" paradigm in the new era of predictive analytics. *Computer Law & Security Review*, 30(6), 643-660.

95 Willmer, A., Duhan, J., & Gibson, L. (2017). The new machinery of government. Robotic Process Automation in the Public Sector. *Deloitte.*

96 UK Cabinet Office. (2018). Robots lend government a helping hand. *Civil Service* Quarterly. Retrieved from https://quarterly.blog.gov.uk/2018/03/28/robots-lend-government-a-helping-hand/

97 Willmer, A., Duhan, J., & Gibson, L. (2017). The new machinery of government. Robotic Process Automation in the Public Sector. *Deloitte.*

98 CGI. (2018). *Intelligent Automation Opportunities in the Federal Government*.

99 Pieterson, W., Ebbers, W., & Madsen, C. Ø. (2017, September). New channels, new possibilities: A typology and classification of social robots and their role in multi-channel public service delivery. In *International conference on Electronic Government* (pp. 47-59). Springer, Cham.

100 Engin, Z., & Treleaven, P. (2019). Algorithmic government: Automating public services and supporting civil servants in using data science technologies. *The Computer Journal*, 62(3), 448-460. Nielsen, J. A., Andersen, K. N., & Sigh, A. (2016). Robots conquering local government services: A case study of eldercare in Denmark. *Information Polity*, 21(2), 139-151.

Besides RPA, which denotes the use of software to automate robots with no physical presence, physical (humanoid and non-humanoid) robots are also being introduced in public service provision in some countries. The academic literature already explores the implications of these developments in the sectors such as healthcare and elderly care[101] [102](see more information in Section 3.4.1).

2.4.4 Internet of Things

IoT refers to the networking of physical objects through the use of embedded sensors, actuators, and other devices that collect and transmit information about real-time activity within the network[103]. Although not a completely new trend[104], IoT technologies are increasingly applied by governments in several broad domains (such as transportation, energy, smart cities, and defence[105]) as a powerful way of gathering and using data.

Analysts emphasise the potential of IoT to transform the public sector[106], by bringing together the major technical and business trends of mobility, automation and data analytics[107]. IoT devices generate huge amounts of data, which can be combined with data from other devices and systems to create new insights. IoT plays a role in what is often referred-to as smart or intelligent government and is among the key trends that governments need to follow in the near future[108].

To realise the potential benefits of greater application of IoT and use of generated data, governments have applied various policy measures. For example, the European Commission has adopted a set of policy actions to accelerate the take-up of IoT both in public and private sectors. These include the Alliance for Internet of Things Innovation (2015)[109], the Digital Single Market Strategy (2015)[110], the staff working document "Advancing the Internet of Things in Europe" (2016)[111] and the "European data economy" initiative (2017)[112]. In addition, the EU has been funding IoT research through the Horizon 2020 programme[113].

A number of authors argue that the potential benefits of IoT applications in the public sector include improved efficiency, effectiveness and flexibility of services; reduction of costs; citizen empowerment; improved government transparency; more efficient enforcement of regulations; improved planning and forecasting; and improved health and safety measures[114], among others.

---

101 Mettler, T., Sprenger, M., & Winter, R. (2017). Service robots in hospitals: new perspectives on niche evolution and technology affordances. *European Journal of Information Systems*, 26(5), 451-468

102 Körtner, T. (2016). Ethical challenges in the use of social service robots for elderly people. *Zeitschrift für Gerontologie und Geriatrie*, 49(4), 303-307.

103 ALE International. (2018). *The internet of things for government*.

104 For example, the state of Texas installed sensors along the Colorado River to track stream levels in an effort to identify and prevent potential flooding more than 20 years ago. See more at: Harbet, T. (2017). Practical Uses of the Internet of Things in Government Are Everywhere. *Government technology.* Retrieved from http://www.govtech.com/network/Practical-Uses-of-the-Internet-of-Things-in-Government-Are-Everywhere.html

105 Chatfield, A. T., & Reddick, C. G. (2018). A framework for Internet of Things-enabled smart government: A case of IoT cybersecurity policies and use cases in US federal government. *Government Information Quarterly*.

106 Brous, P., & Janssen, M. (2015, August). Advancing e-Government using the internet of things: a systematic review of benefits. In *International Conference on Electronic Government* (pp. 156-169). Springer, Cham.

107 Meyers, M., Niech, C., & Eggers, W. D. (2015). Anticipate, sense, and respond: connected government and the internet of things. *Deloitte University Press*.

108 Mellouli, S., Luna-Reyes, L. F., & Zhang, J. (2014). Smart government, citizen participation & open data. *Information Polity*, 19(1), 1-4.

109 European Commission. (2018). The Alliance for Internet of Things Innovation (AIOTI). *European Commission.* Retrieved from https://ec.europa.eu/digital-single-market/en/alliance-internet-things-innovation-aioti

110 European Commission. (2015). Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: A Digital Single Market Strategy for Europe COM(2015) 0192 final

111 European Commission. (2016). Staff Working Document: "Advancing the Internet of Things in Europe", accompanying the document "Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Digitising European Industry - Reaping the full benefits of a Digital Single Market COM(2016) 180

112 See more information at https://ec.europa.eu/digital-single-market/en/policies/building-european-data-economy

113 European Commission. (2018). The Internet of Things. *European Commission.* Retrieved from https://ec.europa.eu/digital-single-market/en/policies/internet-things

114 Brous, P., & Janssen, M. (2015). Advancing e-Government Using the Internet of Things: A Systematic Review of Benefits. Efthimios Tambouris; Marijn Janssen; Hans Jochen Scholl; Maria A. Wimmer; Konstantinos Tarabanis; Mila Gascó; Bram Klievink; Ida Lindgren; Peter Parycek. In *14th International Conference on Electronic Government*.

However, neither the preconditions nor impacts of IoT on e-governance have not been systematically investigated. Studies conducted in Europe[115] and the United States[116] have not yet found evidence of systematic adoption and use of the IoT across the government.

According to Chen et al[117], the studies of IoT lack "theory, technology architecture and standards that integrate the virtual world and the real physical world in a unified framework", especially in government context, although more recently there have been attempts to address the latter issue[118].

2.4.5 Geo-spatial and location data exploitation

Geospatial data is a particular type of data that provides geographic and location information of different data objects that are connected with a specific place or location, which can then be mapped[119]. It is a 'general-purpose' technology that is expected to unlock significant value across the economy[120]. When location data is coupled with other data and expertise, every point on the map can provide a historical and predictive perspective that can aid government in complex policymaking and better location-based service provision[121].

The collection and use of the geospatial data have been accelerated by the applications of IoT and geographical positioning technologies, AI and big data analytics, cloud computing, and wireless and broadband expansion, among others[122]. These allow for the digital exhaust of the geolocated data (e.g., from smartphones, credit card records, physical sensors), implementation of geospatial analytics and development of location-based services.

Insights from the geographically located data allow governments to pursue new models for delivering public services, better understand the challenges of diverse communities across the nation, and design more effective solutions – based on *where* the needs are. Geospatial analytics allow to make sense of the increased complexity, make the government more transparent, and look beyond borders to increase cooperation[123].

For these reasons, applications of geospatial data are becoming increasingly pertinent to the national governments in Europe[124] and beyond[125]. The UK, Germany and the Netherlands were placed among the top 5 world's geospatial-ready countries in 2018[126].

At the EU level, geospatial solutions have been developed within the framework of INSPIRE Directive (with the ISA² Working Group playing an important role). The European Commission's ELISE package of legal/policy, organisational, semantic and technical interoperability solutions is aimed at facilitating more efficient and effective digital cross-border or cross-sector interaction and data re-use. Examples of more specific applications of geo-spatial data are presented in the analysis of the effects of digital transformation in Chapter 3.

---

115 Wirtz, B. W., Weyerer, J. C., & Schichtel, F. T. (2018). An integrative public IoT framework for smart government. *Government Information Quarterly*.

116 Chatfield, A. T., & Reddick, C. G. (2018). A framework for Internet of Things-enabled smart government: A case of IoT cybersecurity policies and use cases in US federal government. *Government Information Quarterly*.

117 Chen, S., Xu, H., Liu, D., Hu, B., & Wang, H. (2014). A vision of IoT: Applications, challenges, and opportunities with China perspective. *IEEE Internet of Things Journal*, 1(4), 349–359.

118 Wirtz, B. W., Weyerer, J. C., & Schichtel, F. T. (2018). An integrative public IoT framework for smart government. *Government Information Quarterly*.

119 Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE).

120 UKGI Digital Land Team. (2018). Location, location, location – tapping the economic potential of geospatial data. Retrieved from https://quarterly.blog.gov.uk/2018/03/28/location-location-location-tapping-the-economic-potential-of-geospatial-data/

121 "Nes" Diaz-Uda, A. & Leinbach, J. (2012). The Power of Zoom: Transforming government through location intelligence. *Deloitte Insights.* Retrieved from https://www2.deloitte.com/insights/us/en/topics/analytics/the-power-of-zoom.html

122 Geobuiz. (2018). Geospatial industry outlook and readiness index. *Geospatial media and communications.*

123 "Nes" Diaz-Uda, A. & Leinbach, J. (2012). The Power of Zoom: Transforming government through location intelligence. *Deloitte Insights.* Retrieved from https://www2.deloitte.com/insights/us/en/topics/analytics/the-power-of-zoom.html

124 UKGI Digital Land Team. (2018). Location, location, location – tapping the economic potential of geospatial data. *Civil Service Quarterly.* Retrieved from https://quarterly.blog.gov.uk/2018/03/28/location-location-location-tapping-the-economic-potential-of-geospatial-data/

125 TerraGo. (2017). 2017 *Guide to Geospatial Transformation for Government. How to Lower Costs, Accelerate Projects and Meet the New Federal Geospatial Mandates with the Cloud*.

126 Geobuiz. (2018). Geospatial industry outlook and readiness index. *Geospatial media and communications.*

2.4.6 Blockchain

The term blockchain refers to a range of general-purpose technologies to exchange information and transact digital assets in distributed networks. It is a form of distributed computing in which transactions are democratised by introducing consensus mechanisms allowing a transaction to happen. In other words, it supports trusted and traceable digital assets management. Blockchain is viewed as one of the most important technology trends that will influence business and society in the years to come. It is expected that it will lead to significant innovation in respect of governmental processes[127], with strategic, organisational, economic, informational and technological benefits.

Blockchain's core tasks are registration, identification, verification and authentication of digital transactions[128]. The literature explores potential cases of application of this technology, including personal records, land registry, supply chain management, contract and vendor management processes. The recent literature also reviews blockchain applications around the World in healthcare[129] (e.g., safe and secure healthcare data management[130]), food safety[131], multinational information sharing (e.g., cross-border vehicle and driver identity[132]), secure document handling[133], and solving data security issues in smart city contexts[134], among others.

The use of blockchain technology promises to reduce fraud, errors and the cost of paper-intensive processes as well as foster transparency and trust over government data and transactions[135]. Nonetheless, as in the case of other technologies reviewed in this report, most arguments on the impacts of blockchain are rather normative or prescriptive, lacking empirical basis.

2.4.7 Open government data and application programming interfaces

Open Government Data (OGD) is a "philosophy" and set of policies promoting transparency, accountability and value creation by making government data available to all. By opening the huge quantities of data and information collected by public organisations and encouraging their use, governments can promote business creation (e.g. companies such as LinkedIn, Kayak, Zillow, and Esri use government data in their work[136]) and innovative citizen-centric services[137].

Gov-tech start-ups use government data and private investment in developing hardware and software for better and more efficient public services[138]. Many sources also emphasise that OGD is expected to improve the overall quality of democratic systems and trust, due to more transparency, accountability and citizen engagement. According to United Nations, OGD is an important enabler of transparent, accountable and effective public administration institutions in support of the 2030 Agenda for Sustainable Development[139].

---

127 Ølnes, S., Ubacht, J., & Janssen, M. (2017). Blockchain in government: Benefits and implications of distributed ledger technology for information sharing. *Government Information Quarterly,* 34, 355-364.

128 Atos. (2018). *e-State 2020 journey to a digital government*.

129 Abujamra, R., & Randall, D. (2019). Blockchain applications in healthcare and the opportunities and the advancements due to the new information technology framework. *Advances in Computers*.

130 Siyal, A., Junejo, A., Zawish, M., Ahmed, K., Khalil, A., & Soursou, G. (2019). Applications of Blockchain Technology in Medicine and Healthcare: Challenges and Future Perspectives. *Cryptography*, 3(1), 3.

131 IBM. (2018). One nation's move to increase food safety with blockchain. *Blockchain Pulse: IBM Blockchain Blog*. Retrieved from https://www.ibm.com/blogs/blockchain/2018/02/one-nations-move-to-increase-food-safety-with-blockchain

132 IBM. (2018). Solving the cross-border need for vehicle and driver identity with blockchain. *Blockchain Pulse: IBM Blockchain Blog*. Retrieved from https://www.ibm.com/blogs/blockchain/2018/08/solving-the-cross-border-need-for-vehicle-and-driver-identity-with-blockchain

133 Ølnes, S., & Jansen, A. (2017, September). Blockchain Technology as s Support Infrastructure in e-Government. In *International Conference on Electronic Government* (pp. 215-227). Springer, Cham.

134 Biswas, K., & Muthukkumarasamy, V. (2016). Securing smart cities using blockchain technology. In *High Performance Computing and Communications*; *IEEE 14th International Conference on Smart City; IEEE 2nd International Conference on Data Science and Systems (HPCC/SmartCity/DSS), 2016 IEEE 18th International Conference* (pp. 1392-1393). IEEE.

135 Berryhill, J., Bourgery, T., & Hanson, A. (2018) Blockchains unchained: blockchain technology and its use in the public sector. *OECD Working Papers on Public Governance*.

136 Data.gov. (n.d.). *Impact*. Retrieved from https://www.data.gov/impact/

137 OECD. (n.d.). *Open Government Data*. Retrieved from http://www.oecd.org/gov/digital-government/open-government-data.htm

138 Jorge, F. (2018), The govtech startups transforming Europe, by country. Public. Retrieved from https://www.public.io/the-govtech-startups-transforming-europe-by-country/

139 UNDESA (2016). United Nations E-Government Survey 2016. E-Government in Support of Sustainable Development. United Nations, New York, 2016, and UNDESA. (2018). UN E-Government Survey 2018, UN Department of Economic and Social Affairs

Recently, a number of benchmarks and indices have been introduced to assess the status of open government data. These include the Global Open Data Index[140], OURdata Index by OECD[141], EU Open Data maturity scores[142] and World Bank's Open Data Readiness Assessment[143], among others[144]. The indicator of Open Data is also a part of Digital Economy and Society Index (DESI)[145]. Some authors suggest that models for measuring eGovernment progress should focus more on open data (as currently such models are too strongly service-oriented), as well as consider dimensions such as organisational/technological complexity and added value for data consumers[146].

However, some authors warn against the assumptions that OGD automatically results in the benefits mentioned above[147] [148]. Even though citizens gain more tools to hold the government accountable, they may lack incentives or skills to check government activities. Paradoxically, ICT-enabled transparency may expose government's problems, reducing citizens' trust[149]. The vast amount and complexity of open data may also serve to effectively hide information[150].

Generally, opening of data results in the need for interoperability solutions, (big) data information sharing and processing infrastructure and capabilities. There is an increasing trend to replace the more traditional means of data access and storage (e.g., data catalogues providing free access to datasets in open or specialised proprietary formats and tools to engage with data) with more sophisticated approaches. For example, governments increasingly use cloud technologies, allowing to store and process data more efficiently[151].

More recently, Application Programming Interface (API) is being increasingly used by public organisations. It provides a 'low level' entry point for developers to access the data catalogues and its contents directly and allows to update data via external systems[152]. APIs are a set of software instructions and standards that allows machine-to-machine communication. It has become a foundational technological component of modern digital architectures, impacting every sector of the global economy[153].

In governments, APIs are seen as a means to support OGD initiatives and efficiently share vast amounts of data across the public sector and with businesses and citizens. APIs make it easier for developers from various organisations to access and use the data to build apps, widgets, websites, and other tools based on government information and services[154]. Existing applications of this technology in governments around the world include provision of information for mobile app development (e.g., in smart city contexts, using data from IoT and allowing collaboration of multiple actors); partnerships between government agencies, departments and non-public sector actors; government data analytics; dissemination of information to the public[155].

---

140 Global Open Data Index. (n.d.). Retrieved from https://index.okfn.org/

141 OECD. (n.d.). *Open Government Data*. Retrieved from http://www.oecd.org/gov/digital-government/open-government-data.htm

142 European Data Portal. (n.d.). Retrieved from https://www.europeandataportal.eu/en/dashboard#2018

143 World Bank. (n.d.). *Readiness Asessment Tool*. Retrieved from http://opendatatoolkit.worldbank.org/en/odra.html

144 Veljković, N., Bogdanović-Dinić, S., & Stoimenov, L. (2014). Benchmarking open government: An open data perspective. *Government Information Quarterly*, 31(2), 278-290.

145 See more information at https://digital-agenda-data.eu/datasets/desi/indicators

146 Kalampokis, E., Tambouris, E., & Tarabanis, K. (2011). Open government data: A stage model. In *International Conference on Electronic Government* (pp. 235-246). Springer, Berlin, Heidelberg.

147 Misuraca, G., & Viscusi, G. (2014). Is Open Data Enough? E-Governance Challenges for Open Government. *International Journal of Electronic Government Research*

148 Janssen, M., Charalabidis, Y., & Zuiderwijk, A. (2012). Benefits, Adoption Barriers and Myths of Open Data and Open *Government. Information Systems Management*, 29(4), 258–268.

149 Bannister, F., & Connolly, R. (2011). The Trouble with Transparency: A Critical Review of Openness in e-Government. *Policy & Internet*, 3(1), 158–187.

150 Janssen, M., & van den Hoven, J. (2015). Big and Open Linked Data (BOLD) in government: A challenge to transparency and privacy? *Government Information Quarterly*, 32(4), 363–368.

151 HM Government. (2011). Government Cloud Strategy. *UK HM Government.*

152 Herzog, T. (2014). Technology Options for Open Government Data Platforms. *World Bank*. Retrieved from http://opendatatoolkit.worldbank.org/en/technology.html

153 Williams, M. (2018). Digital Government Benchmark API study. *DG Joint Research Centre, European Commission.*

154 Paul, J. (2016). An introduction to open data and APIs. *Digitalgov*.

155 Glickenhouse, A., Abbott, S., & Tobias, R. T. (2016). Identifying API use cases: Government. *IBM Cloud;* also see the upcoming study by the JRC "APIs4DGov study - Assessing Government API strategies across the EU". See more information at https://ec.europa.eu/digital-single-market/en/news/new-study-digital-government-apis-apis4dgov-project

3 Effects of digital government transformation

In this chapter we present the findings of the review of the state of the art on the effects of digital transformation on governments. More specifically, we investigate the implications of the four types of digital innovations in government (related to internal process, governance, policy and service), as presented in Section 2.3, and considering different digital technologies, presented in Section 2.4. We start with internal process innovations and their effects on public administration processes. We then move to governance (external process) innovation and its effects on citizen and stakeholder engagement. Next, we discuss policy innovation and how digital technologies affect the policy making cycle. Then we move to service innovation – how digital technologies change public service design and delivery. Finally, as the majority of the reviewed sources were generally positive about the impacts of technology application in the public sector, we devote the last section to review the literature on negative outcomes in more depth, with the aim to balance the overall discussion.

Before entering the discussion, it is important to stress that measuring and evaluating effects of digital government initiatives, as for any initiative involving the use of public funds, is of great strategic importance for any public sector organisation. It is important for the sake of accountability, of monitoring progress and managing projects, as well as for understanding what works and why for the purpose of learning and steadily fine tune and improve interventions. Depending on the aim for which an organisation sets to measure and evaluate the effects of its initiatives there are different approaches each with its pros and cons. However, we want to stress a peculiar challenge that concerns specifically digital government transformations. Traditional eGovernment projects with a start and an end date, a fixed budget, and a time of deployment are more easily measurable than digital government transformation. The latter, in fact, is an ongoing process without a clear-cut end status; it is rather a continuous process that renders any measurement and evaluation even more complicated[156].

As the Digital Government initiatives are considered an ongoing process, we decided not to follow here the classic distinction that is often used in the literature between inputs, outputs, outcomes and impacts. We use the more generic term "effects" which may refer to the different categories above. However, it is important to stress that, at the moment, suitable evaluation indicators for the assessment of the success of Digital Government policies and initiatives are lacking. Measurement and performance indicators often concentrate on the input of policies, such as the number of datasets that are publicly available in the case of open-data policies[157]. This may be a partial explanation of why the majority of the reviewed sources were generally positive about the effects of technology application in the public sector. In fact, less attention has been given to the underlying original intent, or goals, of Digital Government policies, such as the implementation and impact of a policy, the reaction to a policy[158] and consumer needs[159]. And more importantly, little attention has been given to the way in which the effects of Digital Government policies or initiatives can create public value to solve societal problems. However, measuring this is very complicated and it is only possible over time. As the new wave of Digital Government Transformation is relatively new and many policies and initiatives have been developed only recently, they likely have not yet generated any impact that led to public value[160].

3.1 Internal process innovation: effects of digital transformation on public administration processes

Public administrations execute fundamental bureaucratic functions, which are being somehow "reinvented" in the age of digitalisation. With a rising need to manage big volumes of data and complex tasks, and to reduce administrative burdens and resource allocation problems, AI's role in public administration operations is also increasing. Once algorithms are introduced, they have unique impacts on the socio-technical systems of public

156 Mergel, I., Edelmann, N., & Haug, N. (2019). Defining digital transformation: Results from expert interviews. Government Information Quarterly.

157 Bertot, J. C., McDermott, P., & Smith, T. (2012). Measurement of open government: Metrics and process. Paper presented at the 45th Hawaii International Conference on System Sciences (HICSS 2012), Maui, Hawaii, USA.

158 Relyea, H. C. (2008). Federal government information policy and public policy analysis: A brief overview. Library & Information Science Research, 30, 2–21.

159 Gibbs, J., Kraemer, K. L., & Dedrick, J. (2003). Environment and policy factors shaping global E-commerce diffusion: A cross-country comparison. The Information Society, 19(1), 5–18.

160 Zuiderwijk, A., & Janssen, M. (2014). Open data policies, their implementation and impact: A framework for comparison. Government Information Quarterly, 31(1), 17-29.

administration. Related changes in policies and institutions may increase complexity, but at the same time, algorithms can also be used to process this complexity to improve the level of social problem solving[161].

By completing tasks faster, reducing process errors and costs, AI promises to improve public administration performance in several respects[162]. For instance, a report by the Italian Digital Transformation Team[163] argues that AI-transformed public administration has direct positive effects on civil service operations (less bureaucracy and simplified processes), public services and policy making. From administrative operations to resource management, technology applications can lead to reduce costs, curb corruption, increase transparency, ensure timely delivery of public goods and services, and optimise the use of existing resources[164].

This section further reviews the digitalisation of public administration by looking into the applications of digital technologies in civil service processes. We draw on examples stemming from both academic and grey literature to provide examples of specific public initiatives and their effects.

Reducing human involvement. As presented above, Artificial intelligence is a powerful tool to understand, monitor, reason, predict, interact, as well as learn and improve responses overtime[165] - potentially replacing or enhancing many tasks carried out by humans. AI is expected to take over tedious tasks, allowing staff to concentrate on more important ones[166]. For example, since 2014, the US Bureau of Labour Statistics assigns repetitive tasks to AI systems and reported that while AI technology is reading and analysing hundreds of responses, staff concentrates on important tasks[167]. Similarly, to ensure an error-free working environment, the Finnish Tax Administration (FTA) automated nearly 80% of all its operations[168]. A study by Deloitte examined Las Vegas foodborne illness prevention, which applies rule-based algorithms, machine learning, natural language processing, and text analytics to reduce human involvement to minimal or none. Once set up, data collection and geo-tagging require no human involvement, whereas tweets analysis and restaurants rankings require from 10% to 30% human involvement. In other cases, it is reported that applications of rule-based algorithms, machine learning, natural language processing, and text analytics will reduce human involvement to minimal or none, significantly reducing person-hours per task within organisations[169].

Reducing costs. Reducing human involvement in daily tasks provides great **savings in labour costs**. For example, the Estonian government estimates that X-Road – a solution making all government services available in one spot[170] – saves 1,400 years of working time annually. Also, the country used APIs to create an application network, which is estimated to have saved the country a total of 2.8 million working hours, or 3,225 years of time[171]. The North Tyneside Council in the UK is using RPA for activities in customer service, finance, and human resources, and expects to reduce costs by £56 million over the next few years[172]. Meanwhile, Deloitte's simulations show that even low levels of effort behind AI adoption could save government workforces between 2% to 4% percent of all their labour hours. With high levels of efforts, these numbers could exceed 30%[173].

AI and other digital technologies also allow significant savings on **other expenses** of public administrations. In Singapore, through geospatial data sharing and the GeoSpace's APIs and Web services, the Land Authority is reported to have saved $11.5 million in user application costs for 70 government agencies[174]. Machine-to-

---

161 Vogl, T. M., Seidelin, C., Ganesh, B., & Bright, J. (2019). Algorithmic Bureaucracy: Managing Competence, Complexity, and Problem Solving in the Age of Artificial Intelligence. (February 1, 2019).

162 World Government Summit, & Kinetic Consulting Services. (2018). From automation to AI. Key government strategic considerations for execution of automation and AI solutions.

163 Digital Transformation Team. (2018). Digital of the public administration; Digital Transformation Team. (n.d.). Digital innovation for citizens and for the development of the country. Retrieved from https://teamdigitale.governo.it/en

164 IBM Centre for the Business of Government. (2017). Transforming government through technology. *IBM Special Report Series.*

165 Mehr. H. (2017). Artificial intelligence for citizen services and government. *Harvard Kennedy School Ash Center for Democratic Governance and Innovation.*

166 World Government Summit, & Kinetic CS, (2018). From automation to AI government strategic considerations.

167 Bulman, B. M. (2018). The future has begun. *IBM Centre for the Business of Government.*

168 Microsoft. (2017). How Finland is embracing digital transformation. Digital challenges and success showcases.

169 Eggers, W. D. (2017). AI-augmented government. AI-augmented government. Using cognitive technologies to redesign public sector work. *Deloitte Center for Government Insights.*

170 Eggers, W. D., & Hurst, S. (2017). Delivering the digital state. What if state government services worked like Amazon? *Deloitte Center for Government Insights.*

171 Aherne, C. (2017). How an API strategy can help agencies connect data silos. *CGN.* Retrieved from https://gcn.com/articles/2017/08/02/apis-connect-data-silos.aspx

172 Cutura, S. (2018). Digital government trends to look out for in 2018. *Convedo Digital Transformation and process Automation Blog.* Retrieved from http://info.convedo.com/digital-government-trends-to-look-out-for-in-2018

173 Viechincki, P., & Eggers, W. D. (2017). How much time and money can AI save government? *Deloitte Insights.* Retrieved from https://www2.deloitte.com/insights/us/en/focus/cognitive-technologies/artificial-intelligence-government-analysis.html

174 UN Department of Economic and Social Affairs. (2018). UN E-Government Survey 2018. *United Nations.*

machine access among data-enabled agencies made it possible to adjust applications 30% faster and cut storage costs by 60%. It also eliminated data duplication.

In a different case, by using IoT sensors in federal buildings and smart devices responding to outside environments (e.g. automatic shades, smart light bulbs), the US General Services Administration can analyse real-time energy and water consumption, identifying building inefficiencies and reduce energy waste[175].

More effectiveness and consistency. Reducing human involvement, according to a number of authors, decreases the incidence of human error and improves speed, accuracy and effectiveness of service provision. Examples include:

- A study by Griffin et al. examined Hong Kong's immigration office, which has upgraded its passport and visa application processes. The authors argued that the algorithm, which approves, rejects or classifies into grey areas millions of passport and visa applications, improves administrative efficiency and eliminates the number of backlogs[176].
- Similarly, the Department of Science and Technology in Philippines developed an intelligence operations centre software together with IBM. Multiple algorithms analyse data from different sources and produce interactive dashboards. They improve monitoring of the city and response to emergencies[177].
- Italian public administration's single payment platform pagoPA is argued to offer an error-free services provision, standardised user experience, fast and easy payment collection, reduced management costs[178].
- German Patent and Trade Mark Office has applied RPA to direct individuals to appropriate patent examiners, and to improve distribution of patent applications. The automation is expected to enhance service delivery, reduce unnecessary delay, make administration efficient internally and externally. In 2018, Austria and Finland were also exploring automation solutions for patent pre-classifications and distributions[179].
- Lichtenstein has invested in document automation. Nintex Wokflow and dox42 programmes automatically pull data from different sources to produce and deliver government documents in a chosen format. The Principality claims to have gained greater responsiveness, increased accuracy and flexibility, improved and enhanced staff productivity[180].
- The UK's HM Revenue and Customs (HMRC) Department is automating customer-oriented processes. Those include dashboards that guide and automatically open files related to customer queries for contact centre advisers, and automated end-to-end employer registration processing. RPA has reduced call times by up to 40% and processing costs by around 80%, improved customer service and job satisfaction[181].

Cases of internal process innovations, based on distributed ledger technologies, have also been documented. These are said to have helped to **reduce administrative burden, improve privacy** and **security**. For example:

- Australian Commonwealth Bank and the National Disability Insurance Scheme (NDIS) combined blockchain technology with the new payments platform to develop smart contracts. Blockchain tokens attached to smart contracts form smart money. Programmed to know who spends on what and when, government administrative bodies can monitor public services in real-time, which in turn enhances service delivery, reduces administrative burdens, and simplifies user experience[182].
- Dutch government is exploring how they can apply blockchain to improve hundreds of administrative operations in national and local governments. Blockchain projects focus on simplifying policy implementation and financing, data sharing operations[183].

---

175 Castro, D. et al. (2016). How is the federal government using internet of things? *Center for Data Innovation*.

176 Griffin, C. et al. (2016). Advanced science and the future of government. Robotics and Artificial Intelligence, Genomic medicine, biometrics. *The Economist Intelligence Unit*.

177 World Government Summit, & Indra. (2017). Best government emerging technologies.

178 Digital Transformation Team. (2018). Digital of the public administration.

179 WIPO. (nd). Index of AI initiatives in IP offices. Retrieved from https://www.wipo.int/about-ip/en/artificial_intelligence/search.jsp

180 Nintex. (2013). Public administration boosts automation, improving productivity and public service. *Nintex Case Study.*

181 Capgemini. (2016). HMRC advisers use robots to reduce call times by up to 40%.

182 Digital Transformation Agency. (2019). Blockchain case study: Commonwealth Bank and the NDIS. *Australian Government.* Retrieved from https://www.dta.gov.au/help-and-advice/blockchain/do-you-need-blockchain/blockchain-case-studies/blockchain-case-study-commonwealth-bank-and-ndis

183 Dutch government. (n.d.). Blockchain results. Retrieved from https://www.blockchainpilots.nl/results

- In 2016, the Republic of Georgia used a blockchain solution to improve the land registry. The technology keeps confidential information secure and private, and reduces administrative transaction costs[184]. Sweden, Ukraine, and United Kingdom also present similar examples[185].
- The Danish blockchain project Vehicle wallet is said to ease supply chain management processes by handling vehicle's historic life cycle. One distributed ledger contains all data on the car, which remains accessible across the supply chain[186].

More transparency and accountability, less corruption. Digital technologies in public administrations are also related to increased transparency and fairness in at least three aspects. First, it relates to the transparency in decisions made by public servants, largely related to opening of data to the public[187]. Second, the above-mentioned reduced human involvement and human biases (disintermediation). Third, the increased transparency should also result from the more effective policy implementation and service provision, especially in the areas of taxation and payments.

For example, Danish public authorities are looking to apply AI in complex case processes and quality inspections. Yet to be implemented, discussed application scenarios concern such tasks as sorting, filtering and categorising cases to relevant groups, and ensuring quality control in cases selection for additional scrutiny. Such AI implementation is expected to bring faster case processing, transparency and consistency in decisions[188].

In a different case, Australian Taxation Office applied **blockchain** to improve vehicle ownership tracking by government authorities to increase tax compliance of luxury car owners. The office employed blockchain to validate the history of car dealers as well as to continuously monitor car owners[189]. Blockchain has been also used for land and property registry systems. It helped to speed up transaction and registration processes and reduced possibilities for fraud and corruption[190]. Generally, the technology demonstrates a significant potential to solve the problems related to information control, access, security and privacy of data by creating decentralised data management systems in public administrations[191].

Nonetheless, considering the reviewed literature as a whole, the discussed effects of ICT-enabled process innovations in public sector mostly concern the effectiveness, efficiency and productivity of public administrations. The reviewed literature mostly provides illustrations of how AI-based applications can help public agencies cut costs, allow employees to focus on non-routine, critical tasks, and deliver better, faster and more effective services. Although the issues of transparency, trustworthiness, and accountability are touched upon to some extent, in most sources they remain secondary. They are, nonetheless, discussed more extensively in the section on external process/governance innovation.

3.2 Governance innovation: effects of digital transformation on citizens and stakeholders engagement

Traditional views on the public value creation focused on the public organisations as sole initiators of the value creation process. The increasing possibilities and the use of digital technologies have been challenging this understanding. ICTs are linked to the emergence and evolution of new socio-technical systems that bring data, services, technologies and people from different sectors together[192] to respond to changing societal needs, form new social partnerships[193], as well develop innovative solutions.

---

184 New America. (n.d.). Blueprint blockchain and social innovation. Case studies. Retrieved from https://www.newamerica.org/bretton-woods-ii/blockchain-trust-accelerator/reports/blueprint-blockchain-and-social-innovation/case-studies

185 Airtable. (n.d.). Blockchain government tracker. Retrieved from https://airtable.com/shreIXQjzluCxam37/tbl7qVDFKKiEcFFrc?blocks=hide

186 Berryhill., J. (2018). New OPSI guide to blockchain in the public sector. *OPSI*. Retrieved from https://oecd-opsi.org/new-opsi-guide-to-blockchain-in-the-public-sector

187 Bertot, J. C., Jaeger, P. T., & Grimes, J. M. (2010). Using ICTs to create a culture of transparency: E-government and social media as openness and anti-corruption tools for societies. *Government information quarterly*, 27(3), 264-271.

188 Inovation Centre Denmark. (2017). Applied AI in public administration. Retrieved from http://www.icdk.us/aai/public_administration

189 Digital Transformation Agency. (2019). Blockchain case study: Australian Taxation Office. *Australian Government.* Retrieved from https://www.dta.gov.au/help-and-advice/blockchain/do-you-need-blockchain/blockchain-case-studies/blockchain-case-study-australian-taxation-office

190 Kariuki, D. (2018). Blockchain-Based Land Registry Systems Can Help Eliminate Fraud, Corruption and Delays. Cryptotomorrow. Retrieved from https://www.cryptomorrow.com/2018/02/27/blockchain-based-land-registry-and-record-systems

191 UN Department of Economic and Social Affairs. (2018). UN E-Government Survey 2018. *United Nations.*

192 Skaržauskienė, A., & Mačiulienė, M. (2017). Conceptualizing ICT-Enabled Co-creation of Public Value. In *International Conference on Internet Science* (pp. 93-100). Springer, Cham.

193 Susha, I., Grönlund, Å., & Van Tulder, R. (2018). Data driven social partnerships: Exploring an emergent trend in search of research challenges and questions. *Government Information Quarterly*.

By generating new relationships and dynamics, involving actors and resources outside public organisations, and modifying the ways by which the value embedded in the services is produced[194], ICTs allow for bottom-up control over public services[195] and innovations in this area, as well as **empower citizens and other stakeholders to contribute to or lead the creation of public value**[196]. This is often recognised as one key features of digital government transformation.

Janowski et al[197] framed this in terms of **changing governance paradigms**, which reshape the citizen-administration relationships: from impartial application of rules and regulations by administration to exercise its authority over citizens (bureaucratic paradigm), through provision of public services by administration to fulfil the needs of citizens (consumerist paradigm), to responsibility-sharing between administration and citizens for policy and service processes (participatory paradigm). The latest phase – the platform paradigm – is about the empowerment of citizens and other non-state actors to directly contribute to sustainable development. Other authors, investigating narrower areas of digital technology applications for citizen engagement (e.g., social media[198]), also often use the notion of paradigm shift to describe the significance of ongoing transformation.

Similar to Janowski et al, Linders[199] described three types of these new ICT-enabled citizen – government relationships. They do not necessarily follow each other and may co-exist:

- The first is the Citizen Sourcing (Citizens-to-Government) model, in which public helps government be more responsive and effective. Government holds the primary responsibility, but citizens may influence the direction and outcomes of government activities, improve the government's situational awareness, and may even help to implement government services.
- The second, Government as a Platform (Government-to-Citizen) model, is enabled by the near-zero marginal cost of digital data access and computer-based services which allow government to make its knowledge and IT infrastructure available to the public. In this way the state can help citizens improve their day-to-day productivity, decision-making, and well-being. Government is not responsible for the resulting activity, but can leverage its platform and influence to foster greater public value.
- Finally, the Do-it-Yourself Government (Citizen-to-Citizen) model is characterised by effective citizen self-organisation enabled by ICTs and citizen-to-citizen coproduction, potentially presenting a substitute for traditional government responsibilities. In this arrangement, the government plays no active role in day-to-day activities but may provide a facilitating framework. In other sources, similar models are sometimes referred to as (super) collaborative eGovernment[200].

All of these demonstrate the developments in ubiquitous civic engagement enabled by social media and mobile devices, open and big data, data analytics, crowdsourcing, visualization, gaming and so on. However, the impact of such developments on the roles and capabilities of policy makers, as well as on the governance of democratic systems at large, is unclear[201]. The analyses focus on expectations more than on hard evidence.

The research literature identifies both **positive and negative** effects of digitalisation on the governance of democratic systems. Some scholars stress the benefits, for example, that digital technologies may improve the public's perception of the government, increase political participation, and open more channels for collaboration between the public and the government. These changes, in turn, should result in more accountable, transparent, trustworthy and legitimate government. Others, however, note that governments may use digital technologies in a way, which leads to 'surveillance capitalism' and may eventually restrict the democratic process.

---

194 Cordella, A., & Paletti, A. (2018). ICTs and value creation in public sector: manufacturing logic vs service logic. *Information Polity*, 23 (2), 125-141.

195 Osborne, S. P., Radnor, Z., & Strokosch, K. (2016). Co-production and the co-creation of value in public services: a suitable case for treatment? *Public Management Review*, 18(5), 639-653.

196 Janowski, T., Estevez, E., & Baguma, R. (2018). Platform governance for sustainable development: Reshaping citizen-administration relationships in the digital age. *Government Information Quarterly*, 35(4), S1-S16.

197 Janowski, T., Estevez, E., & Baguma, R. (2018). Platform governance for sustainable development: Reshaping citizen-administration relationships in the digital age. *Government Information Quarterly*, 35(4), S1-S16.

198 Chun, S., Shulman, S. et al. (2010). Government 2.0: Making connections between citizens, data and government. *Information Polity*, *15*(1, 2), 1-9.

199 Linders, D. (2012). From e-government to we-government: Defining a typology for citizen coproduction in the age of social media. *Government Information Quarterly*, *29*(4), 446-454.

200 Osimo, D., Szkuta, K. et al. (2012). Study on collaborative production in eGovernment (SMART 2010/0075): Final Report; Part 1. Collaborative production. In *eGovernment-practice and implications*. Vesnic-Alujevic, L., Stoermer, E., Rudkin, J., Scapolo, F., Kimbell, L. (2019) The Future of Government 2030+: A Citizen-Centric Perspective on New Government Models. EUR 29664 EN. Publications Office of the European Union, Luxembourg, 2019. ISBN 978-92-76-00165-2

201 Janowski, T., Estevez, E., & Baguma, R. (2018). Platform governance for sustainable development: Reshaping citizen-administration relationships in the digital age. Government Information Quarterly, 35(4), S1-S16.

Similarly, although there is a lot of support to the idea that digital technologies serve as a catalyst for citizen engagement[202], it remains unclear whether this will lead to greater **social inclusion**. On the one hand, digital technology is seen as enabler of more direct participation in democratic decision making, as mobiliser of greater participation from individuals with traditionally lower political engagement[203], and as enabler of access to services that were previously out of reach for certain groups[204].

On the other hand, it is questionable whether digital technologies in fact increase and broaden citizen participation in democratic processes (instead of simply substituting offline engagement or facilitating deeper engagement of those already active). The reviewed literature points to the digital divides[205] in terms of access and skills. Discrepancies in the use of digital technologies by different population groups[206] may result in their disproportional representation in public processes and "push some voices to the margins"[207]. In fact, some empirical evidence shows that online governments are not reaching the most excluded and that for some people technological forms of exclusion can reinforce and deepen the existing disadvantages[208].

In any case, given the novelty and incremental (rather than disruptive) nature of these innovations, the literature mostly considers theoretical implications of these changes, but lacks empirical evaluations. This makes it difficult to assess which of the competing effects are most likely to prevail in the future. To better illustrate the discussion on ICT-driven change of governance models and processes, we further provide an in-depth analysis of two phenomenon widely covered in literature: political participation and co-creation/co-production.

3.2.1 Political participation and political system

The most recent literature on technology-driven transformation in political participation and political system mostly focuses on the application of artificial intelligence, distributed ledger technology and social media.

Artificial intelligence. Scholarship on the effects of AI on political participation and governance systems at large is highly polarised. On the one hand, AI is seen as a tool to address issues in democratic systems, including marginalisation, citizen disengagement, information imbalances, and lack of accountability[209]. On the other hand, scholars have questioned whether democracies will withstand AI developments[210]. The ultimate effects of AI on citizen engagement will, therefore, depend on who designs AI-empowered tools, and for what purposes[211]. Proponents of AI technology have noted instances in which AI has enhanced or enabled political participation and civic engagement. Deployment of AI-enabled translation services have allowed citizens to vote, which has been particularly useful in highly diverse societies like India with multiple official and unofficial languages[212]. Robotic chatbots used to answer basic citizen inquiries are expected to motivate citizens to interact with the government more[213].

In other cases, AI robots are employed to spot anomalies in congresspersons' spending[214], enabling citizens to gain more information on the politicians and make more informed decisions.

A body of scholarship also discusses potential AI benefits for citizen engagement, even if they have not been realised yet. Scholars argue that AI could be used to provide citizens with targeted information about policy issues citizens are interested in. This can be done, for example, through personalised political targeting[215] or by having an AI bot follow up on citizen inquiries, informing them on what actions a representative has taken to

---

202 UN Department of Economic and Social Affairs. (2018). UN E-Government Survey 2018. United Nations.

203 Dubow, T. (2017), 'Civic engagement: How can digital technologies underpin citizen-powered democracy'. Available at : https://www.rand.org/content/dam/rand/pubs/conf_proceedings/CF300/CF373/RAND_CF373.pdf

204 World Bank. (2016). World Development Report 2016: Digital Dividends. Washington, DC. doi:10.1596/978-1-4648-0671-1

205 Andreasson, K. (Ed.). (2015). *Digital divides: the new challenges and opportunities of e-inclusion* (Vol. 195). CRC Press.

206 UN Department of Economic and Social Affairs. (2018). UN E-Government Survey 2018. United Nations.

207 Dubow, T. (2017), 'Civic engagement: How can digital technologies underpin citizen-powered democracy'. Available at : https://www.rand.org/content/dam/rand/pubs/conf_proceedings/CF300/CF373/RAND_CF373.pdf

208 Helsper, Ellen (2008) Digital inclusion: an analysis of social disadvantage and the information society. Department for Communities and Local Government, London, UK. ISBN 9781409806141.

209 Savaget, P., Chiarini, T., & Evans, S. (2018). Empowering political participation through artificial intelligence. *Science and Public Policy*, Table 1, p. 2.

210 Helbing, D., Frey, B. S., Gigerenzer, G. et al. (2019). Will Democracy Survive Big Data and Artificial Intelligence? In *Towards Digital Enlightenment*. Springer, Cham.

211 Mittelstadt, B. (2016). Auditing for Transparency in Content Personalization Systems. *International Journal of Communication*, 10, 4991-5002.

212 Khemani, D. (2012). A Perspective on AI Research in India. *AI Magazine*, (33)1, 96–8.

213 Mehr. H. (2017). Artificial intelligence for citizen services and government. *Harvard Kennedy School Ash Center for Democratic Governance and Innovation.*

214 Savaget, P., Chiarini, T., Evans, S. (2018). Empowering political participation through artificial intelligence. *Science and Public Policy*, 1, 1-12.

215 Polonski, V. W. (2017). How Artificial Intelligence Conquered Democracy', The Conversation. accessed 14 March 2017.

address the issue[216]. It could inform citizens on the extent of public interest concerning specific political reforms while keeping everyone's identities anonymous, which is important for bottom-up initiatives[217]. AI could similarly be used to contain false information and fake news, or by policy makers to better understand public opinion and citizen needs based on data extracted from blogs, forums, and the press[218].

Nevertheless, AI also could be and has been used to undermine the democratic process. In Germany, the UK, France, Brazil, and the US, bots have been utilised during elections to create false images of public support and thus manipulate public engagement on specific issues[219]. AI has been used to spread misinformation in general[220] and enabled large-scale surveillance[221]. While AI-enabled behavioural techniques have shown success to achieve outcomes that are aligned with the public interest (see Section 3.4.2), some scholars question whether it is possible to prevent nudging that is against the public good[222]. Therefore, adequate regulation is needed[223]. Given the mixed effects of AI regarding public participation and citizen engagement, the ultimate effects of AI on governance will depend on who designs AI-empowered tools, and for what purposes[224].

Distributed ledger. Recent studies also discuss the existing[225] and potential[226] applications of **blockchain** for governance. These applications are said to have the potential to transform the understanding of citizenship and the nation state, enhance citizens' trust in the government by providing more privacy over their data, increase voter turnout, and encourage participation. However, little research suggests if or when these effects will take place, and even the existing applications are of relatively limited scale[227].

In the literature, there is a lively debate on whether blockchain-backed 'cloud communities' may result into **global citizenship, potentially replacing the nation state**[228]. For example, a virtual voluntary community Bitnation offers self-sovereign identities, notarization services, property rights, company registration, and dispute resolution systems[229]. Proponents of 'cloud communities' argue that they are more participatory in nature because people choose to join virtual states rather than receive citizenship of their nation state by default upon their birth[230]. Cloud communities also have the potential to empower minorities whose political voices are often neglected in elite-based political systems by giving them the option to opt-in or opt-out from any virtual state[231]. On the other side, sceptics argue that developments of such cloud communities will have little impact on the real world[232]. If however such communities managed to replace the nation-state, the new virtual states may be more, not less, repressive[233].

---

216 Mehr. H. (2017). Artificial intelligence for citizen services and government. *Harvard Kennedy School Ash Center for Democratic Governance and Innovation.*

217 Ibid.

218 Milano, M., O'Sullivan, B. and Gavanelli, M. (2014) 'Sustainable Policy Making: A Strategic Challenge for Artificial Intelligence', AI Magazine, 35(3), 22–35.

219 Savaget, P., Chiarini, T., Evans, S. (2018). Empowering political participation through artificial intelligence. *Science and Public Policy*, 1, 1-12.

220 Polonski, V. W. (2017) 'How Artificial Intelligence Conquered Democracy', The Conversation. accessed 14 March 2017.

221 Helbing, D., Frey, B. S., Gigerenzer, G. et al. (2019). Will Democracy Survive Big Data and Artificial Intelligence? In *Towards Digital Enlightenment*. Springer, Cham.

222 Ibid.

223 Winfield, A. F. T., & Marina, J. (2018). Ethical governance is essential to building trust in robotics and artificial intelligence systems. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences*.

224 Mittelstadt, B. (2016). Auditing for Transparency in Content Personalization Systems. *International Journal of Communication*, 10, 4991-5002.

225 Ojo, A., & Adebayo, S. (2017). Blockchain as a Next Generation Government Information Infrastructure: A Review of Initiatives in D5 Countries. *Government 3.0 – Next Generation Government Technology Infrastructure and Services*, 32, 283–298.

226 Scekic, O., Nastic, S., & Dustdar, S. (2018). Blockchain-Supported Smart City Platform for Social Value Co-Creation and Exchange. *IEEE Internet Computing*, 1-1. Institute of Development Studies. (2017). Blockchain for development – hope or hype? Retrieved from https://opendocs.ids.ac.uk/opendocs/bitstream/handle/123456789/12945/RRB17.pdf; Shen, C., & Pena-Mora, F. (2018). Blockchain for Cities - A Systematic Literature Review. *IEEE Access*, 6, 76787-76819.

227 Ojo, A., & Adebayo, S. (2017). Blockchain as a Next Generation Government Information Infrastructure: A Review of Initiatives in D5 Countries. *Government 3.0 – Next Generation Government Technology Infrastructure and Services*, 32, 283–298.

228 Orgad L. (2018). Cloud Communities: The Dawn of Global Citizenship? In: Bauböck R. (eds) D*ebating Transformations of National Citizenship*. IMISCOE Research Series. Springer, Cham, and the remaining articles in the same series on cloud communities for responses from other scholars.

229 De Filippi P. (2018). Citizenship in the Era of Blockchain-Based Virtual Nations. In: Bauböck R. (eds) *Debating Transformations of National Citizenship*. IMISCOE Research Series. Springer, Cham

230 Ibid.

231 Orgad L. (2018). Cloud Communities: The Dawn of Global Citizenship?. In: Bauböck R. (eds) *Debating Transformations of National Citizenship*. IMISCOE Research Series. Springer, Cham

232 Blake M. (2018). Virtual Politics, Real Guns: On Cloud Community, Violence, and Human Rights. In: Bauböck R. (eds) *Debating Transformations of National Citizenship*. IMISCOE Research Series. Springer, Cham

233 Bauböck R. (2018). Citizenship in Cloud Cuckoo Land? In: Bauböck R. (eds) *Debating Transformations of National Citizenship*. IMISCOE Research Series. Springer, Cham

Others argue that rather than being replaced, the nation states are actually moving into the virtual space[234]. Estonia has created the first digital residency in the world, allowing Estonians and non-Estonians alike to establish a business in Estonia, enrol into e-school, open a bank account, and have an e-ID[235]. This model—powered by distributed ledger technologies—demonstrates that governments can engage people beyond their territorial borders, which is particularly important given that a significant share of people nowadays identify themselves as 'citizens of the world'[236].

One of the reasons why virtual communities have grown in popularity is the general disenchantment with governments and lack of trust in them[237]. Nevertheless, blockchain technology can make government activities more **transparent**, potentially enhancing **trust** in public authorities, without the creation of virtual states. Transactions carried out via blockchain technologies are automatically recorded, so any government transaction can be checked[238]. While many eGovernance initiatives are currently managed by a handful of third-party technology companies, blockchain could help decentralise the Internet, ensuring that no private or public company controls too much information[239]. Finally, in linked eGovernment data systems, blockchain allows users to select how much personal data they would like to share, enhancing people's trust in that system[240].

Some are also excited about the prospects of blockchain-backed eVoting opportunities[241]. Internet voting has shown some success in Estonia, Canada, Brazil, France, and Switzerland; yet experiences from Norway also point to security concerns regarding election fraud[242]. Blockchain could arguably help address these security issues. Some work on the design of blockchain-based online voting has been undertaken[243] and prototypes exist[244]. For example, systems for corporate and local voting have already been developed in Estonia and South Korea[245]. Nevertheless, the underlying issue in blockchain-based e-voting systems is that authentication at the personal level must occur outside of the blockchain[246].

Finally, blockchain may be used by citizens to **directly report their needs** to the government[247]. Some scholars suggest that blockchain would prioritise some requests over others via blockchain consensus mechanism, informing public authorities on which requests they should address first[248].

Social media. Unlike AI and distributed ledgers which have been applied in the public sector only recently, EU countries[249] and the United States have used social media in government since late 2000s, mostly to

---

234 Blake M. (2018). Virtual Politics, Real Guns: On Cloud Community, Violence, and Human Rights. In: Bauböck R. (eds) *Debating Transformations of National Citizenship*. IMISCOE Research Series. Springer, Cham

235 Orgad L. (2018). Cloud Communities: The Dawn of Global Citizenship?. In: Bauböck R. (eds) Debating Transformations of National Citizenship. IMISCOE Research Series. Springer, Cham

236 https://globescan.com/global-citizenship-a-growing-sentiment-among-citizens-of-emerging-economies-global-poll

237 De Filippi P. (2018) Citizenship in the Era of Blockchain-Based Virtual Nations. In: Bauböck R. (eds) Debating Transformations of National Citizenship. IMISCOE Research Series. Springer, Cham

238 Shen, C., & Pena-Mora, F. (2018). Blockchain for Cities - A Systematic Literature Review. *IEEE Access*, 6, 76787-76819.

239 Ibáñez, L. D., Simperl, E. et al. (2017). Redecentralizing the Web with distributed ledgers. *IEEE Intelligent Systems*, 32(1), 92-95.

240 Margetts, H., & Naumann, A. (2017). Government as a platform: What can Estonia show the world? *Oxford Internet Institute, University of Oxford,* 14-15; Scekic, O., Nastic, S., & Dustdar, S. (2018). Blockchain-Supported Smart City Platform for Social Value Co-Creation and Exchange. *IEEE Internet Computing*, 1–1.

241 Boucher, P. (2016). What if blockchain technology revolutionised voting? European Parliament.

242 Warkentin, M., Sharma, S. et al. (2018). Social identity and trust in internet-based voting adoption. *Government Information Quarterly*, 35(2), 195-209.

243 Tarasov, P., & Tewari, H. (2017). The future of E-voting. *International Journal on Computer Science and Information Systems*, 12(2), 148-165; R Riemann, R., & Grumbach, S. (2017). Distributed protocols at the rescue for trustworthy online voting. In *Proceedings of the 3rd International Conferene on Information Systems Security Privacy* (pp. 499-505); Shaheen, S. H., Yousaf, M., & Jalil, M. (2017).Temper proof data distribution for universal verifiability and accuracy in electoral process using blockchain. In *Proceedings of the 13th International Conference on Emerging Technologies* (pp. 1-6); Moura, T., & Gomes, A. (2017). Blockchain voting and its effects on election transparency and voter confidence. In Proceedings of the 18th Annual International Conference on Digital Government Research - Dg.o '17 (pp. 574-575); Hsiao, J.-H., Tso, R. et al. (2017). Decentralized E-voting systems based on the blockchain technology. In *Advances in Computer Science and Ubiquitous Computing* (pp. 305-309). Singapore: Springer; Hanifatunnisa, R., & Rahardjo, B. (2017). Blockchain based E-voting recording system design. In *Proceedings of the 11th International Conference on Telecommunication Systems Services and Applications, TSSA 2017 (pp.* 1-6).

244 Noizat, P. (2015). Chapter 22 – Blockchain electronic vote. In *Handbook of Digital Currency* (pp. 453-461). San Diego, CA, USA: Academic; Yavuz, E., Koç, A. K. et al. (2018). Towards secure e-voting using ethereum blockchain. In *Proceedings of the 6th In Symposium Digital Forensic Security (ISDFS)* (pp. 1-7); Wang, B., Sun, J., He, Y. et al. (2018). Large-scale election based on blockchain. Procedia Computer Science, 129, 234-237

245 Ojo, A., & Adebayo, S. (2017). Blockchain as a Next Generation Government Information Infrastructure: A Review of Initiatives in D5 Countries. *Government 3.0 – Next Generation Government Technology Infrastructure and Services*, 32, 283–298.

246 Shen, C., & Pena-Mora, F. (2018). Blockchain for Cities - A Systematic Literature Review. *IEEE Access*, 6, 76787-76819.

247 Mottur, P. A., & Whittaker, N. R. (2018). Vizsafe: The Decentralized Crowdsourcing Safety Network. In *2018 IEEE International Smart Cities Conference (ISC2)*, 1-6.

248 Shen, C., & Pena-Mora, F. (2018). Blockchain for Cities - A Systematic Literature Review. *IEEE Access*, 6, 76787-76819.

249 Council of the European Union. (n.d.). Social media: connect with the Council. *European Council*. Retrieved from https://www.consilium.europa.eu/en/contact/social-media

disseminate information to the wider public[250]. As a result, the usage of social media by governments has been discussed extensively in the recent literature[251]. This topic received a wealth of attention especially after recent developments linked to potential misuse and the explosion of online disinformation during political campaign such as in the presidential election in the USA in 2016 and the Brexit referendum.

The proponents of social media see it as part of the shared governance model. According to them, this is a step towards a **more democratic process**, with more transparent, accountable, and trustworthy governments. This is enabled by the very process in which citizens, government officials and other stakeholders participate in content creation, data collection, knowledge sharing and structuring, and collaborative decision making[252]. Some evidence exists to support this, especially in respect to the possibility to enable a more open dialogue with citizens through social media[253]. Opposing evidence exists as well, however, which points out that citizens often do not put much value on civic participation through social media[254].

Furthermore, the use of social media is associated with a number of **risks**[255] and requires not only good implementation strategy[256] to avoid them, but also updating laws and regulations, and promoting changes in government culture and organisational practices[257]. Sceptics point to mass citizen surveillance[258], fake content, privacy violations and other issues[259]. Social media tends to filter content according to political preferences, lowering the chance of meaningful political discussion[260]. Personal data via social media is managed by third parties[261], and, as evidenced by the Cambridge Analytica scandal in 2018, can be used to manipulate public opinion. AI-based systems used by social media platforms can close its users into the 'echo chambers' and 'filter bubbles' that in effect may have polarising effects on the society and compromise social cohesion[262]. Governments, military services, political movements are increasingly engaging social media to manipulate public opinion[263].

3.2.2 Crowdsourcing, co-creation and coproduction

Most authors agree that ICT-enabled co-creation, co-production**,** crowdsourced data and putting public talent in use should lead to public service quality improvements and the provision and creation of new services[264]. It is also a means bringing public service providers closer to their service users. This ICT-enabled mode of value creation is expected to foster further innovations in public sector[265] and overcome the challenges posed by scarce resources, multiplicity of clients and objectives[266].

---

250 Chun, S., Shulman, S., Sandoval, R., & Hovy, E. (2010). Government 2.0: Making connections between citizens, data and government. *Information Polity*, *15*(1, 2), 1-9.

251 Criado, J. I., Sandoval-Almazan, R., & Gil-Garcia, J. R. (2013). Government innovation through social media. *Government Information Quarterly*, 30(4), 319-326.

252 Chun, S., Shulman, S., Sandoval, R., & Hovy, E. (2010). Government 2.0: Making connections between citizens, data and government. *Information Polity*, *15*(1, 2), 1-9.

253 Mossberger, K., Wu, Y., & Crawford, J. (2013). Connecting citizens and local governments? Social media and interactivity in major US cities. *Government Information Quarterly*, 30(4), 351-358.

254 Alarabiat, A., Soares, D., & Estevez, E. (2017). Predicting Citizens Acceptance of Government-led e-Participation Initiatives through Social Media: A Theoretical Model. In *Proceedings of the 50th Hawaii International Conference on System Sciences (2017).*

255 Mergel, I. (2012). *Social media in the public sector: A guide to participation, collaboration and transparency in the networked world*. John Wiley & Sons.

256 Mergel, I. (2013). Social media adoption and resulting tactics in the US federal government. *Government Information Quarterly*, *30*(2), 123-130.

257 Picazo-Vela, S., Gutiérrez-Martínez, I., & Luna-Reyes, L. F. (2012). Understanding risks, benefits, and strategic alternatives of social media applications in the public sector. *Government information quarterly*, 29(4), 504-511.

258 Bekkers, V., Edwards, A., & de Kool, D. (2013). Social media monitoring: Responsive governance in the shadow of surveillance? *Government Information Quarterly*, 30(4), 335-342.

259 Jaeger, P., & Bertot, J. (2019, January). Introduction to the Minitrack on Dark Digital Government: Exploring the Dangers—Issues, Concerns, and Negative Impacts. In *Proceedings of the 52nd Hawaii International Conference on System Sciences*.

260 Parise, Eli (2011). *The Filter Bubble: What the Internet is Hiding from you.* London: Viking, and imprint of Penguin Books.

261 Alarabiat, A., Soares, D., & Estevez, E. (2017). Predicting Citizens Acceptance of Government-led e-Participation Initiatives through Social Media: A Theoretical Model. In *Proceedings of the 50th Hawaii International Conference on System Sciences (2017).*

262 Helbing, D., Frey, B. S., Gigerenzer, G., Hafen, E., Hagner, M., Hofstetter, Y., van der Hoven, J., Zicari, R. V., & Zwitter, A. (2019). Will Democracy Survive Big Data and Artificial Intelligence? In Towards Digital Enlightenment (pp. 73–98). https://doi.org/10.1007/978-3-319-90869-4_7

263 Bradshaw, S. and Howard, P. N. (2017). Troops, Trolls and Troublemakers: A Global Inventory of Organized Social Media Manipulation. Computational Propaganda Research Project Working Paper, (2017.12). Oxford: University of Oxford.

264 See, for example, Morabito, V. (2015). Big data and analytics for government innovation. In *Big data and analytics* (pp. 23-45). Springer, Cham.

265 Misuraca, G., & Viscusi, G. (2014, October). Digital governance in the public sector: challenging the policy-maker's innovation dilemma. In *Proceedings of the 8th International Conference on Theory and Practice of Electronic Governance* (pp. 146-154). ACM

266 Alves, H. (2013). Co-creation and innovation in public services. *The service industries journal*, 33(7-8), 671-682.

According to the reviewed literature, these forms of citizen and stakeholder engagement are enabled and encouraged by the adoption of several technology-enabled innovations in governments (most of which are related very closely to technologies for political participation described above):

- Numerous **OGD initiatives** have been launched in various countries and the so-called linked data technologies emerged allowing to publish structured data on the web in such a way that enables semantically enriching data, uniform access to data, and linking of data[267]. Furthermore, governments are creating one-stop portals for access to governmental data[268] to be used by citizens, non-governmental sector and the private sector. These technologies have enable data analysis for different private and public purposes, and encourage crowdsourcing and co-creation[269] in the creation of public value. For examples of socially-minded companies that have been created using OGD, please see Section 2.4.7.
- Social networks allow large scale distributed collaboration, information sharing and creation of collective intelligence[270]. Some authors present it as a 'paradigm shift', from government providing information and services to **participatory government**, which involves citizens and other organisations as collaborators and partners in information creation, service enhancement and policy making[271].
- **Blockchain** technology is seen as a potential enabler for bottom-up innovation (also in public sector)[272].
- Citizens can provide **their data** (i.e. crowdsourcing) from homes, offices, laptops, webpages, wireless sensors, virtual environments and interactive installations to IoT platforms, thus enabling the creation of new products and services by the government. Examples include a variety of possible applications from interactive art installations to radiation monitoring during the Fukushima catastrophe.[273]

Nonetheless, the literature does not provide a definite conclusion on the broader outcomes and impacts of ICT-enabled co-creation and co-production. For example, a systematic review of 122 articles and books (published in 1987-2013) on co-creation/co-production with citizens in public innovation[274] found a lack of studies focusing on outcomes. The review points out that co-creation and co-production are often simply assumed to be a positive development.

Similarly, in his literature review Lember[275] singled out four key effects: empowerment, participation and inclusiveness, efficiency and effectiveness, and new tasks and capabilities. However, while both positive and negative effects are covered in research, the systematic evidence is lacking. Lember concluded that there is a great deal of ambiguity in how digital technologies shape co-production. They not only enable it, but also frame it and at times reduce it thus minimising the bottom-up potential of co-production.

Existing studies also show that effective co-creation of new OGD-driven public services is subject to important pre-conditions, including a new understanding of the role of stakeholders[276], proper communication, agile implementation and well-developed OGD solutions[277], among others.

---

267 Kalampokis, E., Tambouris, E., & Tarabanis, K. (2011). A classification scheme for open government data: towards linking decentralised data. *International Journal of Web Engineering and Technology*, 6(3), 266-285.

268 Open Government Partnership. (n.d.). About OGP. Retrieved from https://www.opengovpartnership.org/about/about-ogp; Misuraca, G. & Viscusi, G. (2014). Is Open Data Enough? e-Governance challenges for Open Government. *International Journal of Electronic Government Research,* 10(1), 18–34.

269 Linders, D. (2012). From e-government to we-government: Defining a typology for citizen coproduction in the age of social media. *Government Information Quarterly*, *29*(4), 446-454. Balestrini, M., Diez, T., Marshall, P. et al. (2015). IoT Community Technologies: Leaving Users to Their Own Devices or Orchestration of Engagement? EAI Endorsed Transactions on Internet of Things, 1(1), 1-11.

270 Mossberger, K., Wu, Y., & Crawford, J. (2013). Connecting citizens and local governments? Social media and interactivity in major US cities. *Government Information Quarterly*, 30(4), 351-358.

271 Chun, S., Shulman, S., Sandoval, R., & Hovy, E. (2010). Government 2.0: Making connections between citizens, data and government. *Information Polity*, *15*(1, 2), 1-9.; Linders, D. (2012). From e-government to we-government: Defining a typology for citizen coproduction in the age of social media. *Government Information Quarterly*, *29*(4), 446-454.

272 de la Rosa, J. L., Torres-Padrosa, V., el Fakdi, A. et al. (2017). A survey of blockchain technologies for open innovation. In *4th Annual World Open Innovation Conf. WOIC* (pp. 14-15).

273 Salim, F., & Haque, U. (2015). Urban computing in the wild: A survey on large scale participation and citizen engagement with ubiquitous computing, cyber physical systems, and Internet of Things. *International Journal of Human-Computer Studies*, 81, 31-48.

274 Voorberg, W. H., Bekkers, V. J., & Tummers, L. G. (2015). A systematic review of co-creation and co-production: Embarking on the social innovation journey. *Public Management Review*, *17*(9), 1333-1357.

275 Lember, V. (2017). The Increasing Role of Digital Technologies in Co-production. In Brandsen, T., Steen, T. and Verschuere, B. (eds) *Co-production and co-creation: engaging citizens in public service delivery*. Routledge, forthcoming.

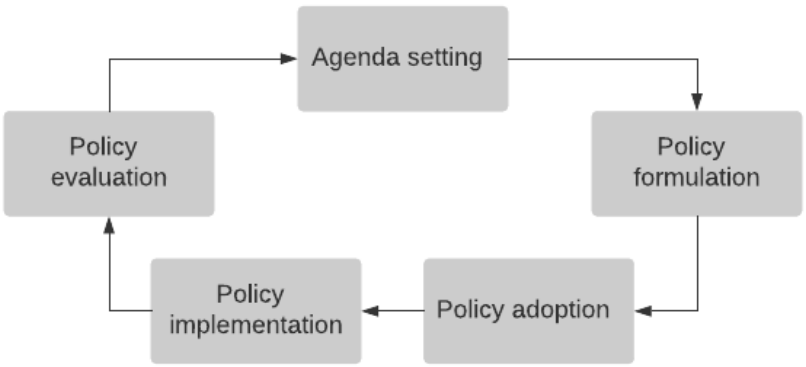
276 McBride, K., Toots, M., Kalvet, T., & Krimmer, R. (2018). Open Government Data Driven Co-creation: Moving Towards Citizen-Government Collaboration. *Electronic Government*, 1, 184-195.

277 McBride, K., Aavik, G., Toots, M. et al. (2019). How does open government data driven co-creation occur? Six factors and a 'perfect storm'; insights from Chicago's food inspection forecasting model. *Government Information Quarterly,* 36(1), 88-97.

3.3 Policy innovation: effects of digital innovation on policy making

According to several reviewed researchers, capturing the positive effects of digitalisation is a crucial precondition to act within all government functions[278], including the decision-making processes[279]. In fact, high-quality relevant data and analytical capacities are increasingly seen as the means to influence and transform all stages of the policy making cycle (see the figure below)[280].

FIGURE 2. POLICY CYCLE



Source: typical policy cycle (adapted from European Commission., 2016).

In this context Misuraca, Mureddu and Osimo (2014) have coined the term **Policy-Making 2.0**[281] to define how digital innovations can impact – and transform - governance processes and policy-making mechanisms. This concept denotes a combination of technologies applied throughout all the phases of the policy cycle to develop better, more participatory and evidence-based policies[282].

In the same vein, Ferro[283], Fredrikkson[284] and Barbero[285] highlight that big data analysis, enabled by algorithmic modelling and machine learning, equips government agencies with:

- faster and better macro insights, hidden pattern recognition, automatic correlations;
- effective, productive, economically valued decision making;
- efficient, accurate, reflective policy making;
- performance benchmarking opportunities;
- directly engaged citizen voices;
- development of data-based, personalised and responsive public services;
- implementation of clever law enforcement.

Building on this emerging – though limited - body of research, we further reviewed the evidence and assessments from the literature on the effects of digitalisation on each of the phases of the policy cycle. As the empirical evidence is rather scarce and most authors provide rather theoretic arguments, we also discuss several real-life examples of ICT-enabled innovations in policy-making.

278 Höchtl, J., Parycek, P., Schöllhammer, R. (2016). Big data in the policy cycle: policy decision making in the digital era. Journal of Organizational Computing and Electronic Commerce, 26(1-2), 147-169.

279 Engin, Z., & Treleaven, P. (2019). Algorithmic government: Automating public services and supporting civil servants in using data science technologies. *The Computer Journal*, 62(3), 448-460.

280 Barbero, M. Coutuer, J. et al. (2016). Big data analytics for policy making. *European Commission.*

281 Misuraca, G., Mureddu, F., and Osimo, D., (2014). Policy Making 2.0: Unleashing the power of big data for open governance, in Open Government: Opportunities and Challenges for Public Governance, edited by Mila Gascó-Hernandez, IPGM-ESADE, Barcelona, Spain

282 Mureddu, F., Misuraca, G., Osimo, D., & Armenia, S. (2012, October). A new roadmap for next-generation policy-making. In *Proceedings of the 6th International Conference on Theory and Practice of Electronic Governance* (pp. 62-66). ACM.

283 Ferro, E., Loukis, E. N., Charalabidis, Y., & Osella, M. (2013). Policy making 2.0: from theory to practice. *Government Information Quarterly*, 30, 359-368.

284 Fredrikkson, C., Mubarak, F. et. al. (2017). Big data in the public sector: a systematic literature review. *School of Public Administration*, 21(3).

285 Barbero, M. Coutuer, J. et al. (2016). Big data analytics for policy making. *European Commission.*

3.3.1 Agenda setting

Agenda setting needs identifying the problems that require attention from policy makers. Big data, predictive analytics and other technologies – aggregating and examining information from a variety of sources to the greatest detail – are providing possibilities for both a precise problem assessment and clarity in policy options[286]. Technology also provides a possibility to forecast situational trends and conditions – thus being one step ahead of problems and responding to those accurately and timely[287]. Although with very little hard evidence, literature claims that these roles played by digital technologies could be crucial in years to come.

Currently, the discussion on ICTs in problem identification and agenda setting illustrates at least two general trends.

One the one hand, application of ICT enables the **increased role of citizens** through crowdsourcing and co-creation (see more in Section 3.2.2) in policy making. Policy development is no longer limited to governments and is an increasingly multi-stakeholder effort. Citizens gradually take over the role of problem identification which was previously mostly played by traditional media. For example, such web-based platforms as the FixMyStreet has grown to be one of the most used tools by citizens and city councils in the UK.[288] They use the tool to report and detect problems such as graffiti, fly tipping, street lighting, and similar. City councils, in turn, map out problem areas and types to act accordingly, through the analysis of gathered data. Similarly, other online communications tools, especially social media[289], enable early, specific and focused issue recognition. By tracking and analysing multiple text streams, models systematically define key problems and predict future opinion trends and issues, equipping policymakers with actionable and specific knowledge.[290]

On the other hand, digital technologies also enable governments to generally **rely less** on public servants and their human biases in generating insights on relevant issues. Technologies can do this job quicker and more reliably, observing the evidence data in its entirety. Authors note that using AI to combine and analyse various data sources (including citizen reports, data from IoT and web, among others):

- allow governments to instantly identify individuals, entities, and regions that are at risk, in danger or in need the most,[291]
- to zoom into specific situations and,
- based on the setting, to design tailored and localised policies that minimise resource waste and harmonise with citizens' preferences or needs.[292]

3.3.2 Policy formulation, adoption and implementation

Some of the reviewed sources foresee that in the near future governments will employ algorithms to create and propose policies, while officials will engage in final assessments and choices between policy options already generated by AI.[293] Researchers argue that this human-machine interaction has a great potential to enhance efficiency, effectiveness and accuracy in policy adoption.

While computer algorithms are good at sorting out data, generating analysis, predicting interactions and producing policy suggestions, humans can account for all key factors such as social and political contexts and history before deciding on the most appropriate policy option.[294]

Several aspects related to digital technologies in policy design, adoption and implementation are documented in the reviewed literature.

---

286 Barbero, M. Coutuer, J. et al. (2016). Big data analytics for policy making. *European Commission*; Tito, J. (2017). Destination unknown: Exploring the Artificial Intelligence on Government. *Centre for Public Impact. A BCG Foundation.*

287 Pencheva, I., Esteve, M., Mikhaylov, S. J. (2018). Big data and AI – A transformational shift for government: So, what next for research? *Public Policy and Administration*, 1-21.

288 Nesta. (n.d.). FixMyStreet. Retrived from https://www.nesta.org.uk/feature/civic-exchange/fixmystreet/

289 Höchtl, J., Parycek, P., Schöllhammer, R. (2016). Big data in the policy cycle: policy decision making in the digital era. *Journal of Organizational Computing and Electronic Commerce*, 26(1-2), 147-169.

290 Kaschesky, M., Sobkowicz, P., Bouchard, G. (2011). Opinion Mining in Social Media: Modeling, Simulating, and Visualizing Political Opinion Formation in the Web. In *Proceedings of the 12th Annual International Conference on Digital Government Research* (pp. 317-326).

291 Tito, J. (2017). Destination unknown: Exploring the Artificial Intelligence on Government. *Centre for Public Impact. A BCG Foundation.*

292 Williamson, B. (2014). Knowing public services: cross-sector intermediaries and algorithmic governance in public sector reform. *Public Policy and Administration*, 29(4), 292-312; Jun, P-S. (2018). Ten years of research change using Google Trends: From the perspective of big data utilizations and applications. *Technological Forecasting and Social Change*, 130, 69-87.

293 Tito, J. (2017). Destination unknown: Exploring the Artificial Intelligence on Government. *Centre for Public Impact. A BCG Foundation.*

294 Ministry of Defence. (2018). Human-machine teaming. Development, Concepts and Doctrine Centre. Joint Concept Note 1/18. *UK Government.*

- Predictive analytics are expected to allow the public sector to focus more on **prevention**, instead of just reacting to societal problems. These tools are already applied in developing targeted, personalised interventions and 'nudges' in healthcare, education and other social services of general interest. Similarly, police departments use predictive models to decide where they want their officers to patrol, while data mining and network analytics help to discover tax fraud[295] (see more in Section 3.4).
- Advanced analytics using AI and big data enable policymakers to **test the potential solutions** in advance. Tests and simulations, taking into account vast and diverse amounts of data, can present a more fine-tuned approach to predict the policy outcomes. They can also be used to understand whether a policy that worked in one country will be effective in another[296].
- Looking at policy implementation processes, evidence shows that building on data collection, application and analysis improve **policies budgeting, procurement, and other operations** (see more information in Section 3.1.). For example, OECD report on Open Government Data claims that OGD has improved accuracy of procured technological and software solutions, as providing data to develop a technology or software prior to the purchase captures the optimal delivery of public services[297]. Other articles also claim that data analytics gears procurement processes towards a more fair, efficient and effective procedure, for example, by faster and more accurate record check.[298] At the same time, AI and machine learning predominantly challenge traditional budget allocation methods, and big data analysis helps shift budget allocation to the most needed areas for funding[299]. This indirectly diminishes political influence of officials or governmental agencies.

Besides this, ICTs can also enable innovative policies and services which would not be possible without them. These often illustrate the greatest transformative potential of digital technologies. They are discussed in more detail in Section 3.4. ICTs also provide more possibilities for policy and service co-production, as well as personalisation and tailored policy implementation through enhanced government interactions with the target public audience.[300] We discuss these aspects in more detail in Sections 3.2.2 and 3.4.4.

3.3.3 Policy evaluation

While generally policy evaluation remains a key component of the policy process, it does not always occur as often or as thoroughly as it should. Financial constraints, the availability of skilled evaluators and data serve as major limiting factors.

However, technologies for monitoring data collection, abundance of historical data, and AI-powered capabilities for its analysis has a great potential to significantly improve the process and results of policy evaluation.

Several reviewed articles touching upon expected benefits argue that AI technologies will enable **more timely policy evaluation**, without much of the human planning required. AI policy assessments in real-time are expected to allow for rapid policy evaluations, as well as policy iterations in response to data-based findings[301]. This, in turn, should equip public servants with robust assessments of operational performance, and understanding of policy effects on the setting and people[302]. Nonetheless, evidence on the actual effects is still lacking.

Besides the role of AI, digital technologies in general can enable **citizen-driven evaluation**, in which general public directly participates in government policies, ideas, programmes and project monitoring. Such involvement is expected to advantage policy makers, where public voice increases trust, transparency and legitimacy, helps to understand situation and public's outlook on policies or identify overlooked issues.[303] Various initiatives presented in literature and internet resources are expected to create more value in policy evaluation through citizen engagement, for example:

---

295 Barbero, M. Coutuer, J. et al. (2016). Big data analytics for policy making. European Commission.

296 Ibid.

297 OECD. (2016). Rebooting Public Service Delivery: How Can Open Government Data Help To Drive Innovation?

298 Höchtl, J., Parycek, P., Schöllhammer, R. (2016). Big data in the policy cycle: policy decision making in the digital era. Journal of Organizational Computing and Electronic Commerce, 26(1-2), 147-169.

299 Pencheva, I., Esteve, M., Mikhaylov, S. J. (2018). Big data and AI – A transformational shift for government: So, what next for research? *Public Policy and Administration*, 1-21.

300 Tito, J. (2017). Destination unknown: Exploring the Artificial Intelligence on Government. *Centre for Public Impact. A BCG Foundation*.

301 Tito, J. (2017). Destination unknown: Exploring the Artificial Intelligence on Government. *Centre for Public Impact. A BCG Foundation*.

302 Pencheva, I., Esteve, M., Mikhaylov, S. J. (2018). Big data and AI – A transformational shift for government: So, what next for research? *Public Policy and Administration*, 1-21.

303 Suherman-Bailey, J. (2015). Data policy and the public: shaping a deeper conversation. *Sciencewise, Expert Resource Centre*.

- D-CENT (Decentralised Citizens ENgagement Technologies) launched Decisions Helsinki – an API-powered tool in Finland. The tool gathers decisions made by city administrative bodies and civil servants and collects real time alerts about city debates and decisions. This enables citizens to directly evaluate and engage in decision making[304]. Citizen engagement is particularly important in building future policies, even locating newly emerged or overlooked problem areas. This also allows governments to measure policy acceptance and this way establish credibility and legitimacy of adopted and implemented policies[305].
- A SafeCity mobile-app experiment in Aarhus, Denmark, aims at involving immigrants and/or people from lower-to-middle class to evaluate government efforts to build a safe city. By analysing Aarhus city residents' opinions, government authorities detect whether they are moving in a right direction[306].
- OpenCoesione portal is an OGD platform enabling quality data use and re-use. Through detailed data insights from multiple local and European sources, citizens evaluate governmental project objectives, achievements and spending[307].
- ICT-facilitated electronic rulemaking or eRulemaking has become an important open public-interfacing website in the US. Many government agencies use the system to promote open government data as well as inform and involve the public in the decision-making processes. Continuous public's involvement also generates many opinions enabling their analysis and segmentation into more structured topic streams for internal government evaluations[308].

3.3.4 Challenges

The presentation of these and similar initiatives generally relates them with high hopes for better informed and improved policy design and ultimately better policy outcomes. Nonetheless, in the review process we did not come across sources providing conclusive evidence of robust empirical analysis. Some of the reviewed sources argued that for paradigm shift towards Policy Making 2.0 to happen **several challenges must be overcome**. According to Charalabidis et al[309], the challenges include the following (see more information on the challenges and preconditions for digital government transformation, also relevant for policy making, in Chapter 4):

- Need for model-based collaborative governance, which would assist policy makers in daily decisions in unpredictable environment. The newly developed models should be robust, reusable and collaborative, to correct the shortcomings of econometric models that do not fully account for human behaviour and to be applicable at macro level. This especially concerns the initial stages of the policy making cycle: agenda setting, policy definition and policy formulation.
- Need for data-driven collective intelligence and action. This includes new more intuitive collaborative tools, which would enable the engagement of wider circles of people, as well as ICT-based feedback mechanism to encourage real action and behavioural change. This challenge is especially relevant to improved policy formulation and pre-assessment, as well as monitoring and evaluation stages.
- Need for improved government service utility, allowing co-production and co-creation, public-private collaboration, citizen interaction and service co-generation and development of completely new services. This is, obviously, mostly related to the implementation phase.
- Need for scientific base on ICT for governance and policy modelling, relevant for all stages of the cycle. However, it seems from our review that the research into and for Policy Making 2.0 is still rather fragmented, despite some recent efforts to develop research strategies and agendas[310].

Moreover, inherent to all applications of AI and big data in the public sector, these technologies in policy making relate to a number of **risks**. For example, Misuraca et al[311] outline several implications of using insights from

---

304 D-CENT. (2016). A new co-designed model for citizen participation in Helsinki. Retrieved from https://dcentproject.eu/a-new-co-designed-model-for-citizen-participation-in-helsinki

305 Höchtl, J., Parycek, P., Schöllhammer, R. (2016). Big data in the policy cycle: policy decision making in the digital era. Journal of Organizational Computing and Electronic Commerce, 26(1-2), 147-169.

306 Organcity. (n.d.). SafeCity. Retrieved from http://organicity.eu/experiment/safecity

307 Canova, L., Vetro, A. et al. (2013). OpenCoesione and Monithon – a transparency effort. *Politecnico di Torino, Technische Universität München, Nexa Center for Internet, & Society at Politecnico di Torino (DAUIN).*

308 DOD Open Government. (n.d.). Electronic rulemaking. *US Department of Defense.* Retrieved from https://open.defense.gov/Transparency/Electronic-Rulemaking

309 Charalabidis, Y., Lampathaki, F., Misuraca, G., & Osimo, D. (2012, January). ICT for governance and policy modelling: Research challenges and future prospects in Europe. In *2012 45th Hawaii International Conference on System Sciences* (pp. 2472-2481). IEEE.

310 Koussouris, S., Lampathaki, F., Kokkinakos, P., Askounis, D., & Misuraca, G. (2015). Accelerating Policy Making 2.0: Innovation directions and research perspectives as distilled from four standout cases. *Government Information Quarterly*, 32(2), 142-153.

311 Misuraca, G., Mureddu, F., & Osimo, D. (2014). Policy-making 2.0: Unleashing the power of big data for public governance. In *Open Government* (pp. 171-188). Springer, New York, NY.

big data in Policy Making 2.0, which could be summarised along two dimensions: data management (e.g. privacy, access sharing) and data analysis (e.g., fabricated data, biased data interpretation). Policies based on mismanaged information or insights from unrepresentative samples could lead to even worse policy outcomes. Besides this, other ethical and digital divides, and other potential negative outcomes are often mentioned in works of many authors on big data and digital technologies in the public sector (see more in Section 4.2).

3.4 Service innovation: effects of digital transformation on public services

In this section we review the literature on the effects of ICT-enabled innovation in government on the public services and their delivery. As the relevant literature is rather fragmented and usually focuses on narrow and specific effects (e.g., application of physical robots (a very specific digital technology) in elderly care (a very specific service)[312]), we concentrate on three specific public service areas which have been discussed most extensively in the reviewed literature: healthcare and long-term care, public safety and security, and smart city services. Having reviewed how digital technology-led innovations transform the selected areas of public services, we summarise and discuss the broader trends and impacts.

3.4.1 Healthcare and long-term care

Public healthcare is framed as a promising area for AI application, likely to redesign the healthcare sector in many aspects[313]. Some authors even argue that it is the public service area in which AI can have the most transformative impact[314]. Despite its slow deployment, AI-enabled innovations are expected to improve health outcomes and quality of life for millions of people[315]. With a wide adoption of online medical consultations, patient portals, and other care delivery channels enabled by digital innovations, the recent trends in healthcare sector include shifts from traditional face-to-face care to e-health, mobile health (m-health) and ubiquitous health (u-health), characterised by real-time information collection about the patient[316]. Also, precision or stratified medicine is on the rise[317]. It is characterised by tailoring of healthcare throughout the patient pathway (advice, diagnosis, referral or treatment) towards specific patients or sub-groups.

According to Sun and Medaglia[318], AI innovations in healthcare can be classified into "physical and virtual":

- The innovations in the physical branch mostly concern service delivery and overlaps with applications of robotics (e.g. assistants for elderly patients or attending robots for surgeons).
- The virtual branch concerns 'the heart of AI' – deep learning applications to control health management systems, healthcare analytics and clinical decision support (AI-powered automated assistance to physicians in the treatment decisions and even diagnosis of patients).
- Related applications encompass care delivery innovations (web patient portals, online medical consultations (eVisit), telemedicine), healthcare analytics applications in disease susceptibility and surveillance, diagnostics, treatment, prognosis, essentially enabling precision medicine. AI applications in management of healthcare systems include mining data from medical records, social media and digital personal monitoring devices aimed at clinical decision support, patient monitoring and coaching.

Generally, broader literature on ICT in healthcare associates AI innovation with two general types of effects: efficiency and service quality.

First, the ICT-enabled innovations are argued to bring **cost-savings and efficiency gains**. E-delivery through channels such as patient portals and online consultations may bring cost savings by replacing face-to-face interactions[319]. Efficiency gains can also be brought by the adoption of disease surveillance systems that allow

---

312 Bemelmans, R., Gelderblom, G. J., Jonker, P., & De Witte, L. (2012). Socially assistive robots in elderly care: A systematic review into effects and effectiveness. *Journal of the American Medical Directors Association*, 13(2), 114-120.

313 Sun, T. Q., & Medaglia, R. (2018). Mapping the challenges of Artificial Intelligence in the public sector: Evidence from public healthcare. *Government Information Quarterly*.

314 PwC. (n.d.). AI and robotics are transforming healthcare. Retrieved from https://www.pwc.com/gx/en/industries/healthcare/publications/ai-robotics-new-health/transforming-healthcare.html

315 Horvitz, E. (2016). Artificial intelligence and life in 2030. *Stanford University.*

316 Jung, C., & Padman, R. (2015). Disruptive Digital Innovation in Healthcare Delivery: The Case for Patient Portals and Online Clinical Consultations. In *The Handbook of Service Innovation* (pp. 297-319).

317 Love-Koh, J., Peel, A., Rejon-Parilla, J.C. et al. (2018). The Future of Precision Medicine: Potential Impacts for Health Technology Assessment. *PharmacoEconomics*, 36(12), 1439-1451.

318 Sun, T. Q., & Medaglia, R. (2018). Mapping the challenges of Artificial Intelligence in the public sector: Evidence from public healthcare. *Government Information Quarterly*.

319 Agarwal, R., Selen, W., Roos, G., & Green, R. (2015). *The Handbook of Service Innovation.* Springer.

for faster response and more accuracy in prevention of spread of infectious diseases[320], in turn saving a lot of money for treatment. Data analytics is also expected to boost efficiency in the delivery of services. For instance, it is estimated that a more successful employment of data analytics by the National Health Service (NHS) in the UK would lead to potential efficiency savings of between GBP 16 and GBP 66 billion a year that could free up capacity of staff and resources to ensure continued improvements in quality of service[321]. On the other hand, studies on the impacts of social media in public healthcare have found that the uptake of social media can be both a **cost driver**[322] and a cost-cutter[323], depending on the institutional arrangement of health care sector and incentives in place for general practitioners.

What concerns the robotics-empowered applications in the physical branch, they are also expected to increase effectiveness of healthcare workers in hospital operations (delivering medications, cleaning hospitals), medical procedures (assisting doctors in surgery) and elderly patient care[324]. However, scholars point out the methodological and empirical gap in evidence on the potential of service robots for hospitals and care facilities. Instead, most studies on the adoption of robotic applications and devices in healthcare report the normative or prescriptive views of policy makers and technologists[325].

Second, digital innovations in healthcare hold a potential to **improve healthcare quality**, especially when it comes to healthcare analytics, e-delivery, personalisation and social media:

- **Macro level analysis** of public health risks can enable well-targeted **pre-emptive action** to avoid disease outbreaks. For instance, a research team in Scotland predicted a chicken pox epidemics outbreak by analysing Google search trends, which helped the government to take appropriate actions on time[326]. Similarly, Chicago Department of Public Health developed a model to predict families that are more likely to be poisoned and applied it to prioritise a response[327]. Another study shows that an adoption of disease surveillance systems based on machine learning algorithms led to more than 90% reduction in outbreaks of norovirus in hospitals in Hampshire, UK[328].
- **Healthcare analytics** can lead to discovery of more **effective, personalised treatment of patients**, spotting symptoms and predicting treatments to which patient is more likely to respond[329].
- **Continuous monitoring and evaluation** of health programmes (including enabled by OGD initiatives) help to ensure that patients receive their annual care checks and achieve their treatment targets[330]. Patient portals, online medical consultations and social media are the new channels of care delivery offering increased access to information and seen as potential enablers of patient empowerment[331].
- **Richer communication** through social media and other ICT-based channels is associated with the empowerment of patients[332]. For example, a study on the impacts of social media in the Danish public healthcare sector found that 'health informatics tools can enhance the continuity of care, through the patients' increased ability to stay in control, which reduces the dependence on the healthcare professionals'[333].

---

320 Tinholt, D., Carrara, W., & van der Linden, N. (2017). Unleashing the potential of Artificial Intelligence in the Public Sector. *Capgemini Consulting*.

321 Bosanquet, N., & Evans, E. (2014). Sustaining universal healthcare in the UK: making better use of information. *Volterra.*

322 Andersen, K. N., Medaglia, R., & Henriksen, H. Z. (2012). Social media in public health care: Impact domain propositions. *Government Information Quarterly*, 29(4), 462-469.

323 Doan, A., Ramakrishnan, R., & Halevy, A. Y. (2011). Crowdsourcing systems on the world-wide web. *Communications of the ACM*, 54(4), 86-96.

324 Mettler, T., Sprenger, M., & Winter, R. (2017). Service robots in hospitals: new perspectives on niche evolution and technology affordences. *European Journal of Information System,* 26(5), 451-468.

325 Hägele, M. (2016). Robots Conquer the World [Turning Point]. *IEEE Robotics & Automation Magazine*, 23, 120-118.

326 University of Aberdee., (2016). Researchers use Google trends to predict chicken pox outbreaks. Retrieved from https://www.abdn.ac.uk/news/9236

327 Potash, E., Brew, J. et al. (2016). Predictive Modeling for Public Health: Preventing Childhood Lead Poisoning. In *Proceedings of the 21th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining*.

328 Mitchell, C., Meredith, P. et al. (2016). Reducing the number and impact of outbreaks of nosocomial viral gastroenteritis: Time-series analysis of a multidimensional quality improvement initiative. *BMJ Quality and Safety*, 25(6), 466–474.

329 Horgan, D. (2018). From here to 2025: Personalised medicine and healthcare for an immediate future. *European Allaince for Personalised Medicine;* Nimmesgern, E., Benediktsson, I., & Norstedt, I. (2017). Personalized medicine in Europe. *Clinical and translational science*, 10(2), 61-63.

330 NHS Digital, (2019). National Diabetes Audit. Retrieved from https://digital.nhs.uk/data-and-information/clinical-audits-and-registries/national-diabetes-audit

331 Andersen, K. N., Medaglia, R., & Henriksen, H. Z. (2012). Social media in public health care: Impact domain propositions. *Government Information Quarterly*, 29(4), 462-469; Jung, C., & Padman, R. (2015). Disruptive Digital Innovation in Healthcare Delivery: The Case for Patient Portals and Online Clinical Consultations. In *The Handbook of Service Innovation* (pp. 297-319)

332 Ibid.

333 Bjørnes, C. D. (2011). The patients' health informatics tool-Exploring the possibilities. A Web 2.0 application for men with prostate cancer. *Virtual Centre for Health Informatics*, Aalborg University, Aalborg.

Nonetheless, empirical evidence is scarce and inconclusive, especially regarding the questions of changes in **actual health outcomes**. A systematic literature review on the effect of patient portals on clinical care carried out by Goldzweig et al[334], found mixed evidence about the effect of portals on patient health outcomes, satisfaction, health care utilisation and efficiency. They also reported on the digital divide in patient portal use. Another systematic review of the experimental and quasi-experimental studies on the impact of patient portals on patient care concluded that there is insufficient evidence that patient portals empower patients and improve quality of care, highlighting that the number of available controlled studies with regard to patient portals is low (only five publications from four studies met the eligibility criteria of this study)[335]. Nonetheless, some studies also report the empowerment effects of online medical support and consultations on patients to become more actively involved in their health management and decision-making processes in case of patients with chronic conditions[336]. Similarly, a systematic review into effects and effectiveness of assistive robots in elderly care found that most studies on the subject report positive effects on (socio)psychological (e.g. mood, loneliness, and social connections and communication) and physiological (e.g. stress reduction) parameters. However, the methodological quality of the studies was mostly low.

Besides the desired effects, the literature covers multiple **challenges** linked to the adoption of AI in public healthcare. Based on interviews with stakeholders, Sun and Medaglia[337] group the perceived challenges into seven dimensions: social; economic; ethnical; political, legal and policy-related; organisational and managerial; data; and technological. A number of authors also talk about issues with privacy and security[338], major problems with the quality of data feeding into AI algorithms and resulting misinterpretations[339], as well as exacerbation of existing disparities in healthcare accessibility[340] due to the digital divide[341]. Finally, issues exist on the demand side as well: results of online surveys show, for example, that not all people are comfortable with having a robot providing them services and companionship when infirm or elderly[342].

3.4.2 Public safety and security

In the public safety and security domain, the reviewed literature examines the use of predictive analytics in services such as policing and fire, mostly linked to gains in effectiveness and efficiency, but also presenting some cautionary findings.

Predictive technologies, powered by machine learning, enhance the ability of law enforcement authorities to predict crimes, identities of offenders and perpetrators as well crime victims: where, when and by whom crimes are more likely to be committed[343]. While there has not been much formal evaluation of predictive policing methods, findings based on practitioners' experience and use cases point to both positive and negative effects.

On the one hand, predictive technologies allow police to work more proactively with limited resources (while studies on the effectiveness of policy work show that pro-activeness leads to better results[344]) and allow for better tailored interventions to actual crime problems[345]. For instance, Rutgers Center on Public Security together with local police forces in several cities in the US developed and evaluated the 'Risk Terrain Modelling' method. It allows police to allocate officers to crime hotspots more effectively and deter crime before it occurs by telling the police where and when an offence is likely to be committed.

---

334 Goldzweig, C. L., Orshansky, G. et al. (2013). Electronic patient portals: evidence on health outcomes, satisfaction, efficiency, and attitudes: a systematic review. *Annals of internal medicine*, 159(10), 677-687.

335 Ammenwerth, E., Schnell-Inderst, P., & Hoerbst, A. (2012). The impact of electronic patient portals on patient care: a systematic review of controlled trials. *Journal of medical Internet research*, 14(6).

336 Cummings E, Chau S, Turner P (2009) Assessing a patient-centered e-health approach to chronic disease self-management. In: Wilson EV (ed) *Patient-centered e-health* (pp. 168–185). IGI Global, Hershey; Jung, C., & Padman, R. (2015). Disruptive Digital Innovation in Healthcare Delivery: The Case for Patient Portals and Online Clinical Consultations. In *The Handbook of Service Innovation* (pp. 297-319)

337 Sun, T. Q. & Medaglia, R. (2018). Mapping the challenges of Artificial Intelligence in the public sector: Evidence from public healthcare. *Government Information Quarterly*, 1–16.

338 Science and Technology Committee. (2016). The big data dilemma. Fourth Report of Session 2015-16. *UK House of Commons.*

339 Science and Technology Committee (2018). Algorithms in decision-making. Science and Technology Committee. *UK House of Commons.*

340 Jung, C., & Padman, R. (2015). Disruptive Digital Innovation in Healthcare Delivery: The Case for Patient Portals and Online Clinical Consultations. In *The Handbook of Service Innovation* (pp. 297-319)

341 Goldzweig, C. L., Orshansky, G. et al. (2013). Electronic patient portals: evidence on health outcomes, satisfaction, efficiency, and attitudes: a systematic review. *Annals of internal medicine*, 159(10), 677-687.

342 European Commission. (2017). Attitudes towards the impact of digitisation and automation on daily life. *European Commission*. Retrieved from https://ec.europa.eu/digital-single-market/en/news/attitudes-towards-impact-digitisation-and-automation-daily-life

343 Horvitz, E. (2016). Artificial intelligence and life in 2030. *Stanford University*.

344 Telep, C. W. (2009). Police interventions to reduce violent crime: a review of rigorous research. *Fairfax, Va.: Center for Evidence-Based Crime Policy*, George Mason University.

345 Perry, W. L., McInnis, B. et al. (2013). Predictive Policing: The Role of Crime Forecasting in Law Enforcement Operations. *RAND.*

According to the analysis of its results, Risk Terrain Modelling has helped to reduce gun crimes by 35% in Newark, vehicle theft by 33% in Colorado Springs, and contributed to a more than 40% reduction in robberies in Glendale, Arizona[346]. Another study by Goldsmith and Crawford report a 27% reduction in burglaries and 19% reduction in property theft enabled by AI-based analytics tool to predict hotspots in various US cities[347].

Nonetheless, the reported benefits go in line with risks: while on the one hand policing might become more targeted, on the other, it may become overbearing or pervasive raising concerns over the widespread surveillance and ultimately privacy issues[348]. Scholars also disagree on whether the AI prediction tools can remove or reduce human bias as opposed to introducing, reinforcing or perpetuating it. Research suggests that vulnerable communities (such as the poor) are disproportionately susceptible to big data discrimination[349]. Biased policing techniques (such as broken windows policing) may disproportionately impact poor neighbourhoods and racialised communities, and contribute to biased police data, which raise serious concerns for civil rights[350] (see more details in Section 3.5).

The less contentious AI-enabled technology impacts are reported in hospital, fire and natural disaster emergency services. Use cases in the US show that data analytics can enable more efficient 911 responses by better allocating the scarce resources of ambulances and improve operational efficiency[351] and increase efficiency in identifying and prioritising commercial property fire inspections[352]. The Disaster Reporter app in the US, which gathers and analyses information from social media and triangulates it with data from GIS, sensors, big data, bio-data, and environmental data, assists the resource allocation and response strategies needed in the disaster area[353]. In the aftermath of the earthquake in Emilia Romagna, Italy, real time data was also used to find housing solutions for victims[354].

3.4.3 Smart cities

Many cities are becoming 'live laboratories' as data intensive technologies like AI and IoT are integrated into the operation of public infrastructure and spaces as a means of optimising public services[355]. The literature mostly covers stories of success and points to the potential of ICT enabled innovations to improve cities' resilience and sustainability[356]. The reviewed scientific literature describes a range of services and their provision in the smart city context, mostly through individual case studies. These range from transportation to waste management. While significant, the yet not fully untapped nor systematically researched potential of ICT application in urban services is linked – as in other ICT applications discussed in this review – mostly to service improvement and efficiency gains[357].

---

346 Apolitical. (2017). US police use fata to focus on places, not people, and cut crime by up to 40%. Retrieved from https://apolitical.co/solution_article/us-police-use-data-focus-places-not-people-cut-crime-40

347 Goldsmith, S., & Crawford, S. (2014). *The responsive city: Engaging communities through data-smart governance*. John Wiley & Sons.

348 Horvitz, E. (2016). Artificial intelligence and life in 2030. *Stanford University.*

349 Gangadharan, S. P., Eubanks, V., & Barocas, S. (2014). Data and discrimination: collected essays. *Open Technology Institute & New America*; Newman, N. (2014). How Big Data Enables Economic Harm to Consumers, Especially to Low-Income and Other Vulnerable Sectors of the Population. *US Federal Trade Commission*; Barocas, S., & Selbst, A. (2016). Big Data's Disparate Impact. *California Law Review,* 104(1), 671-729; Madden, M., Gilman, M. et al. (2017) Privacy, Poverty, and Big Data: A Matrix of Vulnerabilities for Poor Americans. *Washington University Law Review*, 95(1).

350 Hunt, P., Saunders, J., & Hollywood, J. S. (2014). Evaluation of the Shreveport Predicitve Policing Experiment. *RAND*; Angwin, J., Larson, J. et al. (2016). Machine Bias. *ProPublica*. Retrieved from https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing; Lum, K., & Isaac, W. (2016). To predict and serve? *Significance*, 15-19; Obar, J., & McPhail, B. (2018). Preventing Big Data Discrimination in Canada: Addressing Design, Consent and Sovereignty Challenges. *Data Governance in the Digital Age: Special Report*, 56-64.

351 Wiseman, J., & Goldsmith, S. (2017). Ten great ways data can make government better. *Data-smart city solutions, Harvard Kennedy School Ash Center for Democratic Governance and Innovation*. Retrieved from https://datasmart.ash.harvard.edu/news/article/ten-great-ways-data-can-make-government-better-1041;

352 Madaio, M., Chen, S.-T. et al. (2016). Identifying and prioritizing fire inspections: a case study of predicting fire risk in Atlanta. *Georgia Tech, College of Computing*.

353 Bertot, J., Estevez, E., & Janowski, T. (2016). Universal and contextualized public services: Digital public service innovation framework. *Government Information Quarterly*, 33, 211-222.

354 UN Department of Economic and Social Affairs. (2018). UN E-Government Survey 2018. *United Nations.*

355 Bass, T., Sutherland, E. & Symons, T. (2018). Reclaiming the Smart City. *Nesta; Naafs, S. (2018).* 'Living laboratories': the Dutch cities amassing data on oblivious residents. Retrieved from https://www.theguardian.com/cities/2018/mar/01/smart-cities-data-privacy-eindhoven-utrecht

356 UN Department of Economic and Social Affairs. (2018). UN E-Government Survey 2018. *United Nations.*

357 @Gov Inspiring Innovative Government. (2017). Data driven government. *KPMG @gov*; CA Technologies, & Deloitte. (2018). Building our cities smarter: How APIs Take Smart Cities From Concept to Value; McKinsey Global Institute. (2018). Smart Cities: Digital Solutions for a More Livable Future; PwC. (2016). From conectp to applied solutions. Data-driven cities

Many authors discussing the effects of digitalisation in the context of smart cities relate it to the possibilities that can be unleashed by IoT. This technology has made possible the recent implementation of smart grids[358], smart transportation[359], smart healthcare[360], which are the building blocks of the smart cities concept[361].

Telecommunication companies, consultancy firms and researchers speak of the **potential of IoT** to transform city services, primarily through changing how government entities gather data. The analysis of this information enables public officials to:

- **Improve services** by basing them on real-time information, which can improve trust between government and citizens.
- **Increase citizen safety** through faster and more effective emergency response, and monitoring of streets and other public areas.
- **Optimise the use of infrastructur**e, reduce congestion and energy use through leveraging real-time data to meet the changing demands (e.g. by reacting quickly to fast-changing traffic patterns).
- **Improve operational performance, management and maintenance** through proactive monitoring of critical public infrastructure and optimisation of processes[362].

Besides IoT, digital technologies, often based on **geo-spatial data, allow citizens to articulate their demands**. For example, websites and apps such as Tvarkau miestą[363], FixMyCity[364] and Tu Bogotá[365] enable residents in their respective cities to report incidents related to municipal affairs, from issues with stray pets to public transport, by selecting a specific place on the map where the issue has occurred. Citizens can upload pictures to illustrate their complaints. Understanding citizens' demands helps governments respond faster and more effectively.

Tracking statistics on citizens' requests over time can help policy-makers inform strategies for cities' development and become more responsive. Applications enabled by geo-spatial data are also inherently democratic: everyone can voice their opinions about what needs to be fixed[366].

Nonetheless, governments are often criticized for employing IoT technologies and sharing geo-spatial data over privacy concerns. In Toronto, for example, Alphabet's subsidiary Sidewalk Labs and a publicly-mandated Waterfront Toronto in 2017 made plans to develop a 12-acre area into a smart neighbourhood, but the project received public rebuke when Sidewalk Labs failed to assure the public that personal data will not be accessible to third parties[367]. Similarly, in 2013, Seattle's Police Department implemented wireless sensors throughout the city to provide better emergency response, but then faced backlash because sensors could be used to track people's wireless devices[368].

---

358 Chen, S.-Y., Song, S.-f, Li, L., & Shen, J. (2009). Survey on smart grid technology. *Power System Technology*, 33(8), 1-7.

359 Adeli, H., & Jiang, X. (2009). *Intelligent infrastructure: neural networks wavelets, and chaos theory for intelligent transportation systems and smart structures*. CRC Press.

360 Anisetti, M., Ardagna, C. et al. (2018). Privacy-aware Big Data Analytics as a Service for Public Health Policies in Smart Cities. *Sustainable Cities and Society*; Demirkan, H. (2013). A smart healthcare systems framework. *IT Professional*, 15(5), 38-45.

361 Caragliu, A., Del Bo, C., & Nijkamp, P. (2011). Smart cities in Europe. *Journal of Urban Technology*, 18(2), 65-82; Chourabi, H., Nam, T. et al. (2012). Understanding Smart Cities: An Integrative Framework. In *45th Hawaii International Conference on System Sciences (2012)*; Hashem, I.A.T, Chang, V. et al. (2016). The role of big data in smart city. *International Journal of Information Management*, 36(5), 748-758.

362 Rabari, C., & Storper, M. (2014). The digital skin of cities: Urban theory and research in the age of the sensored and metered city, ubiquitous computing and big data. *Cambridge Journal of Regions, Economy and Society*, 8(1), 27-42.; Bass, T., Sutherland, E. & Symons, T. (2018). Reclaiming the Smart City. *Nesta*; PwC. (2016). From connect to applied solutions. Data-driven cities; national Infrastructure Commission. (2018). Data for public good; McKinsey Global Institute. (2018). Smart Cities: Digital Solutions for a More Liveable Future; Ju, J., Liu, L., & Feng, Y. (2018). Citizen-centered big data analysis-driven governance intelligence framework for smart cities. *Telecommunications Policy*, *42*(10), 881-896; CA Technologies, & Deloitte. (2018). Building our cities smarter: How APIs Take Smart Cities From Concept to Value; Atos. (2015). Data driven government. Preparing for the age of the citizen; Mora, L., Deakin, M., & Reid, A. (2018). Strategic principles for smart city development: A multiple case study analysis of European best practices. *Technological Forecasting and Social Change*; Ojo, A., Curry, E., Janowski, T., & Dzhusupova, Z. (2015). Transforming city governments for successful smart cities - the SCID framework. *Transforming City Governments for Successful Smart*, 43-65; UN General Assembly. (2016). Preparatory Committee for the United Nations Conference on Housing and Sustainable Urban Development (Habitat III). *United Nations*.

363 Tvarkau miesta. (n.d.). Retrieved from https://tvarkaumiesta.lt/new_problem

364 Fixmycity Greece. (n.d.). Retrieved from http://glyfada.intelligentcity.gr/

365 Tu Bogotá. Retrieved from http://www.idecabogota.appspot.com/main.html

366 Barrenechea, M. J., & Jenkins, T. (2014). e-Government or Out of Government. *Open Text.*

367 Bass, T., Sutherland, E. & Symons, T. (2018). Reclaiming the Smart City. *Nesta.*

368 Crump, C. (2016). Surveillance policy making by procurement. *Berkley Law.*

3.4.4 The general effects of digitalisation in public services

AI, distributed ledger and new technologies for data collection, sharing and analysis create opportunities for **innovative service design** that would have not been possible without ICTs. Such developments well illustrate the transformative effects of digitalisation in public sector. Quite often the literature presents the introduction of an innovative service as a positive and valuable development by itself.

As the review above illustrates, **cost savings and efficient, more effective service delivery** is the most often-repeated (although often speculative in nature) argument when investigating the adoption of digital technologies in the public services. In addition to what was mentioned above, Eggers et al argue that cognitive technologies offer a simultaneous improvement in speed, quality and cost reduction[369].

According to many authors, effects of AI in public services range from higher voluntary tax compliance, predicting and discouraging fraudulent transactions (benefits fraud), freeing up or eliminating labour hours by government workers, to identifying criminal suspects using facial recognition and so on.

Similar benefits are also seen in the applications of technologies such as distributed ledger. Government agencies across the world are experimenting with blockchain-based applications for government service provision and procurement. In public service provision, blockchain has potential application for record and identity management, taxes and remittances[370].

It seems that **higher service quality and user satisfaction** quite often remains a secondary argument, although it is often emphasised in the most recent studies. It is also closely related to the improvements in effectiveness and service delivery, described above. For example, Scholta et al[371] propose that a transition from a one-stop shop to a no-stop shop, where the citizen does not have to perform any action or fill in any forms to receive government services, will contribute to solving two issues. First is the fact that citizens still perceive forms as cumbersome; second, citizens expect governments to act proactively by initiating appropriate government services themselves, instead of relying on requests.

Other examples of current AI practices and applications in the public sector demonstrate the potential of AI to improve service quality through service personalisation, as analytics allows to better understand the needs of citizens, e.g. in case of personalised education, predictive healthcare, improved traffic management[372]. In addition to quality improvements, case studies of public service innovations across the different social welfare areas report greater user satisfaction, cost reductions, and even increased autonomy and empowerment[373].

More quality, effectiveness and efficiency in public services, in turn, are expected to lead to better outcomes and **broader societal effects.** The studies presented above hint – although often without conclusive evidence – to better health outcomes, increased public safety and reduced pollution as a result of technology applications.

Tinholt et al.[374] go as far as to suggest that AI, given its ability to process and analyse vast amounts of data avoiding discrimination and decision-making biases, can improve the reliability and accuracy of services across the different public sector domains and ultimately lead to more equality.

Other authors also emphasise the prospects of digital technologies to promote the socio-economic inclusion of marginalised groups such as persons with disabilities[375], make education more inclusive, especially in case of disabled students[376]. In the context of smart cities, technology can promote inclusion through citizen involvement in reporting local issues and needs[377].

---

369 Eggers, W. D. (2017). AI-augmented government. AI-augmented government. Using cognitive technologies to redesign public sector work. *Deloitte Center for Government Insights*.

370 UN Department of Economic and Social Affairs. (2018). UN E-Government Survey 2018. United Nations.

371 Scholta, H., Mertens, W., Kowalkiewicz, M., & Becker, J. (2019). From one-stop shop to no-stop shop: An e-government stage model. *Government Information Quarterly*, 36(1), 11-26.

372 Tinholt, D., Carrara, W., & van der Linden, N. (2017). Unleashing the potential of Artificial Intelligence in the Public Sector. *Capgemini Consulting*.

373 OECD (2016), Digital Government Strategies for Transforming Public Services in the Welfare Areas, OECD Comparative Study, 2016.

374 Tinholt, D., Carrara, W., & van der Linden, N. (2017). Unleashing the potential of Artificial Intelligence in the Public Sector. *Capgemini Consulting*.

375 Chen, J. (2018), 'New technology is key to overcoming disability exclusion – but the most important tech is centuries old'. Available at https://medium.com/@James.Chen/new-technology-is-key-to-overcoming-disability-exclusion-but-the-most-important-tech-is-centuries-e5fd9ad6538

376 Mead, K. (2018), 'The Role of Accessible Technology in Inclusive Education'. Available at http://www.mcie.org/blog/the-role-of-accessible-technology-in-inclusive-education

377 World Bank. (2016). World Development Report 2016: Digital Dividends. Washington, DC:, doi:10.1596/978-1-4648-0671-1.

Nonetheless, others also warn about the opposite effects. Examples of discrimination and biases by algorithms are documented, and scientists caution about machine learning being used to make predictions affecting people's lives[378]. While having significant potential, AI solutions do not necessarily bring neutrality and objectivity to citizens and can create a sense of lacking control among the citizens and public sector employees[379]. Some scholars also raise concerns over the "growing and troubling unchecked global consensus around the merits of technocratic governance and data-driven decision making, an approach that informs the creation of government software" threatening to normalise the efficiency obsession[380]. The literature on AI-enabled public services highlights the issue of privatisation of policy development and public service delivery linked to the increased information asymmetry as governments are purchasing proprietary products and services that they do not understand nor can build themselves[381] (see more information in the following section).

3.5 Risks and negative effects

Although some negative effects of technology adoption have been mentioned in the reviewed literature on citizens' engagement, policy making, public administration, and public services, in general the potential benefits and positive effects figured more prominently, reflecting the ongoing 'hype' about new technologies. In this section, we focus exclusively on the negative effects regarding digitalisation of the public sector to bring balance to the overall discussion.

Research has begun to identify the manifold challenges faced in the public sector, spotlighting labour replacement, data management, quality, ethics and privacy concerns.[382] Largely intertwined in all government functions, concerns ask for a more exhaustive scrutiny focusing on negative digitalisation effects on civil societies and governments. Thus, this section reviews key adverse effects, covered most widely in the literature:

- Labour redundancy in the public sector;
- Technological bias, unfairness, and discrimination;
- A growing accountability gap; and
- Threats to data privacy.

3.5.1 Labour redundancy in the public sector

Given the potential application of AI to analyse public opinion, inform public policy, analyse trends, direct the police to areas where crime is most likely to occur and so on (see earlier sections in this chapter), it is worth considering what will happen to public sector employees who currently perform these functions. Although literature on the new technologies and public sector employment is relatively scarce, scholarship on automation more generally, which began to evolve with eGovernment 1.0, is still relevant in this field today.

In order to assess the impact of automation on public sector employment, it is important to understand the routine-biased technical change (RBTC)[383] theory. It posits that new technologies will be used to replace **routine tasks**, defined as tasks - both manual and cognitive - that can be accomplished by machines using explicit programmed rules[384]. Estimates on the share of public sector employees that primarily perform routine tasks in the EU are not available to allow to estimate the potentials risks of this change. Nonetheless, such risk has been discussed in the literature, along with another possibility, mentioned in Section 3.1: that only the routine tasks will be replaced by machines, allowing more time for public sector workers to perform non-routine work.

---

378 Devlin, H. (2016). Discrimination by algorithm: scientists devise test to detect AI bias. *The Guardian*. Retrieved from https://www.theguardian.com/technology/2016/dec/19/discrimination-by-algorithm-scientists-devise-test-to-detect-ai-bias

379 Tinholt, D., Carrara, W., & van der Linden, N. (2017). Unleashing the potential of Artificial Intelligence in the Public Sector. *Capgemini Consulting*.

380 Medhora, P. R., Awad, B., Boettger, S. et al. (2018). Data Governance in the Digital Age. *Centre for International Governance Innovation*.

381 Ibid.

382 Fredriksson, C., Mubarak, F., Tuohimaa, M., & Zhan, M. (2017). Big data in the public sector: A systematic literature review. *Scandinavian Journal of Public Administration*, 21(3), 39-62.

383 Autor, D. H., Katz, L. F. and Kearney, M. S. (2006), 'The polarization of the US labor market,' *American Economic Review Papers and Proceedings*, Vol. 96, No. 2, pp. 189–194; Goos, M. and Manning, A. (2007), 'Lousy and lovely jobs: The rising polarization of work in Britain', *Review of Economics and Statistics,* Vol. 89, No. 1, pp. 118–133.

384 Autor, D. H., Levy, F., & Murnane, R. J. (2003). The Skill Content of Recent Technological Change: An Empirical Exploration. *The Quarterly Journal of Economics*, 118(4), 1279–1333. doi:10.1162/003355303322552801.

To answer which of these effects - job or routine task replacement - is more likely to occur for different types of public sector employees, Frey and Osborne[385] classified public sector employment into three groups:

- Administrative and operative roles, which include administrative but also certain physical jobs such as hospital porters;
- Interactive and frontline roles, such as teachers, social service workers and police officers;
- Cognitive roles, which mostly apply to management positions.

Frey and Osborne argue that technology will likely to replace jobs in the first—administrative and operative group—by 2030. In the UK, these jobs account for roughly a quarter of all public sector employment.[386] Given how rapidly projected replacement can occur and its large extent, governments should consider ways to cushion the impact felt by public sector workers who are likely to lose their jobs.

Regarding interactive and cognitive roles, the scholars argue that technology will more likely replace some routine tasks in these jobs, complementing existing employment. That is because interactive and cognitive roles require both routine and non-routine tasks. Automated robots, for example, can measure patients' vital signals, but cannot interact with patients the same way nurses can.

Furthermore, there is some evidence from the US that jobs in the public sector performed by females and non-whites are more likely to be subject to automation, challenging the public administration's commitment to equity and diversity if it promotes public sector innovation.[387] Also, even if jobs are not replaced, job satisfaction might decrease: literature cautions that the overreliance on AI creates a sense of lacking control among the citizens and public sector employees.[388]

It is nevertheless important not to exaggerate the negative effects on public sector employment. Research on Northern Ireland shows that jobs in public administration, education and health are at the lowest risk of automation compared to other sectors.[389] Theoretical considerations instead suggest that automation will enhance the productivity of the public sector, which will allow for more job creation, compensating at least in part for the job losses.[390] Nevertheless, these considerations lack empirical evidence. Finally, jobs replaced by automated robots will likely yield savings not only in terms of payroll, but also real estate,[391] which could allow to create more non-routine jobs.

3.5.2 Technological bias, unfairness and discrimination

Even without human involvement, technology can produce biased results. Analysing independently and starting to learn from their environments, advanced algorithms may introduce unconscious biases by excluding or not including some individuals from the start, such as those who have the least and no access to technology.[392]

Some authors also warn that automatic grouping of particular individuals or contexts that make further correlations misrepresents individuals as such,[393] reshaping the notion of individualistic identity, and transforming into collectively grouped behaviours and consumptions.[394]

A relevant real life illustration is Canada's immigration and refugee system, raising serious human rights concerns as technology loses the sense of complex and nuanced situations resulting in unjust deportations and visa rejections[395].

---

[385] Deloitte (2017). The State of the State: Government through business lenses. Retrieved from: https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/public-sector/deloitte-uk-government-through-talent-lenses.pdf

[386] Ibid.

[387] Borry, E. L., & Getha-Taylor, H. (2018). Automation in the Public Sector: Efficiency at the Expense of Equity? Public Integrity, 1–16.

[388] Tinholt, D., (2017). Unleashing the potential of Artificial Intelligence in the Public Sector. Capgemini Consulting.

[389] Mac Flynn, P. & Wilson, L. (2019). The Future of Work: The impact of automation technologies for job quality in Northern Ireland. NERI Working Paper Series. NERI: Dublin, 19.

[390] Arntz, M., Gregory, T. and Zierahn, U. (2016) 'The Risk of Automation for Jobs in OECD Countries'. OECD Social, Employment and Migration Working Papers. Paris: Organisation for Economic Co-operation and Development.

[391] Deloitte (2017). The State of the State: Government through business lenses. Retrieved from: https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/public-sector/deloitte-uk-government-through-talent-lenses.pdf

[392] Pencheva, I., Esteve, M., & Mikhaylov, S. J. (2018). Big Data and AI–A transformational shift for government: So, what next for research?. *Public Policy and Administration*, 0952076718780537.

[393] Williamson, B. (2014). Knowing public services: Cross-sector intermediaries and algorithmic governance in public sector reform. Public Policy and Administration, 29(4), 292-312.

[394] European Economic and Social Committee (2017). The ethics of Big Data: balancing economic benefits and ethical questions of Big Data in the EU policy context. Retrieved from: https://www.eesc.europa.eu/resources/docs/qe-02-17-159-en-n.pdf

[395] Molnar, P. & Gill, L. (2018). Bots at the Gate: a human rights analysis of automated decision-making in Canada's immigration and refugee system. International Human Rights Program & Citizen Lab.

Technological shortcomings may also occur because of poor quality of technologies. A number of real-life examples already exist. For example, researchers at the University of California Berkeley tested Amazon Rekognition – an intelligent face recognition tool the tool, which incorrectly matched 28 US Congress members with a database of arrested people.[396] This suggests that the incorrect facial recognition match biases an individual before the encounter. It also leads to false identifications and correlations crucial in taking further actions.

Another example is IBM's search by skin tone technology for NYPD, which was eventually phased out in 2016.[397] Quite often police officers would ask individuals to report to police station because of a generic physical characteristics match. These system mismatches increased opportunities for negative effects, such as racial biases and groups targeting.

Similarly, a notable investigation by NGO Pro Publica found that a risk assessment software used across the US was biased against black defendants[398]. Meanwhile, the Los Angeles Police Department's tool predicting the likelihood of a next crime PredPol is suspected of reinforcing racial discrimination by directing police officers to black neighbourhoods instead of zeroing on the drug crime scene[399]. The adoption of these tools, often with very little public consent and knowledge, endangers the notions of democracy, civil liberties and human rights.

Besides these aspects, Automated Decisions Systems (ADS), which government domains have come to adopt in its functions, present further dangers. Since ADS are relatively new, governments have not yet thoroughly assessed and evaluated this technology. With the main goal of efficiency, the use of this technology often comes at the expense of the most vulnerable populations, since ADS technology may disregard important nuances in predictive analysis and skew results. For instance, in 2013, ADS misidentified the policy target group in Los Angeles County. While assessing and predicting the likelihood of children in danger, ADS failed to create a comprehensive family picture and misidentified a family at-risk resulting in a child's death.[400] Automated decision making in Canada's immigration and refugee system misses the complexity in nuanced situations resulting in unjust deportations and visa rejections.[401] Evidence shows that untested and poorly designed technologies could result in unfair, discriminative and ethically concerning effects within government systems, which also makes it difficult to question or remedy bad decisions and errors at a later stage.

3.5.3 A growing accountability gap

The new era of digital transformation has shown that private sector has taken an undisputed lead in adopting new technologies, so it is often advantageous for public agencies to form public-private partnerships to tap into the knowledge already accumulated in private organisations. However, some authors argue that private sector leadership in digitalisation threatens to create a power asymmetry between public authorities and private companies.[402] For example, already in 2014, the Danish Ministry of Tax declared to have no control of over more than 200 systems, which used machine learning algorithms in policy making to directly affect citizens.[403]

Scholars also suggest that smart cities are becoming overly dependent on private companies.[404] For example, in the Netherlands, Utrecht's smart city pilots and projects entirely rely on private companies.[405] The local government is not aware how many sensors and cameras exist or what information private companies collect. Companies, in fact, are getting away with it because of their advanced technological developments and bold applications of data compared to public sector.

---

396 Snow, J., (2018). Amazon's face recognition falsely matched 28 members of Congress with mugshots. Retrieved from: https://www.aclu.org/blog/privacy-technology/surveillance-technologies/amazons-face-recognition-falsely-matched-28

397 Joseph, G., et al., (2018) IBM used NYPD surveillance footage to develop technology that lets police search by skin tone. Retrieved from:https://theintercept.com/2018/09/06/nypd-surveillance-camera-skin-tone-search/

398 Angwin, J., Larson, J. et al. (2016). Machine Bias. *ProPublica*. Retrieved from https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing

399 Smith, J., (2016). Crime-prediction tool may be reinforcing discriminatory policing. Business Insider. Retrieved from https://www.businessinsider.com/predictive-policing-discriminatory-police-crime-2016-10

400 Whittaker, M. et al (2018). AI now report 2018. Retrieved from https://ainowinstitute.org/AI_Now_2018_Report.pdf

401 Molnar, P. & Gill, L., (2018) Bots at the gate. A human rights analysis of automated decision-making in Canada's Immigration and Refugee system. University of Toronto & The Citizen Lab.

402 Whittaker, M. et al (2018). AI now report 2018. Retrieved from https://ainowinstitute.org/AI_Now_2018_Report.pdf

403 Popova, I., (2018). The good, the bad and the unintended of public sector. Digitalized Management. Retrieved from https://digitalizedmanagement.com/blog-eng/2018/11/21/the-good-the-bad-and-the-unintended-of-public-sector-digitalisation#_msocom_2

404 Bass, T., et al., (2018). Reclaiming the Smart City. Personal Data, Trust and the New Commons. Nesta. Retrieved from https://media.nesta.org.uk/documents/DECODE-2018_report-smart-cities.pdf

405 Naafs, S., (2018). 'Living labaratories': the Dutch cities amassing data on oblivious residents. The Guardian. Retrieved from https://www.theguardian.com/cities/2018/mar/01/smart-cities-data-privacy-eindhoven-utrecht

A Dutch CityTec case depicts how private companies are taking a full control and refuse to share collected data with city municipalities.[406] Outsourced decision making with dubious accountability and regulation effects has proven to be an alarming theme in government processes, questioning the extent to which governments should involve private sectors.

3.5.4 Threats to data privacy

Governments collect increasing amounts of data, and are increasingly criticised for employing digital data-driven technologies over preserving privacy concerns. At the same time, although open data is seen as a positive development, making government datasets publicly available may further threaten personal information disclosure, which can result in open profiling or data mining for various private purposes.[407]

A number of examples exist depicting a combined private and public sector's invasion into private lives. For instance, in 2013, Seattle's Police Department implemented wireless sensors throughout the city to provide better emergency response, but then faced backlash because sensors could be used to track people's wireless devices.[408] Swedish government experienced a leak of population's personal vehicle data, forcing the authorities to restrict outsourcing private and sensitive data to third parties.[409] In 2018, a hospital in Portugal received a fine for an indiscriminate access to, violation of and failure to ensure continued integrity and confidentiality of processed personal data of users.[410]

Such instances call to question how much power digital technologies award to governments, and how that power might impact democracies. Some authors – mostly of popular science literature – warn that government access to personal data can result in Big Brother type of surveillance, eliminating checks on government processes.[411] In fact, quite many times digital tools are employed with little public oversight, putting the basis for unethical personal data use practices.[412] These issues relate to important barriers and preconditions for big data use in government, further discussed in the following chapter.

3.6 Summary: Have digital innovations led to government transformation?

The synthetic overview of the empirical evidence on the effects presented in literature, as well as of the more prospective and prescriptive arguments, allows to distinguish between three very general groups of effects of the applications of most recent and emerging digital technologies in government:

- **Efficiency and productivity gains, cost-savings**. Applications of ICTs allow saving public resources or allocating them more efficiently. The body of literature on the economics of ICT in public sector provided the most conclusive evidence on actual (rather than *expected*) outcomes of digital technology applications. Effects, such as reducing operational and labour costs in public administrations, allowing staff to focus on more important tasks, making service delivery faster and cheaper, are more immediate and comparatively easier to measure as compared to the effects on, for example, government accountability or inclusion.
  At the same time, these direct effects are among the main drivers for introducing digital innovations, as we discuss in the next Chapter. As anticipated, there is a gap in terms of the possible negative side effects on jobs and employment. Already at a time of the first eGovernment wave, many talked about the redeployment of public sector employees to more added value tasks, which rarely occurred. These gains either remained virtual (no re-deployment), or led to layoffs, precarisation and flexibilization of public sector employment. The promise of personnel redeployment calls for new skills in government, as it does in industry in the perspective of Industry 4.0.
- **Effectiveness and quality improvements.** Besides making things cheaper, technologies also allow to make them better. Most of the reviewed sources also highlight – directly or indirectly – the effectiveness and quality of public sector operations, functions and services as a result of digital innovations in government. With more accurate prediction, real-time detection and tracking, improved

406 Ibid.
407 Scassa, T. (2014). Privacy and open government. Future Internet, 6(2), 397-413..
408 Crump, C. (2016). Surveillance Policy Making by Procurement. Washington Law Review, 91, 1595.
409 Joinup, (2017). Following security breach, Sweden shores up outsourcing rules. Retrieved from https://joinup.ec.europa.eu/news/following-security-breach-sw
410 Monteiro, M. A., (2019). First GDPR fine in Portugal issued against hospital for three violations. IAPP. Retrieved from https://iapp.org/news/a/first-gdpr-fine-in-portugal-issued-against-hospital-for-three-violations/
411 Everest-Phillips, M. (2018). *The Passionate Bureaucrat: Lessons for the 21st Century from 4,500 Years of Public Service Reform*. World Scientific Publishing Company Pte Limited.
412 Whittaker, M. et al (2018). AI now report 2018. Retrieved from https://ainowinstitute.org/AI_Now_2018_Report.pdf

resource allocation, better decision making, and personalised context-aware and context-smart services, powered by AI and other discussed technologies, governments can develop better, more inclusive and empowering services and policies. These, in turn, improve user satisfaction and solve problems of collective action.

— **Transparency, accountability, trust and legitimacy.** The outcomes of digitalisation in terms of more trustworthy governments and stronger democratic processes are also touched upon in the literature – although they are covered to a lesser extent and supported by weaker evidence. The definition of the impacts and their measurability in this dimension remains still vague and fragmented. While many sources point out several possible negative side effects, generally it is expected that better outputs of the government – in terms of administrative effectiveness, public services and daily interactions between citizens and public administration – should lead to more transparency, accountability and, ultimately, more legitimacy. Given such a long causal chain, these effects are even more difficult to evaluate empirically. Nonetheless, they remain among the core expectations from digitalisation in the public sector.

Important to note, these findings are quite in line with the trends of actual digital government initiatives and reform trends in the last ten years in the EU. The initiatives largely include programs to raise the efficiency and quality of public services, increase access to services and customer orientation, and encourage further ICT-enabled public sector innovation[413].

Nonetheless, measuring digital government transformation in terms of actual change introduced by ICT-driven innovations remains a challenging task. For example, in their systematic literature review of 181 articles on innovation in the public sector (published between 1990 and 2014), De Vries et al found that 40% of studies did not report outcomes, many articles focused on the positive effects of innovations and concluded that innovation is often considered as a value in itself[414]. Our literature review focusses on more recent research, but we observed very similar trends.

First, research on actual effects and impacts of technology in government still lacks comprehensive and conclusive evidence, and the reviewed literature – even the most recent articles – still talks about the transformative effects rather theoretically and normatively.

Second, the image of digital government transformation is often framed as simply the introduction of digital innovations, which are seen as a value or a positive development in itself. Fewer sources speak about transformation in terms of outcomes, caused by these innovations – which are also much more often incremental rather than disruptive. Related to this, the majority of reviewed sources are generally positive about the current and future impacts of digital transformation. As the lack innovations (especially of disruptive ones) is framed as the main problem, generally fewer sources talk about actual and potential problems caused by biased algorithms, insufficient data protection or privacy violations.

[413] Heichlinger, A., Thijs, N., Hammerschmid, G., & Attström, K. (2018). Public Public Administration Reform in Europe: Conclusions, lessons learned and recommendations for future EU Policy.

[414] De Vries, H., Bekkers, V., & Tummers, L. (2016). Innovation in the public sector: A systematic review and future research agenda. *Public administration*, 94(1), 146-166.

4 Drivers and barriers to digital government transformation

In this chapter we present the main findings from the literature addressing the drivers and barriers to the digital government transformation. Some authors adopted the umbrella concept of 'antecedents' to describe the influential factors in the public sector innovation process, arguing that antecedents can be either a driver or a barrier depending on their level and the specific context[415]. For instance, a general culture supportive of digital innovation can be a crucial factor for the digital transformation of the public sector, as it is partly exemplified by the case of Estonia[416]. At the same time, a risk-averse public administration culture can be a key aspect that impedes governments to fully embrace a digital transformation[417]. Even though we recognise that the same factor, as organisational culture in this case, can have opposite roles depending on the context, drivers and barriers are presented separately in this chapter to favour a clearer discussion of the literature reviewed.

In the previous chapters, the focus has been on technological innovations, taken as the main unit of analysis of the new wave of digital government transformation. However, we will show that while technological factors are certainly important antecedents, other types of innovations, such as organisational and regulatory changes[418], are also necessary preconditions for digital transformation to happen. For example, a case study explored later in this section on establishing legal parenthood in Sweden illustrated that digital service development indeed can drive transformation of government, but also that ongoing transformations in societal values can drive digitalization.

Moreover, the findings suggested that public digital service development need not only be leveraged by changing and redesigning the information technology, process and organisation layers, but that also the institutional layer may require redesign. Institutional change and redesign mean changes in the law, and in the way public accountability is realised, facilitated by transparency and openness. However, both changes are complex endeavours. A change to the law is not only challenging, as many different stakeholders need to be involved, but it is also difficult to sustain ongoing change rather than effectively creating new stovepipes. As laws are likely to enshrine public value rather than accommodate ongoing change, they are unlikely to become flexible for accommodating shifts in societal value. This may mean that the flexibility for accommodating these innovations needs to take place on other levels[419].

4.1 Drivers

Since the beginning of the research field, several scholars have discussed the many drivers behind the adoption and implementation of e-government initiatives. Overall, drivers can vary in size and impact and these can include the diffusion of electronic devices, reforming the public sector, reducing bureaucracy, reducing service costs, improving services delivery, empowering citizens, increasing accountability, enhancing transparency and many others[420]. Here we have focused only on the broad environmental drivers, and we divided the key drivers into three categories: political/social, economic and technological.

The first category of drivers includes **political and social factors**. We refer here to political factors as the degree to which the decisions to introduce technologies to digitalise public services or transform the policy-making process is influenced by the political environment and by citizens' demands. In fact, governments often seek to meet citizens' expectations in order to sustain or increase their legitimacy and approval. In many cases, these expectations come from technological developments already taking place in the private sector.

Authors noted that policy makers that adopted and implemented eGovernment initiatives have been influenced by the technological developments of the private sector which put governments under pressure to adopt eGovernment strategies. From the incorporation of ICTs to the digitalisation of some services, examples show how the public sector has sought to modernise and improve the way decisions are made and services delivered

415 De Vries, H., Bekkers, V., & Tummers, L. (2016). Innovation in the public sector: A systematic review and future research agenda. Public administration, 94(1), 146-166.

416 Kalvet, T. (2012). Innovation: a factor explaining e-government success in Estonia. Electronic Government, an International Journal, 9(2), 142.

417 Hardy, K. & Maurushat, A. (2017). Opening up government data for Big Data analysis and public benefit. Computer Law & Security Review, 33.

418 De Vries, H., Bekkers, V., & Tummers, L. (2016). Innovation in the public sector: A systematic review and future research agenda. Public administration, 94(1), 146-166.

419 Lindgren, I., & Van Veenstra, A. F. (2018). Digital government transformation: a case illustrating public e-service development as part of public sector transformation.

420 Meijer, A., & Thaens, M. (2010). Alignment 2.0: Strategic use of new internet technologies in government. Government Information Quarterly, 27(2), 113–121. Tung, L.L. and Rieck, O. (2005) Adoption of Electronic Government Services among Business Organizations in Singapore. Journal of Strategic Information Systems, 14, 417-440.

in order to keep pace with private sector developments[421]. As citizens experienced improved, personalised services, their expectations have grown significantly and created a social pressure on governments. Alongside this, service delivery has had to advance from an approach focused solely on service quality to a model that emphasises the delivery of better outcomes more efficiently[422].

In other cases, political and social changes towards a more open society, with calls from citizens for transparency and increasing role in democratic processes, also played a key role for government to adopt digital technologies[423]. Some authors have recently started exploring whether political participation represents a key driver for the diffusion of the most recent technologies in the public sector, noting that AI has the potential to radically change the existing political environment, empowering citizens through more diffused forms of political participation[424]. As citizens start realising that these technologies can drastically improve the democratic processes, their demands can represent a strong driver for governments to adopt them. Access to political outcomes are not the only demand from the government, as citizens also want transparency of the decision making itself and are developing a greater culture of interacting and participating during policy-making processes. Moreover, it is widely accepted in the literature that citizens are more empowered if they are able to access the publication of government-related activities in the public domain without any copyright restrictions for scrutiny and re-use[425]. Despite some challenges, open data initiatives could make governments more transparent about public expenditure, enhance accountability of public officials, and raise citizen awareness about specific issues[426]. As discussed already in Section 3.2, some authors even talk about citizen co-production, whereby citizens perform the role of partner rather than customer in the design and delivery of public services[427].

The second category of drivers, which has been the key focus of most of the analysis on the development of digital government transformation, include the **economic factors**. Many authors identified the economic objectives of internal efficiency, effectiveness, rationalization as simplification as the main rationale behind the adoption of digital technologies in government organisation, both at the early and later stages of their evolution[428]. With many governments moving towards higher levels of digitalisation, public bodies are quickly realising that technologies can facilitate more efficient and effective service delivery, dramatically improving public sector value. The expectations related to the most recent AI-based technologies, even though their economic benefits have not been properly evaluated, are especially high.

The expected cost savings are both direct and indirect in nature – i.e., relate to the lesser expenditure on administrative processes from the public budget, and improve efficiencies and enable citizens, businesses and administrators to complete tasks faster and with greater success rate. For instance, as discussed in previous sections, AI has been shown to speed up services, improve human accuracy, reduce the number of people necessary to fulfil specific tasks and organise sophisticated ideas via expertise analysis. Cognitive automation can perform tasks at previously impractical scales, speeds, and volumes, which allows for not only resource redistribution but workforce optimization: allocating the right resources to the right tasks[429]. Adaptation to IoT technologies and interoperability enables systems to work together, realising substantial cost savings[430]. Besides service delivery, the use of advanced technologies to inform decision-making across government provides a great opportunity for governments to achieve important economic and social benefits[431].

---

421 Tito, J. (2017). Destination unknown: Exploring the Artficial Intelligence on Goverment. Centre for Public Impact. Retrieved from https://publicimpact.blob.core.windows.net/production/2017/09/Destination-Unknown-AI-and-government.pdf

422 Daly, E., & Singham, S. (2012). Public Sector Delivery 2.0: The new challenge for governments. Retrieved from https://www.mckinsey.com/~/media/mckinsey/dotcom/client_service/public sector/pdfs/delivery2_oct_2012.ashx

423 Halachmi, A., & Greiling, D. (2013). Transparency, E-Government, and Accountability. Public Performance & Management Review, 36(4), 572–584.

424 Savaget, P., Chiarini, T., & Evans, S. (2018). Empowering Political Participation through Artificial Intelligence. Science and Public Policy, (1), 1–12.

425 Janssen, M., Charalabidis, Y., & Zuiderwijk, A. (2012). Benefits, Adoption Barriers and Myths of Open Data and Open Government. Information Systems Management, 29(4), 258–268.

426 Misuraca, G. & Viscusi, G. (2014). Is Open Data Enough? e-Governance challenges for Open Government. International Journal of Electronic Government Research, 10(1), 18–34.

427 Linders, D. (2012). From e-government to we-government: Defining a typology for citizen coproduction in the age of social media. Government Information Quarterly, 29(4), 446–454.

428 Janowski, T. (2015). Digital government evolution: From transformation to contextualization. Government Information Quarterly, 32(3), 221–236.

429 Eggers, W. D. (2017). AI-augmented government. Using cognitive technologies to redesign public sector work. Deloitte Center for Government Insights. Retrieved from https://www2.deloitte.com/content/dam/insights/us/articles/3832_AI-augmented-government/DUP_AI-augmented-government.pdf

430 World Bank. (2017). Internet of things. The new government to business platform. World Bank Group.

431 Pencheva, I., Esteve, M., Mikhaylov, J. S. (2018). Big Data and AI – A transformational shift for government: So, what next for research? Public Policy and Administration.

The third set of drivers behind the digital government transformation comprises **technological factors**, stemming from great recent advancements in ICTs. New available technologies, as well as technological cultures and practices greatly influence the expectations and drive for new eGovernment services, as well as new policy-making processes. As introduced in Section 2.4, the Hype cycle is one of the useful frameworks that helps explain how technological factors themselves can drive the digital transformation of governments. The model that explains the progression of an emerging technology from overenthusiasm through a period of disillusionment to an eventual understanding of the technology's relevance can be applied also to the public sector. There are in fact a number of scholars that explain the continuous attempts to adopt the most advanced digital innovations by governments. The new technologies always represent something more exciting to embrace, and the governments are more interested in adopting new emerging technologies than dealing with the failures of past ones[432]. Treating digital technology enabled innovations as valuable and beneficial by themselves also creates fundamental drivers.

Digital government transformation is driven also by the actual benefits that these technologies can bring. The ubiquity of ICTs, their increasing capacity to make connections and process, analyse and store data, as well as increasing ICT literacy and accessibility are all major drivers for open and digital government. For instance, the great advancement in mobile technology and the decreasing cost of smart mobile devices has acted as a strong driver to further develop open eGovernment services to be mobile compatible. An example of a successful implementation of mobile open eGovernment service was that in 2013, more than 300,000 French citizens used smartphones to make tax payments via a mobile application[433]. The fast-increasing technological capacity of smart phones, and the constant connection they offer, has allowed citizens to access public services 'on the go' and has driven a surge in civic and public authority app development for open eGovernment services.

4.2 Barriers and preconditions

The different barriers and preconditions for a successful digital transformation in the public sector are examined in research very extensively. Since the appearance of the first wave of eGovernment in the early 1990s, the literature has addressed the issue of the impediments to the adoption of digital technologies by governments and public agencies. Even though the focus of this study is on the most recent technologies, some of the typologies of such barriers have not changed substantially. In this section we briefly overview this current stay of play of research that specifically addresses the barriers and conditions of digital government transformation, with a special focus on the technologies and the effects of their adaptation in governments, discussed in the previous chapters. The barriers identified are often interrelated and do not stand alone.

Despite that the new technologies are expected to challenge virtually every process, system and structure of government[434], scholars have suggested that the current investments in new technologies for the public sector have led to incremental change rather than transformative shifts[435]. As many digital government projects failed[436], there is an open debate about the so-called 'e-government paradox' which is exemplified by the contrast between the level of investments made on deploying ICT-enabled services and the little impact produced and/or demonstrated so far[437].

The important factors that may affect the success and failure of the digital government transformation, provided in the literature[438], could be grouped into six categories: technological, organisational, legal, ethical, social/cultural and economic/financial factors. The table below summarises the key elements for each of these categories which will be addressed individually. In the table we present only a short list of sources that address the following factors.

---

[432] Bannister, F. & Connolly, R. (2012). Forward to the past: Lessons for the future of e-government from the story so far. Information Polity, (August 2018), 3–18.

[433] Davies, R. (2015). eGovernment: Using technology to improve public services and democratic participation. European Parliamentary Research Service.

[434] Eggers, W. D. & Bellman, J. (2015). Digital government transformation. The journey to government's digital future. Deloitte University Press. Retrieved from https://www2.deloitte.com/content/dam/Deloitte/global/Documents/About-Deloitte/gx-global-findings-digital-government-transformation.pdf

[435] Norris, D. F., & Reddick, C. G. (2013). Local E-Government in the United States: Transformation or Incremental Change? Public Administration Review, 73(1), 165–175.

[436] Anthopoulos, L., Reddick, C. G., Giannakidou, I., & Mavridis, N. (2016). Why e-government projects fail? An analysis of the Healthcare.gov website. Government Information Quarterly 33, 161–173.

[437] Savoldelli, A., Codagnone, C., & Misuraca, G. (2014). Understanding the e-government paradox: Learning from literature and practice on barriers to adoption. Government Information Quarterly, 31, S63–S71.

[438] Sun, T. Q. & Medaglia, R. (2018). Mapping the challenges of Artificial Intelligence in the public sector: Evidence from public healthcare. Government Information Quarterly, 1–16.

TABLE 3. TYPES OF FACTORS AFFECTING THE DIGITAL GOVERNMENT TRANSFORMATION

FACTORS	main elements	list of Sources
Technological	*IT infrastructures, interoperability, access to data, data storage*	Van der Wee et al. 2015; Joseph & Johnson, 2013; Barbero et al., 2016; Desouza, 2018; Hashem et al., 2016; Hellberg et al., 2013; Giest et al., 2018
Organisational	*Digital strategy, workforce skills, data sharing, alignment of agencies*	Ferro & Sorrentino, 2010; Sun et al., 2018; Lnenicka & Komarkova, 2018; Acemoglu & Restrepo, 2018; Zhang et al, 2014
Legal	*New legal and regulatory frameworks, privacy, cybersecurity*	Pencheva et al., 2018; Desouza and Jacob, 2017; Washington, 2014; Horvitz, 2016; Hossain et al., 2017
Ethical	*Citizens' trust, accountability of new technologies, human rights*	Janssen, 2016; Alzahrani et al., 2017; Molanr, 2018; Warkentin, 2018; Al-Hujran et al. 2015
Social/cultural	*Citizens' adoption, conservative habits and cultural barriers*	Rey-Moreno et al., 2018; Carter & Weerakkody, 2008; Salvodelli et al, 2014; Al-Hujran et al, 2015; Yavwa, 2018
Economic/financial	*Lack of financial resources to implement and scale innovations*	Schwester, 2009; Weerekkody et al, 2009; Henningsson & van Veenstra, 2010; Capgemini, 2010; Salvodelli et al, 2014; Meijer, 2015

Source: authors elaboration

4.2.1 Technological factors

The technological barriers are obviously a key factor that is impeding successful digital transformation in the public sector, and this has been an important focus of the literature since the beginning of the e-government field. The new technologies introduced in the previous chapters present different types of challenges, and the conditions required for a successful digital transformation have changed. The recent literature available addresses the issue from different perspectives, and we focus here on infrastructures, interoperability and access to data.

The first technological challenge is represented by the fact that the public sector continues to be troubled by an aging and outdated IT **infrastructure**. This factor is viewed differently in studies covering European countries, where ICTs are widespread[439], and developing countries, where the lack of infrastructure is still the major obstacle for eGovernment development[440]. In particular, some studies noted that most governments spend significant portion of their IT budgets on maintenance of current IT systems, while the most recent technologies would need some radical modernisation of these infrastructures[441]. For instance, those governments that want to exploit the potentials of big data and related analytics are facing new several challenges which are related to the kind of infrastructures that governments need[442]. First, traditional database systems are not well suited to manage the big data collected from unstructured sources. Second, governments need to adopt the appropriate technical infrastructure to manage big data. As governments are currently facing the challenge of investing and modernising the IT infrastructures of public administration, they are confronted with multiple technical solutions and deciding on the combination and best ones to adopt is becoming increasingly complex[443]. Some authors highlighted that the problem of adequate infrastructures – able to store and manage big data – becomes particularly relevant in the context of smart cities, as enormous volumes of data are at the core of the services rendered by the Internet of Things (IoT) in which everyday objects and devices are interconnected[444].

439 Van Der Wee, M., Verbrugge, S., Sadowski, B., Driesse, M., & Pickavet, M. (2014). Identifying and quantifying the indirect benefits of broadband networks for e-government and e-business: A bottom-up approach.

440 Amagoh, F. (2016). Determinants of e-government diffusion in Nigeria. Information Development, 32(4), 1137–1154.

441 Desouza, K. (2018). Delivering Artificial Intelligence in Government: Challenges and Opportunities. IBM Center for The Business of Government Delivering. Retrieved from http://www.businessofgovernment.org/sites/default/files/Delivering_Artificial_Intelligence_in_Government.pdf

442 Joseph, R. C. & Johnson, N. A. (2013). Big Data and Transformational Government. IT Professional, 15(6), 43–48.

443 Barbero, M., Coutuer, J., Jackers, R. et al. (2016). Big data analytics for policy making. European Commission. Retrieved from https://joinup.ec.europa.eu/sites/default/files/document/2016-07/dg_digit_study_big_data_analytics_for_policy_making.pdf

444 Hashem, I.A.T., Chang, V., Anuar, N. B. et al. (2016). The role of big data in smart city. International Journal of Information Management, 36(5), 748–758.

The second and related technological barrier is the **lack of interoperability**. This adds the additional layer of limitations, for instance, on the ability of different public bodies to integrate multiple databases that machine learning algorithms can analyse to provide richer insights for better service delivery or for more informed policy making. The problem of interoperability is not new as scholars argue that since the beginning of the digital transformation governments complained that systems were too rarely interoperable, and the infrastructures were insufficient integrated[445]. However, as new technologies continue to develop, governance is becoming a growing problem as the integration of the vast amount of data and the interoperability between different IT systems is even more important for a successful digital transformation[446]. A recent report by the World Bank stresses the fact that the lack of interoperability can lead to disruptions in the network, poor data exchange, and suboptimal performance[447]. Therefore, interoperability is a top priority today as governments try to integrate services across departments so as to improve effectiveness as well as efficiency.

But even if the concept of interoperability is often used in a technical system engineering sense, dealing with the technical issues of linking up computer systems, the term can also refer to a broader outlook taking into account social, political, and organisational factors that impact system to system performance. In this context, scholars reported that eGovernment research focuses too much on 'government' and noted a lack of focus on 'governance'[448]. Taking a governance view can help understanding that implementing interoperability requires addressing problems on different fronts simultaneously, most of which are not technological (such as privacy or organisational challenges).

As the new technological developments associated with digital government are more data-driven and data-centred than ever before, another relevant technical barrier that the literature is addressing is related to the **access to data.** This is a fundamental precondition to produce their potential benefits, because the more government data that is available as open data, the greater the capacity to contribute to policy innovation through Big Data analysis[449]. For instance, as people continuously generate behavioural data which becomes an important resource for policy-makers to base their policy decisions, governments are exploring the application of a combination of data-based predictive analytics and behavioural economics[450]. However, in order to utilise these opportunities that the combination of behavioural insights and big data can offer, governments require access to quite extensive reliable data about citizens' behaviour[451].

Data challenges are also framed as highly relevant by numerous stakeholders interviewed by academics that explored the nascent adoption of AI in the public sector[452]. All AI systems require large data sets to train in decision-making, therefore data lies at the heart of AI functions and as they are still at the experimental phase, there are no large data sets available yet. General data challenges include database size being too small, lack of data integration, and lack of data standards (i.e., how and what data is collected, and what format it is stored in). Another significant challenge posed by Big Data is the possibility that individuals may be re-identified from cross-referring disparate large datasets and their personal details exposed. De-identification is the removal, stripping or obfuscation of directly identifying elements from a dataset such that the data is not immediately identifiable as associated or linked with a particular individual – a common practice to ensure that the data is anonymised. However, different cases demonstrate that there is still ongoing uncertainty about the reliability of de-identification, as often this is done without the relevant expertise[453].

The case of de-identification shows that data challenges do not only represent a technological barrier for digital government transformation, but they involve also substantial **legal, political, social, institutional** issues. The global trend of opening government data is not new, but increasingly governments are committed to release large number of datasets in order to drive innovation through Big Data analysis. The so-called Big and Open

---

445 Bannister, F. & Connolly, R. (2012). Forward to the past: Lessons for the future of e-government from the story so far. Information Polity, (August 2018), 3–18.

446 Desouza, K. (2018). Delivering Artificial Intelligence in Government: Challenges and Opportunities. IBM Center for The Business of Government Delivering.

447 World Bank. (2017). Internet of things. The new government to business platform. World Bank Group.

448 Hellberg, A.-S. et al. (2013). Conflicts in implementing interoperability: Re-operationalizing basic values. Government Information Quarterly, 30(2), 154–162.

449 Hardy, K. & Maurushat, A. (2017). Opening up government data for Big Data analysis and public benefit. Computer Law & Security Review, 33.

450 Mont, O., Lehner, M., Heiskanen, E., & Agency, T. S. E. P. (2017). Nudging A tool for sustainable behavior? The Swedish environmental protection Agency, Stockholm.

451 Giest, S. & Mukherjeeb, I. (2018). Behavioral instruments in renewable energy and the role of big data: A policy perspective. Energy Policy, 123.

452 Sun, T. Q. & Medaglia, R. (2018). Mapping the challenges of Artificial Intelligence in the public sector: Evidence from public healthcare. Government Information Quarterly, 1–16.

453 Hardy, K. & Maurushat, A. (2017). Opening up government data for Big Data analysis and public benefit. Computer Law & Security Review, 33.

Linked Data, abbreviated as BOLD, which consists of the integration of the three major technological developments (open data, linked data and big data), is now facing similar challenges of the first open data initiatives[454]. The amount of data that individuals produce is growing exponentially and the potential for information collected by new technologies in real time is increasing. On the one side, this reinforces the need to protect individual privacy, because the potential availability of BOLD can be used to excessively increase control of citizens' private lives. On the other side, these large volumes of different types of data can be used to open the government and create more transparency in its functioning.

However, the realisation of both privacy and transparency is challenging[455]. This complex situation shows how the data challenges are not only technical barriers that impede the most advanced technologies from being adopted by governments. If it was only a technical problem, values such as privacy should be seen as obstacles that must be overcome. Nonetheless, from a government value perspective, the issue raises fundamental challenges including legal, ethical and political issues that need to be addressed to safeguard the relation between government and citizens[456].

4.2.2 Organisational factors

There is a wide number of organisational factors covered in research articles that impede a successful digital transformation, and the main challenges include the following:

- issues at a strategy level, such as the lack of strategy plans for adoption and development of new technologies;
- issues at a management level, such as 'silos' mentality, vertical and horizontal organizational fragmentation[457] and the potential organisational resistance to data sharing[458]; and
- issues at a human resource level, such as the lack of skilled workforce and the perceived threats of workforce replacement.

The **lack of strategy** aimed at a fundamental digital transformation has been identified by an extensive global survey of government officials as the leading barrier impeding early-stage organisations from taking full advantage of digital trends[459]. Many real-life examples show how organisations focused too much on technologies without investing in the organisational capabilities that can ensure their impacts. This is typical of the organisations at the early stage of digitalisation, lacking the ambition to radically transform the public sector, and instead having a more operational focus (such as increasing efficiency). Conversely, the lack of strategy is not among the top five barriers for digitally maturing agencies which already embraced the most recent digital trends and are more concerned about insufficient funding, cybersecurity and other barriers[460]. However, the size of the particular project, allocated resources, its alignment with organisational goals and the diversity of the users and organisations involved also play an important role. The lack of strategy can also mean the lack of alignment between central and local governments[461]. In the realm of IoT, the most successful initiatives were possible because governments managed to tie directly overall strategies with real problems and challenged faced by citizens and businesses at the local level[462].

The augmentation of work and processes also call for government agencies to rethink their overall **human resource strategy**. Transforming the public-sector workforce has not been easy for most governments, but this will become a key factor for a successful digital transformation.

---

454 Zuiderwijk, A., Janssen, M., Choenni, S., et al. (2012). Socio-technical Impediments of Open Data. Electronic Journal of e-Government (Vol. 10).

455 Janssen, M. & van den Hoven, J. (2015). Big and Open Linked Data (BOLD) in government: A challenge to transparency and privacy? Government Information Quarterly, 32(4), 363–368.

456 Hellberg, A.-S. et al. (2013). Conflicts in implementing interoperability: Re-operationalizing basic values. Government Information Quarterly, 30(2), 154–162.

457 United Nations (2014). United Nations E-Government Survey 2014: E-Government for the future we want. United Nations Department of economic and social affairs.

458 Ferro, E., & Sorrentino, M. (2010). Can intermunicipal collaboration help the diffusion of E-Government in peripheral areas? Evidence from Italy. Government Information Quarterly, 27(1), 17–25.

459 Eggers, W. D. & Bellman, J. (2015). Digital government transformation. The journey to government's digital future. Deloitte University Press.

460 Chatfield, A. T. & Reddick, C. G. (2018). A framework for Internet of Things-enabled smart government: A case of IoT cybersecurity policies and use cases in U.S. federal government. Government Information Quarterly, 1–0.

461 Ferro, E., & Sorrentino, M. (2010). Can intermunicipal collaboration help the diffusion of E-Government in peripheral areas? Evidence from Italy. Government Information Quarterly, 27(1), 17–25.

462 World Bank. (2017). Internet of things. The new government to business platform. World Bank Group.

Many authors agree that the **digital skills of government employees** have an important impact on the diffusion of eGovernment[463]. If this was true for the first adoption of ICT technologies, it becomes even more relevant for the intense use of data made by the new technologies. For instance, robust data management demands technical knowledge and capacity that can minimise negative effects emerging from the use of advanced technologies and vast amounts of data. Humans remain crucial in data management and organisation: a number of scholars agree that algorithms perform based on parameters defined by humans. However, several authors note that today one of the main challenges for the adoption of AI, as well as for exploiting the potentials of Big Data, is the lack of skilled workforce in public administrations[464]. People working with data must select, input and/or flag it as required for further AI analysis, which from that stage is done without or with limited human involvement. However, the initially overflowing amount, complexity and unnecessary data noise is overwhelming. Preliminary data entry and duplicate errors, missing data are common human shortcomings, creating limited, deficient or incorrect datasets for further AI analysis. These shortcomings deviate the records, mislead policy makers, and create biased results. Ultimately, the quality and result depend on the skill and literacy level that is widening as more digital tools evolve. The UK, for example, already acknowledged this problem and in their 2017 Government Transformation Strategy focused on creating conditions for satisfactory data management.[465]

However, the skills required for a digital transformation are not simply technical, as general **managers** need broad skills to engage in e-government decision making. Managers must be able to integrate the organisation's ICT strategy with its broader goals and to lead on extending these goals with new IT capabilities, coordinating inside and outside people and resources. Necessary skills include not only a technical understanding, but also a broad understanding of information management and the information society. The need for enhanced data management skills is even more pertinent given the evidence that preliminary data entered by humans already creates biased policy making (see Section 3.5).[466]

4.2.3 Legal factors

The nature of governance systems – especially the law system – have been found to affect the way in eGovernment (and he open government in particular) initiatives are implemented and what effects they have[467]. In fact, several scholars identified the **lack of legal frameworks** that are fit to the new technologies as another barrier that governments are facing, as new privacy and regulatory issues are emerging[468].

Privacy concerns are not new in the literature on eGovernment, but the intense reliance on data of the new technologies make many researchers worry about the privacy violations that come with the new wave of digital government transformation and personal data sharing. Several cases already proved that these worries are justified. For instance, the Swedish government experienced a leak of population's personal vehicle data. This forced the Swedish government to restrict outsourcing private and sensitive data to third parties[469]. In 2018, a hospital in Portugal received a fine for an indiscriminate access to, violation of and failure to ensure continued integrity and confidentiality of processed personal data of users[470]. These and other examples depict a combined private and public sector's invasion into people's lives, intruding and disposing of as much different information as possible. Due to this technological invasion, literature also looks at possibilities for a data misuse as more people have access to the data[471]. Occurrences of making government datasets publicly available threatens personal information disclosure, which may result in open profiling or data mining for various private purposes[472]. Violations coming from private and public sectors prove justifiable data privacy and security concerns which may hinder the digital transformation of the public sector.

---

463 Al-Busaidy, M., & Weerakkody, V. (2009). E-government diffusion in Oman: a public sector employees' perspective. Transforming Government: People, Process and Policy, 3(4), 375–393.

464 Lnenicka, M. & Komarkova, J. (2018). Big and open linked data analytics ecosystem: Theoretical background and essential elements. Government Information Quarterly.

465 Wiseman, M. J., (2018). Data-driven government: the role of Chief Data Officers. IBM Center for The Business of Government.

466 Science and Technology Committee, (2016). Robotics and Artificial Intelligence. House of Commons.

467 Misuraca, G., & Viscusi, G. (2014). Is open data enough?: E-governance challenges for open government. International *Journal of Electronic Government Research* (IJEGR), 10(1), 18-34.

468 Pencheva, I. , Esteve, M., Mikhaylov, J. S. (2018). Big Data and AI – A transformational shift for government: So, what next for research? Public Policy and Administration.

469 Joinup, (2017). Following security breach, Sweden shores up outsourcing rules. https://joinup.ec.europa.eu/news/following-security-breach-sw

470 Monteiro, M. A., (2019). First GDPR fine in Portugal issued against hospital for three violations. IAPP. https://iapp.org/news/a/first-gdpr-fine-in-portugal-issued-against-hospital-for-three-violations/

471 Everest-Phillips, M. (2018). *The Passionate Bureaucrat: Lessons for the 21st Century from 4,500 Years of Public Service Reform*. World Scientific Publishing Company Pte Limited.

472 Scassa, T., (2014). Privacy and open government.

Such incidences also call into question how much power digital technologies award to governments, and how that power might impact democracies. As mentioned in Section 3.5, some authors worry that government access to personal data can result in Big Brother type of surveillance, eliminating checks on government processes[473]. In fact, quite many times digital tools are employed with little public oversight, putting the basis for unethical personal data use practices. Literature also stresses how growing AI sector creates power and knowledge asymmetries empowering those who create and employ technologies, while disadvantaging those who get affected[474]. Some of those technologies are AI use in facial recognition, sensor networks or social media tracking, widely popular in many governments.

Another major challenge that has become even more relevant with the intense use of data by the new technologies discussed is the issue of cybersecurity. To unlock the potential of digital government into data-driven smart government, this challenge has to be addressed[475]. Recent cybersecurity incidents have shown that IoT devices can be harnessed to compromise the privacy of their owners[476]. While the IoT has become a key infrastructure for developing smart ecosystems, the ubiquitous deployment of IoT devices with poor security has already rendered them increasingly vulnerable to cyberattacks and cybercrimes[477].

All these privacy-related threats that are linked to the use of new technologies require governments to provide a clear and new framework for data privacy laws in order to ensure an ethical use of new technologies and unlock their full potential[478]. To tackle the issues around privacy and the use of Big Data, it has been suggested that policies and legislation fit for the Big Data age should be designed[479]. Scholars argue that new legal framework should be introduced to govern the ever-expanding variety of statistical sources and data services at government disposal[480], and established regulatory regimes will need to be adapted to AI innovations or fundamentally reconfigured[481]. The new legal framework to design does not only concern privacy issues, but also it should address broader accountability challenges. As we see below, for instance, AI technology replaces parts of the decision-making process traditionally carried out by humans, but today in many countries there is not a clear regulation on how to include non-human actors in the legal accountability system. As noted earlier, these institutional innovations represented by the introduction of new legal and regulatory frameworks able to address these challenges represent a necessary precondition for the realisation of the full potential of the technological innovations.

The new legal frameworks will need to also address the challenges emerging from the public-private partnerships that introduce new technologies in many countries in the first place. Some authors argue that private sector leadership in digitalisation threatens power asymmetries between public authorities and private companies[482]. Literature on AI-enabled public services adds an issue on private sector domination in development and public service delivery. This increases information asymmetry since governments purchase proprietary products and services that they do not understand nor can build themselves[483] (see more on the related risks in Section 3.5.3). But the demand to continuously innovate prompts public authorities to collaborate with many private entities that develop digital tools seizing big data opportunities, for which appropriate regulation is necessary.

4.2.4 Ethical factors

Transparency and ethical use of data also become critical issues with the move towards AI and other technologies, increasing the need to develop new ethical frameworks around algorithms that support decision making. This is a key challenge that governments have to deal with, as it can become a serious barrier of their digital transformation, mainly because a successful adoption of new technologies requires **citizens' trust and confidence**. The issue of trust in eGovernment is not new and there is extensive literature discussing the fact

473 EC., (2018). eGovernment Benchmark 2018. Securing eGovernment for all.
474 Whittaker, (2018). AI now report 2018.
475 Chatfield, A. T. & Reddick, C. G. (2018). A framework for Internet of Things-enabled smart government: A case of IoT cybersecurity policies and use cases in U.S. federal government. Government Information Quarterly, 1–0.
476 Cass, S., & Stephen. (2017). A chip to protect the internet of things. IEEE Spectrum, 54(1), 20–21.
477 Hossain, M., Hasan, R., & Skjellum, A. (2017). Securing the Internet of Things: A Meta-Study of Challenges, Approaches, and Open Problems.
478 Tito, J. (2017). Destination unknown: Exploring the Artficial Intelligence on Goverment. Centre for Public Impact.
479 Desouza, K. & Jacob, B. (2017). Big Data in the Public Sector: Lessons for Practitioners and Scholars. Administration & Society, 49(7), 1043–1064.
480 Washington, A. L. (2014). Government Information Policy in the Era of Big Data. Review of Policy Research, 31(4), 319–325.
481 Horvitz, E. (2016). Artificial intelligence and life in 2030. Stanford University.
482 Whittaker, (2018). AI now report 2018.
483 Medhora, P. R. et al. (2018). Data Governance in the Digital Age. Centre for International Governance Innovation. Retrieved from: https://www.cigionline.org/sites/default/files/documents/Data Series Special Reportweb.pdf

that citizens still do not trust using online services and e-government applications, and this impact a full adoption of e-government services[484]. Trust in e-government services is certainly a complex relationship as it includes many complicated issues, but it is one of the most significant barriers of a successful digital transformation of governments[485]. The existing literature focuses mainly of the technical aspects of technology[486], although recent research also analysed the factors and issues that influence trust in e-government from a citizens' perspective[487].

Even though the literature on trust in e-government services is quite vast, some scholars have recently discussed the issue of citizens' trust specifically connected to the power of algorithms and non-human decision-making. There is a growing attention about algorithms making decisions and predicting citizens' behaviour. This results in more technocratic and bureaucratic governance, where human decisions are reduced, as they become more and more automated[488]. Literature cautions that the overreliance on AI eliminates a promised neutrality and objectivity of government functions creating a sense of lacking control among the citizens and public sector employees[489]. Analysing independently and starting to learn from their environments, advanced algorithms may introduce unconscious biases by excluding some individuals, such as those who have the least and no access to technology or neglect individuals based on their race[490].

The extensive use of AI is already becoming a gold standard in criminal justice in various countries[491]. However, as illustrated in Section 3.5.2, this is related to important risks of biases, unfairness and discrimination. Conscious of these potential problems, the European Commission has recently published guidelines for an ethical adoption of AI in order to ensure a human-centric approach to this new technology and minimise the potential risks, respecting fundamental rights, principles and values[492]. A failure to adopt such an ethical approach can become a serious impediment for a successful implementation of AI, with its related benefits. Therefore, the challenge will be to secure a framework which facilitates and encourages innovation, but which also maintains vital public trust and confidence[493].

4.2.5 Social and cultural factors

The literature on the adoption of e-government has been focused for a long time on technological and organisational issues. More recently, along with the discussion of citizens' trust, the attention switched to broadly defined societal factors to explain the lack of e-government adoption[494]. Overall, many authors are now focusing on the citizens' side, as the low level of citizens' adoption of e-government services is seen as one of most relevant barriers in the e-government evolution[495]. The assumption was that if citizens were able to access e-government services, the benefits of e-government would automatically emerge. However, it was argued that this kind of prediction did not take into account citizens' preferences for the status quo of traditional government services. There is a broad and open discussion in the literature around which citizens' habits act as inhibitors of e-government use[496]. In this realm, the scholars are divided between those focusing on the antecedents of resistance, as switching costs, perceived value, the opinion of colleagues, sunk costs, loss aversion and uncertainty, and those focusing on the antecedents of inertia, which include habit, and transition costs.

---

484 Warkentin, M., Sharma, S., Gefen, D. et al. (2018). Social identity and trust in internet-based voting adoption. Government Information Quarterly, 35(2), 195–209.

485 Khasawneh, R. T., Rabayah, A., & Abu-Shanab, E. A. (2013). E-government acceptance factors: trust and risk. The 6th International Conference on Information Technology.

486 Al-Hujran, O., Al-Debei, M. M., Chatfield, A., & Migdadi, M. (2015). The imperative of influencing citizen attitude toward e-government adoption and use. Computers in Human Behavior, 53, 189–203.

487 Alzahrani, L., Al-Karaghouli, W., & Weerakkody, V. (2017). Analysing the critical factors influencing trust in e-government adoption from citizens' perspective: A systematic review and a conceptual framework. International Business Review, 26(1), 164–175.

488 Janssen, M. & Kuk, G. (2016). The challenges and limits of big data algorithms in technocratic governance. Government Information Quarterly, 33(3), 371–377.

489 Tinholt, D. (2017). Unleashing the potential of Artificial Intelligence in the Public Sector. Capgemini Consulting.

490 Pencheva, I., (2018). Big data and AI – A transformational shift for government: So, what next for research?

491 Peeters, R. & Schuilenburg, M. (2018). Machine justice: Governing security through the bureaucracy of algorithms. Information Polity, 23(3), 267–280.

492 European Commission (2018). Draft Ethics Guidelines for Trustworthy AI. Brussels: European Commission.

493 House of Commons (2018). Algorithms in decision-making. Science and Technology Committee. Retrieved from https://publications.parliament.uk/pa/cm201719/cmselect/cmsctech/351/351.pdf

494 Savoldelli, A., Codagnone, C., & Misuraca, G. (2014). Understanding the e-government paradox: Learning from literature and practice on barriers to adoption. Government Information Quarterly, 31, S63–S71.

495 Al-Hujran, O., Al-Debei, M. M., Chatfield, A., & Migdadi, M. (2015). The imperative of influencing citizen attitude toward e-government adoption and use. Computers in Human Behavior, 53, 189–203.

496 Rey-Moreno, M. et al. (2018). Facilitator and inhibitor factors: Adopting e-government in a dual model. Journal of Business Research, 88, 542–549.

The social and behavioural factors that explain the low level of adoption of eGovernment services however varies across countries[497]. Similarly, it has been noted that the different levels of eGovernment implementation between developed and developing countries is often due cultural differences, rather than economic or technological development[498].

4.2.6 Economic and financial factors

Although economic and financial factors, especially after the financial crisis, have been an obvious impediment for developing ambitious digital government innovations in the past decade, they are not covered as extensively in the reviewed literature. Instead, these are more often implied or covered by the above-mentioned organisational (like lack of staff or skills) or technological issues (like lack of infrastructure), which are caused quite directly by budgetary constraints[499].

Only a small number of reviewed authors, who talk about financial constraints directly, provide more specific insights. For example, Meijer[500] in his analysis of an ICT-based innovation in police work argues that financial issues become an obstacle for innovation already at the idea generation and idea selection phase: many ideas are being developed for public sector improvement, and only a limited number can be developed further.

Budgetary barriers are especially prominent when branches or departments with their own budgets need to get collective projects funded. Further, Martin[501] found that mobilisation of financial resources is perceived as an important challenge by the OGD community, especially given the post-financial crisis narrative of public deficit reduction through public spending reduction, which dominates the political agenda.

Weerakkody et al[502], in their comparison of eGovernment implementation in the UK and Sri Lanka showed that budgetary matters can be as important a barrier in developed countries as in developing ones, but they depend on unwilling politicians more in the latter. However, even in these articles, financial barriers are not discussed as extensively as technological, cultural or organisational ones. Generally, their influence seems to be considered too obvious to investigate in-depth.

4.3 Summary

The diffusion of the most recent technologies in the public sector is in its nascent stage, and so the body of literature exclusively focuses on this phenomenon. However, the types of macro drivers emerging from the literature reviewed are similar to the ones that characterised the first wave of eGovernment. Economic drivers still feature prominently in the literature, as the potentials of efficiency gains and cost savings derived from the new technologies are highly valued by governments. The rapid technological developments and diffusion of electronic devices are still seen as important drivers, even though they are not considered sufficient conditions for the adoption of eGovernment services. Lastly, political and social factors are also discussed, with a particular focus on the growing call by citizens for more transparency and for participating in the policy-making process thanks to the possibilities offered by the new technologies.

The literature reviewed confirmed that the barriers and preconditions for a successful Digital Government transformation are not only confined to technological matters. Many cases presented in the literature suggest that the introduction and adoption of new technologies by governments is often impeded by organisational, institutional and legal barriers. This is often explained by the fact that the new technologies are expected to challenge virtually every process, system and structure of government. However, these changes are complex and require radical transformations. The transformation aspect is often considered in the literature to be the ultimate goal of Digital Government development and implies a shift from digitalising public services to a larger scale reform of the government. In order to sustain this transformation, multiple processes of change and redesign need to be in place, not only of the organisational processes involved, but also of regulatory and institutional aspects, such as changes to the law and in the discretion and work practice of public officials[503].

---

497 Carter, L., & Weerakkody, V. (2008). E-government adoption: A cultural comparison. Information Systems Frontiers, 10(4), 473–482.

498 Yavwa, Y., & Twinomurinzi, H. (2018). Impact of Culture on E-Government Adoption Using UTAUT: A Case Of Zambia. In 2018 International Conference on eDemocracy & eGovernment (ICEDEG) (pp. 356–360). IEEE.

499 For example, in Schwester, R. (2009). Examining the barriers to e-government adoption. Electronic Journal of e-government, 7(1).

500 Meijer, A. (2015). E-governance innovation: Barriers and strategies. Government Information Quarterly, 32(2), 198-206.

501 Martin, C. (2014). Barriers to the open government data agenda: Taking a multi-level perspective. Policy & Internet, 6(3), 217-240.

502 Weerakkody, V., Dwivedi, Y. K., & Kurunananda, A. (2009). Implementing e-government in Sri Lanka: Lessons from the UK. Information Technology for Development, 15(3), 171-192.

503 Lindgren, I., & Van Veenstra, A. F. (2018). Digital government transformation: a case illustrating public e-service development as part of public sector transformation.

5 Summary of findings of the policy review

In parallel to the literature review the research team has carried out a policy review that aimed to identify the initiatives that EU Member States are pursuing in order to foster government transformation by using AI-related technologies. Given the fast-paced change in this field, we cannot claim to have collected a complete repository; rather we identified a range of strategies, projects, guidelines, and pilot activities that show Member States exploring various ways to take advantage of the new technologies in order to reach public policy goals[504].

A standardised template was used to collect the information, which included a more detailed look into the strategic documents concerned with the digital government transformation, an overview of the key institutional players, and identification of more specific initiatives. Such a template also allowed for a more systematic summary of the information collected as well as some comparison among countries.

The information collected shows that Member States formulate their aims with regard to digital government transformation in a variety of documents, from general public administration strategies to specific eGovernment and digital government related programmes. The documents vary in length and form; some of them are only available in the national language. The aims and targets are also heterogeneous: from more specific (improving the quality of public services) to broader economic goals, fostering innovation, public participation and improving public trust. The documents are often in line with and even draw on the Digital Single Market Strategy, eGovernment Action Plan 2016-2020 and the Tallinn Declaration, although the EU documents are not always directly cited. Notably, the strategic documents rarely take a critical assessment of the current situation.

The review also showed that while countries are experimenting with the transformative technologies to achieve public policy goals, these are mostly pilot projects and initiatives without widespread adoption and transformative impact. On the other hand regions and cities in particular appear to be at the forefront of innovative experimentation.

5.1 Artificial Intelligence

Many strategic documents discuss AI as part of the general context of technological progress sections, but do not always link it to specific objectives or actions. Overall, countries and governments are interested in and have plans for investing into AI. The countries reported in the table above are those that dedicate a section of national strategic documents to AI or have specific strategic documents dedicated to AI.

Some notable examples include Belgium, where the government started AI4Belgium[505], a community-led approach to enable people and organizations to take advantage of the opportunities created by AI, and Germany that included a hub dedicated to AI[506] within the national programme for the creation of ecosystems of innovation de.hub[507]. In particular, the hub in Karlsruhe brings together research centres and a large network of digital enterprises in the region. The UK has adopted a programme to foster the development of AI, first and foremost in industry[508].

TABLE 4. ARTIFICIAL INTELLIGENCE – SUMMARY

	EARLY PROJECTS	STRATEGY / SET AGENDA	GUIDELINES	PILOT ACTIVITIES AND TRIALS (TOP-DOWN)	WIDESPREAD ADOPTION
Countries	UK	Austria, Belgium, Finland, France, Germany, Hungary, Ireland, Italy, Lithuania, Malta, Netherlands, Portugal, Slovenia, Spain, Switzerland, UK	Austria, Sweden, UK	Ireland, Latvia, Italy, Lithuania, Portugal, UK	Finland, Germany
Total	**1**	**16**	**3**	**6**	**2**

504 The policy review has been carried out in the period January – June 2019. An updated analysis may be conducted in 2020 by JRC in collaboration with the Observatory on the Digital Agenda and eGovernment of the Politecnico di Milano.

505 http://www.ai4belgium.be/

506 Artificial intelligence Hub – Karlsruhe

507 https://www.de-hub.de/

508 AI Sector Deal (2018)

5.2 Distributed Ledger Systems

The policy review identified 11 countries that explore the usage of blockchain in the public sector, from considering it in their strategic documents to implementing specific projects and pilot trials. For example, the United Kingdom in 2016 published the national report "Distributed Ledger Technology: beyond block chain". France published a dedicated strategy in 2018 ("Les enjeux des blockchains"). In Denmark the Danish Maritime Authority uses blockchain to redevelop the Danish International Ship Registry. In Lithuania, the Bank of Lithuania is setting up a blockchain 'sandbox' LBChain aimed at fintech companies, which could be used both to try out the technological platform as well as receive advice on the regulatory environment.

TABLE 5. DISTRIBUTED LEDGER SYSTEMS – SUMMARY

	EARLY PROJECTS	STRATEGY / SET AGENDA	GUIDELINES	PILOT ACTIVITIES AND TRIALS (TOP-DOWN)	WIDESPREAD ADOPTION
Countries	Denmark, Italy, Lithuania, Spain	Austria, France, Germany, Italy, Lithuania, Malta, Netherlands, Spain, UK	Italy	Belgium, Denmark, Portugal, UK	
Total	**4**	**9**	**1**	**4**	**0**

5.3 Internet of Things

As presented in the literature review, the IoT technologies have been increasingly used by the public sector in transportation, energy, smart cities, and defence. Our review has identified at least 10 countries that are referencing IoT and/ or already using it to improve public services, in particular at the local or city level. For example, the Spanish Smart Cities Association (RECI)[509] brings together 49 City Councils to exchange good practices, share experiences and tools. Germany in 2017 developed guidelines for smart cities "Smart City Charta: Digitale Transformation in den Kommunen nachhaltig gestalten". When it comes to specific pilot initiatives, SmartSantander[510] has been designed as an experimental facility aiming to tackle technical and societal barriers related to the usage of the IoT. In Lithuania the operator of Vilnius public transport (VĮ "Susisiekimo paslaugos") uses sensors to track the movement of public transport as well as usage of public transport, and draws on this data in order to improve mobility in the city.

TABLE 6. INTERNET OF THINGS – SUMMARY

	EARLY PROJECTS	STRATEGY / SET AGENDA	GUIDELINES	PILOT ACTIVITIES AND TRIALS (TOP-DOWN)	WIDESPREAD ADOPTION
Countries	Denmark, Spain	Austria, Belgium, Cyprus, Finland, Germany, Hungary, Malta, Portugal, Slovenia	Germany	Lithuania, Spain	Germany
Total	**2**	**9**	**1**	**2**	**1**

5.4 Data use and reuse

The policy review showed that all the European countries have policies, agendas, guidelines and/ or initiatives with regard to data use and use. There are institutions and regulations dealing with national registries, data security, exchange of data between institutions, protection of personal data. Almost all the Member States have national data portals. The collection and use of the geospatial data has been accelerated by the applications of the IoT and geographical positioning technologies, artificial intelligence and big data analytics, cloud computing, and wireless and broadband technologies.

509 https://www.redciudadesinteligentes.es/
510 http://www.smartsantander.eu/

Pertinent examples come from Italy, which developed national guidelines for geospatial data; Germany has a national geoportal[511] and a dedicated strategy ("National strategy for geolocated information"); Portugal aims to develop a national geoportal by 2020.

TABLE 7. DATA USE AND REUSE – SUMMARY

	EARLY PROJECTS	STRATEGY / SET AGENDA	GUIDELINES	PILOT ACTIVITIES AND TRIALS (TOP-DOWN)	WIDESPREAD ADOPTION
Countries	Austria, Hungary, UK	Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Hungary, Ireland, Latvia, Lithuania, Malta, Netherlands, Poland, Slovakia, Slovenia, Spain, Sweden, Switzerland, UK	Austria, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Germany, Ireland, Italy, Latvia, Lithuania, Netherlands, Poland, Portugal, Spain, Sweden, Switzerland, UK	Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Greece, Ireland, Italy, Latvia, Lithuania, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, UK	Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Lithuania, Malta, Poland, Portugal, Romania, Slovenia, Switzerland, UK
Total	**3**	**23**	**20**	**26**	**18**

5.5 Open Government

Most European countries are members of the Open Government Partnership, an international consortium bringing together governments and civic society leaders with an aim to open and use data for more inclusive, responsive and accountable public sector[512]. The partnership encourages adoption of action plans and guidelines for open government. A number of governments also underline the importance of open government in other strategic documents (e.g. the Czech Republic, France, Luxembourg and Portugal). Austria adopted an 'open innovation' strategy (Open Innovation Strategie für Österreich[513]), while in Slovenia the Information Society Development Strategy to 2020[514] includes a reference to 'inclusive innovation'.

TABLE 8. OPEN GOVERNMENT – SUMMARY

	EARLY PROJECTS	STRATEGY / SET AGENDA	GUIDELINES	PILOT ACTIVITIES AND TRIALS (TOP-DOWN)	WIDESPREAD ADOPTION
Countries	Poland	Austria, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, UK	Austria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, Malta, Netherlands, Portugal, Romania, Slovakia, Spain, Sweden, UK	Croatia, Finland, France, Greece, Luxembourg, Poland, United Kingdom	Czech Republic, Finland, Germany, Greece, Italy, Lithuania, Luxembourg, Poland, UK
Total	**1**	**25**	**21**	**7**	**9**

511 http://www.geoportal.de
512 https://www.opengovpartnership.org/about/about-ogp
513 http://openinnovation.gv.at/wp-content/uploads/2016/08/Open-Innovation-barrierefrei.pdf
514 http://www.mju.gov.si/fileadmin/mju.gov.si/pageuploads/DID/Informacijska_druzba/pdf/DSI_2020_3-2016_pic1.pdf

5.6 Digital security

Digital security is currently of utmost importance to governments at all levels. Almost all the EU countries have set up their Computer Emergency Response Team (CERT)/ Computer Security Incident Response Team (CSIRT); therefore they were classified under the label of 'widespread adoption'. These teams cooperate both at the EU level through the CSIRT Network, and internationally through the Forum of Incident Response and Security Teams (FIRST). Several EU countries developed specific national strategies on digital security. Examples of relevant initiatives include United Kingdom, which is piloting Cyber Schools Hubs to encourage students to enrol into computer science subjects. Luxembourg implements the BEE SECURE[515] initiative designed to increase awareness for a safer use of new information and communication technologies. In Spain, several universities established a Center for Cybersecurity Research of Catalonia to undertake research in cybersecurity and privacy.

TABLE 9. DIGITAL SECURITY – SUMMARY

	EARLY PROJECTS	STRATEGY / SET AGENDA	GUIDELINES	PILOT ACTIVITIES AND TRIALS (TOP-DOWN)	WIDESPREAD ADOPTION
Countries	Spain, UK	Belgium, Croatia, Cyprus, Czech Republic, Estonia, France, Hungary, Latvia, Lithuania, Malta, Poland, Portugal, Slovakia, Slovenia, Spain, Switzerland, UK	Belgium, Lithuania, Spain, UK	Portugal	Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxemburg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Sweden, UK
Total	**2**	**17**	**4**	**1**	**26**

5.7 Innovation in service provision

Most countries started digitising their public services in 1990s – early 2000s (the first wave of eGovernment) and have gone already through several rounds of incremental improvements as well as more substantive innovation (e.g. innovation based on joining up different administrative data bases, interoperability of registers, digital by default, digital signature, etc.). Most countries are moving toward the implementation of a central portal as a single access/ delivery point to all public services. Characteristic examples include the United Kingdom (gov.uk), Finland (Suomi.fi), Estonia (Eesti.ee) and others. The Croatian cloud and shared service centre is an example of central administration setting up a government cloud "for the development of programme solutions, especially horizontal e-services, platforms and applications for public sector bodies"[516], in order to achieve internal synergies and save resources for more efficient and effective delivery of public services.

TABLE 10. INNOVATION IN SERVICE PROVISION - SUMMARY

	EARLY PROJECTS	STRATEGY / SET AGENDA	GUIDELINES	PILOT ACTIVITIES AND TRIALS (TOP-DOWN)	WIDESPREAD ADOPTION
Countries	UK	Austria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Slovakia, Slovenia, Spain, Switzerland, UK	Czech Republic, Denmark, Finland, France, Italy, Lithuania, UK	Croatia, Cyprus, Finland, France, Germany, Hungary, Ireland, Italy, Netherlands, Portugal, Spain, UK	Czech Republic, Denmark, Estonia, Finland, France, Greece, Latvia, Lithuania, Luxembourg, Malta, Poland, Portugal, Romania, Slovakia, Slovenia, Sweden, Switzerland, UK
Total	**1**	**23**	**7**	**12**	**18**

[515] https://www.bee-secure.lu/fr/a-propos

[516] e-Croatia2020 strategy, section 7.5.2. "Government cloud and Shared Services Centre"

6 Policy and research pointers

Building on the analysis of the state of the art conducted by reviewing scientific and grey literature, as well as integrating insights from the policy review of EU Member States, in this final section we outline a selected number of what we call "policy and research pointers" which are aimed to facilitate ICT-enabled government transformation.

These are anticipated indications of some of the policy and research recommendations that will be elaborated further in the next phases of the research. Clearly the goal is not be exhaustive, rather be thought-provoking and incentivize the debate on future Digital Government transformation strategies and policy development at EU and Member States level.

The "decalogue" of pointers serves also to inform the conceptualisation and empirical component of the research which will further discuss some of the issues raised through theoretical and empirical analysis. The ten policy and research pointers are in fact instrumental to raise the political debate on the setting up of the Digital Europe Programme and its implementation both at European and national level, including the implications Digital Government transformation has on regional and local government and society at large.

1) The effects of AI on public sector employment should be assessed more thoroughly

In the literature reviewed there is limited consideration concerning task routinization (so called Routine Biased Technical Change[517]), including the impacts of AI on public sector jobs[518], job losses, and need for new skills[519]. This is an important gap because public sector is a very large employer in the EU countries. The automation and digitisation of government processes could lead to a significant reconfiguration of work and employment patterns[520]. eGovernment 4.0 could contribute to the rise of 'Work 4.0' as much as (if not more) than Industry 4.0. eGovernment 4.0 has implications in terms of new skills requirements, unemployment or intermittent employment, and further polarisation of the labour force. In broader terms, these developments are relevant to the current discussion on the future of welfare and social protection models and feed into the debate on universal income, flexicurity, and social innovation.

2) Platformisation versus distributed networks

The literature has not yet thoroughly examined the platformisation of government services, which is more discussed by legal scholars[521] and political philosophers[522], but not by eGovernment scholars[523].

---

517 See the seminal work by Autor as for instance in: Autor, D. (2015). Why Are There Still So Many Jobs? The History and Future of Workplace Automation. Journal of Economic Perspectives, 29(3), pp. 3-30; Autor, D (2013). The "task approach" to labor markets: an overview. Journal for Labour Market Research, 46(3), 185-199; Autor, D. (2008). The Economics of Labor Market Intermediation: An Analytic Framework. Cambridge, Mass: Cambridge, Mass. National Bureau of Economic Research.

518 See for instance: Acemoglu, D. & Restrepo, P. (2018). The Race between Man and Machine: Implications of Technology for Growth, Factor Shares, and Employment. American Economic Review, 108(6), 1488-1542); Aghion, F., & Jones, P. (2018). Artificial Intelligence and Economic Growth. In A. Agrawal & A. Goldfarb (Eds.), The Economics of Artificial Intelligence: An Agenda, chap. 9. Chicago: University of Chicago Press.

519 See, among others, the following: Acemoglu, D. and Restrepo, P. (2017). Robots and Jobs: Evidence from US Labor Markets. NBER Working Paper, 23285; Arntz, M., T. Gregory and U. Zierahn (2016). The Risk of Automation for Jobs in OECD Countries: A Comparative Analysis. OECD Social, Employment and Migration Working Papers, No. 189, OECD Publishing, Paris; Bessen, J. (2015). Toil and Technology. *Finance & Development*, 52(1), 16-19; Bessen, J. (2016) How Computer Automation Affects Occupations: Technology, Jobs, and Skills (October 3, 2016). Boston Univ. School of Law, Law and Economics Research Paper No. 15-49. Available at SSRN: https://ssrn.com/abstract=2690435; Bowles, J. (2014). The computerisation of European jobs. Bruegel Centre; Chiacchio, F., Petropoulos, G., & Pichler, D. (2018). The impact of industrial robots on EU employment and wages: A local labour market approach. Bruegel Working Paper Issue 02/18; Dauth, W., S. Findeisen, J. Südekum, and N. Woessner (2017). German robots-the impact of industrial robots on workers. CEPR Discussion Paper No. DP12306; Frey, C., & Osborne, M. (2017). The future of employment: How susceptible are jobs to computerisation? *Technological Forecasting and Social Change, 114*, 254-280; Graetz, G., & Michaels, G. (2017). Is modern technology responsible for jobless recoveries? *American Economic Review,* 107 (5), 168-173.

520 See the various essays on digital transformation and work in Neufeind, M., O'Reilly, J and F. Ranft (Eds.), *Work in the Digital Age: Challenges of the Fourth Industrial Revolution*. Rowman & Littlefield: London.

521 See for instance: Hildebrandt, M. (2018). Primitives of Legal Protection in the Era of Data-Driven Platforms. *Georgetown Law Technology Review*, 2, 252-273; Cohen, J. (2016), The Regulatory State in the Information Age, Theoretical Inquiries in Law, 17, 369-414.

522 We have in mind in particular the work by Luciano Floridi: Floridi, L. (2014). *The Fourth Revolution: How the Infosphere is Reshaping Human Reality*. Oxford: Oxford University Press; Floridi, L., ed. (2014). *The Onlife Manifesto: Being Human In A Hyperconnected Era*. New York: Springer Open. Floridi notes in his book on the Fourth Revolution that in the practice of automation and the design of a robot's environment (called the envelop) is as important as the design of the robot itself. They become infrastructures that determine the choice architecture that characterize every aspect of life. So, from the organization of work, the effects overspill on the domain of societal impacts and individual liberties.

523 See: Janowski, T., Estevez, E., & Baguma, R. (2018). Platform governance for sustainable development: Reshaping citizen-administration relationships in the digital age. Government Information Quarterly, 35(4), S1–S16.

Platforms tend to foster efficiency of coordination, but through the network effects they are also bound to reduce pluralism 'as more users beget more users, a dynamic which in turn triggers a self-reinforcing cycle of growth'[524]. Platforms favour seamless integration and at the same time may reduce variety of streams of information and communication. The much-criticised silos into which governmental bureaucracies are segmented, may also be considered as part of the system of checks and balances. Therefore it is important to understand better the dynamics of platformisation in government, in order to reap the benefits while also avoiding monopolistic or oligopolistic outcomes.

3) e-Government 4.0 and 'mode of regulation'

eGovernment 4.0 and Industry 4.0 may transform both how jobs are performed and how activities are coordinated, and in doing so they may alter the very social fabric of our societies. They may change what the French School of Regulation calls the 'Mode of Regulation' (MR). A MR is a combination of institutional, normative, cultural, and regulatory components that ensure the functioning of economy and society. In complex modern systems there are forces that keep these components together despite evolving industrial structures, social relations, techniques of production, patterns of consumption. On the other hand, any transformation is by nature dis-equilibrating and have implications, e.g. for social relations, in terms of income accumulation and distribution. The current research lacks discussion of implications of digital government transformation on social structures and other components of the mode of regulation.

4) Selectivity on impacts and realism on trajectories: from linearity to complexity

A significant share of the eGovernment literature entails prescriptive analyses that are overly optimistic, normative and express high expectations with regard to potential impacts of transformation. This trend has been seen ever since the initial wave of literature on eGovernment. Therefore, the impacts of digital transformation should be identified realistically and in way which favours empirical measurement. Whereas benchmarking exercises will remain among the nuts and bolts of policy monitoring, such benchmarks often assume a linear progress, which does not reflect the reality of digital transformation in government. In fact, the process of transformation unfolds in twists and turns, through changing hypes and discourses, via different projects and applications, and is subject to both incremental change and radical innovation. In many EU countries new and innovative technological initiatives coexist with old ones. Therefore, the vocabulary and methods of complexity theory and analysis should be applied to digital government transformation.

5) Building human capacity to ensure a successful digital transformation

Public servants are playing a key role fostering the diffusion of the new technologies in government. Digital government transformation requires new digital skills which will open new job opportunities. Several authors noted that today one of the main challenges for the adoption of AI, as well as for exploiting the potential of the big data, is the lack of skilled workforce and IT leadership capacity in public administration[525]. Governments should create new roles that respond to the skills necessary to take advantage of the new technologies and create career paths to attract high-skilled professionals. Technical knowledge and capacity should also be developed internally through training schemes. There are significant advantages that come with building administrative capacity inside the public sector due to in-depth understanding of the public sector's mission as well as of the mode of its operation[526].

6) Adopting ethical framework to minimise the negative effects of new technologies

Overreliance on the new technologies such as AI may decrease fairness, neutrality and accountability of the public sector and lead to a perceived or real of loss of control[527]. There were cases reported where advanced algorithms used by police departments unintentionally reinforced racial discrimination and unfairness[528]. The European Commission is taking actions to address such risks. For example, it recently published Guidelines for Trustworthy AI that aim to ensure a human-centric approach to AI and minimise the potential risks, respecting fundamental rights, principles and values[529]. Taking this into account, governments should ensure that every person has the right to choose human contact and decline to be cared for by a robot. Policymakers should introduce regulations that ensure that AI systems are designed with an ethical framework in mind.

---

524 Evans, P., & Gawer, A. (2016). *The Rise of the Platform Enterprise. A Global Survey*. New York: The Center for Global Enterprise, pp. 5-6.

525 Lnenicka, M. & Komarkova, J. (2018). Big and open linked data analytics ecosystem: Theoretical background and essential elements. Government Information Quarterly.

526 Tito, J. (2017). Destination unknown: Exploring the Artificial Intelligence on Government. *Centre for Public Impact. A BCG Foundation.*

527 Tinholt, D., (2017). Unleashing the potential of Artificial Intelligence in the Public Sector. Capgemini Consulting.

528 Pencheva, I., (2018). Big data and AI – A transformational shift for government: So, what next for research?

529 European Commission (2018). Draft Ethics Guidelines for Trustworthy AI. Brussels: European Commission.

7) Taking advantage of predictive analytics to ensure efficiency and effectiveness of policy

Predictive analytics offer a range of options for data driven policy making. According to the literature reviewed, it has already been used by governments in areas as diverse as public safety, public health, education, housing, transportation, defence and others. Predictive analytics may contribute to a more efficient usage of public resources, help to deliver services faster and undertake a preventive approach. Nevertheless, various authors signal a variety of ethical and empirical issues that range from personal data protection to biases in historical data. Fundamentally, in many instances there is a lack of quality data to generate meaningful predictions. From the policy perspective, in order to take advantage of predictive analytics, the public sector should a) invest into internal capacity and skills necessary to work with data and use predictions in an informed way; b) ensure interoperability among various data sources, data sharing, cooperation between public and private data providers; c) ensure transparency of how predictive algorithms are created and used.

8) Opening access to data through a legal framework that protects privacy

Many scholars agree that the current legal framework should be developed to cover the ever-expanding variety of data sources and data services at government disposal[530]. European policymakers have already inspired regulation across the World concerning the use of personal data with the introduction of the GDPR. Nevertheless, a clear and consistent framework for exchanging, sharing and purchasing of data is still to be developed. While the new data-driven technologies require access to enormous volumes of data, this has to be balanced with clear rules to prevent abuse and to protect personal data.

9) Creating a digital transformation culture within the public administration

Organisational and bureaucratic obstacles decrease the usage of new technologies in the public sector. Interdepartmental differences and inter-institutional competition create bureaucratic silos that slow down the pace of transformation. A successful digital transformation requires a conceptual and cultural change within the public administration. Therefore, a culture of innovation should be encouraged. Governments should set out a long-term vision for the advancement of data-driven governance and technological innovation. Many cities have introduced the role of the Chief Data Officer (CDO), who is in charge of fostering technological innovation in various departments within government and improving IT capacity[531], as well as the positions of Chief Information Officer, Chief Innovation Officer, Chief Knowledge Officer, and so on. Together with a long-term vision, governments should set concrete targets and communicate effectively the results obtained.

10) Tackling restrictions to data flows to build a European data ecosystem

There is a need of a regulatory framework that maximises accessibility to data by governments. The open data initiatives respond to this imperative, but they should be extended to the private domain, with an aim of creating frameworks and infrastructure for data sharing between the public and private sectors. Access conditions should be designed in a way that the marginal costs for data sharing are covered, while incentives to invest in data collection are preserved. This debate should be addressed at the European level, all the more so that public authorities often impose data localisation requirements on companies[532].

[530] Washington, A. L. (2014). Government Information Policy in the Era of Big Data. Review of Policy Research, 31(4), 319–325.
[531] Wiseman, M. J., (2018). Data-driven government: the role of Chief Data Officers. IBM Center for The Business of Government.
[532] European Political Strategy Centre (2017). Enter the data economy. EPSC Strategic Notes.

Bibliography

"Nes" Diaz-Uda, A. & Leinbach, J. (2012). The Power of Zoom: Transforming government through location intelligence. *Deloitte Insights*. Retrieved from https://www2.deloitte.com/insights/us/en/topics/analytics/the-power-of-zoom.html

@Gov Inspiring Innovative Government. (2017). Data driven government. *KPMG @gov*. Retrieved from https://assets.kpmg/content/dam/kpmg/be/pdf/Markets/at-gov-brochure.pdf

Abdolrahimi, C., Barsky, S., Brett, J., de Vaulx Duc Duong, Engel, B., Mark, F., Hager, T., Lyberg, S., Satten, S. L. J., Sokol, S., Srivastava, A., Tame, J., Tennenbaum, J., Vanamali, S., Vanjani, A., Wuhrman, R., & Zelenovic, A. (2017). Enabling blockchain innovation in the US federal government. *American Council for Technology – Industry Advisory Council (ACT-IAC)*. Retrieved from https://www.actiac.org/system/files/ACT-IAC ENABLING BLOCKCHAIN INNOVATION_3.pdf

Abujamra, R., & Randall, D. (2019). Blockchain applications in healthcare and the opportunities and the advancements due to the new information technology framework. *Advances in Computers*, 1–14. https://doi.org/10.1016/bs.adcom.2018.12.002

Accenture Federal Services. (2018). Compelling Benefits, Common Misconceptions. Putting intelligent automation to work for federal. *Accenture*. Retrieved from https://www.accenture.com/t20181207T205937Z__w__/us-en/_acnmedia/PDF-90/Accenture-Putting-Automation-to-Work-for-Federal.pdf#zoom=50

Accenture Federal Services. (2018). Essential Insights: Artificial Intelligence Unleashed: How agencies can use AI to automate and augment operations to improve performance. *Accenture*. Retrieved from https://www.accenture.com/t20180918T085210Z__w__/us-en/_acnmedia/PDF-86/Accenture-Essential-Insights-POV.pdf#zoom=50

Accenture. (2015). *A digital government perspective*. Retrieved from https://www.accenture.com/us-en/~/media/Accenture/next-gen/public-service-technology-vision-trends-2015/downloads/Accenture-Public-Service-A-digital-government-perspective-US-letter.pdf#zoom=50

Acemoglu, D. & Restrepo, P. (2018). The Race between Man and Machine: Implications of Technology for Growth, Factor Shares, and Employment. *American Economic Review*, 108(6), 1488-1542

Acemoglu, D. and Restrepo, P. (2017). Robots and Jobs: Evidence from US Labor Markets. NBER Working Paper, 23285.

Adeli, H., & Jiang, X. (2009). Intelligent infrastructure: neural networks wavelets, and chaos theory for intelligent transportation systems and smart structures. *CRC Press*. Retrieved from https://www.crcpress.com/Intelligent-Infrastructure-Neural-Networks-Wavelets-and-Chaos-Theory/Adeli-Jiang/p/book/9781420085365

Agarwal, R., Selen, W., Roos, G., & Green, R. (2015). *The Handbook of Service Innovation*. Springer. https://doi.org/10.1007/978-1-4471-6590-3_27

Aghion, F., & Jones, P. (2018). Artificial Intelligence and Economic Growth. In A. Agrawal & A. Goldfarb (Eds.), *The Economics of Artificial Intelligence: An Agenda*, chap. 9. Chicago: University of Chicago Press.

Aguzzi, S., Bradshaw, D., Canning, M., Cansfield, M., Carter, P., Cattaneo, G., Gusmeroli, S., Micheletti, G., Rotondi, D., & Stevens, R. (2014). Definition of a Research and Innovation Policy Leveraging Cloud Computing and IoT Combination. *European Commission*. https://doi.org/10.2759/38400

Aherne, C. (2017). How an API strategy can help agencies connect data silos. *GCN*. Retrieved March 20, 2019, from https://gcn.com/articles/2017/08/02/apis-connect-data-silos.aspx

Airtable. (n.d.). *Airtable - Blockchain in Government Tracker - Database*. Retrieved March 18, 2019, from https://airtable.com/shreIXQjzluCxam37/tbl7qVDFKKiEcFFrc?blocks=hide

Al-Yafi, K., & El-Masri, M. (2016). Gamification of e-Government Services: A Discussion of Potential Transformation. *Gamification of E-Government Services: A Potential Transformation*. Retrieved from https://pdfs.semanticscholar.org/e4be/b6d053c1c723c39fa8cd449a76ba0b218958.pdf

Alarabiat, A., Soares, D., & Estevez, E. (2017). Predicting Citizens Acceptance of Government-led e-Participation Initiatives through Social Media: A Theoretical Model. *Proceedings of the 50th Hawaii International Conference on System Sciences (2017)*, (January). https://doi.org/10.24251/hicss.2017.345

Alcaide–Muñoz, L., Rodríguez–Bolívar, P. M., Cobo J. M., & Herrera-Viedma, E. (2017). Analysing the scientific evolution of e-Government using a science mapping approach. *Government Information Quarterly*, 34(3), 545–555. https://doi.org/10.1016/j.giq.2017.05.002

Allam, Z., & Dhunny, Z. A. (2019). On big data, artificial intelligence and smart cities. *Cities*, 89, 80–91. https://doi.org/10.1016/j.cities.2019.01.032

Allard, S. W., Wiegand, E. R., Schlecht, C., Datta, A. R., Goerge, R. M., & Weigensberg, E. (2017). State Agencies' Use of Administrative Data for Improved Practice: Needs, Challenges, and Opportunities. *Public Administration Review*, 78(2), 240–250. https://doi.org/10.1111/puar.12883

Alvarez, L. M., Gago, J. M S., & Fern, M. J. (2014). An Adaptive and Social-Aware Recommendation. *Journal of Universal Computer Science*, 20(11), 1523–1542.

Alves, H. (2013). Co-creation and innovation in public services. *The Service Industries Journal*, 33(7–8), 671–682. https://doi.org/10.1080/02642069.2013.740468

Alzahrani, L., Al-Karaghouli, W., & Weerakkody, V. (2017). Analysing the critical factors influencing trust in e-government adoption from citizens' perspective: A systematic review and a conceptual framework. *International Business Review*, 26(1), 164–175. https://doi.org/10.1016/j.ibusrev.2016.06.004

Amarasingham, R., Patzer, R. E., Huesch, M., Nguyen, N. Q., & Xie, B. (2014). Implementing electronic health care predictive analytics: considerations and challenges. *Health Affairs*, 33(7), 1148-1154.

Ammenwerth, E., Schnell-Inderst, P., & Hoerbst, A. (2012). The Impact of Electronic Patient Portals on Patient Care: A Systematic Review of Controlled Trials. *Journal of Medical Internet Research*, 14(6). https://doi.org/10.2196/jmir.2238

and process. Paper presented at the 45th Hawaii International Conference on System Sci- ences (HICSS 2012), Maui, Hawaii, USA

Angwin, J., Larson, J., Mattu, S., & Kirchner, L. (2016). Machine Bias. *Propublica*. Retrieved March 21, 2019, from https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing

Anisetti, M., Ardagna, C., Bellandi, V., Cremonini, M., Frati, F. (2018). Privacy-aware Big Data Analytics as a Service for Public Health Policies in Smart Cities. *Sustainable Cities and Society*. https://doi.org/10.1016/j.scs.2017.12.019

Annoni, A., Benczur, P., Bertoldi, P., Delipetrev, P., De Prato, G., Feijoo, C., Fernandez Macias, E., Gomez, E., Iglesias, M., Junklewitz, H., López Cobo, M., Martens, B., Nascimento, S., Nativi, S., Polvora, A., Sanchez, I., Tolan, S., Tuomi, I., & Alujevic, L. V. (2018). Artificial Intelligence: A European Perspective. *Joint Research Centre, European Commission*. https://doi.org/10.2760/11251

Anttiroiko, A.-V. (2013). U-cities reshaping our future: Reflections on ubiquitous infrastructure as an enabler of smart urban development. *AI and Society*, 28(4), 491–507. https://doi.org/10.1007/s00146-013-0443-5

Antwi, M., Appiahene, P., & Boakye-Ansah, Y. A. (2018). Promoting Afforestation for Sustainable Communities through Gamification. *ICCCSDA 2017 Special Issue: Agriculture, Natural Resources and Renewable Energy* (Vol. 1). JENRM. Retrieved from https://www.researchgate.net/publication/321017385

Apolitical. (2017). *US police use data to focus on places, not people, and cut crime by up to 40%*. Retrieved March 21, 2019, from https://apolitical.co/solution_article/us-police-use-data-focus-places-not-people-cut-crime-40/

Arntz, M., T. Gregory and U. Zierahn (2016). *The Risk of Automation for Jobs in OECD Countries: A Comparative Analysis*. OECD Social, Employment and Migration Working Papers, No. 189, OECD Publishing, Paris.

Asquer, A. (2014). Not Just Videogames: Gamification and its Potential Application to Public Services. In *Digital Public Administration and E-Government in Developing Nations: Policy and Practice* (pp. 146–165). IGI Global. Retrieved from https://www.igi-global.com/chapter/not-just-videogames/110279

Atkins, C. (2018). Real-Time, Data-Driven Government. Develop forward-thinking, citizen-centric programs. *SAP*. Retrieved from https://d.dam.sap.com/m/pkif5Fh/56366_WP_56366_enEN.pdf

Atos. (2015). *Data driven government. Preparing for the age of the citizen*. Retrieved from https://atos.net/wp-content/uploads/2016/06/atos-data-driven-government-whitepaper.pd

Atos. (2018). *e-State 2020. Journey to a digital government*. Retrieved from https://atos.net/wp-content/uploads/2018/11/atos-eState2020-ph-marketing-brochure.pdf

Atos. (2018). *Look Out 2020+ Industry Trends Government Thought Leadership Realizing the promise of Government-as-a-platform*. Retrieved from https://atos.net/content/mini-sites/look-out-2020/assets/pdf/ATOS_LOOK OUT_GOVERNMENT.pdf

Attard, J., Orlandi, F., Scerri, S., & Auer, S. (2015). A systematic review of open government data initiatives. *Government Information Quarterly*, 32(4), 399–418.

Autor, D (2013). The "task approach" to labor markets: an overview. Journal for Labour Market Research, 46(3), 185-199;

Autor, D. (2008). The Economics of Labor Market Intermediation: An Analytic Framework. Cambridge, Mass: Cambridge, Mass. National Bureau of Economic Research.

Autor, D. (2015). Why Are There Still So Many Jobs? The History and Future of Workplace Automation. Journal of Economic Perspectives, 29(3), pp. 3-30;

Autor, D. H., Katz, L. F. and Kearney, M. S. (2006), 'The polarization of the US labor market,' *American Economic Review Papers and Proceedings*, Vol. 96, No. 2, pp. 189–194.

Autor, D. H., Levy, F., & Murnane, R. J. (2003). The Skill Content of Recent Technological Change: An Empirical Exploration. *The Quarterly Journal of Economics*, 118(4), 1279–1333. doi:10.1162/003355303322552801.

Baig, A., Dua, A., & Riefberg, V. (2014). Putting citizens first: How to improve citizens' experience and satisfaction with government services. *McKinsey Center for Government*. Retrieved from https://www.mckinsey.com/~/media/mckinsey/industries/public%20sector/our%20insights/how%20us%20state%20governments%20can%20improve%20customer%20service/putting%20citizens%20first%20how%20to%20improve%20citizens%20experience%20and%20satisfaction%20with%20government%20services.ashx

Baisalbayeva, K., van der Enden, E., Tenan, R. & Flores, R. (2018). The Data Intelligent Tax Administration. Meeting the challenges of Big Tax Data and Analytics. *PwC & Microsoft*. Retrieved from https://www.pwc.nl/nl/assets/documents/the-data-intelligent-tax-administration-whitepaper.pdf

Balestrini, M., Diez, T., Marshall, P., Gluhak, A., & Rogers, Y. (2015). IoT Community Technologies: Leaving Users to Their Own Devices or Orchestration of Engagement? *EAI Endorsed Transactions on Internet of Things*, 1(1), 1–11. https://doi.org/10.4108/eai.26-10-2015.150601

Bannister, F., & Connolly, R. (2011). The Trouble with Transparency: A Critical Review of Openness in e-Government. *Policy & Internet*, 3(1), 158–187. https://doi.org/10.2202/1944-2866.1076

Bannister, F., & Connolly, R. (2012). Forward to the past: Lessons for the future of e-government from the story so far. *Information Polity*, (August 2018), 211–226. https://doi.org/10.3233/978-1-61499-244-8-3

Bannister, F., & Conolly, R. (2014). ICT, public values and transformative government: A framework and programme for research. *Government Information Quarterly*, 31(1), 119–128. https://doi.org/10.1016/j.giq.2013.06.002

Banyan, M. E. (n.d.). Civic engagement. *Encyclopaedia Britannica*. Retrieved March 21, 2019, from https://www.britannica.com/topic/civic-engagement

Barbero, M., Coutuer, J., Jackers, R., Moueddene, K., Renders, E., Stevens, W., Toninato, Y., van der Peijl, S., & Versteele, D. (2016). Big data analytics for policy making. *European Commission*. Retrieved from https://joinup.ec.europa.eu/sites/default/files/document/2016-07/dg_digit_study_big_data_analytics_for_policy_making.pdf

Barbosa, A.F., Pozzebon, M., & Diniz, E. H. (2013). Rethinking E-government performance assessment from a citizen perspective. *Public Administration*, 91(3), 744–762. https://doi.org/10.1111/j.1467-9299.2012.02095.x

Barocas, S., & Selbst, A. (2016). Big Data's Disparate Impact. *California Law Review*, 104(1), 671–729. https://doi.org/http://dx.doi.org/10.15779/Z38BG31

Barrenechea, M. J., & Jenkins, T. (2014). e-Government or Out of Government. *Open Text*. Retrieved from https://www.opentext.com/file_source/OpenText/en_US/PDF/e-Gov Book.pdf

Bass, T., Sutherland, E., & Symons, T. (2018). Reclaiming the Smart City. Personal data, trust and the new commons. *Nesta*. Retrieved from https://media.nesta.org.uk/documents/DECODE-2018_report-smart-cities.pdf

Bauböck, R. (2018). *Debating Transformations of National Citizenship*. IMISCOE Research Series. Springer, Cham. Retrieved from https://www.springer.com/us/book/9783319927183

Baum, H., & Di Maio, A. (2000). Gartner's Four Phases of E-Government Model. *Gartner*. Retrieved March 19, 2019, from https://www.gartner.com/doc/317292/gartners-phases-egovernment-model

Bekkers, V., Edwards, A., & de Kool, D. (2013). Social media monitoring: Responsive governance in the shadow of surveillance? *Government Information Quarterly*, 30(4), 335–342. https://doi.org/10.1016/j.giq.2013.05.024

Benton, M., & Simon, J. (2016). Connected Councils A Digital Vision of Local Government In 2025. *Public Service Transformation Network & Nesta*, (March). Retrieved from https://media.nesta.org.uk/documents/connected_councils_report.pdf

BerryHill, J. (2018). New OPSI guide to blockchain in the public sector. *Observatory of Public Sector Innovation (OPSI)*. Retrieved March 18, 2019, from https://oecd-opsi.org/new-opsi-guide-to-blockchain-in-the-public-sector/

BerryHill, J., Bourgery, T., & Hanson, A. (2018). Blockchains Unchained. Blockchain technology and its use in the public sector. *OECD Working Papers on Public Governance*. https://doi.org/10.1787/3c32c429-en

Bertot, J. C., & Jaeger, P. (2019). Introduction to the Minitrack on Dark Digital Government: Exploring the Dangers — Issues, Concerns, and Negative Impacts. *Proceedings of the 52nd Hawaii International Conference on System Sciences*. Retrieved from https://www.theatlantic.com/technology/archive/2018/06/w

Bertot, J. C., Estevez, E., & Janowski, T. (2016). Digital Public Service Innovation: Framework Proposal. *Proceedings of the 9th International Conference on Theory and Practice of Electronic Governance*, 10. https://doi.org/10.1145/12345.67890

Bertot, J. C., Gorham, U., Jaeger, P. T., Sarin, L. C., & Choi, H. (2014). Big data, open government and e-government: Issues, policies and recommendations. *Information Polity*, 19(1, 2), 5–16. https://doi.org/10.3233/ip-140328

Bertot, J. C., Jaeger, P. T., & Grimes, J. M. (2010). Using ICTs to create a culture of transparency: E-government and social media as openness and anti-corruption tools for societies. *Government Information Quarterly*, 27, 264–271. https://doi.org/10.1016/j.giq.2010.03.001

Bertot, J. C., McDermott, P., & Smith, T. (2012). Measurement of open government: Metrics

Bertot, J., Estevez, E., & Janowski, T. (2016). Universal and contextualized public services: Digital public service innovation framework. *Government Information Quarterly*, 33(2), 211–222. https://doi.org/10.1016/j.giq.2016.05.004

Bessant, J., Hughes, T., & Richards, S. (2011). Beyond Light Bulbs and Pipelines: Leading and Nurturing Innovation in the Public Sector. *Sunningdale Institute, National School of Government*. Retrieved from https://johnrbessant.files.wordpress.com/2016/01/beyond-light-bulbs-and-pipelines-leading-and-nuturing-innovation-in-the-public-sector-2.pdf

Bessen, J. (2015). Toil and Technology. *Finance & Development*, 52(1), 16-19.

Bessen, J. (2016) How Computer Automation Affects Occupations: Technology, Jobs, and Skills (October 3, 2016). Boston Univ. School of Law, Law and Economics Research Paper No. 15-49. Available at SSRN: https://ssrn.com/abstract=2690435

Biesdorf, S., & Niedermann, F. (n.d.). Healthcare's digital future. *McKinsey & Company*. Retrieved March 21, 2019, from https://www.mckinsey.com/industries/healthcare-systems-and-services/our-insights/healthcares-digital-future

Bista, S. K., Nepal, S., & C. P. (2014). Gamification for Online Communities: A Case Study for Delivering Government Services. *International Journal of Cooperative Information Systems*, 23(02), 1441002. https://doi.org/10.1142/s0218843014410020

Biswas, K., & Vallipuram, M. (2016). Securing Smart Cities Using Blockchain Technology. *Griffith University*. https://doi.org/10.1109/HPCC-SmartCity-DSS.2016.0198

Bjørnes, C. D. (2011). The patients' health informatics tool - Exploring the possibilities. A Web 2.0 application for men with prostate cancer. *Aalborg University*. Retrieved from https://www.dachi.aau.dk/digitalAssets/131/131630_11_6_the-patients-health-informatics-tool.pdf

Bliss, L. (2018). Meet the Jane Jacobs of the Smart Cities age. *CityLab*. Retrieved March 19, 2019, from https://www.citylab.com/life/2018/12/bianca-wylie-interview-toronto-quayside-protest-criticism/574477/

Boden, L. A., & McKendrick, I. J. (2017). Model-Based Policymaking: A Framework to Promote ethical "Good Practice" in Mathematical Modeling for Public Health Policymaking. *Frontiers in Public Health*, 5. https://doi.org/10.3389/fpubh.2017.00068

Booz Allen Hamilton Inc. (2017), Predictive Analytics Handbook for National Defense.

Borry, E. L., & Getha-Taylor, H. (2018). Automation in the Public Sector: Efficiency at the Expense of Equity? *Public Integrity*, 1–16.

Bosanquet, N., & Evans, E. (2014). Sustaining universal healthcare in the UK: making better use of information. *Volterra*. Retrieved from https://volterra.co.uk/wp-content/uploads/2014/09/Final-EMC-Volterra-Healthcare-report-web-version.pdf

Boucher, P. (2016). What if blockchain technology revolutionised voting? *European Commission*. Retrieved from http://epthinktank.eu/author/stoablogger/

Boughzala, I., Janssen, M., & Assar, S. (2015). *Case Studies in e-Government 2.0*. Springer, Cham. Retrieved from https://link.springer.com/book/10.1007/978-3-319-08081-9

Bowles, J. (2014). The computerisation of European jobs. Bruegel Centre.

Bradshaw, S., & Howard, P. N. (2017). Troops, Trolls and Troublemakers: A Global Inventory of Organized Social Media Manipulation. *University of Oxford*, 12. Retrieved from https://comprop.oii.ox.ac.uk/wp-content/uploads/sites/89/2017/07/Troops-Trolls-and-Troublemakers.pdf

Bright, J., Ganesh, B., Seidelin, C. & Vogl, T. (2019). *Data Science for Local Government*. Oxford Internet Institute, University of Oxford.

Brous, P., & Janssen, M. (2015). Advancing e-Government Using the Internet of Things: A Systematic Review of Benefits. *14th International Conference on Electronic Government*, 156–169. https://doi.org/10.1007/978-3-319-22479

Browser, A., Hansen, D., He, Y., Boston, C., Reid, M., Gunnel, L., & Preece, J. (2013). Using gamification to inspire new citizen science volunteers. *Gamification 2013. PROCEEDINGS*, 18–25. https://doi.org/10.1145/2583008.2583011

Bulman, M. B., Donaldson, S., Goetz, K., Kamocsai, P, Leuthard, A., Perlman, E., Stier, M., Winters, J., Xue, D., Chenok, D., Cooney, H., & Yusti, C. (2018). The Future Has Begun: Using Artificial Intelligence to Transform Government. *Partnership for Public Service & IBM Center for The Business of Government*. Retrieved from http://www.businessofgovernment.org/sites/default/files/Using Artificial Intelligence to Transform Government.pdf

C40 Cities. (2018). Nanjing 'Green Credit' system. *C40*. Retrieved March 21, 2019, from https://www.c40.org/case_studies/nanjing-green-credit-system

CA Technologies & Deloitte. (2018). *Building our cities smarter: How APIs Take Smart Cities from Concept to Value*. Retrieved from https://www.ca.com/content/dam/ca/us/files/white-paper/building-our-cities-smarter.pdf

Candiello, A., Albarelli, A., & Cortesi, A. (2012). Quality and impact monitoring for local eGovernment services. *Transforming Government: People, Process and Policy*, 6(1), 112–125. https://doi.org/10.1108/17506161211214859

Canova, L., Vetro, A., Torchiano, M., Iemma, R., & Morando, F. (2013). OpenCoesione and Monithon - a transparency effort. *Politecnico di Torino, Technische Universität München, Nexa Center for Internet and Society at Politecnico di Torino (DAUIN)*. Retrieved from http://opendefinition.org/od/

Capgemini (2010). Digitizing public services in Europe: Putting ambition into action: 9th benchmark measurement. Brussels: European Commission, Directorate General for Information Society and Media.

Capgemini, Sogeti, IDC, & Politecnico di Milano. (2018). eGovernment Benchmark 2018. Securing eGovernment for all. *European Commission*. https://doi.org/10.2759/371003

Capgemini. (2016). *HMRC advisers use robots to reduce call times by up to 40%*. Retrieved from https://www.capgemini.com/gb-en/wp-content/uploads/sites/3/2017/07/hmrc_advisers_use_robots_to_reduce_call_times_by_up_to_40_uk.pdf

Caragliu, A., Del Bo, C., & Nijkamp, P. (2011). Smart cities in Europe. *Journal of Urban Technology*, 18(2), 65–82. https://doi.org/10.1080/10630732.2011.601117

Carrasco, M. (2018). 2018 BCG Digital government benchmark: citizens' perspectives on the use of artificial intelligence by government. *BCG*. Retrieved from https://ict.moscow/static/bcgaiingovernmentdiscussionpaper-181015150548.pdf

Castro, D., & McLaughlin, M. (2018). How the Federal Government's Bad Data Practices Made the Immigrant Family Separation Crisis Worse. *Information Technology and Innovation Foundation*. Retrieved March 18, 2019, from https://itif.org/publications/2018/08/23/how-federal-governments-bad-data-practices-made-immigrant-family-separation

Castro, D., & New, J. (2016). The Promise of Artificial Intelligence. *Center for Data Innovation*. https://doi.org/10.2307/41409394

Castro, D., New, J., & McQuinn, A. (2016). How Is the Federal Government Using the Internet of Things? *Center for Data Innovation*. Retrieved from http://www2.datainnovation.org/2016-federal-iot.pdf

CBC News. (2018). *"Not good enough": Toronto privacy expert resigns from Sidewalk Labs over data concerns*. Retrieved March 19, 2019, from https://www.cbc.ca/news/canada/toronto/ann-cavoukian-sidewalk-data-privacy-1.4872223

CGI. (2018). *Intelligent automation opportunities in the Federal Government*. Retrieved from www.cgi.com/client-global-insights

Charalabidis, Y., Lampathaki, F., Misuraca, G., & Osimo, D. (2012, January). ICT for governance and policy modelling: Research challenges and future prospects in Europe. In 2012 45th *Hawaii International Conference on System Sciences* (pp. 2472-2481). IEEE.

Charalabidis, Y., Sarantis, D., & Askounis, D. (2009). Knowledge-Driven Project Management in Government Transformation. In *Handbook of Research on ICT-Enabled Transformational Government: A Global Perspective* (pp. 213–239). IGI Global. https://doi.org/10.4018/978-1-60566-390-6.ch012

Chatfield, A. T., & Reddick, C. G. (2018). A framework for Internet of Things-enabled smart government: A case of IoT cybersecurity policies and use cases in U.S. federal government. *Government Information Quarterly*, 1–0. https://doi.org/10.1016/j.giq.2018.09.007

Chen, S.-Y., Song, S.-F, Li, L., & Shen, J. (2009). Survey on smart grid technology. *Power System Technology*, 33(8), 1–7. Retrieved from http://en.cnki.com.cn/Article_en/CJFDTotal-DWJS200908002.htm

Chen, S., Xu, H., Liu, D., Hu, B., & Wang, H. (2014). A vision of IoT: Applications, Challenges and opportunities with China Perspective. *IEEE Internet of Things Journal*, 1(4), 32–33. https://doi.org/10.1109/JIOT.2014.2337336

Chiacchio, F., Petropoulos, G., & Pichler, D. (2018). The impact of industrial robots on EU employment and wages: A local labour market approach. Bruegel Working Paper Issue 02/18.

Chou, J. S., Lin, C-W., Pham, A.-D., & Shao, J.-Y. (2015). Optimized artificial intelligence models for predicting project award price. *Automation in Construction*, 54, 106–115. https://doi.org/10.1016/j.autcon.2015.02.006

Chourabi, H., Nam, T., Walker, S., Gil-Garcia, J. R., Mellouli, S., Nahon, K., Pardo, T. A., & Scholl, H. J. (2012). Understanding Smart Cities: An Integrative Framework. *45th Hawaii International Conference on System Sciences (2012)*. https://doi.org/10.1109/HICSS.2012.615

Christos, G., Xenia, Z., Antonis, R., Panagiotis, K, Jain, A., Gangadharan, G. R., & Yehia, T. (2013). Applying open innovation strategies to eGovernment for better public services. In *E-Government Success Factors and Measures: Theories, Concepts, and Methodologies* (pp. 308–330). IGI Global. https://doi.org/10.4018/978-1-4666-4058-0.ch017

Chui, M., Harryson, M., Mainyika, J., Roberts, R., Chung, R., van Heteren, A., & Nel, P. (2018). Notes from the AI frontier. Applying AI for social good. *McKinsey Global Institute*. Retrieved from https://www.mckinsey.com/~/media/McKinsey/Featured Insights/Artificial Intelligence/Applying artificial intelligence for social good/MGI-Applying-AI-for-social-good-Discussion-paper-Dec-2018.ashx

Chun, S., Shulman, S., Sandoval, R., & Hovy, E. (2010). Government 2.0: Making connections between citizens, data and government. *Information Polity*, 15(1–2), 1–9. https://doi.org/10.3233/IP-2010-0205

Cleary, D. (2011). Predictive analytics in the public sector: Using data mining to assist better target selection for audit. *Electronic Journal of E-Government*, 9(2), 132–140.

Cobo, C. (2012). Networks for citizen consultation and citizen sourcing of expertise. *Journal of the Academy of Social Sciences*, 7(3), 283–304. https://doi.org/10.1080/21582041.2012.683445

Codagnone, C., Misuraca, G., & Savoldelli, A., & Lupiáñez-Villanueva, F. (2015). Institutional isomorphism, policy networks, and the analytical depreciation of measurement indicators: The case of the EU e-Government benchmarking. *Telecommunications Policy*, 39(3-4), 305-319.

Coglianese, C., & Lehr, D. (2017). Regulating by robot: administrative decision making in the machine-learning era. *Institute for Law and Economics, University of Pennsylvania Law School*, 1147. Retrieved from https://georgetownlawjournal.org/articles/232/regulating-by-robot/pdf

Cohen, J. (2016), The Regulatory State in the Information Age, *Theoretical Inquiries in Law*, 17, 369-414.

Congressional Research Service. (2019). *Artificial Intelligence and National Security*. Retrieved from https://fas.org/sgp/crs/natsec/R45178.pdf

Consoli, S., Presutti, V., Recupero, D. R., Recupero, D. R., Nuzzolese, A. G., & Peroni, S. (2017). Producing Linked Data for Smart Cities: The Case of Catania. *Big Data Research*, *7*(October), 1–15. https://doi.org/10.1016/j.bdr.2016.10.001

Coombes, P., & Barry, M. E. (2014). A systems framework of big data driving policy making – Melbourne's water future. *OzWater14 Conference*, (January).

Cordella, A., & Paletti, A. (2018). ICTs and value creation in public sector: Manufacturing logic vs service logic. *Information Polity*, 23(2), 125–141. https://doi.org/10.3233/IP-170061

Coronado, J. E., & Urriago, A. R. V. (2014). Gamification: an effective mechanism to promote civic engagement and generate trust? *Proceedings of the 8th International Conference on Theory and Practice of Electronic Governance*, (12), 514–515. https://doi.org/10.1145/2691195.2691307

Corydon, B., Ganesan, V., & Lundqvist, M. (2016). Digital by default: A guide to transforming government. *McKinsey & Company*. Retrieved from https://www.mckinsey.com/~/media/mckinsey/industries/public sector/our insights/transforming government through digitization/digital-by-default-a-guide-to-transforming-government.ashx

Council of the European Union. (n.d.). Social media: connect with the Council. *European Council*. Retrieved March 19, 2019, from https://www.consilium.europa.eu/en/contact/social-media/

Criado, J. A., Sandoval-Almazan, R., & Gil-Garcia, J. R. (2013). Government innovation through social media. *Government Information Quarterly*, 30(4), 319–326. https://doi.org/10.1016/j.giq.2013.10.003

Crump, C. (2016). Surveillance Policy Making by Procurement. *Berkeley Law*. Retrieved from https://scholarship.law.berkeley.edu/facpubs

CTV News. (2019). *Politicians, business experts call for end of Sidewalk Labs project*. Retrieved March 19, 2019, from https://www.ctvnews.ca/canada/politicians-business-experts-call-for-end-of-sidewalk-labs-project-1.4302206

Cummings, E., Chau S., & Turner P. (2009). Assessing a patient-centered e-health approach to chronic disease self-management. In *Patient-Centered E-Health* (pp. 168–185). IGI Global. Retrieved from http://www.igi-global.com

Cutura, S. (2018). Digital Government Trends to look out for in 2018. *Convedo*. Retrieved March 19, 2019, from https://info.convedo.com/digital-government-trends-to-look-out-for-in-2018

D-CENT. (2016). *A New Co-Designed Model for Citizen Participation in Helsinki*. Retrieved March 18, 2019, from https://dcentproject.eu/a-new-co-designed-model-for-citizen-participation-in-helsinki/

D21. (2016). *I manage Říčany.* Retrieved March 18, 2019, from https://en.d21.me/reference/ricany

Da, O. M., & Lai, J. W. (2013). How Am I Doing? The Effects of Gamification and Social Sharing on User Engagement. *AAPOR2013*. Retrieved from http://www.asasrms.org/Proceedings/y2013/files/400275_500752.pdf

Damanpour, F., & Schneider, M. (2009). Characteristics of innovation and innovation adoption in public organizations: Assessing the role of managers. *Journal of Public Administration Research and Theory*, 19(3), 495–522. https://doi.org/10.1093/jopart/mun021

Dash, S., & Pani, S. K. (2016). E-Governance Paradigm Using Cloud Infrastructure: Benefits and Challenges. *Procedia Computer Science*, 85, 843–855. https://doi.org/10.1016/j.procs.2016.05.274

Data.gov. (n.d.). *Impact*. Retrieved March 21, 2019, from https://www.data.gov/impact/

Dauth, W., S. Findeisen, J. Südekum, and N. Woessner (2017). German robots-the impact of industrial robots on workers. CEPR Discussion Paper No. DP12306.

De Fremery, R. (2018), Big Data and Government: How the Public Sector Leverages Data Insights. Hortonworks. Retrieved from https://hortonworks.com/article/big-data-and-government-how-the-public-sector-leverages-data-insights/

De Vries, H. H., Bekkers, V., & Tummers, L. (2015). Innovation in the public sector: a systematic review and future research agenda. *Public Administration*. https://doi.org/10.1111/padm.12209

Deloitte (2017). The State of the State: Government through business lenses. Retrieved from: https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/public-sector/deloitte-uk-government-through-talent-lenses.pdf

Deloitte Access Economics. (2015). *Digital government transformation*. Retrieved from https://www2.deloitte.com/content/dam/Deloitte/au/Documents/Economics/deloitte-au-economics-digital-government-transformation-230715.pdf

Deloitte Consulting & Deloitte Touche. (2000). At the Dawn of e-Government. The citizen as customer. *Deloitte*. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?rep=rep1&type=pdf&doi=10.1.1.196.7298

Demirkan, H. (2013). A smart healthcare systems framework. *IT Professional*, 15(5), 38–45. https://doi.org/10.1109/MITP.2013.35

Dermentzi, E., Tambouris, E., & Tarabanis, K. (2016). Cloud computing in eGovernment: Proposing a conceptual stage model. *International Journal of Electronic Government Research*, 12(1), 50–68. https://doi.org/10.4018/IJEGR.2016010103

Derrington, D. (2017). Artificial Intelligence for Health and Health Care. *MITRE Corporation* (Vol. 7508). Retrieved from https://www.healthit.gov/sites/default/files/jsr-17-task-002_aiforhealthandhealthcare12122017.pdf

Desouza, K. (2018). Delivering Artificial Intelligence in Government: Challenges and Opportunities. *IBM Center for The Business of Government Delivering*. Retrieved from http://www.businessofgovernment.org/sites/default/files/Delivering Artificial Intelligence in Government.pdf

Desouza, K., & Jacob, B. (2017). Big Data in the Public Sector: Lessons for Practitioners and Scholars. *Administration & Society*, 49(7), 1043–1064. https://doi.org/10.1177/0095399714555751

Detwiler, D. (2018). One nation's move to increase food safety with blockchain. *Blockchain Pulse: IBM Blockchain Blog*. Retrieved March 19, 2019, from https://www.ibm.com/blogs/blockchain/2018/02/one-nations-move-to-increase-food-safety-with-blockchain/

Digital Transformation Agency. (2019). Blockchain case study: Australian Taxation Office. *Australian Government*. Retrieved March 18, 2019, from https://www.dta.gov.au/help-and-advice/blockchain/do-you-need-blockchain/blockchain-case-studies/blockchain-case-study-australian-taxation-office

Digital Transformation Agency. (2019). Blockchain case study: Commonwealth Bank and the NDIS. *Australian Government*. Retrieved March 18, 2019, from https://www.dta.gov.au/help-and-advice/blockchain/do-you-need-blockchain/blockchain-case-studies/blockchain-case-study-commonwealth-bank-and-ndis

Digital Transformation Team. (2018). Digital Transformation of the public administration. *Italian Government*, (6 (272)), 3–16. https://doi.org/10.15407/usim.2017.06.003

Doan, A., Ramakrishnan, R., & Halevy, A. Y. (2011). Crowdsourcing systems on the World-Wide Web. *Communications of the ACM*, 54(4), 86. https://doi.org/10.1145/1924421.1924442

DOD Open Government. (n.d.). Electronic Rulemaking. *US Department of Defense*. Retrieved March 18, 2019, from https://open.defense.gov/Transparency/Electronic-Rulemaking/

Dubow, T. (2017). Civic Engagement: How can digital technologies underpin citizen-powered democracy? *RAND*. https://doi.org/10.7249/CF373

Duffy, N. (2012). Using Social Media to Build Community Disaster Resilience. *Australian Journal of Emergency Management*, 27(1), 40–45. Retrieved from https://www.researchgate.net/profile/Neil_Dufty/publication/279861590_Using_Social_Media_to_Build_Community_Disaster_Resilience/links/559cabd908ae7f3eb4d033dc.pdf

Dupont, J. (2018). The smart state. Redesigning government in the era of intelligent services. *Policy Exchange*. Retrieved from https://policyexchange.org.uk/wp-content/uploads/2018/05/The-Smart-State-1.pdf

Dutch Government. (n.d.). *blockchain-projects | Results*. Retrieved March 18, 2019, from https://www.blockchainpilots.nl/results

e-estonia. (n.d.). *X-Road*. Retrieved March 20, 2019, from https://e-estonia.com/solutions/interoperability-services/x-road/

Eaton, M., & Bertoncin, C. (2018). State of Offices of Data Analytics (ODA) in the UK. *Nesta*. Retrieved from https://media.nesta.org.uk/documents/State_of_Offices_of_Data_Analytics_ODA_in_the_UK_WEB_v5.pdf

Eggers, W. D. (2017). AI-augmented government. Using cognitive technologies to redesign public sector work. *Deloitte Center for Government Insights*. Retrieved from https://www2.deloitte.com/content/dam/insights/us/articles/3832_AI-augmented-government/DUP_AI-augmented-government.pdf

Eggers, W. D., & Bellman, J. (2015). Digital government transformation. The journey to government's digital future. *Deloitte University Press*. Retrieved from https://www2.deloitte.com/content/dam/Deloitte/global/Documents/About-Deloitte/gx-global-findings-digital-government-transformation.pdf

Eggers, W. D., & Bellman, J. (2015). The journey to government's digital transformation. *Deloitte University Press*. Retrieved from www.deloittedigital.com.

Eggers, W. D., & Hurst, S. (2017). Delivering the digital state. What if state government services worked like Amazon? *Deloitte Center for Government Insights*. Retrieved from https://www2.deloitte.com/content/dam/insights/us/articles/4226_Digital-state-govt-enterprise/DI_Delivering-the-digital-state.pdf

Eggers, W. D., & Macmillan, P. (2015). Gov2020: A Journey into the Future of Government. *Deloitte*. Retrieved from https://www2.deloitte.com/content/dam/Deloitte/au/Documents/public-sector/deloitte-au-ps-gov2020-journey-future-government2-130315.pdf

Ekowo, M., & Palmer, I. (2016). The Promise and Peril of Predictive Analytics in Higher Education: A Landscape Analysis. *New America - ERIC*.

El-Haddadeh, R., Osmania, M., Thakkerc, D., Weerakkody, V., & Kapoor, K. K. (2018). Examining citizens' perceived value of internet of things technologies in facilitating public sector services engagement. *Government Information Quarterly*, (September), 1–11. https://doi.org/10.1016/j.giq.2018.09.009

Engin, Z., & Treleaven, P. (2018). Algorithmic Government: Automating Public Services and Supporting Civil Servants in using Data Science Technologies. *The Computer Journal*, 62(3), 448–460. https://doi.org/10.1093/comjnl/bxy082

Engin, Z., & Treleaven, P. (2019). Algorithmic government: Automating public services and supporting civil servants in using data science technologies. *The Computer Journal*, 62(3), 448-460.

Ernst & Young Global. (2018). *How can data tell a story that keeps a child safe?* Retrieved March 21, 2019, from https://www.ey.com/en_gl/government-public-sector/how-can-data-tell-a-story-that-keeps-a-child-safe-

Ernst & Young. (2017). *Public sector innovation. From ideas to actions*. Retrieved from https://www.ey.com/Publication/vwLUAssets/EY-innovation-public-sector-en/$FILE/EY-innovation-public-sector-en.pdf

Eubanks, V. (2018). *Automating inequality: How high-tech tools profile, police, and punish the poor*. St. Martin's Press. Retrieved from https://www.amazon.com/Automating-Inequality-High-Tech-Profile-Police/dp/1250074312

European Commission. (2017). Attitudes towards the impact of digitisation and automation on daily life. *European Commission*. Retrieved from https://ec.europa.eu/digital-single-market/en/news/attitudes-towards-impact-digitisation-and-automation-daily-life

European Commission. (2017). Quality of Public Administration: A Toolbox for Practitioners. *Publications Office of the European Union*. https://doi.org/10.2767/91797

European Commission. (2018). Communication Artificial Intelligence for Europe. *European Commission*. Retrieved March 19, 2019, from https://ec.europa.eu/digital-single-market/en/news/communication-artificial-intelligence-europe

European Commission. (2018). Draft Ethics Guidelines for Trustworthy AI. *European Commission*. Retrieved from https://ec.europa.eu/digital-single-market/en/news/draft-ethics-guidelines-trustworthy-ai

European Commission. (2018). eGovernment Benchmark 2018: the digital efforts of European countries are visibly paying off. *European Commission*. Retrieved March 19, 2019, from https://ec.europa.eu/digital-single-market/en/news/egovernment-benchmark-2018-digital-efforts-european-countries-are-visibly-paying

European Commission. (2018). EU Member States sign up to cooperate on Artificial Intelligence. *European Commission*. Retrieved March 19, 2019, from https://ec.europa.eu/digital-single-market/en/news/eu-member-states-sign-cooperate-artificial-intelligence

European Commission. (2018). Factsheet: Artificial Intelligence for Europe. *European Commission*. Retrieved March 19, 2019, from https://ec.europa.eu/digital-single-market/en/news/factsheet-artificial-intelligence-europe

European Commission. (2018). Member States and Commission to work together to boost artificial intelligence "made in Europe." *European Commission*. Retrieved March 19, 2019, from https://ec.europa.eu/digital-single-market/en/news/member-states-and-commission-work-together-boost-artificial-intelligence-made-europe

European Commission. (2018). The Alliance for Internet of Things Innovation (AIOTI). *European Commission*. Retrieved March 19, 2019, from https://ec.europa.eu/digital-single-market/en/alliance-internet-things-innovation-aioti

European Commission. (2018). The Internet of Things. *European Commission*. Retrieved March 19, 2019, from https://ec.europa.eu/digital-single-market/en/policies/internet-things

European Commission. (n.d.). *Digital single market*. Retrieved March 21, 2019, from https://ec.europa.eu/commission/priorities/digital-single-market/

European Commission. (n.d.). Projects about eGovernment. *European Commission*. Retrieved March 19, 2019, from https://ec.europa.eu/digital-single-market/en/projects/75991/3520?page=1

European Data Protection Supervisor. (2015). Towards a new digital ethics. Data, dignity and technology. *European Data Protection Supervisor*. Retrieved from https://edps.europa.eu/sites/edp/files/publication/15-09-11_data_ethics_en.pdf

European Economic and Social Committee. (2017). The ethics of big data: balancing economic benefits and ethical questions of big data in the EU policy context. *European Economic and Social Committee*, *15*(3), 55–60. https://doi.org/10.18374/rbr-15-3.6

Evans, P., & Gawer, A. (2016). The Rise of the Platform Enterprise. A Global Survey. New York: The Center for Global Enterprise, pp. 5-6.

Everest-Phillips, M. (2018). *The Passionate Bureaucrat: Lessons for the 21st Century from 4,500 Years of Public Service Reform*. World Scientific Publishing Company Pte Limited.

Ferro, E., Loukis, E. N., Charalabidis, Y., & Osella, M. (2013). Policy making 2.0: From theory to practice. *Government Information Quarterly*, 30(4), 359–368. https://doi.org/10.1016/j.giq.2013.05.018

Fietkiewicz, K. J. Mainka, A., & Stock, W. G. (2017). eGovernment in cities of the knowledge society. An empirical investigation of Smart Cities' governmental websites. *Government Information Quarterly*, *34*(1), 75–83. https://doi.org/10.1016/j.giq.2016.08.003

FixMyCity Greece. (n.d.). Retrieved March 21, 2019, from http://glyfada.intelligentcity.gr/

Floridi, L. (2014). *The Fourth Revolution: How the Infosphere is Reshaping Human Reality*. Oxford: Oxford University Press.

Floridi, L., ed. (2014). *The Onlife Manifesto: Being Human in a Hyperconnected Era*. New York: Springer Open.

Foley, P., & Alfonso, X. (2009). eGovernment and transformation agenda. *Public Administration*, 87(2), 371–396. https://doi.org/10.1111/j.1467-9299.2008.01749.x

Fredriksson, C., Mubarak, F., Tuohimaa, M., & Zhan, M. (2012). A single-blind randomised controlled trial of the effects of a web-based decision aid on self-testing for cholesterol and diabetes. Study protocol. *BMC Public Health*, 12(3), 6.

Frey, C., & Osborne, M. (2017). The future of employment: How susceptible are jobs to computerisation? Technological Forecasting and Social Change, 114, 254-280.

Gangadharan, S. P., Eubanks, V., & Barocas, S. (2014). Data and discrimination: collected essays. *Open Technology Institute & New America*. Retrieved from https://www.ftc.gov/system/files/documents/public_comments/2014/10/00078-92938.pdf

GAO. (2018). Artificial Intelligence: Emerging Opportunities, Challenges, and Implications. *United States Government Accountability Office*, (March), 94–99.

Geobuiz. (2018). Geospatial industry outlook and readiness index. *Geospatial media and communications*. Retrieved from https://geobuiz.com/pdf/geoBuiz-2018-report.pdf

Gibbs, J., Kraemer, K. L., & Dedrick, J. (2003). Environment and policy factors shaping global E-commerce diffusion: A cross-country comparison. The Information Society, 19(1), 5–18.

Giest, S., & Mukherjeeb, I. (2018). Behavioral instruments in renewable energy and the role of big data: A policy perspective. *Energy Policy*, 123. https://doi.org/10.1016/j.enpol.2018.09.006

Gil-Garcia, J. R., Helbig, N., & Ojo, A. (2014). Being smart: Emerging technologies and innovation in the public sector. *Government Information Quarterly*, 31(S1), I1–I8. https://doi.org/10.1016/j.giq.2014.09.001

Glasscock, A. (2018). Ready for Prime time? State Governments Tune in to Artificial Intelligence. *NASCIO*. Retrieved from https://www.nascio.org/Portals/0/AI Machine Learning_FINAL.pdf

Glickenhouse, A., Abbott, S., & Tobias, R. T. (2016). Identifying API use cases: Government. *IBM Cloud*. Retrieved from https://www.ibm.com/downloads/cas/DX4WME7J

GlobeScan. (2016). *Global Citizenship A Growing Sentiment Among Citizens Of Emerging Economies: Global Poll*. Retrieved March 21, 2019, from https://globescan.com/global-citizenship-a-growing-sentiment-among-citizens-of-emerging-economies-global-poll/

Gobble, M. M. (2016). Defining disruptive innovation. *Research Technology Management*, 59(4), 66–71. https://doi.org/10.1080/08956308.2016.1185347

Goldkuhl, G. (2016). E-government design research: Towards the policy-ingrained IT artifact. *Government Information Quarterly*, 33(3), 444–452. https://doi.org/10.1016/j.giq.2016.05.006

Goldsmith, S., & Crawford, S. (2014). *The responsive city: engaging communities through data-smart governance*. Jossey-Bass. Retrieved from http://www.stellenboschheritage.co.za/wp-content/uploads/The-Responsive-City.pdf

Goldsmith, S., Crawford, S., & Grohsgal, B. W. (2016). Predictive analytics: driving improvements using data. *Inter-American Development Bank*.

Goldzweig, C. L., Orshansky, G., Paige, N. M., Towfigh, A. A., Haggstrom, D. A., Miake-Lye, I., Beroes, J. M., & Shekelle, P. G. (2013). Electronic Patient Portals: Evidence on Health Outcomes, Satisfaction, Efficiency, and Attitudes: a systematic review. *Annals of Internal Medicine*, *159*(10), 677–687. Retrieved from www.annals.org

Goos, M. and Manning, A. (2007), Lousy and lovely jobs: The rising polarization of work in Britain, *Review of Economics and Statistics*, Vol. 89, No. 1, pp. 118–133.

Gouvernement.fr. (2017). *Le numérique: instrument de la transformation de l'État*. Retrieved March 18, 2019, from https://www.gouvernement.fr/action/le-numerique-instrument-de-la-transformation-de-l-etat

Gover, J. (2018). How to Do Data Analytics in Government. *Government Technology*. Retrieved from https://www.govtech.com/data/How-to-Do-Data-Analytics-in-Government.html

Government Office for Science. (2014). The Internet of Things: making the most of the Second Digital Revolution. *UK Government*. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/409774/14-1230-internet-of-things-review.pdf

Government Office for Science. (2016). Artificial intelligence: opportunities and implications for the future of decision making. *UK Government*. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/566075/gs-16-19-artificial-intelligence-ai-report.pdf

Graetz, G., & Michaels, G. (2017). Is modern technology responsible for jobless recoveries? *American Economic Review*, 107 (5), 168-173.

Granickas, K. (2015). Ethical and Responsible Use of Open Government Data. *EPSI Platform*, 1–18.

Greater London Authority & Transport of London. (n.d.). *Written evidence submitted by the Greater London Authority and Transport for London (BIG0067)*.

Greenawalt, L. (2018). What Will It Take to Achieve Truly Data-Driven Policy? *New America*. Retrieved March 18, 2019, from https://www.newamerica.org/weekly/edition-214/what-will-it-take-achieve-truly-data-driven-policy/

Gregor, S., & Lee-Archer, B. (2016). The digital nudge in social security administration. *International Social Security Review*, 69(3-4), 63-83.

Griffin, C., Green, A., Martins, M., Apostolescu, M-L., Alajaji, N., Popescu, B., Pannelay, A., Owen, G., & Mayhew, E. (2016). Advanced science and the future of government. *The Economist Intelligence Unit*. Retrieved from https://www.cs.cityu.edu.hk/~hwchun/doc/news/Advanced_Science_future_of_gov_en.pdf

GSMA. (2018). Air Quality Monitoring Using IoT and Big Data. *GSMA*. Retrieved from https://www.gsma.com/iot/wp-content/uploads/2018/02/iot_clean_air_02_18.pdf

Guessoum, N. (2018). How artificial intelligence is changing education. *Gulf News*. Retrieved March 21, 2019, from https://gulfnews.com/opinion/op-eds/how-artificial-intelligence-is-changing-education-1.2274665

Guha, J., & Chakrabarti, B. (2014). Making e-government work: Adopting the network approach. *Government Information Quarterly*, 31(2), 327–336. https://doi.org/10.1016/j.giq.2013.11.008

Hacklin, F., Raurich, V., & Marxt, C. (2004, October). How incremental innovation becomes disruptive: the case of technology convergence. In *2004 IEEE International Engineering Management Conference* (IEEE Cat. No. 04CH37574) (Vol. 1, pp. 32-36). IEEE.

Hägele, M. (2016). Robots Conquer the World [Turning Point]. *IEEE Robotics and Automation Magazine*, 23(1), 1–3. https://doi.org/10.1109/MRA.2015.2512741

Halaweh, M. (2018). Viewpoint: Artificial Intelligence Government (Gov. 3.0): The UAE Leading Model. *Journal of Artificial Intelligence Research*, 62, 269–272. https://doi.org/10.1613/jair.1.11210

Hall, W., & Presenti, J. (2017). Growing the artificial intelligence in the UK. *Department for Digital, Culture, Media & Sport and Department for Business, Energy & Industrial Strategy, UK Government*. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/652097/Growing_the_artificial_intelligence_industry_in_the_UK.pdf

Hanifatunnisa, R., & Rahardjo, B. (2017). Blockchain based e-voting recording system design. *Proceedings of the 11th International Conference on Telecommunication Systems Services and Applications, TSSA 2017*, 1–6. https://doi.org/10.1109/TSSA.2017.8272896

Hannan, E., & Wilson, S. (n.d.). What is RESTful API? *TechTarget*. Retrieved March 21, 2019, from https://searchmicroservices.techtarget.com/definition/RESTful-API

Hao, K. (2018). Amazon is the invisible backbone behind ICE's immigration crackdown. *MIT Technology Review*. Retrieved March 18, 2019, from https://www.technologyreview.com/s/612335/amazon-is-the-invisible-backbone-behind-ices-immigration-crackdown/

Harbert, T. (2017). Practical Uses of the Internet of Things in Government Are Everywhere. *Government Technology*. Retrieved March 19, 2019, from https://www.govtech.com/network/Practical-Uses-of-the-Internet-of-Things-in-Government-Are-Everywhere.html

Harding, M., Knowles, B., Davies, N., & Rouncefield, M. (2015). HCI, Civic Engagement & Trust. *CHI 2015*, 2833–2842. https://doi.org/10.1145/2702123.2702255

Hardy, K., & Maurushat, A. (2017). Opening up government data for Big Data analysis and public benefit. *Computer Law & Security Review*, 33. https://doi.org/10.1016/j.clsr.2016.11.003

Hashem, I. A. T, Chang, V., Anuar, N. B., Adewole, K., Yaqoob, I., Gani, A., Ahmed, E., & Chiroma, H. (2016). The role of big data in smart city. *International Journal of Information Management*, 36(5), 748–758. https://doi.org/10.1016/j.ijinfomgt.2016.05.002

Heath, R. (2016). Private sector tries to fill EU void on refugees. *Politico*. Retrieved March 21, 2019, from https://www.politico.eu/article/private-sector-fill-eu-void-refugees-ngos-activists-migration-crisis-solutions/

Heichlinger, A., Thijs, N., Hammerschmid, G., & Attström, K. (2018). Public Public Administration Reform in Europe: Conclusions, lessons learned and recommendations for future EU Policy. European Commission, DG for Employment, Social Affairs and Inclusion.

Helbing, D., Frey, B. S., Gigerenzer, G., Hafen, E., Hagner, M., Hofstetter, Y., van der Hoven, J., Zicari, R. V., & Zwitter, A. (2018). Will Democracy Survive Big Data and Artificial Intelligence? In *Towards Digital Enlightenment* (pp. 73–98). https://doi.org/10.1007/978-3-319-90869-4_7

Hellberg, A. S., & Grönlund, Å. (2013). Conflicts in implementing interoperability: Re-operationalizing basic values. *Government Information Quarterly*, 30(2), 154–162. https://doi.org/10.1016/j.giq.2012.10.006

Henke, N., Bughin, J., Chui, M., Manyika, J., Saleh, T., Wiseman, B., & Sethupathy, G. (2016). The age of analytics: Competing in a data-driven world. *McKinsey Global Institute*. https://doi.org/10.1111/bjet.12230

Henningsson, S., & van Veenstra, A. F. (2010). Barriers to IT-driven Governmental Transformation. In *ECIS* (p. 113).

Hildebrandt, M. (2018). Primitives of Legal Protection in the Era of Data-Driven Platforms. *Georgetown Law Technology Review*, 2, 252-273.

Hillenius, G. (2017). Following security breach, Sweden shores up outsourcing rules. *Joinup*. Retrieved March 18, 2019, from https://joinup.ec.europa.eu/news/following-security-breach-sw

Hiller, J. S., & Bélanger, F. (2001). Privacy Strategies for Electronic Government. E-Government Series. *PwC Endowment for the Business of Government*. Retrieved from http://130.18.86.27/faculty/warkentin/SecurityPapers/Merrill/HillerBelanger2001_PWCWhitePaper_PrivacyStrategiesElectronicGovernment.pdf

Hinings, B., Gegenhuber, T., & Greenwood, R. (2018). Digital innovation and transformation: An institutional perspective. *Information and Organization*, 28(1), 52–61. https://doi.org/10.1016/j.infoandorg.2018.02.004

HM Government. (2011). Government Cloud Strategy. *UK HM Government*. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/266214/government-cloud-strategy_0.pdf

Höchtl, J., Parycek, P., & Schöllhammer, R. (2015). Big data in the policy cycle: Policy decision making in the digital era. *Journal of Organizational Computing and Electronic Commerce*, 26(1–2), 147–169. https://doi.org/10.1080/10919392.2015.1125187

Holgate, R. (2016). Hype Cycle for Digital Government Technology 2018. Gartner. Available at https://www.gartner.com/doc/3884179/hype-cycle-digital-government-technology

Hondula, D. M., Kuras, E. R., Longo, J., & Johnston, E. W. (2018). Toward precision governance: infusing data into public management of environmental hazards. *Public Management Review*, 20(5). https://doi.org/10.1080/14719037.2017.1320043

Horgan, D. (2018). From here to 2025: Personalised medicine and healthcare for an immediate future. *European Alliance for Personalised Medicine*. Retrieved from https://www.euapm.eu/pdf/EAPM_CongressBooklet_Digital.pdf

Hsiao, J. H., Tso, R., Chen, C. M., & Wu, M. E. (2018). Advances in Computer Science and Engineering. *Advances in Computer Science and Engineering*, (September), 305–309. https://doi.org/10.5772/606

Hunt, P., Saunders, J., & Hollywood, J. S. (2014). Evaluation of the Shreveport Predictive Policing Experiment. *RAND*. https://doi.org/10.1214/07-EJS057

Ibáñez, L. D., Simperl, E., Gandon, F., & Story, H. (2017). Redecentralizing the web with distributed ledgers. *IEEE Intelligent Systems*, 32(1), 92–95. https://doi.org/10.1109/MIS.2017.18

IBM Center for the Business of Government. (2017). Transforming government through technology. *IBM Center for the Business of Government*. Retrieved from http://www.businessofgovernment.org/sites/default/files/Transforming%20Government%20Through%20Technology.pdf

Innovation Centre Denmark. (2017). *Applied AI in Public Administration*. Retrieved March 18, 2019, from http://www.icdk.us/aai/public_administration

Institute of Development Studies. (2017). Blockchain for development – hope or hype? *Institute of Development Studies*, 17.

Institute on Governance & DEEP Centre. (2017). *The Path to Digital Governance: An Agenda for Public Service Innovation and Excellence*. Retrieved from https://iog.ca/docs/The-Path-to-Digital-Governance.pdf

Janowski, T. (2015). Digital Government Evolution: from Transformation to Contextualization. *Government Information Quarterly*, 32(3), 221–236. https://doi.org/10.1016/j.giq.2015.07.001

Janowski, T., Estevez, E., & Baguma, R. (2018). Platform governance for sustainable development: Reshaping citizen-administration relationships in the digital age. *Government Information Quarterly*, 35(4), S1–S16. https://doi.org/10.1016/j.giq.2018.09.002

Jansen, A., & Ølnes, S. (2016). The nature of public e-services and their quality dimensions. *Government Information Quarterly*, 33(4), 647–657. https://doi.org/10.1016/j.giq.2016.08.005

Janssen, M., & Kuk, G. (2016). The challenges and limits of big data algorithms in technocratic governance. *Government Information Quarterly*, 33(3), 371–377. https://doi.org/10.1016/j.giq.2016.08.011

Janssen, M., & van den Hoven, J. (2015). Big and Open Linked Data (BOLD) in government: A challenge to transparency and privacy? *Government Information Quarterly*, 32(4), 363–368. https://doi.org/10.1016/J.GIQ.2015.11.007

Janssen, M., Charalabidis, Y. & Krcmar, H. (2017). Open Data, Information Processing and Datification of Government. *Proceedings of the 50th Hawaii International Conference on System Sciences*. Retrieved from http://hdl.handle.net/10125/41478

Janssen, M., Charalabidis, Y., & Zuiderwijk, A. (2012). Benefits, Adoption Barriers and Myths of Open Data and Open Government. *Information Systems Management*, 29(4), 258–268. https://doi.org/10.1080/10580530.2012.716740

Jones, B. A., Madden, G. J., & Wengreen, H. J. (2014). The FIT Game: Preliminary evaluation of a gamification approach to increasing fruit and vegetable consumption in school. *Preventive Medicine*, 68, 76–79. https://doi.org/10.1016/j.ypmed.2014.04.015

Jorge, F. (2018), The govtech startups transforming Europe, by country. Public. Retrieved from https://www.public.io/the-govtech-startups-transforming-europe-by-country/

Joseph, G. & Lipp, K. (2018). IBM used NYPD surveillance footage to develop technology that lets police search by skin color. *The Intercept*. Retrieved March 18, 2019, from https://theintercept.com/2018/09/06/nypd-surveillance-camera-skin-tone-search/

Joseph, R. C., & Johnson, N. A. (2013). Big Data and Transformational Government. *IT Professional*, 15(6), 43–48. https://doi.org/10.1109/MITP.2013.61

Ju, J., Liu, L., & Feng, Y. (2018). Citizen-centered big data analysis-driven governance intelligence framework for smart cities. *Telecommunications Policy*, 42(10), 881–896. https://doi.org/10.1016/j.telpol.2018.01.003

Jun, S-P., Yoo, H. S., & Choi, S. (2018). Ten years of research change using Google Trends: From the perspective of big data utilizations and applications. *Technological Forecasting and Social Change*, 130, 69–87. https://doi.org/10.1016/j.techfore.2017.11.009

Jung, C., & Padman, R. (2015). Disruptive Digital Innovation in Healthcare Delivery: The Case for Patient Portals and Online Clinical Consultations. In *The Handbook of Service Innovation* (pp. 297–319). Springer. https://doi.org/10.1007/978-1-4471-6590-3_15

K-12 Education Team. (2015). Continued progress promising evidence on personalized learning. *Bill & Melinda Gates Foundation*. Retrieved from www.gatesfoundation.org1

Kalampokis, E., Tambouris, E., & Tarabanis, K. (2011). A classification scheme for open government data: towards linking decentralised data. *International Journal of Web Engineering and Technology*, 6(3), 266–285. https://doi.org/10.1504/ijwet.2011.040725

Karanjia, B., Karanth, A. G., Veerapaneni, S., Goswami, S., Sharma, A., & Boda, M. (2017). Blockchain in public sector. Transforming government services through exponential technologies. *Deloitte*. Retrieved from https://www2.deloitte.com/content/dam/Deloitte/in/Documents/public-sector/in-ps-blockchain-noexp.pdf

Kariuki, D. (2018). Blockchain-Based Land Registry Systems Can Help Eliminate Fraud, Corruption and Delays. *cryptotomorrow*. Retrieved March 20, 2019, from https://www.cryptomorrow.com/2018/02/27/blockchain-based-land-registry-and-record-systems/

Kaschesky, M., Sobkowicz, P., & Bouchard, G. (2011). Opinion mining in social media: Modeling, Simulating, and Visualizing Political Opinion Formation in the Web. *Proceedings of the 12th Annual International Conference on Digital Government Research*, 317–326. https://doi.org/10.1145/2037556.2037607

Khemani, D. (2017). A Perspective on AI Research in India. *AI Magazine*, 33(1), 96–98. https://doi.org/10.1609/aimag.v33i1.2356

Killmeyer, J., White, M., & Chew, B. (2017). Will blockchain transform the public sector? Blockchain basics for government. *Deloitte Center for Government Insights*. Retrieved from https://www2.deloitte.com/content/dam/insights/us/articles/4185_blockchain-public-sector/DUP_will-blockchain-transform-public-sector.pdf

Kim, H.-G. (2014). Big data applications in the government sector: a comparative analysis among leading countries. *Communications of the ACM*, 57(3), 78–85. https://doi.org/10.1145/2500873

Körtner, T. (2016). Ethical challenges in the use of social service robots for elderly people. *Zeitschrift Für Gerontologie Und Geriatrie*, 49(4), 303–307. https://doi.org/10.1007/s00391-016-1066-5

Kosorukov, A. A. (2017). Digital Government Model: Theory and Practice of Modern Public Administration. *Journal of Legal, Ethical & Regulatory Issues*, 20(3), 1–10. Retrieved from https://www.abacademies.org/articles/Digital-government-model-theory-and-practice-of-modern-public-administration-1544-0044-20-3-141.pdf

Koussouris, S., Lampathaki, F., Kokkinakos, P., Askounis, D., & Misuraca, G. (2015). Accelerating Policy Making 2.0: Innovation directions and research perspectives as distilled from four standout cases. *Government Information Quarterly*, 32(2), 142-153.

Laskowski, M., & Badurowicz, M. (2014). Gamification in higher education: a case study. *Make Learn International Conference*. Retrieved from http://www.toknowpress.net/ISBN/978-961-6914-09-3/papers/ML14-663.pdf

Layne, K., & Lee, J. (2001). Developing fully functional E-government: A four stage model. *Government Information Quarterly*. Retrieved from http://www.egov.ee/media/1310/developing-fully-functional-egovernment_a-four-stage-model.pdf

Lee, J. (2010). 10 year retrospect on stage models of e-Government: A qualitative meta-synthesis. *Government Information Quarterly*, 27, 220–230. https://doi.org/10.1016/j.giq.2009.12.009

Leyden, J. (2017). Revealed: 779 cases of data misuse across 34 British police forces. *The Register*. Retrieved March 18, 2019, from https://www.theregister.co.uk/2017/07/26/uk_police_data_handling_foi/

Linden, A. (2003). Understanding Gartner's Hype Cycles. *Gartner*. Retrieved from https://www.bus.umich.edu/KresgePublic/Journals/Gartner/research/115200/115274/115274.pdf

Linders, D. (2012). From e-government to we-government: Defining a typology for citizen coproduction in the age of social media. *Government Information Quarterly*, 29(4), 446–454. https://doi.org/10.1016/j.giq.2012.06.003

Linders, D., Wilson, S. C., & Bertot, J. C. (2012). Open government as a vehicle for government transformation. In *Public Sector Transformation through E-Government* (pp. 20–35). Routledge. https://doi.org/https://dx.doi.org/10.4324/9780203096680

Lindgren, I., & Van Veenstra, A. F. (2018). Digital government transformation: a case illustrating public e-service development as part of public sector transformation. *18 Proceedings of the 19th Annual International Conference on Digital Government Research*. https://doi.org/10.1145/3209281.3209302

Lnenicka, M., & Komarkova, J. (2018). Big and open linked data analytics ecosystem: Theoretical background and essential elements. *Government Information Quarterly*. https://doi.org/10.1016/j.giq.2018.11.004

Love-Koh, J., Peel, A., Rejon-Parilla, J. C., Ennis, K., Lovett, R., Manca, A., Chalkidou, A., Wood, H., & Taylor, M. (2018). The Future of Precision Medicine: Potential Impacts for Health Technology Assessment. *PharmacoEconomics*, 36(12), 1439–1451. https://doi.org/10.1007/s40273-018-0686-6

Lum, K., & Isaac, W. (2016). To predict and serve? *Significance*, *October*, 15–19. https://doi.org/10.1111/j.1740-9713.2016.00960.x

Luna-Reyes, L. F., & Gil-Garcia, J. R. (2014). Digital government transformation and internet portals: The co-evolution of technology, organizations, and institutions. *Government Information Quarterly*. https://doi.org/10.1016/j.giq.2014.08.001

Mac Flynn, P. & Wilson, L. (2019). The Future of Work: The impact of automation technologies for job quality in Northern Ireland. NERI Working Paper Series. NERI: Dublin, 19.

Maciejewski, M. (2017). To do more, better, faster and more cheaply: using big data in public administration. *International Review of Administrative Sciences*, 83(1S), 120–135. https://doi.org/10.1177/0020852316640058

Madaio, M. (2016). Identifying and prioritizing fire inspections: a case study of predicting fire risk in Atlanta. *Georgia Tech, College of Computing*, 185–194. https://doi.org/10.1145/2939672.2939682

Madden, M., Gilman, M., Levy, K., & Marwick, A. (2017). Privacy, Poverty, and Big Data: A Matrix of Vulnerabilities for Poor Americans. *Washington University Law Review*, 95(1). Retrieved from http://openscholarship.wustl.edu/law_lawreviewhttp://openscholarship.wustl.edu/law_lawreview/vol95/iss1/6

Maio, A.D., & Howard, R. (2017). Introducing the Gartner Digital Government Maturity Model 2.0. *Gartner*. Retrieved March 19, 2019, from https://www.gartner.com/doc/3764382/introducing-gartner-digital-government-maturity

Mantelero, A. (2014). The future of consumer data protection in the EU Re-thinking the "notice and consent" paradigm in the new era of predictive analytics. *Computer Law & Security Review*, 30(6), 643-660.

Manyika, J., Chui, M., Miremadi, M., Bughin, J., George, K., Willmott, P., & Dewhurst, M. (2017). A future that works: automation, employment, and productivity. *McKinsey Global Institute*. Retrieved from www.mckinsey.com/mgi.

Margets, H., Dorobantu, C. (2019). Rethink government with AI. *Nature*. Retrieved from: https://www.nature.com/articles/d41586-019-01099-5

Margetts, H., & Naumann, A. (2017). Government as a platform: what can Estonia show the world? *Oxford Internet Institute, University of Oxford*.

Marjanovic, O., & Cecez-Kecmanovic, D. (2017). Exploring the tension between transparency and datification effects of open government IS through the lens of Complex Adaptive Systems. *Journal of Strategic Information Systems*, 26(3), 210–232. https://doi.org/10.1016/j.jsis.2017.07.001

Marr, B. (2018). How Much Data Do We Create Every Day? The Mind-Blowing Stats Everyone Should Read. *Forbes*. Retrieved March 19, 2019, from https://www.forbes.com/sites/bernardmarr/2018/05/21/how-much-data-do-we-create-every-day-the-mind-blowing-stats-everyone-should-read/#5f4adaaa60ba

McBride, K., Aavik, G., Kalvet, T., & Krimmer, R. (2017). Co-creating an Open Government Data Driven Public Service: The Case of Chicago's Food Inspection Forecasting Model. *Technology Governance and Economic Dynamics*. Retrieved from http://hum.ttu.ee/wp/paper76.pdf

McBride, K., Aavik, G., Toots, M., Kalvet, T., & Krimmer, R. (2019). How does open government data driven co-creation occur? Six factors and a 'perfect storm'; insights from Chicago's food inspection forecasting model. *Government Information Quarterly*, 36(1), 88–97. https://doi.org/10.1016/j.giq.2018.11.006

McBride, K., Toots, M., Kalvet, T., & Krimmer, R. (2018). Open Government Data Driven Co-creation: Moving Towards Citizen-Government Collaboration. *Electronic Government* (Vol. 1). Springer International Publishing. https://doi.org/10.1007/978-3-540-74444-3

McKinsey & Company. (2018). *McKinsey on government*. Retrieved from https://www.mckinsey.com/~/media/McKinsey/Industries/Public Sector/McKinsey on Government Nov 2018/McKinsey-on-Government-November-2018.ashx

McKinsey Global Institute. (2018). *Smart Cities: Digital Solutions for a More Livable Future*. Retrieved from https://www.mckinsey.com/~/media/McKinsey/Industries/Capital Projects and Infrastructure/Our Insights/Smart cities Digital solutions for a more livable future/MGI-Smart-Cities-Full-Report.ashx

Medhora, P. R. (2018). Data Governance in the Digital Age. *Centre for International Governance Innovation*. Retrieved from https://www.cigionline.org/sites/default/files/documents/Data Series Special Reportweb.pdf

Mehr, H. (2017). Artificial Intelligence for Citizen Services and Government. *Harvard Kennedy School Ash Center for Democratic Governance and Innovation*, (August), 19. Retrieved from https://ash.harvard.edu/files/ash/files/artificial_intelligence_for_citizen_services.pdf

Meijer, A. (2015). E-governance innovation: Barriers and strategies. *Government Information Quarterly*, 32(2), 198-206.

Meijer, A., & Thaens, M. (2018). Quantified street: Smart governance of urban safety. *Information Polity*, *23*(1), 29–41. https://doi.org/10.3233/IP-170422

Mellouli, S., Luna-Reyes, L. F., & Zhang, J. (2014). Smart government, citizen participation and open data. *Information Polity,* 19, 1-4. https://doi.org/10.3233/IP-140334

Mergel, I. (2013). Social media adoption and resulting tactics in the U.S. federal government. *Government Information Quarterly*, 30, 123–130. https://doi.org/10.1016/j.giq.2012.12.004

Mergel, I. (2013). *Social media in the public sector: A guide to participation, collaboration and transparency in the networked world*. John Wiley & Sons. Retrieved from https://www.wiley.com/en-us/Social+Media+in+the+Public+Sector%3A+A+Guide+to+Participation%2C+Collaboration+and+Transparency+in+The+Networked+World-p-9781118109946

Mergel, I., Edelmann, N., & Haug, N. (2019). Defining digital transformation: Results from expert interviews. Government Information Quarterly.

Mettler, T., Sprenger, M., & Winter, R. (2017). Service robots in hospitals: New perspectives on niche evolution and technology affordances. *European Journal of Information Systems*, 26(5), 451–468. https://doi.org/10.1057/s41303-017-0046-1

Meyers, M., Niech, C., & Eggers, W. D. (2015). Anticipate, sense, and respond. Connected government and the Internet of Things. *Deloitte University Press*. Retrieved from http://dupress.com/

Microsoft & PwC. (2017). *How Finland is embracing digital transformation. Digital challenges and success showcases*. 1–48. Retrieved from https://info.microsoft.com/rs/157-GQE-382/images/How%20Finland%20is%20embracing%20digital%20transformation2.pdf

Milano, M., O'Sullivan, B., & Gavanelli, M. (2017). Sustainable Policy Making: A Strategic Challenge for Artificial Intelligence. *AI Magazine*, 35(3), 22–35. https://doi.org/10.1609/aimag.v35i3.2534

Ministry of Defence. (2018). Human-Machine Teaming. Development, Concepts and Doctrine Centre. *UK Government*. Retrieved from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/709359/20180517-concepts_uk_human_machine_teaming_jcn_1_18.pdf

Misuraca, G., & Viscusi, G. (2014, October). Digital governance in the public sector: challenging the policy-maker's innovation dilemma. In *Proceedings of the 8th International Conference on Theory and Practice of Electronic Governance* (pp. 146-154). ACM.

Misuraca, G., & Viscusi, G. (2014). Is Open Data Enough? e-Governance challenges for Open Government. *International Journal of Electronic Government Research*, 10(1), 18–34. https://doi.org/10.4018/ijegr.2014010102

Misuraca, G., & Viscusi, G. (2015). Shaping public sector innovation theory: an interpretative framework for ICT-enabled governance innovation. *Electronic Commerce Research*, 15(3), 303-322.

Misuraca, G., Mureddu, F., & Osimo, D. (2014). Policy-making 2.0: Unleashing the power of big data for public governance. In *Open Government* (pp. 171-188). Springer, New York, NY.

Misuraca, G., Pasi, G., & Brancati, C. U. (2017). ICT-enabled social innovation. Evidence and prospective. *Joint Research Centre, European Commission*. https://doi.org/10.2760/494727

Misuraca, G., Savoldeli, A., & Codagnone, C. (2013). Evaluating e-Government: A Comprehensive Methodological Framework to Assess Policy Impacts. In *Government Management Planning and e-Strategic Practices, Patterns and Roadmaps* (pp. 25–48). Springer. https://doi.org/10.1061/9780784481400.025

Misuraca, G., Mureddu, F., and Osimo, D., (2014). Policy Making 2.0: Unleashing the power of big data for open governance, in *Open Government: Opportunities and Challenges for Public Governance*, edited by Mila Gascó-Hernandez, IPGM-ESADE, Barcelona, Spain

Mitchell, C., Meredith, P., Richardson, M., Greengross, P., & Smith, G. B. (2016). Reducing the number and impact of outbreaks of nosocomial viral gastroenteritis: Time-series analysis of a multidimensional quality improvement initiative. *BMJ Quality and Safety*, 25(6), 466–474. https://doi.org/10.1136/bmjqs-2015-004134

Mittelstadt, B. (2016). Auditing for Transparency in Content Personalization Systems. *International Journal of Communication* (Vol. 10).

Mocker V., & Chapman, O. (2016). Policy making for the 21st century: how digital tools can help. *Nesta*, 1–10. Retrieved from http://readie.eu/wp-content/uploads/2017/08/Policymaking-for-the-21st-Century1-1.pdf

Molnar, P., & Gill, L. (2018). Bots at the Gate: a human rights analysis of automated decision-making in Canada's immigration and refugee system. *International Human Rights Program & Citizen Lab*. Retrieved from https://citizenlab.ca/2018/09/bots-at-the-gate-human-rights-analysis-automated-decision-making-in-canadas-immigration-refugee-system/

Monteiro, A. M. (2019). First GDPR fine in Portugal issued against hospital for three violations. *IAPP*. Retrieved March 18, 2019, from https://iapp.org/news/a/first-gdpr-fine-in-portugal-issued-against-hospital-for-three-violations/

Moon, M. J. (2002). The Evolution of E-Government among Municipalities: Rhetoric or Reality? *Public Administration Review*, 62(4). Retrieved from http://www.firstgov.gov

Mora, L., Deakin, M., & Reid, A. (2018). Strategic principles for smart city development: A multiple case study analysis of European best practices. *Technological Forecasting and Social Change*, (December 2017), 0–1. https://doi.org/10.1016/j.techfore.2018.07.035

Morabito, V. (2015). Big data and analytics for government innovation. In Big data and analytics (pp. 23-45). Springer, Cham.

Mossberger, K., Wu, Y., & Crawford, J. (2013). Connecting citizens and local governments? Social media and interactivity in major U.S. cities. *Government Information Quarterly*, 30(4), 351–358. https://doi.org/10.1016/j.giq.2013.05.016

Mottur, P. A., & Whittaker, N. R. (2018). Vizsafe: The Decentralized Crowdsourcing Safety Network. *2018 IEEE International Smart Cities Conference (ISC2)*, 1–6. https://doi.org/10.1109/ISC2.2018.8656658

Moura, T., & Gomes, A. (2017). Blockchain Voting and its effects on Election Transparency and Voter Confidence. *Proceedings of the 18th Annual International Conference on Digital Government Research - Dg.o '17*, 574–575. https://doi.org/10.1145/3085228.3085263

Mulgan, G. (2014). Innovation in the Public Sector: How Can Public Organisations Better Create, Improve and Adapt? *Nesta*. https://doi.org/10.2214/AJR.07.2082

Mureddu, F., Misuraca, G., Osimo, D., & Armenia, S. (2012, October). A new roadmap for next-generation policy-making. In *Proceedings of the 6th International Conference on Theory and Practice of Electronic Governance* (pp. 62-66). ACM.

Naafs, S. (2018). "Living laboratories": the Dutch cities amassing data on oblivious residents. *The Guardian*. Retrieved March 18, 2019, from https://www.theguardian.com/cities/2018/mar/01/smart-cities-data-privacy-eindhoven-utrecht

Nagy, D., Schuessler, J., & Dubinsky, A. (2016). Defining and identifying disruptive innovations. *Industrial Marketing Management*, 57, 119–126. https://doi.org/10.1016/j.indmarman.2015.11.017

Nanjing government. (n.d.). *"My Nanjing" APP Application Open Platform Technology Docking Guide*. Retrieved March 21, 2019, from http://mynj.cn/syzn/

Nash, R., & Havers, B. (2018). Solving the cross-border need for vehicle and driver identity with blockchain. *Blockchain Pulse: IBM Blockchain Blog*. Retrieved March 19, 2019, from https://www.ibm.com/blogs/blockchain/2018/08/solving-the-cross-border-need-for-vehicle-and-driver-identity-with-blockchain/

National Center for Environmental Information. (2016). *Data Access*. Retrieved March 18, 2019, from https://www.ncdc.noaa.gov/data-access

National Infrastructure Commission. (2018). *Data for the public good*. Retrieved from https://www.nic.org.uk/wp-content/uploads/Data-for-the-Public-Good-NIC-Report.pdf

Nazer, R., Hana, M. A., Lanvin, B., & Darwish, H. (2018). Inspire and Orchestrate: Innovation-Driven Government (IDG). *PwC*. Retrieved from https://www.pwc.com/m1/en/publications/documents/wgs-innovation-paper-new-updates.pdf

Nesta & Greater London Authority. (2018). *Piloting the London Office of Data Analytics*. Retrieved from https://londondatastore-upload.s3.amazonaws.com/LODA pilot report.pdf

Nesta. (n.d.). *FixMyStreet UK*. Retrieved March 18, 2019, from https://www.nesta.org.uk/feature/civic-exchange/fixmystreet/

Nesta. (n.d.). *Madame Mayor I have an idea*. Retrieved March 18, 2019, from https://www.nesta.org.uk/feature/10-people-centred-smart-city-initiatives/madame-mayor-i-have-an-idea/

Neufeind, M., O'Reilly, J and F. Ranft (2018), *Work in the Digital Age: Challenges of the Fourth Industrial Revolution*. Rowman & Littlefield: London.

Neumeier, S. (2017). Social innovation in rural development: identifying the key factors of success. *The Geographical Journal*. https://doi.org/10.1111/geoj.12180

New America. (n.d.). *The Blueprint for Blockchain and Social Innovation: Case Studies*. Retrieved March 18, 2019, from https://www.newamerica.org/bretton-woods-ii/blockchain-trust-accelerator/reports/blueprint-blockchain-and-social-innovation/case-studies/

Newman, N. (2014). How Big Data Enables Economic Harm to Consumers, Especially to Low-Income and Other Vulnerable Sectors of the Population. *US Federal Trade Commission*. Retrieved from https://www.ftc.gov/system/files/documents/public_comments/2014/08/00015-92370.pdf

NHS Digital. (2019). National Diabetes Audit. *UK NHS*. Retrieved March 18, 2019, from https://digital.nhs.uk/data-and-information/clinical-audits-and-registries/national-diabetes-audit

Nielsen, J. A., Andersen, K. N., & Sigh, A. (2016). Robots conquering local government services: A case study of eldercare in Denmark. *Information Polity*, 21(2), 139–151. https://doi.org/10.3233/IP-160381

Nimmesgern, E., Benediktsson, I., & Norstedt, I. (2017). Personalised Medicine in Europe. *Clinical and Translational Science*, 2(1), 1–1. https://doi.org/10.1159/000479406

Nintex case study. (2013). Public Administration Boosts Automation, Improving Productivity & Public Service. *Nintex*. Retrieved from www.llv.li

Noizat, P. (2015). Blockchain Electronic Vote. In *Handbook of Digital Currency* (pp. 453–461). Elsevier Inc. https://doi.org/10.1016/B978-0-12-802117-0.00022-9

Norris, D. F., & Reddick, C. G. (2013). Local E-Government in the United States: Transformation or Incremental Change? *Public Administration Review*, 73(1), 165–175. https://doi.org/10.1111/j.1540-6210.2012.02647.x

Nott, G. (2018). University of Adelaide employs chatbot to handle ATAR score queries. *CIO*. Retrieved March 21, 2019, from https://www.cio.com.au/article/640706/university-adelaide-employs-chatbot-handle-atar-score-queries/

Novero, M. (2019), "Beyond digital government: government, governance and digital transformation in the SDG era". E-Government, Digital Cooperation and the Sustainable Development Goals (SDGs). In preparation of the United Nations E-Government Survey 2020. Expert Group Meeting, 1-2 April 2019, New York, NY 10017.

NYC.gov. (2011). Launch of 311 Online Service Request Map. *Mike Bloomberg*. Retrieved March 18, 2019, from https://www.mikebloomberg.com/news/launch-of-311-online-service-request-map/

OECD Comparative study. (2016). Digital Government Strategies for Transforming Public Services in the Welfare Areas. *OECD*. https://doi.org/10.1063/1.3689939

OECD iLibrary. (2013). Open Government Data: Towards Empirical Analysis of Open Government Data Initiatives. *OECD*. Retrieved March 18, 2019, from https://www.oecd-ilibrary.org/governance/open-government-data_5k46bj4f03s7-en

OECD, World Government Summit, OPSI, & MBRCGI. (2018). *Embracing Innovation in Government: Global Trends 2018*. Retrieved from https://oecd-opsi.org/wp-content/uploads/2018/03/Embracing-Innovation-2018-Web-Version.pdf

OECD. (2014). *Recommendation of the Council on Digital Government Strategies*. Adopted by the OECD Council on 15 July 2014.

OECD. (2016). *Rebooting Public Service Delivery: How Can Open Government Data Help To Drive Innovation?* https://doi.org/10.1007/s10870-005-5133-9

OECD. (2017). *Core Skills for Public Sector Innovation*. Retrieved from https://oecd-opsi.org/wp-content/uploads/2018/07/OECD_OPSI-core_skills_for_public_sector_innovation-201704.pdf

OECD. (n.d.). *OECD initiatives on AI*. Retrieved from http://www.oecd.org/going-digital/ai/oecd-initiatives-on-ai.htm#policy-observatory

OECD. (n.d.). *Open Government Data*. Retrieved from http://www.oecd.org/gov/digital-government/open-government-data.htm

Official Journal of the European Union. (2007). Directive 2007/2/EC of the European Parliament and the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE). *Official Journal of the European Union*. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32007L0002&from=EN

Ojo, A., & Adebayo, S. (2017). Blockchain as a Next Generation Government Information Infrastructure: A Review of Initiatives in D5 Countries. *Government 3.0 – Next Generation Government Technology Infrastructure and Services*, 32, 283–298. https://doi.org/10.1007/978-3-319-63743-3

Ojo, A., & Millard, J. (Eds.). (2017). *Government 3.0–Next Generation Government Technology Infrastructure and Services: Roadmaps, Enabling Technologies & Challenges* (Vol. 32). Springer.

Ojo, A., Curry, E., Janowski, T., & Dzhusupova, Z. (2015). Transforming city governments for successful smart cities - the SCID framework. In *Transforming City Governments for Successful Smart Cities* (pp. 43–65). https://doi.org/10.1007/978-3-319-03167-5

Ølnes, S., & Jansen, A. (2017). Blockchain Technology as s Support Infrastructure in e-Government. In *International Conference on Electronic Government* (Vol. 1, pp. 215–227). https://doi.org/10.1007/978-3-540-74444-3

Ølnes, S., Ubacht, J., & Janssen, M. (2017). Blockchain in government: Benefits and implications of distributed ledger technology for information sharing. *Government Information Quarterly*, 34(3), 355–364. https://doi.org/10.1016/j.giq.2017.09.007

Open Government Partnership. (2018). *About OGP (Open Government Partnership).* Retrieved March 21, 2019, from https://www.opengovpartnership.org/about/about-ogp

Open Government Partnership. (2018). *Driving democracy forward.* Retrieved from https://www.opengovpartnership.org/sites/default/files/OGP_Annual-Report-2018_20190227.pdf

Oracle. (2018). *Create Tomorrow, Today. Delivering Modern Digital HR in Local Government*. Retrieved from https://www.oracle.com/a/ocom/docs/dc/lpd100729854-local-government-2-pages-lrc.pdf?elqTrackId=6cb8aa9458034f50a77fb1dfb94ad9c2&elqaid=72864&elqat=2

Organcity. (n.d.). *SafeCity*. Retrieved March 18, 2019, from http://organicity.eu/experiment/safecity/

Osborne, S. P., Radnor, Z., & Strokosh, K. (2016). Co-Production and the Co-Creation of Value in Public Services: A suitable case for treatment? *Public Management Review*, 18(5), 639–653. https://doi.org/10.1080/14719037.2015.1111927

Osman, I. H., Anouze, A. L., Irani, Z., Al-Ayoubi, B., Lee, H., Balci, A., Medeni, T. D., & Weerakkody, V. (2014). COBRA framework to evaluate e-government services: A citizen-centric perspective. *Government Information Quarterly*, 31, 243–256. https://doi.org/10.1016/j.giq.2013.10.009

Pak, B., Chua, A., & Moere, A. V. (2017). Who is Really Using FixMyStreet? Analyzing the extent of Socio-Demographic Inequality in Crowdsourced Civic Participation on FixMyStreet Brussels. *Journal of Urban Technology*, (April).

Palantir. (2014). Responding To Crime in Real Time. *Palantir*, 1–2. Retrieved from https://www.palantir.com/wp-assets/wp-content/uploads/2014/03/Impact-Study-LAPD.pdf

Pan, Y., Tian, Y., Liu, X., Gu, D., & Hua, G. (2016). Urban Big Data and the Development of City Intelligence. *Engineering*, 2(2), 171–178. https://doi.org/10.1016/J.ENG.2016.02.003

Panagiotopoulos, P., Al-Debei, M. M., Fitzgerland, G., & Elliman, T. (2012). A business model perspective for ICTs in public engagement. *Government Information Quarterly*, 29(2), 192–202. https://doi.org/10.1016/j.giq.2011.09.011

Papadakis, E. (1999). Constituents of confidence and mistrust in Australian institutions. *Australian Journal of Political Science*, 34(1), 75–93. https://doi.org/10.1080/10361149950470

Parise, E. (2011). *The Filter Bubble: What The Internet Is Hiding From You*. London: Viking, and Penguin Books. Retrieved from https://www.goodreads.com/book/show/10596103-the-filter-bubble

Paul, J. (2016). An Introduction to Open Data and APIs. Retrieved March 19, 2019, from https://digital.gov/2016/05/03/an-introduction-to-open-data-and-apis/

Pawelke, A., & Hernandez, K. (2017). Data for development : What's next? Concepts, trends and recommendations for German development cooperation. *GIZ, Institute of Development Studies & World Wide Web Foundation*. Retrieved from http://webfoundation.org/docs/2018/01/Final_Data-for-development_Whats-next_Studie_EN.pdf

Peeters, R., & Schuilenburg, M. (2018). Machine justice: Governing security through the bureaucracy of algorithms. *Information Polity*, 23(3), 267–280. https://doi.org/10.3233/IP-180074

Pencheva, I., Esteve, M., & Mikhaylov, J. S. (2018). Big Data and AI – A transformational shift for government: So, what next for research? *Public Policy and Administration*, 1–21. https://doi.org/10.1177/0952076718780537

Pereira, V. G., Macadar, M. A., & Luciano, E. M. (2016). Delivering public value through open government data initiatives in a Smart City context. *Information Systems Frontiers*. https://doi.org/10.1007/s10796-016-9673-7

Perry, W. L., McInnis, B., Price, C. C., Smith, S. C., & Hollywood, J. S. (2013). Predictive Policing: The Role of Crime Forecasting in Law Enforcement Operations. *RAND*. Retrieved from https://www.rand.org/content/dam/rand/pubs/research_reports/RR200/RR233/RAND_RR233.pdf

Picazo-Vela, S., Gutiérrez-Martínez, I., & Luna-Reyes, L. F. (2012). Understanding risks, benefits, and strategic alternatives of social media applications in the public sector. *Government Information Quarterly*. https://doi.org/10.1016/j.giq.2012.07.002

Pieterson, W., Ebbers, W., & Madsen, C. Ø. (2017). New Channels, New Possibilities: A Typology and Classification of Social Robots and Their Role in Multi-channel Public Service Delivery. *International Conference on Electronic Government*, 1, 634–642. https://doi.org/10.1007/978-3-540-74444-3

Polonksi, V. (2017). How artificial intelligence conquered democracy. *The Conversation*. Retrieved March 21, 2019, from http://theconversation.com/how-artificial-intelligence-conquered-democracy-77675

Popova, I. (2018). The Good, the Bad and the Unintended of Public Sector Digitalisation. *Digitalized Management (DIGMA)*. Retrieved March 18, 2019, from https://digitalizedmanagement.com/blog-eng/2018/11/21/the-good-the-bad-and-the-unintended-of-public-sector-digitalisation#_msocom_2

Potash, E., Brew, J., Loewi, A., Majumdar, S., Reece, A., Walsh, J., Roxier, E., Jorgensen, R., Monsour, R., & Ghani, R. (2016). Predictive Modeling for Public Health: Preventing Childhood Lead Poisoning. *Proceedings of the 21th ACM SIGKDD International Conference on Knowledge Discovery and Data Mining*. https://doi.org/10.1145/2783258.2788629

Powell, N. (2018). Sidewalk Labs pledges 'open' approach to data, but that's no guarantee they'll actually share it. *Financial Post*. Retrieved March 19, 2019, from https://business.financialpost.com/technology/sidewalk-labs-pledges-open-standard-for-data-governance-but-thats-no-guarantee-experts-say

PwC. (2016). *From concept to applied solutions. Data-driven cities*. Retrieved from https://www.pwc.ru/en/government-and-public-sector/assets/ddc_eng.pdf

PwC. (n.d.). *AI and robotics are transforming healthcare*. Retrieved March 21, 2019, from https://www.pwc.com/gx/en/industries/healthcare/publications/ai-robotics-new-health/transforming-healthcare.html

Qureshi, B. (2014, September). Towards a digital ecosystem for predictive healthcare analytics. In *Proceedings of the 6th International Conference on Management of Emergent Digital EcoSystems* (pp. 34-41). ACM.

Rabari, C., & Storper, M. (2014). The digital skin of cities: Urban theory and research in the age of the sensored and metered city, ubiquitous computing and big data. *Cambridge Journal of Regions, Economy and Society*, 8(1), 27–42. https://doi.org/10.1093/cjres/rsu021

Rathore, M. M., Paul, A., Hong, W. H., Seo, H., Awan, I., & Saeed, S. (2018). Exploiting IoT and big data analytics: Defining Smart Digital City using real-time urban data. *Sustainable Cities and Society*. https://doi.org/10.1016/j.scs.2017.12.022

Reddick, C. G., Chatfield, A. T., & Ojo, A. (2017). A social media text analytics framework for double-loop learning for citizen-centric public services: A case study of a local government Facebook use. *Government Information Quarterly*, 34(1), 110–125. https://doi.org/10.1016/j.giq.2016.11.001

Reis, J., Amorim, M., & Matos, P. (2018). Digital Transformation: A Literature Review and Guidelines for Future Research. In *Trends and Advances in Information Systems and Technologies* (pp. 411–421). https://doi.org/10.1007/978-3-319-77703-0_41

Relyea, H. C. (2008). Federal government information policy and public policy analysis: A brief overview. Library & Information Science Research, 30, 2–21.

Rey-Moreno, M. Felício, J. A., Medina-Molina, C., & Rufín, R. (2018). Facilitator and inhibitor factors: Adopting e-government in a dual model. *Journal of Business Research*, 88(November), 542–549. https://doi.org/10.1016/j.jbusres.2017.11.015

Riemann, R., & Grumbach, S. (2017). Distributed Protocols at the Rescue for Trustworthy Online Voting. *Proceedings of the 3rd International Conference on Information Systems Security Privacy*, 499–505. Retrieved from https://arxiv.org/pdf/1705.04480.pdf

Rooks, G., Matzat, U., & Sadowski, B. (2017). An empirical test of stage models of e-government development: Evidence from Dutch municipalities. *The Information Society*. https://doi.org/10.1080/01972243.2017.1318194

Ruijer, E., Grimmelikhuijsen, S., & Meijer, A. (2017). Open data for democracy: Developing a theoretical framework for open data use. *Government Information Quarterly*, 34(1), 45–52. https://doi.org/10.1016/j.giq.2017.01.001

Ruijer, E., Grimmelikhuijsen, S., Hogan, M., Enzerink, S., Ojo, A., & Meijer, A. (2017). Connecting societal issues, users and data. Scenario-based design of open data platforms. *Government Information Quarterly*, 34(3), 470–480. https://doi.org/10.1016/j.giq.2017.06.003

Ruiz, D. (2018). UK Surveillance Regime Violated Human Rights. *Electronic Frontier Foundation*. Retrieved March 18, 2019, from https://www.eff.org/deeplinks/2018/09/uk-surveillance-regime-violated-human-rights

Saari, E., Lehtonen, M., & Toivonen, M. (2015). Making bottom-up and top-down processes meet in public innovation. *The Service Industries Journal*, 35(6), 325–344. https://doi.org/10.1080/02642069.2015.1003369

Sabucedo, L. Á., Gago, J. M., & Iglesias, M. J. F. (2014). A tensor-based approach for semantic recommenders in eGovernment. *Advanced Science Letters*, 20(1), 317–320. https://doi.org/10.1166/asl.2014.5287

Salim, F., & Haque, U. (2015). Urban computing in the wild: A survey on large scale participation and citizen engagement with ubiquitous computing, cyber physical systems, and Internet of Things. *International Journal of Human-Computer Studies*, 81, 31–48. https://doi.org/10.1016/j.ijhcs.2015.03.003

Samuel, S. (2018). China's Surveillance Tech Is a Nightmare for Muslims. *The Atlantic*. Retrieved March 18, 2019, from https://www.theatlantic.com/international/archive/2018/08/china-surveillance-technology-muslims/567443/

Sanders, M. (2017). Using Data Science in Policy. *The Behavioural Insights Team*. Retrieved from http://38r8om2xjhhl25mw24492dir-wpengine.netdna-ssl.com/wp-content/uploads/2017/12/BIT_DATA-SCIENCE_WEB-READY.pdf

SAP. (2017). *Transforming Government for the Digital Era: To Improve Citizens' Lives*. Retrieved from https://assets.cdn.sap.com/sapcom/docs/2016/03/7aabb73a-667c-0010-82c7-eda71af511fa.pdf

Savaget, P., Chiarini, T., & Evans, S. (2018). Empowering Political Participation through Artificial Intelligence. *Science and Public Policy*, (1), 1–12. https://doi.org/doi:10.1093/scipol/scy064

Savoldelli, A., Codagnone, C., & Misuraca, G. (2014). Understanding the e-government paradox: Learning from literature and practice on barriers to adoption. *Government Information Quarterly*, 31, S63–S71. https://doi.org/10.1016/j.giq.2014.01.008

Savoldelli, A., Misuraca, G., & Codagnone, C. (2013). Measuring the Public value of e-Government: The eGEP2.0 model. *Electronic Journal of E-Government*, 1(1), 563–567. https://doi.org/10.1109/IEEM.2011.6035221

Scannell, R. J. (2016). Broken Windows, Broken Code. *Reallifemag*. Retrieved March 21, 2019, from https://reallifemag.com/broken-windows-broken-code/

Scassa, T. (2014). Privacy and Open Government. *Future Internet*, 6(2), 397–413. https://doi.org/10.3390/fi6020397

Scekic, O., Nastic, S., & Dustdar, S. (2018). Blockchain-Supported Smart City Platform for Social Value Co-Creation and Exchange. *IEEE Internet Computing*, PP(c), 1–12. https://doi.org/10.1109/MIC.2018.2881518

Schellong, A. (2009). Citizen Government Interaction: The Promise of the E-Channel. In *ICTs, citizens and governance: after the hype* (pp. 13–20). Ios Press. https://doi.org/https://dx.doi.org/10.3233/978-1-58603-973-8-13

Schindler, H. R., Cave, J., Robinson, N., Horvath, V., Hackett, P. J., Gunashekar, S., Botterman, M., Forge, S., & Graux, H. (2012). Europe's policy options for a dynamic and trustworthy development of the Internet of Things. *RAND*.

Schinler, L., & Kulkarani, R. (2014). Big Data for Policy Analysis: The Good, The Bad, and The Ugly. *Review of Policy Research*, 31(4), 343–348. https://doi.org/10.1111/ropr.12079

Scholta, H., Mertens, W., Kowalkiewicz, M., & Becker, J. (2019). From one-stop shop to no-stop shop: An e-government stage model. *Government Information Quarterly*, 36(1), 11-26.

Schwester, R. (2009). Examining the barriers to e-government adoption. *Electronic Journal of e-government*, 7(1).

Science and Technology Committee. (2016). Robotics and artificial intelligence. *UK House of Commons*. Retrieved from https://publications.parliament.uk/pa/cm201617/cmselect/cmsctech/896/896.pdf

Science and Technology Committee. (2016). The big data dilemma. Fourth Report of Session 2015-16. *UK House of Commons*. Retrieved from https://publications.parliament.uk/pa/cm201516/cmselect/cmsctech/468/468.pdf

Science and Technology Committee. (2018). Algorithms in decision-making. *UK House of Commons*. Retrieved from https://publications.parliament.uk/pa/cm201719/cmselect/cmsctech/351/351.pdf

Scott, M., DeLone, W., & Golden, W. (2016). Measuring eGovernment success: A public value approach. *European Journal of Information Systems*, 25(3), 187–208. https://doi.org/10.1057/ejis.2015.11

Service Now. (2018). *Today's State of Federal Automation*. Retrieved from https://www.servicenow.com/content/dam/servicenow-assets/public/en-us/doc-type/resource-center/ebook/ebk-todays-state-of-federal-automation.pdf

Shaheen, S. H., Yousaf, M., & Jalil, M. (2017). Temper proof data distribution for universal verifiability and accuracy in electoral process using blockchain. *Proceedings of the 13th International Conference on Emerging Technologies (2017)*, 1–6. https://doi.org/10.1109/ICET.2017.8281747

Shareef, M. A., Archer, N., & Dwivedi, Y. K. (2015). An empirical investigation of electronic government service quality: from the demand-side stakeholder perspective. *Total Quality Management and Business Excellence*, 26(3–4), 339–354. https://doi.org/10.1080/14783363.2013.832477

Shen, C., & Pena-Mora, F. (2018). Blockchain for Cities - A Systematic Literature Review. *IEEE Access*, *6*, 76787–76819. https://doi.org/10.1109/ACCESS.2018.2880744

Sidewalk Labs. (2018). *An Update on Data Governance for Sidewalk Toronto*. Retrieved March 19, 2019, from https://www.sidewalklabs.com/blog/an-update-on-data-governance-for-sidewalk-toronto/

Sidewalk Labs. (n.d.). *#BlockSidewalk*. Retrieved March 19, 2019, from https://www.blocksidewalk.ca/

Siemens, G., Dawson, S., & Lynch, G. (2013). Improving the Quality and Productivity of the Higher Education Sector: Policy and strategy for systems-level deployment of learning analytics. *Australian Government*. Retrieved from https://solaresearch.org/wp-content/uploads/2017/06/SoLAR_Report_2014.pdf

Siyal, A. A., Junejo, A. Z., Zawish, M., Ahmed, K., Khalil, A., & Soursou, G. (2019). Applications of Blockchain Technology in Medicine and Healthcare: Challenges and Future Perspectives. *Cryptography*, 3(1), 3. https://doi.org/10.3390/cryptography3010003

Skaržauskienė, A., & Mačiulienė, M. (2017). Conceptualizing ICT-Enabled Co-Creation of Public Value. *International Conference on Internet Science*. Retrieved from http://internetscienceconference.eu/presentations/Conceptualizing_ICTEnabled_CoCreation.pdf

Smith, F. S., Barlow, G. J., Xie, X.-F., & Rubinstein, Z. B. (2013). Smart Urban Signal Networks: Initial Application of the SURTRAC Adaptive Traffic Signal Control System. *The Robotics Institute, Carnegie Mellon University*, 434–442. https://doi.org/10.1093/aje/kwn411

Smith, F. S., Barlow, G. J., Xie, X.-F., & Rubinstein, Z. B., (2013). SURTRAC: scalable urban traffic control. *The Robotics Institute, Carnegie Mellon University*, 31(1–2), 37–54. Retrieved from https://www.ri.cmu.edu/pub_files/2013/1/13-0315.pdf

Smith, J., (2016). Crime-prediction tool may be reinforcing discriminatory policing. Business Insider. Retrieved from https://www.businessinsider.com/predictive-policing-discriminatory-police-crime-2016-10

Snow, J. (2018). Amazon's Face Recognition Falsely Matched 28 Members of Congress with Mugshots. *American Civil Liberties Union*. Retrieved from https://www.aclu.org/blog/privacy-technology/surveillance-technologies/amazons-face-recognition-falsely-matched-28

Stanziola, E., Espil, M. M., Landoni, L., & Montoya, S. (2006). Hidden Negative Social Effects of Poor e-Government Services Design. *International Conference on Electronic Government*, 150–161. https://doi.org/10.1007/11823100_14

Stewart, J., Jr., Hedge, D.M., & Lester, J. P. (2008). Public policy: An evolutionary approach. Australia: Thomson Wadsworth.

Stone, P., Brooks, R., Brynjolfsson, E., Calo, R., Etzioni, O., Hager, G., Hirschberg, J., Kalyanakrishnan, S., Kamar, E., Kraus, S., Leyton-Brown, K., Parkes, D., Press, W., Saxenian, A., Shah, J., Tambe, M., & Teller, A. (2016). Artificial intelligence and life in 2030. *Stanford University*. Retrieved from https://ai100.stanford.edu/sites/default/files/ai_100_report_0831fnl.pdf

Strokosch, K. (2018). Co-VAL [770356] "Understanding value co-creation in public services for transforming European public administrations." *COVAL*, 1–46.

Studinka, J., & Guenduez, A. A. (2018). The Use of Big Data in the Public Policy Process: Paving the Way for Evidence-Based Governance. *Smart Government Lab, Institute for Public Management and Governance*. Retrieved from https://www.alexandria.unisg.ch/255680/1/Studinka%20and%20Guenduez%20-%20The%20Use%20of%20Big%20Data%20in%20the%20Public%20Policy%20Process-%20Paving%20the%20Way%20for%20Evidence-Based%20Governance%20.pdf

Suherman-Bailey, J. (2015). Data policy and the public: shaping a deeper conversation. *Sciencewise*. Retrieved from https://sciencewise.org.uk/wp-content/uploads/2018/12/Data-policy-and-the-publicJan-2015.pdf

Sun, T. Q., & Medaglia, R. (2018). Mapping the challenges of Artificial Intelligence in the public sector: Evidence from public healthcare. *Government Information Quarterly*, 1–16. https://doi.org/10.1016/j.giq.2018.09.008

Susha, I., Åke, G., & Van Tulder, R. (2018). Data driven social partnerships: Exploring an emergent trend in search of research challenges and questions. *Government Information Quarterly*, 0–1. https://doi.org/10.1016/j.giq.2018.11.002

Susskind, R., & Susskind, D. (2016). Technology Will Replace Many Doctors, Lawyers, and Other Professionals. *Harvard Business Review*. Retrieved March 21, 2019, from https://hbr.org/2016/10/robots-will-replace-doctors-lawyers-and-other-professionals?sf50989575=1

Sutcliffe, D. (2017). What are the barriers to big data analytics in local government? Oxford Internet Institute, The Policy and Internet Blog. Retrieved from http://blogs.oii.ox.ac.uk/policy/what-are-the-barriers-to-big-data-analytics-in-local-government/

Symons, T. (2016). Datavores of Local Government: Using data to make services more personalised, effective and efficient. *Nesta*. Retrieved from http://www.nesta.org.uk/publications/datavores-local-government

Symons, T. (2016). Wise council: Insights from the cutting edge of data-driven local government. *Local Government Association & Nesta*. Retrieved from http://www.nesta.org.uk/publications/wise-council-insights-cutting-edge-data-driven-local-government

Tarasov, P., & Tewari, H. (2017). The future of e-voting. *International Journal on Computer Science and Information Systems*, 12(2), 148–165. Retrieved from http://www.iadisportal.org/ijcsis/papers/2017210210.pdf

Telep, C. W. (2009). Police Interventions to Reduce Violent Crime: A Review of Rigorous Research. *Fairfax, Va.: Center for Evidence-Based Crime Policy, George Mason University*. Retrieved from http://gemini.gmu.edu/cebcp

Terán, L. (2015). Enhancing citizens' participation via recommender systems. In *Digital Solutions for Contemporary Democracy and Government* (pp. 99–123). IGI Global. https://doi.org/10.4018/978-1-4666-8430-0.ch006

Terrago. (2017). 2017 *Guide to Geospatial Transformation for Government. How to Lower Costs, Accelerate Projects and Meet the New Federal Geospatial Mandates with the Cloud.* Retrieved from http://info.terragotech.com/WP/2017-Guide-Geospatial-Transformation-Government

The Chartered Institute for IT & Oxford Internet Institute. (2013). *The Societal Impact of the Internet of Things*. Retrieved from https://www.bcs.org/upload/pdf/societal-impact-report-feb13.pdf

The Partnership for Robotics in Europe. (2015). *Robotics 2020 Multi-Annual Roadmap. For robotics in Europe*. Retrieved from https://www.eu-robotics.net/cms/upload/downloads/ppp-documents/Multi-Annual_Roadmap2020_ICT-24_Rev_B_full.pdf

Thiel, S. K. (2016). A review of introducing game elements to e-participation. *Proceedings of the 6th International Conference for E-Democracy and Open Government*, 3–9. https://doi.org/10.1109/CeDEM.2016.14

Thierer, A., O'Sullivan, C. A., & Russell, R. (2017). Artificial Intelligence and Public Policy. *Mercatus Research, Mercatus Center at George Mason University*. https://doi.org/10.2139/ssrn.3021135

Tinholt, D., Enzernik, S., Sträter, W., Hautvast, P., & Carrara, W. (2017). Unleashing the potential of Artificial Intelligence in the Public Sector. *Capgemini*. Retrieved from https://www.capgemini.com/consulting/wp-content/uploads/sites/30/2017/10/ai-in-public-sector.pdf

Tito, J. (2017). Destination unknown: Exploring the Artificial Intelligence on Government. *Centre for Public Impact*. Retrieved from https://publicimpact.blob.core.windows.net/production/2017/09/Destination-Unknown-AI-and-government.pdf

Tomar, L., Guicheney, W., Kyarisiima, H., & Zimani, T. (2016). Big Data in the Public Sector. Selected Applications and Lessons Learned. *Inter-American Development Bank*. Retrieved from https://webimages.iadb.org/publications/english/document/Big-Data-in-the-Public-Sector-Selected-Applications-and-Lessons-Learned.pdf

UK Cabinet Office. (2018). Robots lend government a helping hand. *Civil Service Quarterly*. Retrieved March 19, 2019, from https://quarterly.blog.gov.uk/2018/03/28/robots-lend-government-a-helping-hand/

UKGI Digital Land Team. (2018). Location, location, location – tapping the economic potential of geospatial data. *Civil Service Quarterly*. Retrieved March 19, 2019, from https://quarterly.blog.gov.uk/2018/03/28/location-location-location-tapping-the-economic-potential-of-geospatial-data/

UN Department of Economic and Social Affairs. (2018). UN E-Government Survey 2018. *United Nations*. https://doi.org/e-ISBN: 978-92-1-055353-7

UN General Assembly. (2016). Preparatory Committee for the United Nations Conference on Housing and Sustainable Urban Development (Habitat III). *United Nations*. Retrieved from http://habitat3.org/wp-content/uploads/Policy-Paper-9-English.pdf

UNICRI. (n.d.). *The Hague, The Netherlands UNICRI Centre for Artificial Intelligence and Robotics*. Retrieved from http://www.unicri.it/in_focus/on/UNICRI_Centre_Artificial_Robotics

United Nations (2014). United Nations E-Government Survey 2014: E-Government for the future we want. United Nations Department of economic and social affairs.

United Nations (2016). United Nations E-Government Survey 2016. E-Government in Support of Sustainable Development. United Nations Department of economic and social affairs.

United Nations (2018), "Technology and Innovation Report 2018. Harnessing Frontier Technologies for Sustainable Development". United Nations Conference on Trade and Development (UNCTAD).

United Nations (2018). "Transforming our world: the 2030 Agenda for Sustainable Development". Sustainable Development Goals Knowledge Platform, available at https://sustainabledevelopment.un.org/post2015/transformingourworld

United Nations (2018). Resolution adopted by the General Assembly on 26 November 2018 (A/73/L.20 and A/73/L.20/Add.1).

United Nations (n/a), "Digital Government". Public Institutions and Digital Government, Department of Economic and Social Affairs. Retrieved from: https://publicadministration.un.org/en/ict4d

University of Aberdeen. (2016). *Researchers use Google trends to predict chicken pox outbreaks*. Retrieved March 19, 2019, from https://www.abdn.ac.uk/news/9236/

US General Services Administration. (2016). *GSA fleet telematics*. Retrieved from https://www.gsa.gov/cdnstatic/GSA_Fleet_Telematics_Facts.pdf

USA Department of Homeland Security. (2018). *Blockchain and Suitability for Government Applications*. Retrieved from https://www.dhs.gov/sites/default/files/publications/2018_AEP_Blockchain_and_Suitability_for_Government_Applications.pdf

Valle-Cruz, D., & Sandoval-Almazán, R. (2014, June). E-gov 4.0: a literature review towards the new government. In Proceedings of the 15th Annual International Conference on Digital Government Research (pp. 333-334). ACM.

Vesnic-Alujevic, L., Stoermer, E., Rudkin, J., Scapolo, F., Kimbell, L. (2019) *The Future of Government 2030+: A Citizen-Centric Perspective on New Government Models*. EUR 29664 EN. Publications Office of the European Union, Luxembourg, 2019. ISBN 978-92-76-00165-2

Victoria State Government. (2018). A Data Reform Strategy for the Victorian Public Service. *Department of Premier and Cabinet, Victoria State Government*. Retrieved from https://www.vic.gov.au/system/user_files/Documents/vcdi/Data Reform Strategy.PDF

Viderity. (2018). *The Future of Digital Government*. Retrieved March 19, 2019, from http://viderity.com/2018/10/09/the-future-of-digital-government/

Viswanath, K., & Kreuter, M. W. (2007). Health Disparities, Communication Inequalities, and e-Health: A Commentary. *American Journal of Preventive Medicine*, 32(5), S131–S133. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2043145/pdf/nihms-23186.pdf

Vlahovic, N., & Vracic, T. (2015). An Overview of E-Government 3.0 Implementation. In *Encyclopedia of Information Science and Technology, Third Edition* (pp. 2700-2708). IGI Global.

Vogl, T. M., Seidelin, C., Ganesh, B., & Bright, J. (2019). Algorithmic Bureaucracy: Managing Competence, Complexity, and Problem Solving in the Age of Artificial Intelligence. (February 1, 2019).

Walker, R. M. (2014). Internal and External Antecedents of Process Innovation: A review and extension. *Public Management Review*, 16(1), 21–44. https://doi.org/10.1080/14719037.2013.771698

Wang, B., Sun, J., He, Y., Pang, D., & Lu, N. (2018). Large-scale Election Based On Blockchain. *Procedia Computer Science*, 129, 234–237. https://doi.org/10.1016/j.procs.2018.03.063

Warkentin, M., Sharma, S., Gefen, D., Rose, G. M., & Pavlou, P. (2018). Social identity and trust in internet-based voting adoption. *Government Information Quarterly*, 35(2), 195–209. https://doi.org/10.1016/j.giq.2018.03.007

Washington, A. L. (2014). Government Information Policy in the Era of Big Data. *Review of Policy Research*, 31(4), 319–325. https://doi.org/10.1111/ropr.12081

Webster, C. W. R., & Leleux, C. (2018). Smart governance: Opportunities for technologically-mediated citizen co-production. *Information Polity*, 23(1), 95–110. https://doi.org/10.3233/IP-170065

Weerakkody, V., Dwivedi, Y. K., & Kurunananda, A. (2009). Implementing e-government in Sri Lanka: Lessons from the UK. *Information Technology for Development*, 15(3), 171-192.

Westley, F., & Antadze, N. (2010). Making a Difference: Strategies for Scaling Social Innovation for Greater Impact. *The Innovation Journal: The Public Sector Innovation Journal* (Vol. 15). Retrieved from http://www.eura.org/pdf/westall_news.pdf

Whittaker, M., Crawford, K., Dobbe, R., Fried, G., Kaziunas, E., Mathur, V., West, S. M., Richardson, R., Schultz, J., & Schwartz, O. (2018). AI Now Report 2018. *AI Now*. Retrieved from https://ainowinstitute.org/AI_Now_2018_Report.pdf

Williams, M. (2018). Digital Government Benchmark API study. *European Commission*. Retrieved from https://joinup.ec.europa.eu/sites/default/files/document/2018-10/330046042Joint Research Centre_digitalgovernmentbenchmark_finalreport_api_7.0.pdf

Williams, M., & Valayer, C. (2018). Digital Government Benchmark. Study on Digital Government Transformation. *Joint Research Centre, European Commission*. Retrieved from https://joinup.ec.europa.eu/sites/default/files/document/2018-10/330046042JOINT RESEARCH CENTRE_DigitalGovernmentBenchmark_FinalReport v2.0_DigGovSection.pdf

Williamson, B. (2014). Knowing public services: Cross-sector intermediaries and algorithmic governance in public sector reform. *Public Policy and Administration*, 29(4), 292–312. https://doi.org/10.1177/0952076714529139

Williamson, B. (2014). Public Policy and Administration governance in public sector reform. *Public Policy and Administration*. https://doi.org/10.1177/0952076714529139

Willmer, A., Duhan, J., & Gibson, L. (2017). The new machinery of government. Robotic Process Automation in the Public Sector. *Deloitte*. Retrieved from https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/Innovation/deloitte-uk-innovation-the-new-machinery-of-govt.pdf

Winfield, A. F. T., & Jirotka, M. (2018). Ethical governance is essential to building trust in robotics and AI systems. *Philosophical Transactions of the Royal Society*, 376(2133). Retrieved from http://eprints.uwe.ac.uk/37556%0A

Wirtz, B. W., Weyerer, J. C., & Geyer, C. (2018). Artificial Intelligence and the Public Sector—Applications and Challenges. *International Journal of Public Administration*, 1–20. https://doi.org/10.1080/01900692.2018.1498103

Wirtz, B. W., Weyerer, J. C., & Schichtel, F. T. (2018). An integrative public IoT framework for smart government. *Government Information Quarterly*, 1–0. https://doi.org/10.1016/j.giq.2018.07.001

Wiseman, J., & Godlsmith, S. (2017). Ten Great Ways Data Can Make Government Better. *Data-Smart City Solutions*. Retrieved March 21, 2019, from https://datasmart.ash.harvard.edu/news/article/ten-great-ways-data-can-make-government-better-1041

Wiseman, M. J. (2018). Data-driven government: The role of Chief Data Officers. *IBM Center for the Business of Government*. Retrieved from http://www.businessofgovernment.org/sites/default/files/Data-Driven Government_0.pdf

World Bank. (2014). Technology Options. *World Bank Group*. Retrieved March 19, 2019, from http://opendatatoolkit.worldbank.org/en/technology.html

World Bank. (2017). Internet of things. The new government to business platform. *World Bank Group*. https://doi.org/10.1007/978-1-4419-8237-7

World Economic Forum. (2018). *White Paper on Agile Governance: Reimagining Policymaking for the Fourth Industrial Revolution*. Retrieved from http://www3.weforum.org/docs/WEF_Agile_Governance_Reimagining_Policy-making_4IR_report.pdf

World Government Summit & INDRA. (2017). *Best government emerging technologies*. Retrieved from https://www.indracompany.com/sites/default/files/best_government_emerging_technologies__0.pdf

World Government Summit & Kinetic Consulting Services. (2018). *From automation to AI. Key government strategic considerations for execution of automation and AI solutions*. Retrieved from https://www.worldgovernmentsummit.org/api/publications/document?id=a8908dc4-e97c-6578-b2f8-ff0000a7ddb6

World Intellectual Property Organization (WIPO). (n.d.). *Index of AI initiatives in IP offices*. Retrieved March 18, 2019, from https://www.wipo.int/about-ip/en/artificial_intelligence/search.jsp

Yang, Z. Ng, B.-Y., Kankanhalli, A., & Wei Luen Yip, J. (2012). Workarounds in the use of IS in healthcare: A case study of an electronic medication administration system. *International Journal of Human-Computer Studies*, *70*(1), 43–65. https://doi.org/10.1016/j.ijhcs.2011.08.002

Yavuz, E., Koç, A. K., Çabuk, U. C., & Dalkiliç, G. (2018). Towards Secure E-Voting Using Ethereum Blockchain. *Proceedings of the 6th Symposium Digital Forensic Security (ISDFS)*. https://doi.org/10.1109/ISDFS.2018.8355340

Young, A., & Verhulst, S. (2016). *The Global Impact of Open Data: Key Findings from Detailed Case Studies Around the World*. O'Reilly. https://doi.org/10.1080/00071668.2011.559454

Zhao, Y., & Fan, B. (2018). Exploring open government data capacity of government agency: Based on the resource-based theory. *Government Information Quarterly*, 35(1), 1–12. https://doi.org/10.1016/j.giq.2018.01.002

Zheng, E. D. (2015). Leveraging the Internet of Things for a More Efficient and Effective Military A Report of the CSIS Strategic Technologies Program. *Center for Strategic and International Studies*. Retrieved from https://csis-prod.s3.amazonaws.com/s3fs-public/legacy_files/files/publication/150915_Zheng_LeveragingInternet_WEB.pdf

Zuiderwijk, A., & Janssen, M. (2014). Open data policies, their implementation and impact: A framework for comparison. Government Information Quarterly, 31(1), 17-29.

Zuiderwijk, A., & Janssen, M. (2014). Open data policies, their implementation and impact: A framework for comparison. *Government Information Quarterly*, 31, 17–29. https://doi.org/10.1016/j.giq.2013.04.003

Zuiderwijk, A., Janssen, M., Choenni, S., Meijer, R., & Alibaks, R. S. (2012). Socio-technical Impediments of Open Data. *Electronic Journal of e-Government* (Vol. 10).

List of abbreviations and definitions

AI	Artificial Intelligence
API	Application Programming Interface
BOLD	Big and Open Linked Data
CDO	Chief Data Officer
D-CENT	Decentralised Citizens Engagement Technologies
E4I	Effectiveness for Inclusion (dimension of the conceptual framework)
EGDI	eGovernment Development Index
eGov-MM	eGovernment Maturity Model
e-ID	Electronic identification
ELISE	European Location Interoperability Solutions for eGovernment
EU	European Union
FTA	Finnish Tax Administration
FTE	Full-time equivalent
GDPR	General Data Protection Regulation
GIS	Geographic information system
H2020	Horizon 2020
HCI	Human Capital Index
HMRC	Her Majesty's Revenue and Customs (The UK)
ICT	Information and Communication Technologies
IoT	Internet of Things
ISA	Interoperability Solutions
IT	Information Technology
JRC	Joint Research Centre of European Commission
LEG	Legitimacy (dimension of the conceptual framework)
MR	Mode of Regulation
NDIS	National Disability Insurance Scheme
NGO	Non-governmental organisation
NHS	National Health Service
OECD	Organization for Economic Co-operation and Development
OGD	Open Government Data
PEF	Productivity & Efficiency (dimension of the conceptual framework)
RPA	Robotic Process Automation
TII	Telecommunication Infrastructure Index
UN	United Nations
UNICRI	United Nations Interregional Crime and Justice Research Institute

List of figures

List of tables

GETTING IN TOUCH WITH THE EU

In person

All over the European Union there are hundreds of Europe Direct information centres. You can find the address of the centre nearest you at: https://europa.eu/european-union/contact_en

On the phone or by email

Europe Direct is a service that answers your questions about the European Union. You can contact this service:

- by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),

- at the following standard number: +32 22999696, or

- by electronic mail via: https://europa.eu/european-union/contact_en

FINDING INFORMATION ABOUT THE EU

Online

Information about the European Union in all the official languages of the EU is available on the Europa website at: https://europa.eu/european-union/index_en

EU publications

You can download or order free and priced EU publications from EU Bookshop at: https://publications.europa.eu/en/publications. Multiple copies of free publications may be obtained by contacting Europe Direct or your local information centre (see https://europa.eu/european-union/contact_en).

KJ-NA-29987-EN-N

The European Commission's science and knowledge service

Joint Research Centre

JRC Mission

As the science and knowledge service of the European Commission, the Joint Research Centre's mission is to support EU policies with independent evidence throughout the whole policy cycle.

EU Science Hub

ec.europa.eu/jrc

@EU_ScienceHub

EU Science Hub - Joint Research Centre

EU Science, Research and Innovation

EU Science Hub

Publications Office of the European Union

doi:10.2760/17207

ISBN 978-92-76-13299-8