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Assessing the impacts of digital government transformation in the EU

Conceptual framework and empirical case studies

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Abstract

This report presents the results of the conceptual and empirical work conducted as part of the JRC research on *Exploring Digital Government Transformation: understanding public sector innovation in a data-driven society"* conducted within the framework of the "European Location Interoperability Solutions for eGovernment (ELISE)" Action of the ISA2 Programme on Interoperability solutions for public administrations, businesses and citizens, coordinated by DIGIT. Building on the systematisation of the state of the art carried out in the previous phase of the research, the report presents an original conceptual framework for assessing the impacts of Digital Government transformation in the EU and discusses the results of case studies carried out using an experimental or quasi-experimental approach to test and validate it, carried out in different policy areas in various EU countries. The report concludes outlining the final proposal of DigiGov F 2.0, which defines the dimensions and elements of analysis for assessing the effects that can be generated by digital innovation in the public sector and the impacts they have at social, economic and political levels in different policy-cycle phases and governance contexts.

Foreword

This report presents the results of the conceptual and empirical work conducted as part of the JRC research on *"Exploring Digital Government Transformation: understanding public sector innovation in a data-driven society"* conducted in collaboration with the Consortium led by PPMI.

The study was conceived in line with the orientations of the JRC2030 strategy and the Work Programme of the ELISE Action of the ISA[2] Programme of DIGIT, to contribute to provide evidence and indications on how to shape the future research agenda and policy development in the field of Digital Government and public sector innovation in the EU.

The aim of the research is in fact to better understand how innovation in the public sector, enabled by digital technologies, can transform governance systems, especially in terms of new approaches to use geospatial/location data for policy design and service delivery, so that governments can better address systemic problems.

To this end, building on the systematisation of the state of the art carried out in the previous phase of the research, available as JRC Science for Policy Report entitled *Exploring Digital Government transformation in the EU - Analysis of the state of the art and review of literature,[1]* an original conceptual framework for assessing the impacts of Digital Government transformation in the EU has been developed. This takes into consideration the various modes of organization and implementation in different Member States and the multiple effects that transformations enabled by digital technologies can have on policy-making mechanisms, governance processes and service delivery.

To test and validate the conceptual framework, empirical research and case studies with experimental approach have been carried out to determine direct and indirect impacts of Digital Government transformation in different contexts and phases of the policy-cycle. The objective was to identify key drivers and barriers to successful implementation and the consequences of digital policy interventions, so to categorise - at different levels of abstraction - strategies and initiatives implemented within the framework of public sector reforms in selected EU Member States.

The four case studies cover different contexts and policy areas: the **Tvarkau Vilnių** case in Lithuania, which investigates the use and impact of the platform developed to support city management by streamlining the process of gathering information from citizens; the impact of the implementation of the use of **Body Worn Cameras** in the context of policing in the UK, drawing also on existing experiments and studies in different countries; the **Kids Go Green** project implemented in the schools of the city of Trento and Ferrara in Italy, to assess the impact of gamification on education and sustainable mobility and, using a different methodology, the **Online experiment on the relationship between citizens' privacy and trust** conducted in Germany and Spain, to investigate the effects of the introduction of digital public services, under hypothetical scenarios, in four different policy domains (transport, health, security and voting).

This report describes in details the proposed conceptual framework developed in collaboration between JRC and the consortium, which aims to set the basis for assessing in a theoretically-informed manner and in a consistent and scientifically robust way, the effects of Digital Government initiatives on governance systems and policy-making.

For this purpose, a well-grounded conceptualisation of public sector innovation in Digital Government has been elaborated, in order to assure the framework's ability to find testable implications on an empirical base. This entailed the elaboration of categories of analysis to inform the proposal for a framework able to show the association between Digital Government strategies and their consequences to transform the *modus operandi* of public sector organisations on service delivery, regulatory governance systems and policy-making mechanisms.

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[1] https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/exploring-digital-government-transformation-eu

In doing so, the framework defines the required dimensions and elements of analysis for assessing the effects that can be generated by digital innovation in public sector organisations and the impacts they have at social, economic and political levels in different contexts and policy-cycle phases.

The case studies and experiments conducted had therefore the twofold objective of illustrating the possible impacts of Digital Government transformation in different contexts and policy areas and, at the same time, testing different dimensions of the conceptual framework proposed, adjusting and refining it against the analysis of the empirical findings.

In this respect, the results of this phase of the DIGIGOV research has shown that Digital Government transformation and public sector innovation broadly speaking, are frequently still at the discussion or at piloting stage, while raising funding and political support for further investment may be difficult, because of limited resources and, sometimes, little evidence that previous innovations have delivered the promised efficiency gains.

At one level, this calls for some careful and theory-informed analysis as to why such expected gains were not realized. For example, were the expectations unrealistically inflated from the very beginning, or is there something in the policy process that did not allow to achieve the original objectives?

At another level this also calls for broader, more systematic discussion, using also foresight techniques and forward looking approaches. At this level, the key question is three-fold: (a) may be expectations that we entertain with regard to ICT-based innovations are wrong and we are missing some important objectives?; (b) what combination of technology, procedures and resources makes an innovation possible?; (c) how the new technologies are changing and challenging the power balance between the public authorities, companies and citizens, and how this balance should be reimagined for the benefit of society?

These issues are investigated further in the concluding part of the DIGIGOV study, and will set the basis for future research and innovative policy directions that are much needed to exploit the benefits of Digital Government transformation.

In this perspective, it should be noted that since this report was already completed and under publication since March 2020, the impact of the COVID-19 is not discussed.

However, it is clear that the need of a real transformation of governance systems and policy-making mechanisms, adopting digital technologies to innovate and improve public services and government practices emerged as a crucial element to navigate through the "Pandemic Society" we have just entered.

It is therefore imperative to turn the Coronavirus crisis into an opportunity, embracing the complexity of public sector innovation and ensure to move away from what we have warned in our first DIGIGOV Report in 2019, and "differentiate between evidence and hope!"

And for hope to become reality, tangible changes of procedures, functions and institutional redesigns as well as an overall cognitive reframing of public sector innovation is needed; which concerns not only policy and organisational processes, rather values, culture and shared understandings of the impacts of Digital Government transformation in the EU.

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1 Introduction

This technical report brings together the work carried out as part of the study 'Exploring Digital Government Transformation in the EU: understanding public sector innovation in a data-driven society', firstly to develop a conceptual framework for understanding and exploring the digital transformation of the public sector (henceforth DigiGov-F), and then to produce case studies/experiments that explore the impact of digital transformation and are at the same time triangulated with the conceptual framework to validate/refine it.

In this introduction, we briefly illustrate the objectives, scope and methodological approach followed in building the proposed conceptual framework. (The methodology used for experiments differs by case. Each methodology is presented in the relevant chapter). In **Chapter 2**, we present the DigiGov-F 1.0 framework and the various components that underpin it. This was the version consolidated as a result both of internal activities conducted by the research team, and of consultation with experts and stakeholders carried out during two workshops and via DigiGov online communities. In **Chapter 3**, we present in full the results from the case studies / experiments. **Chapter 4** concludes presenting a summary of the results and implications of the empirical research, and how these have been reflected in the final proposal of DigiGov-F 2.0, the final version of the framework, which has been modified and refined in the light of the findings from the case studies.

The overall aim of this study is to systematise and reconceptualise Digital Government transformation within the scope of public sector innovation, in light of the efforts made to enhance the quality of public services in a data-driven society. As suggested by Barcevičius et al. (2019), despite significant interest in Digital Government Transformation over recent years, definitions of the term remain varied and sometimes contradictory. The same applies to the way in which digital transformation relates to other widely used expressions such as e-Government, ICT-enabled government and Transformational Government (or T-Government). The specific focus of this study is on artificial intelligence (AI), as well as other new and related predictive and cognitive technologies. It also examines other supporting technologies and applications such as those delivering geospatial/location data for policy design and service delivery. The study explores the possible use and impacts that can be achieved by combining new and existing technologies that go beyond those traditionally regarded as the 'nuts and bolts' of e-Government.

In this report, we define **Digital Government Transformation (DGT)** as follows:

> *DGT is the introduction into government operations of radical changes, alongside more incremental ones, within both internal and external processes and structures, to achieve greater openness and collaboration within and beyond governmental boundaries. DGT is enabled by the introduction of a combination of existing ICTs and/or new data-driven technologies and applications, and by a radical reframing of both organisational and cognitive practices. It may encompass various forms of public sector innovation across different phases of the service provision and policy cycles, to achieve key context-specific public values and related objectives including increased efficiency, effectiveness, accountability and transparency, in order to deliver citizen-centric services and policies that increase inclusion, and enhance trust in government.*

This general definition posits that a true transformation involves radical changes at various levels. It is particularly suited to the scientific and research-based exploration conducted in this study, as it encompasses many dimensions that merit investigation by scholars as either barriers to, or drivers of, transformation. These include institutional, organisational, cultural, technological, cognitive and behavioural factors.

The proposed DigiGov-F framework contributes to the systematising and reconceptualising of Digital Government Transformation within the scope of public sector innovation. It does so by highlighting the key dimensions and factors that should be further studied in order to understand how ICT-enabled innovation can transform governance and policy making. By doing so, the framework paves the way for a more in-depth assessment of the effects of digital transformation.

The rationale behind DigiGov-F is therefore to systematise insights from a multidisciplinary body of literature in order to shape future policy research and prepare the ground for the assessment of the effects of digital transformation. The elaboration of DigiGov-F is informed by theory and scientifically grounded. It rests on a clear definition of what a conceptual framework is, and on a step-by-step methodology for concept building. It follows the literature that specifically discusses conceptual frameworks (Jabareen, 2009; Imenda, 2014; Rocco and Plakhotnik, 2009), as well as more general and classic sources on the epistemology and methodology of social research (Creswell, 2003; Fox and Bayat, 2007; Glaser and Strauss, 1967; Levering, 2002; Liehr and Smith 1999; Merriam, 2001; Miles and Huberman, 1994; Strauss and Corbin, 1990; Wacker, 1998).

First, it is important to clarify that a conceptual framework is not the same thing as a theory, a model, or a theoretical framework. Our framework is -informed by theory and scientifically robust, given the methodological steps followed (see *infra*), but it does not aim to provide a theoretical explanation of '*what causes what*' within the broadly defined ecosystem of digital government. Conceptual frameworks are usually the first step when dealing with very complex phenomena, where knowledge is spread across different bodies of literature that must be pulled together to provide a first map and understanding of the given phenomenon. As Jabareen puts is, (2009, p. 50): "*most social phenomena are complex and linked to multiple bodies of knowledge that belong to different disciplines. For this reason, better understanding of such phenomena requires a multidisciplinary approach*". Hence, tapping into different literatures, a conceptual framework "*lays out the key factors, constructs, or variables, and presumes relationships among them*" (Miles & Huberman, 1994, p. 440). The same authors also state that a conceptual framework can be "*rudimentary or elaborate, theory-driven or commonsensical, descriptive or causal*" (Miles & Huberman, 1994, p. 18).

As a type of intellectual artefact, a conceptual framework "*relates concepts, empirical research, and relevant theories to advance and systematize knowledge about related concepts or issues*" (Rocco and Plakhotnik, 2009, p. 128). Imenda (2014) shows that although 'conceptual frameworks' and 'theoretical frameworks' are often used as synonyms in the literature, they are different constructs both by definition and in terms of the way in which they are constructed. While both start from a review of relevant literature, they each use these sources in different ways. A theoretical framework is constructed *deductively*, extracting theories/hypotheses for formal testing. Meanwhile, using the sources *inductively* leads to the development of a conceptual framework (2014). A conceptual framework is not intended to provide a causal/analytical basis for theoretical explanation, but instead provides an initial lens through which social reality can be interpreted. As such, conceptual frameworks are "*indeterminist in nature and therefore do not enable us to predict an outcome*" (Jabareen, 2019, p. 51).

To further appreciate the difference between a conceptual framework and a theoretical framework (or a theory or model[2]), we should consider whether or not one's main aim is to test a theory, which is a different exercise from generating hypotheses or laying the groundwork for emergent theories. As illustrated by Cresswell (2003), a theoretical framework is crucial for quantitative studies that aim to test a theory. A theory (see footnote) presented for formal testing entails a set of terms and concepts, as well as a set of variables and the relationships between them. It also possesses a precisely delimited and narrow domain of application, and some explanatory/predictive claims. In qualitative studies, or within initial explorations of a phenomenon (which may subsequently lead to a quantitative study), the aim is not to test a given theory, but rather to shed light on under-

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[2] A model is used to explore reality when its complexity is beyond empirical description and testing. A theory is a set of assumptions, propositions or accepted facts intended to explain some very specific phenomenon, at times independently of the explanandum. According to Fox and Bayat (2007, p. 29) a theory presents a systematic point of view specifying the relationships between a set of variables, with the aim of predicting and explaining a phenomenon. A similar definition can also be found in Liehr and Smith (1999, p. 8). A more analytical definition of a theory is presented by Wacker (1998, pp. 363-364), according to whom a theory has four components: (a) definition of terms, concepts or variables; (b) a domain within which the theory is applicable; (c) a set of relationships between the variables; and (d) specific predictive claims.

studied aspects of the phenomenon, to generate hypotheses, and to search for emergent theories. To this end, a conceptual framework is required to ground the exploration in existing bodies of knowledge, whether in published documents or obtained via field work, interviews and consultations with experts. So, whereas a theoretical framework is used to investigate a specific theory, a conceptual framework is extracted from the relevant theoretical and empirical work (Rocco & Plakhotnik, 2009).

As Jabareen (2009) argues, one can build a conceptual framework using as inspiration a grounded theory approach (Glaser and Strauss, 1967; Strauss and Corbin, 1990). Although grounded theory is usually considered a qualitative method in case studies, it can be used to develop a conceptual framework that can be elaborated using not only primary evidence but also secondary sources. Indeed, we have applied grounded theory as an inspiration by extracting our proposed framework from secondary sources, which were integrated with expert consultations and, in the final validation step, contrasted against primary sources derived from field work (case studies). Below, we briefly list and explain the steps both followed and to be followed for the development of DigiGov-F.

1. Mapping of sources

We selectively mapped the sources first gathered by Barcevičius et al. (2019), then integrated them with additional sources considered relevant (i.e. general theory of innovation, literature on public sector innovation, literature on public administration features and reforms, literature on evaluation and measurement, etc.).

2. Reading and extrapolation of relevant and applicable insights

We extensively read the sources, categorised them in term of the relevance of their contribution to the understanding of Digital Government Transformation, and extracted key elements (i.e. building the institutional and cognitive dimension, identifying applicable elements from innovation theories, etc.).

3. Deconstructing and reconstructing concepts/elements

We read and reread the selected data to deconstruct, reconstruct, and 'discover' concepts and elements relevant to our purpose. This is the main inspiration from grounded theory that we have applied to secondary sources. For instance, out of numerous (and at times contradictory) concepts and definitions of innovation and transformation, we have elaborated our own definition of four types of public sector innovations. From these, we developed a typology of digital innovation in a syncretic fashion – i.e. integrating insights from public sector innovation with those coming from the literature on digital government, in particular Janowski (2015).

4. Integrating concept/elements and making sense

We grouped together concepts/elements that showed similarities in order to reduce complexity and produce a manageable conceptual framework. In doing so, however, we have strived to exhaustively include the most important elements from all the literature reviewed. To use an analogy from a particular quantitative technique (data envelope analysis), we have tried to envelope the reviewed literature so as to define as sort of frontier including all the most important insights from all the sources reviewed. In doing this, we strived also to maintain the '*indeterminist*' and '*non-linear*' nature of the framework.

5. Validation

Our first source of validation were interactions with both academic experts and stakeholders during the workshops organised in 2019, as well as via the DigiGov online community. A second source of validation came from contrasting the framework with the case studies presented in Chapter 3 of the present report.

As a result of the five steps above, the proposed DigiGov-F framework must be seen as a comprehensive and exhaustive, heuristic conceptual framework that is informed by theory and scientifically robust. It systematises and reconceptualises digital government within the field of public sector innovation and the institutional settings of public administration. The framework paves the way for further assessment of the effects of Digital Government Transformation, and for the generation of new hypotheses.

2 DigiGov-F 1.0

In the first three sections of this chapter, we present the building blocks upon which the framework is constructed: the innovation dimension (2.1); the institutional dimension (2.2); and the technology dimension (2.3). In Section 2.4, we present DigiGov-F 1.0. Section 2.5 looks at the effects of digital transformation, while Section 2.6 provides examples of how DigiGov could be used in practice.

2.1 Innovation dimension

In this section, which brings together insights from a vast body of literature, we consider public sector innovation, and review the various types of innovation proposed in the literature (2.1.1), the antecedents for the adoption and implementation of innovation (2.1.2), and sum up our synthesis in Section 2.1.3.

2.1.1 Types of innovation

Table 1 below reports the nine different types of innovation extracted from the various literature sources. The first six types are presented by De Vries et al. (2016) in the most recent systematic review of empirically applied studies focusing on public sector innovation. This is complemented by other sources adding other elements of interest. As is evident from the table, some overlap exists between these nine types, and the terminology used in the various sources may give rise to some misunderstanding. For instance, one definition of process innovation talks about improvement in both internal and external processes, while the latter also falls to some extent within the domain of governance innovation. Furthermore, the term 'processes' itself may be misleading, as processes characterise not only the internal functioning of a public sector organisation, but also its interactions and collaboration with external actors.

Table 1. Types of innovation: synoptic overview of the literature.

Type of innovation	Definition and sources
(1) Processes innovation	Improvement of the quality and efficiency of internal and external processes (Walker 2014, as reported in De Vries et al., 2016); changes in organisational structures and routines (Windrum, 2008); creation of new organisational forms, the introduction of new management methods and techniques, new working methods (Bertot et al, 2016; de Vries et al, 2016).
(2) Administrative Process innovation	Creation of new organisational forms, the introduction of new management methods and techniques and new working methods (De Vries et al., 2016); implementation of methods for the production and provision of goods and services that are either new or significantly improved compared to existing processes (Hartley, 2010)
(3) Technological process innovation	Creation or use of new technologies, introduced within an organisation to render services to users and citizens (De Vries et al., 2016).
(4) Service innovation	Creation of new public services or products (De Vries et al., 2016); new service or significant improvement to an existing service (Windrum, 2008); new services or new users (Walker, 2002); service delivery innovation: new ways of supplying services (Windrum, 2008); creation of new public services or products or improvement of the existing ones Bessant et al, 2010; de Vries et al, 2016; Misuraca & Viscusi, 2014).

(5) Governance innovation	Development of new forms and processes to address specific societal problems (De Vries et al., 2016); systematic innovation as new or improved ways of interacting with other organisations and/or knowledge bases (Windrum, 2008); participatory government, open government or public-private-people-partnerships (Hartley, 2010); creation of new governance methods, involvement of new actors, new patterns of co-creation and interaction (Bertot et al, 2016; de Vries et al, 2016).
(6) Conceptual innovation	Introduction of new concepts, frames of reference or new paradigms that help to reframe the nature of specific problems as well as their possible solutions (De Vries et al., 2016); development of new ways of thinking that challenge the assumptions that underlie processes, services and products (Windrum, 2008)
(7) Policy innovation	Changes to the thoughts or behavioural intentions underlying policy development (Windrum, 2008); improvement in identifying the needs of constituents and shortening the time required to develop, test, implement and diffuse a policy (Bertot et al, 2016; de Vries et al, 2016).
(8) Rhetorical innovation	New languages and concepts (Hartley, 2010)
(9) Communication innovation	Implementation of a new method of promoting the organisation or its services and goods, or new methods to influence the behaviour of individuals or others (Hartley, 2010)

Source: elaborated by the authors from the sources cited.

The distinction between 'internal process innovation' and 'administrative process innovation' is blurred and not clear-cut, plus it does not capture the creation of new institutions and agencies (a main result of the application of New Public Management [NPM] reforms). Innovation types (6), (7) and (8) share common elements, as they all relate to the more intangible cognitive-normative dimension of change. Type (9) overlaps between the previous three types, as well as type (5). In view of these considerations, in Section 2.1.3 we present a synthesis instrumental to the proposed framework.

2.1.2 Antecedents of innovation

In this Section, we consider the antecedents of innovation as they appear in the broader literature on innovation. Antecedents can be either drivers or barriers, depending on their presence or absence in a specific context.

Innovation level (intrinsic attributes). Traditional innovation literature, inspired by Rogers's innovation diffusion theory (2003), focuses mainly (if not exclusively) on those intrinsic attributes of innovations that may increase or decrease the likelihood of their adoption, and/or the feasibility of their implementation. These attributes may be objective, or may simply be perceived subjectively. The key attributes are:

a) Relative advantage: there should be sufficient confidence and possibly evidence that introducing an innovation will bring benefits (in terms of economic return, but also social prestige, convenience and satisfaction) compared to the status quo.

b) Compatibility: the innovation must be perceived as being compatible with existing practices and values.

c) Complexity: innovations perceived as less complex are more likely to be adopted.

d) 'Triability': if an innovation can initially be piloted on a limited scale, this increases the chances of it being introduced and implemented.

Rogers's approach, which is also rooted in theories of S-shaped innovation diffusion[3], suffers from a number of limitations. Above all, it presupposes a sort of linear optimism that may fit well the trajectories of self-contained and fixed products, but is not entirely appropriate for complex technology-driven innovations entailing additional and complex complementary changes. There is a rationalist assumption that runs as follows: the more obvious the relative advantages of an innovation become, the more influence they exert, and the more visible the network effects, which in turn increases adoption. Yet, especially in the public sector, empirical evidence shows that things do not always work that way. The intrinsic attributes of an innovation are certainly relevant to include in a comprehensive framework, but must be integrated alongside the other dimensions discussed below.

Organisational level (internal factors). The seminal contribution that sheds light on the organisational dimension of innovation is Damanpour (1991), which stresses in particular the availability of 'slack' resources (money, time, technology, skills, employees), complexity and functional differentiation, and the origin of professional knowledge. Larger organisation's size should increase the chances of slack resources being available, which in turn provides a wider set of assets for the adoption and implementation of innovation. Larger organisations are more structurally differentiated, and those with slack resources were thought to be the more likely adopters of innovation. Empirical studies and meta-reviews yield important but inconclusive evidence on the explanatory power of such dimensions. In other words, they explain *some* of the variations in innovation diffusion, but not all of them[4]. Other, 'softer' dimensions include organisational processes and culture. As early as 1975, a seminal empirical work found that innovation pilot projects were almost all successful in their limited area, but failed to spread and be accepted due to wider organisational resistance (Walton, 1975). The author concluded that success of innovation must be understood in terms of choices and social processes within the inner organisational context. This means we must also consider antecedents such as leadership and the capacity for organisational processes to absorb new knowledge and practices. Another additional aspect to consider is the innovation-system fit – that is to say, whether an innovation fits with the organisational values, norms and processes, as well as skills, that support legacy technologies[5], in addition to an organisation's absorptive capacity[6]. Organisational antecedents can therefore be summarised with the following five issues: (a) slack resources; (b) leadership; (c) organisational structures and processes; (d) organisational culture (i.e. risk aversion or learning style); e) incentives. As part of the internal organisational context, important dimensions include organisational cultures, behavioural patterns, and the normative and cognitive routine used. In this respect, the contributions reviewed earlier that stress conceptual and behavioural innovation are of relevance (reviewed in De Vries et al., 2016 and see in particular Windrum, 2008). Organisations introduce these intangible dimensions, such as new concepts, frames of

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[3] For quite a long time, and still today, the diffusion of innovation has been simply described using an S-shaped curve, broken down into different phases that matched with 'early adopters', 'early majority', 'late majority' and 'laggards'. The basic idea behind this descriptive approach was first introduced in 1903 by the French social psychologist Gabriel Tarde (Tarde, 1903). Tarde formulated the law of imitation to explain why only a few ideas or products spread widely: a few influential individuals invent or adopt a new product, which then spreads as a result of social imitation. In 1943, two American rural sociologists, Ryan and Gross (Ryan and Gross, 1943) studied the diffusion of "hybrid seed" among Iowa farmers, and formulated the typology of 'early adopters', 'early majority', 'late majority', and 'laggards' plotted over a typical S-shaped curve. Working almost in parallel, a group of medical sociologists at Columbia University studied the diffusion of new drugs and came to very similar conclusions (Greenhalgh et al., 2005, pp. 53-55). Early studies on innovation, operationalising insights from Tarde's law of imitation, stressed the importance of interpersonal communication and influence, and especially of the social networks of the early adopters. For instance, in discussing medical innovations, Coleman et al. formulated the hypothesis that the rate of diffusion of a new drug depends largely on the size and quality of the doctors who first start to prescribe them (Coleman et al., 1966).

[4] See chapter 7 in Greenhalgh et al., 2005.

[5] See chapter 4 in Greenhalgh et al., 2005.

[6] This is an important aspect first developed by Cohen and Levinthal (1990). They argued that the ability of a firm to recognise the value of new, external information, assimilate it, and apply it to commercial ends, is critical to its innovative capabilities. They labelled this capability a firm's 'absorptive capacity'.

reference or paradigms in their efforts to define issues and how to tackle them. Innovating thus requires organisations to develop new ways of thinking, in order to challenge the assumptions underlying those processes and structure that need to be changed. It also entails changes in the thought and behavioural intentions behind the development of services and/or policies, such as improvements in the methods and sources used to identify the needs of constituents, and reducing the time taken to develop, test, implement and diffuse a transformed service or policy.

Thus, an organisation's conceptual and cognitive repertoire for action as an institution can function either as a driver of, or a barrier to, innovation. At any given time, this repertoire is an internal characteristic of the individual organisation, but is dynamically influenced and shaped by its external context. The same applies to the types of technological innovation an organisation decides to implement. These two elements, indeed, are a bridge between the internal and external context – as demonstrated by the application of Big Data and data analytics within the public sector. These concepts have acquired momentum in a broader context, and have been adopted in the public sector even in situations where simple traditional statistics would suffice, or when the data infrastructure is not yet ready and/or the necessary paradigm shift in interpreting the data has not yet permeated the organisation's cognitive repertoire. Organisations are made up of people, and may therefore possess or lack resources at an individual level. At this level, important antecedents are the presence within the organisation of 'intrapreneurs' who can overcome risk-averse cultures; empowered and motivated employees; commitment and shared values; and the availability of skills related to the technical nature of the innovation introduced. As De Vries et al. (2016, p. 158) observed, agents play an important role in enabling innovation, both at the organisational level (focus on leadership), and the individual level (where there is a strong focus on innovative employees and their characteristics).

The decision to adopt an innovation and to make certain implementation choices – as well as the results of the innovation itself – are also influenced by a number of environmental factors that can be considered external, as those who adopt and implement innovations work within organisations embedded in particular social and institutional contexts. If innovation was originally seen as a discrete event resulting from knowledge developed by isolated actors, subsequent studies have come to regard it as the result of a process based on interactions between various internal and external factors. The external environment antecedents include: (a) the objective or perceived demands that must be met by the innovation; (b) political and institutional settings and levers; and (c) networks of inter-organisational influence, collaboration and competition. Of course, this is a conceptual simplification: in practice, the factors grouped under these three headings may interact and/or overlap.

Environmental level: external demands. Innovation may be undertaken because its relative advantage is perceived as a way to respond to the unmet needs or demands from a specific constituency. This unmet demand may be objective or subjectively perceived, and pressure to meet it may be exerted by the media and, in turn, by politicians. More generally, the decision to innovate results from a co-evolution of different demands/needs, related pressures, new ways of thinking, and trends that stem from separate but closely related environments (e.g. public opinion, politics, media, academia, management gurus and consulting companies), which interact/overlap with the dimension of networks discussed below. A good example are the changes launched within the public sector since the 1980s under various headings. The starting points for these were new consumerist expectations among users of public services; the need to make public administration more efficient and less costly; as well as the pressure exerted by globalisation on governments to increase the competitiveness of their economies. While these trends were to some extent empirical, they have been championed by the media, by academia, in business literature, in bestsellers by business gurus, and propagated through the practice of management consulting companies. This momentum heavily shaped the perception of the need to innovate, and the definition of how to do it. This in turn has heavily influenced politics and policy, giving rise to a wave of institutionalised and standardised changes.

Environmental level: institutional factors. We use this expression to generically refer to aspects than can be considered as part of broadly defined political institutions: *politics, government, laws and regulations, policy, and all of government governance*. In practice, this dimension has two components: one more stable and long-term; and the second more dynamic and short-term. The first has to do with the institutionalised characteristics of public administration we discuss in the next section. The second refers to the dynamic, short-term influences, pressures, and levers that can spring from, or be exerted by, politics, policy, and regulation. Politics may also be placed within the previous dimension of external demands, and is not considered within our conceptual framework, but digital government is more directly influenced by policy and regulation, and also by mechanisms of governance. Policy goals, where they are enforceable, can directly shape the choices and methods used to implement innovation. Regulatory measures can constrain innovation, but can also push it or shape it in better ways. If the innovators are the 'makers' and the regulators are the 'shapers', striking a good balance between the two can ensure better outcomes and reduce negative effects. Such collaboration between 'makers' and 'shapers' is especially necessary in the case of innovations such as those driven by artificial intelligence, to drive innovation while at the same time ensuring privacy and ethical concerns are addressed. For a public agency, the institutional settings within which it operates, politics, policies, regulation, and all of government governance mechanisms, can all be considered to some extent as external factors.

Environmental level: networks. The role of inter-organisational and inter-personal networks and communication channels in innovation has been widely recognised in the literature[7]. This aspect is related to the notion of institutional isomorphism, a process that leads organisations in the same field to become more similar, as defined by (Di Maggio and Powell, 1991)[8]. Institutional isomorphism is a process of "convergent inertia or change", whereby organisations do or try to do what is considered legitimate in their own institutional environment. In order to become legitimised in their environment, organisations tend to replicate the routines and templates for action of those organisations that are considered the most legitimate and successful. At any given time, there is a fixed and legitimised set of organisational routines upon which most organisation conform/converge. So how can change and innovation occur, breaking fixed routines and resulting in a new institutionalised routine? If innovation initiated by a few is able to spread, this will unleash a mimetic process of "institutional isomorphism". Most organisations will converge towards the innovation, which will eventually become institutionalised within a given population of organisations. Change can also occur if an innovation adopted in one highly legitimised population of organisations also creates normative pressures to conform for organisations belonging to a different population. An example of this occurred when the hype relating to the private sector 'Dotcom' boom of the mid-1990s spilled over into the public sector, contributing to the launch of the first wave of investments and initiatives in eGovernment.

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[7] The foundations for the importance of networks and social embeddedness were laid down in two seminal articles by Granovetter (1973; 1985) and applied in insightful ways by other economic sociologists such as Burt (1992). Social network analysis has been widely applied to organisations in the context of studies focusing on inter-organisational networks (Baum et al., 2000; Hansen, 1999; Kang et al., 2010; Kogut and Zander, 1992; Lorenzoni and Lipparini, 1999; Monge and Contractor, 2003; Nelson and Sidney, 1982; Nooteboom, 1999; Powell et al., 1996; Schilling, 2005). Collaborative practices and networks are considered viable methods of innovation through knowledge creation and transfer (Kogut and Zander, 1992; Lorenzoni and Lipparini, 1999). The evolutionary theory of economic and organisational changes stresses that networks bridge already existing knowledge / experience on innovation (Nelson and Sidney, 1982). Networks are studied to identify nodes that enable organisations to share information and knowledge (Hansen, 1999; Monge and Contractor, 2003).
[8] A similar account, applied to managerial trends and fashion, is also provided by Abrahamson (1991) and by Abrahamson and Fairchild (1999).

2.1.3 Summing up

For the purposes of the framework, we propose the following synthesis of the nine types of innovation extracted from the literature (see Table 2).

Table 2. Types of innovation: our synthesis.

Type of innovation	Definition
(1) Organisational innovation	Improvement of the quality and efficiency of internal and external processes through changes in organisational structures and routines; creation of new organisational forms and/or new structures.
(2) Service and/or policy innovation	Creation of new public services and introduction of new policies and/or new ways of delivering them, to increase reach and personalisation.
(3) Governance innovation	Development of new forms and processes to address specific societal problems through new or improved ways of interacting with other organisations outside the public sector and with citizens, bridging different knowledge bases through participatory government, open government data, public-private-people-partnerships, enabling new patterns of co-creation and interaction through the use of innovative methods of communicating and promoting the organisation or its services.
(4) Conceptual innovation	Introduction of new concepts, normative and cognitive routines concerning the internal function of organisations and in relation to their external environment, which help to reframe the definition of problems and their solutions, leading to new ways of thinking that change the thoughts or behavioural intentions underlying the development and deployment of policies and services. Improving the identification of the needs of constituents and shortening the time required to develop, test, implement and diffuse a policy; adopting new languages and concepts and new methods to influence behaviour.

Source: Authors' elaboration from Table 1.

In Section 2.4.3, we use these four types to define a typology of digital government innovation. We dispense with the use of the term 'processes' to characterise innovations, and introduce a new and more comprehensive definition of conceptual policy innovation that, as we argue later, is fundamental to the proposed framework.

Below we list the five groups of antecedents identified:

- **Innovation attributes**: *relative advantage, compatibility, complexity, triability*

- **Organisational factors**: *resources and leadership, structure and processes, culture, cognitive and behavioural routines and frames, committed and skilled employees*

- **External demands**: *constituency needs/demands and related discourses/pressures from public opinion, media, academia, politics, etc.*

- **Institutional factors**: *institutional settings, policy and regulatory levers, governance mechanisms*

- **Networks**: *participation in inter-organisational and/or inter-personal networks possibly leading to processes of isomorphism*

The antecedents listed above are generally applicable to the study of digital government innovation and transformation, along with some additional specifications that we present in part here, and which are also the subject of the next two sections. The literature reviewed deals mostly with the generation and adoption of innovation but can also be applied to its implementation, which is relevant to our framework. For this reason, it is important also to consider some key aspects of institutional and technological dimensions. The institutional setting for innovation influences external antecedents (i.e. regulation and processes of conformity) and also organisational antecedents (governance mechanisms). Most importantly, it can shape the structure of incentives that may or may not favour the adoption and implementation of the innovation inside a public sector organisation. The specific characteristics of the technologies involved may be influenced by the antecedents relating to innovation attributes (i.e. compatibility and triability), by organisational antecedents (i.e. slack resources), and by individual level antecedents (i.e. skills); some requisites and challenges related to the specific technologies may impact the implementation processes.

2.2 Institutional dimension

2.2.1 Public administration characteristics and traditions

The Weberian model (M. Weber, 1968 [1924]), which lies at the core of what has been termed 'Progressive-era Public Administration' or PPA (Hood, 1995), exerted a strong influence on the formation of most Western administrative systems. The Weberian model or PPA remained the dominant yardstick and source of legitimacy for public administration systems from the late 19th century until the 1970s. Since then, it has lost appeal as a result of various waves of public sector reforms (see *infra*); and yet its legacy is still visible in the way in which institutions of government actually function, regardless of the prescriptions and rhetoric surrounding subsequent reforms. If we consider the three models of organisation identified in organisational studies – rational systems, natural systems and open systems (Scott, 2003) – the Weberian model corresponds to a closed rational system, whereas the open systems model for the public sector captures to a large extent the new discourses on open governance. Meanwhile, institutionalism (Selznick, 1948, 1949) and related neo-institutionalist approaches fit the natural model: "the most important thing about organizations is *that, though they are tools, each nevertheless has a life of its own*" (Selznick, 1949, p. 10).

The main principles of the Weberian model include hierarchy, formal rules, uniformity, legitimacy, standardisation of procedures, division of labour, impersonality, meritocracy and technical qualifications. It is a hierarchical, paper-based system; a universalist but vertically specialised form of 'command-and-control' administration (Dunleavy and Hood, 1994). The Weberian model rests on four key tenets: (a) the idealisation of career public service professionals insulated from the general labour market; (b) a set of generalised rules that limit the discretionary power of public servants; (c) universalistic and equal treatment of citizens in the manner of the rule of law; (d) vertical specialisation and separation as a democratic principle, to avoid encroachment upon citizens by an all-pervasive and fully integrated government machine. Under the principles and practice of this system, data were centralised in filing systems and only started to be digitised in the 1960s during the first wave of office automation in the public sector. As a rational, closed-system model it remains externally opaque, not only in the sense of not opening data and information to citizens, but also in not using information held about them to understand their needs and behaviour for service delivery and policy making. Under this model, information for policy and service design comes from census statistics and from ad hoc collection by national statistics offices. As such, if the legacy of this model remains strong and rigidly applied in a part of the government machinery, any digital transformation made possible by new technologies would find experience severe barriers and bottlenecks[9].

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[9] Among the potential challenges identified in the OECD paper on the data-centric public sector, some of those listed spring directly from of this model of public sector functioning (van Ooijen, Welby and Ubaldi, 2019).

In this sense, our definition of Digital Government Transformation stresses the need for changes that are radical, not simply incremental, in organisational structures, processes and cognitive / behavioural repertoires. These changes should move away from the legacy of the siloed bureaucratic model. The Weberian model has influenced various administrative systems in different ways, giving rise to different national traditions. Without entering into the history of how this classic model became differentiated, we present below a brief and mostly synthetic summary of the various models and the main dimensions for a comparative analysis of administrative systems, based on selected key sources (Bleiklie and Michelsen, 2013; Kuhlmann and Wollmann, 2014; Lampropoulou and Oikonomou, 2018; Loughlin, 2002; Painter and Peters, 2010; Pierre, 2011; Pollitt and Bouckaert, 2017; Rugge, 2003; Thijs, Hammerschmid and Palaric, 2017). The schemes presented below are idealised types, with only a few indications of the country to which a particular model might apply. It is beyond the scope of this publication to present a full characterisation based on up-to-date observations placing all EU 28 MSs within this typology – and in any case, such as comparison has been already compiled (Thijs, Hammerschmid and Palaric, 2017). Below, we descriptively present the models and consider their implications later in Section 2.2.3. With considerable analytical simplification, cultural administrative traditions have been positioned first as either 'public interest' or 'rechtstaat' models (see Figures 1 and 2).

Figure 1. 'Rechstaat' versus 'public interest': discursive characterisation.

Rechtstaat

❏ The *State* is a central actor, preparing, enacting, and applying laws, which is disciplined by administrative law as a juridical person

❏ Law are crucial and public servants tend to have a juridical type of education and expertise

❏ More barriers, due to laws and norms, exist to link monetary rewards to performance, a procedural evaluation prevails (input and output focus, less on outcomes)

Public Interest

❏ The *State* as juridical person is not recognised and there is no administrative law, the main actor is just Government, at the services of citizens and under steady scrutiny by them

❏ Laws are important but not central, public servants tend to have a more generalist education and experience and not only of a juridical natures

❏ Less barriers, due to laws and norms, exist to link monetary rewards to performance, evaluation is not only procedural but also focussed on outcomes

Source: elaborated by the authors, based on the sources cited.

Figure 2. Rechstaat versus public interest: stylised characterisation.

	Rechtstaat	Public Interest
Key norms and values	Legality and equality	Service and managerialism
Key objectives	Legal security	Efficiency
Model of client	Citizen	Customer
Definition of rights	Group rights	Individual rights
Type of legal system	Public law	Common law
Accountability	Upward	Upward and downward

Source: Pierre (2011, p. 5).

A more nuanced characterisation (Figure 3) identifies the four administrative traditions depicted below in self-explanatory fashion, requiring no further commentary.

Figure 3. Four administrative traditions.

	Anglo-American	Napoleonic	Germanic	Scandinavia
Legal basis for the state	No	Yes	Yes	Yes
State-society relations	Pluralist	Interventionist	Organic	Organic/welfareist ''open government''
Policy style	Pragmatic incremental	Legal	Corporatist/legal	Technocratic consensual
Organisation of government	Limited, unitary government	Indivisible / hierarchical	Integrated cooperative federalism, interlocking coordination	Decentralized through administrative or political decentralization
Civil service	High status, unified, neutral, generalist permanent	Very high status permanent, specialized, elite training, segmented corps	Very high status, permanent, legal training, upper ranks permanent, openly partisan	High status, professional, non-politicized
Countries (exemplificative)	UK	France, Italy, Portugal	Germany, Austria, Netherlands	Denmark, Sweden

Source: Painter and Peters (2010, as reported in Bleiklie and Michelsen, 2013, p. 121)

By combining the traditions with other characteristics, Figure 4 presents an abbreviated outline of the dimensions that can be applied for a comparative analysis of public administrations. (A more detailed version that can be found in the public administration literature and that has been empirically used in Thijs, Hammerschmid and Palaric, 2017.)

Figure 4. Six dimensions of administrative regimes.
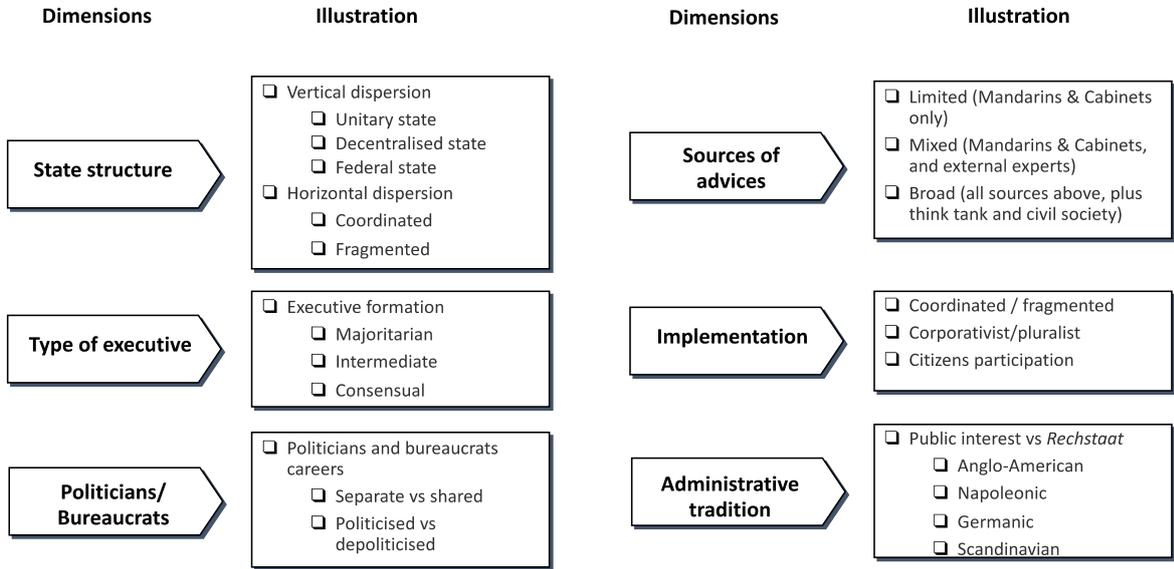
Source: Synthesised by the authors from Pollitt and Bouckaert (2017); Thijs, Hammerschmid, and Palaric (2017); and Bleiklie & Michelsen (2013).

In the figure above, the first dimension (state structure) has two sub-dimensions: vertical dispersion and horizontal coordination (Pollitt and Bouckaert, 2017, pp. 49-51); the vertical dispersion of authority ranges from a unitary state (e.g. the UK) to federal states (e.g. Germany), while in the middle lies a non-federal but decentralised state (e.g. Italy).

This difference in structure can also be measured by the number of administrative tiers that, in Europe, range from just two to up to five depending on the Member State (see Thijs, Hammerschmid and Palaric, 2017, p. 12). The horizontal sub-dimension refers to the level of coordination or fragmentation among the various ministries/department at central government level (e.g. in the UK, the Treasure performs a coordinating function, making central government less fragmented than it is in Germany, France or Italy). The nature of the executive relates to the electoral systems used and the ways in which majorities are formed. Here, we identify three types, although Pollit and Bouckaert (2017) make further distinctions (single party, minimally winning coalition, etc.) The combination of state structure and the nature of executive can influence the formation of public policy, as well as the introduction of reforms and all of government innovations. 'Majoritarian' executives, as opposed to 'consensual', and centralised as opposed to decentralised, can affect decision making and implementation. Relationships between politicians and bureaucrats can be analysed according to two dimensions: whether or not their careers are strictly separated, and whether or not they are politicised or depoliticised. This, obviously, influence the structure of incentives for top-level bureaucrats and the choices they make to achieve visibility and legitimacy, including through the introduction of innovations.

Sources of advice is another important dimension, as it concerns the influences that shape important policy decisions as well as the introduction of innovation. In relation to this, the expression 'mandarin' is used to refer to top civil servants; 'cabinet' to the bodies providing advice to the executive; and 'external source' refers to diverse advisors from consultants to think tanks and academics, etc. (see Thijs, Hammerschmid and Palaric, 2017, pp. 32-34, based on Pollitt and Bouckaert, 2017). We expand this category to include advice from civil society and citizens, as citizen participation is not included as a separate dimension in the figure but is accounted for as a source of advice or as a factor contributing to implementation. Obviously, greater diversity of sources from which advice is taken increases the possibility of new ideas being introduced, but also acts an additional channel for the process of institutional isomorphism. In this respect, it is worth briefly digressing to anticipate a topic discussed later with respect to waves of reform and governance. Although mandarins and cabinets are still prominent in EU Member States, their monopoly on advice is no longer as firm and complete as before. This monopoly has been weakened by several external pressures (internationalisation, Europeanisation and multi-level policy-making processes), as part of a trend that has been described as a shift from government to governance, with formal hierarchies being supplemented as well as challenged by alternative organisational forms such as networks (Peters and Pierre, 1998; Peters and Pierre, 2006; Rhodes, 1988; Rhodes, 1996; Rhodes, 1997). This is, to the extent that it has been empirically confirmed, a change that must be considered when discussing the environmental antecedents of innovation and the processes of institutional isomorphism.

The initial Weberian benchmark and the way it shaped the above characteristics, depending on country-specific histories and circumstances since the 1980s, has been swept by waves of public sector reform over the last four decades. Indeed, as Muccio and Mauri (2012) noted, over the past 30 years the public sector in Europe, as in most parts of the world, has been shaken by various intellectual and political waves of (attempted) reforms. These have gone under various names: 'New Public Management' (Dunleavy and Hood, 1994); 'Public Value Management' (O'Flynn, 2007); 'Reinventing Government' (Osborne and Gaebler, 1993); 'New Governance' (Osborne, 2006; Rhodes, 1996); 'Digital Era Governance' (Dunleavy et al., 2005, 2006); and 'ICT-enabled public sector innovation' (Misuraca et al., 2013). The economic managerialism of New Public Management (Hood, 1991; Osborne and Gaebler, 1993), was followed in the late 1990s by the theories of governance that identified new modes of collaboration between the state and social-economic spheres (Peters and Pierre, 1998; Peters and Pierre, 2006; Rhodes, 1988; Rhodes, 1996; Rhodes, 1997). Other narratives signalled the retreat of government, as in the ideology of the 'Big Society' launched in Great Britain by David Cameron's government (Lowndes and Pratchett, 2012).

The pertinent question in this research is to ask whether these waves of reform have radically changed the organisational structures and mental frames prevalent in public agencies in such a way that they provide more conducive setting for digital government and the transformation it is expected to bring. To consider this, we briefly discuss below two of these waves: NPM, prominent from 1980s to the 2000s; and from the 2000s onwards, Digital Era Governance (DEG), which has been a product of new discourses on governance and the emergence of new digital possibilities.

For around two decades, NPM predicated and implemented a management-inspired modernisation of public administration that rested on the deconstruction and disaggregation of large public bodies ('agentification'); the introduction of competition and quasi-markets within the public sector; and performance-based incentives to public officials (Pollit and Bouckaert, 2011). NPM was short-lived and not fully implemented, leaving big chunks of government still operating according to Weberian bureaucracy. Moreover, where it was implemented, it did not deliver the expected benefits. Under this model, agentification and outsourcing produced a marginalisation of digital technology, as IT operations were either assigned to separate, specialised agencies or contracted out to global service providers. Digital expertise lay outside of government, and sources of data were fragmented. The comprehensive gathering, storage, use and interpretation of citizen information, data, and feedback was out of reach. The widespread use of private service contracts protected by commercial confidentiality also limited accountability and transparency.

The lessons of this for Digital Government Transformation are obvious, in that the mechanical transposition into government of private sector practices should be avoided or at least handled with care. Moreover, such practices are irrelevant when attempting to improve policy making and governance. Some elements of the move away from NPM such as decentralisation, networked governance, social innovation and social enterprise, transparency and participation, found a natural match with the potential of digital technologies. This led to the emergence of the broadly defined Digital Era Government (DEG) paradigm. One example of this pairing of policy with technology is the wave of Open Data initiatives (Clarke and Margetts, 2014).

DEG can be subdivided into three main waves: (a) the mechanical digitisation of government services; (b) a holistic approach to citizens' needs; and (c) a focus on transparency, engagement and participation. This last wave also occurred under pressure from the demands of austerity, with digital channels being introduced that were shared by default, in order to enhance efficiency and 'do more with less', including by encouraging citizens to co-produce and co-create to generate cost-savings (Clarke and Margetts, 2014; Margetts and Dunleavy, 2013).

The 'digital by default' ideal of DEG makes information and data strategic, and placing them at the core of innovation and change. A citizen-centric approach, Open Data, transparency, engagement and participation, the use of social media as novel way to understand citizens' needs and opinions, are all part of various digital initiatives prescribed in policy pronouncements and implemented under various programmes. Particularly during the third wave of DEG, the idea emerged, taken from the private sector, of an '*intelligent centre/devolved delivery design in the management of data across tiers of government*' (Clarke and Margetts, 2014, p. 396). Yet, the new technologies considered in this study are geared toward a new, fourth wave of data-driven, context-aware, and context-smart DEG. This new wave of DEG will require some of the previous challenges to be faced, as well as the bridging of the gap between technology and institutional settings. It will also require initiatives to go beyond the mostly rhetorical and insufficiently deep measures undertaken in the domain of Open Data, engagement, participation and the use of social media.

2.2.2 Governance

Governance[10] is part and parcel of the main institutional characteristics and settings characterising government and the public sector as a whole; however, the concept is surrounded by a number of ambiguities that need be cleared up[11]. In particular, two uses of the term 'governance' may generate misunderstanding. The first is the one in which governance is always associated with the adjective 'good' in a prescriptive manner (typically in the United Nation and World Bank usage of this expression); this normatively coloured concept is not relevant to our framework, and will not be used or further discussed. The second, typical of the broadly defined literature on ICT in public administration, is the use of 'governance' merely to mean openness and participation. From this use derives the misleading practice of defining governance outcomes as being separate from the outcomes of service provisions or policy making. In reality, if digital innovation has impacts on governance processes, these will be horizontal, also affecting service provision and policy making.

In its purest and most original sense, the term 'governance' is neutral and empirical (i.e. its form needs to be ascertained). However, in political science the term has come to be used to describes the structures and processes by which a social organisation or an ecosystem of agents – from the family to corporate business to international institutions – steers itself. These range from centralised control to self-regulation. In certain analyses, the term is associated with the process of de-centralising authority, and of fragmentation among public and private actors on multiple levels – national, sub-national, local and international – that is alleged to accompany globalisation. The usage of 'governance' rather than 'government' is justified by the fact that it can refer to social interactions that are co-ordinated and organised, not just to formally exerted state authority. We propose the following as a working definition: *"Governance denotes the structures and processes that enable a set of public, private, and social actors and stakeholders to coordinate their independent needs and interests through the making and implementation of binding decisions integrating and/or going beyond the parameters springing from mandatory regulations and laws emanating from state-vested authorities at various levels"*.

Table 3. Different coordination modes and their characteristics

	Hierarchy	**Agency**	**Association**	**Governance**
Mechanism	Vertical: 'command and control'	Vertical: delegation	Horizontal: vote	Horizontal: exchange, negotiation
Objectives	Top-down	Set by principal	Shared	Shared
Membership	Closed, possibly heterogeneous	Open and functionally homogeneous	Closed and homogeneous	Open and heterogeneous
Boundaries	Formally defined	Formally defined	Defined by statute	Informal, floating
Strengths	Capacity to impose optimal	Capacity to impose optimal	High legitimacy and	Shared optimal decisions,

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[10] The term governance, left unused for a very long time, was brought back into the vocabulary of the social sciences for the first time in the seminal 1937 article 'The Nature of the Firm' by Ronald Coase, in the form of the expression 'corporate governance', indicating the coordination mechanisms, different from those provided by both the formal hierarchies and the market, characterising the complex and diverse contexts of large corporations and conglomerate groups.

[11] For a review of the debate on governance and for empirical evidence from the political science literature, see, among many others, the earlier cited sources (Peters and Pierre, 1998; Peters and Pierre, 2006; Rhodes, 1988; Rhodes, 1996; Rhodes, 1997).

	decisions, shape environment, sanction opportunism	decisions, specific expertise, flexibility to changes	transparency of process, capacity of bearing externality	managing change and full delivery processes, including externalities
Problems	'Routinisation', hysteresis, internalisation of externalities, high cost of control of sub-ordinates	Typical risk of principal/agent relationship, lack of capacity to act on externality outside sector of competence	Time-consuming decision making, only pareto-optimal solutions, low control over post-decision making phases	Blurred accountability and definition of membership, high management costs, low capacity to sanction opportunism

Source: Elaborated by the authors.

Governance (possibly blurred, networked or participative) is one of many types of coordination mechanism that an ecosystem of separate but interconnected actors may enact, depending on the ecosystem's characteristics and its highly contingent goals. As illustrated in the table below, when problems and situations require a multi-level and blurred governance approach, this differs substantially from the traditional coordination ensured by regulation and laws emanating from the top downwards.

Table 4. Government versus governance.

Stakes	**Government**	**Governance**
Defining problems	Parties, executive, bureaucracies	Epistemic community, advocacy coalition, networks
Solving problems	Parties, executive, bureaucracies	Epistemic community, advocacy coalition, networks
Prioritising problems	Executive	Issue network, advocacy coalition, policy community, policy sub-system/ sub-government
Making the solution public	Legislative / executive	Policy community, policy sub-system/ sub-government
Defining the solution to be implemented	Parties (experts), executive, high bureaucracies	Policy community, policy sub-system/ sub-government, Iron duet
Who implements the solution?	Bureaucracy	Policy community, policy sub-system/ sub-government, implementation network

Source: Elaborated by the authors.

It is important to stress that no scale exists stating that one form of coordination is better than another, or that multi-level blurred governance is always better than a government-ensured form of coordination. The suitability of such forms depends entirely on the characteristics of the ecosystem in question, and particular contingent situation of the innovative intervention being launched. In situation A, innovation X may be better steered by top-down government regulation, whereas in situation B the same innovation X may be more effectively guided by a networked and multi-level governance approach. In the following section, we extract from this clarification some important aspects that are relevant to consider in the proposed framework.

2.2.3 Summing up

In the previous paragraphs, we elucidate some key points concerning the peculiarity of the public sector, which shape the way in which some of the innovation antecedents should be approached. The greater relative length of this summing-up reflects the importance of this aspect. We will deal with the various issues in the order in which they have been discussed in previous paragraphs, although some areas of overlap will require a certain amount of cross-referencing between them.

Incentives. To discuss incentives and the decision to invest in innovation, we borrow some insights from the literature on the economics of innovation[12]. Where separation exists between ownership and management, managers may invest in innovation more or less than would be desirable, as a result of what is termed a 'moral hazard'. This is classic, textbook Principal-Agent situation. Managers (the agent) may spend on 'innovation' activities that benefit them more than they do the shareholders (the principal) –, such as, for instance, the innovation to grow the firm beyond the scale of efficiency, or simply to keep up with current trends. Alternatively, managers may be risk-adverse and therefore forego opportunities for innovation. In the public sector, we face exactly this Principal-Agent situation, and there is a lack of direct and intuitive monetary incentives for the public sector innovators. In the public sector, there is no incentive to maximise profit, and in the vast majority of public sector institutions, costs are funded by the public budget. In addition, the public sector is characterised by multi-layered Principal-Agent situations and related their moral hazards. This situation may produce two opposite results. On the one hand, due to a lack of real incentives public sector managers may invest less in innovation than is required to increase the return to society as a whole through a positive outcome. On the other hand, because costs are borne by the public budget, managers may invest in innovation more than is warranted by the possible positive outcomes. Incentives can be part of the governance mechanisms at all levels of government.

Institutional isomorphic innovation. Public sector managers may launch innovations just to increase the legitimacy of their organisations, or to follow currently hyped trends, precisely as a result of the process of institutional isomorphism we described earlier. This can produce 'mirror' effects that should be avoided: following a trend among other organisations, or simply digitising analogue procedures or service provisions without changing them. The core premise of this critique is that administrative agencies are fundamentally concerned with securing their own legitimacy, in the sense of meeting societal expectations about appropriate structures, practices, rhetoric or output (Scott, 1991, p. 169), By being perceived as legitimate for drawing on expert knowledge, an organisation seeks 'epistemic authority', which it can use to ensure its goal prevails in the event that its policy domain is contested. Thus, organisations tend to undertake processes of convergent change in order to appear legitimised within their institutional environment (DiMaggio and Powell, 1983, 1991). Through mimetic processes, individual organisations imitate the most legitimate and/or successful players in their environment, in order that they too will acquire legitimacy, thus producing institutional isomorphism. A similar process can result in the institutionalisation of recurrent innovations[13].

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[12] Based on Hall and Rosenthal (2011); Hall (2005).
[13] See two example of new-institutionalist approaches in sociology and economics: D'Aunno, Succi and Alexander (2000) and Nee (2005).

The characteristics of public administration can also compound these processes (see below). In this sense, external exogenous factors can intervene to increase the objectively and subjectively perceived legitimacy and desirability of a given innovation, ensuring there is no over- or under-investment in innovations within the public sector. Herein lies the important role of higher-level policy making and governance: the legitimacy of certain innovations can be increased through more or less direct, or softer and harder, policy measures. Conversely, they can be put in check where signs of copycat innovations are detected. This can happen as a result of governance and regulation mechanisms, as well as through evaluation, performance monitoring and benchmarking – an aspect to which we shortly turn.

Public administration institutional settings. All else being equal, unitary states with a high level of horizontal coordination, and which use a majoritarian system to form their executive, should be in a better position to introduce uniform innovation than decentralised states with a low level of horizontal coordination and consensually formed governments, where a lot of negotiation and compromise are needed. Deep and rapid structural reform tends to be more difficult in consensual systems than in majoritarian systems. Majoritarian systems focus on political will and the designation of winners and losers. The more consensual the regime, the more likely it is to achieve the opposite result. Consensual systems are less inclined towards, and less capable of, radical reform. Centralised countries find it less difficult to carry out radical reform than decentralised countries. On the other hand, abrupt policy changes produce winners and losers. The more consensual the regime, the more likely it is that losers will be represented in the executive. This leads to the likelihood that polices will become diluted in the process. At the same time, majoritarian policies may also fall victim to abrupt policy shifts. An extreme top-down approach creates a lack of ownership at the lower level, where innovation must be implemented. In consensual systems, by contrast, if agreement is reached as to what to do, fewer problems are encountered with ownership at lower levels. In federal states, the opportunity exists for particular regions to become places of experimentation and innovation.

For the sake of simplicity, when comparing the two extreme types of Public Interest and Rechtsstaat tradition, *ex-ante* one can expect that certain changes that are required for the introduction of digital innovation may be easier in the latter, thanks to there being less need for new legislation. Which sources of advice are used, and whether or not bureaucrats are politicised and their careers linked to those of politicians, can influence the selection of innovations and may be a channel of copycat innovation. Further, broad sources of advice can foster innovation, and the ambition of public servants can lead them to deliver the necessary leadership. Which type of organisational model prevails (along with its practices, norms, structures, and processes) will impact the chances that new data-centric digital government innovations will be successfully implemented. (Adoption is less of a problem, as such reforms are already part of a new wave being adopted everywhere.) Where traditional practices still resemble the Weberian model, barriers will exist to data sharing and usage. On the other hand, where NPM has left as its legacy the fragmentation of IT systems and expertise, this too will be a barrier. Where a given agency has already made progress towards a DEG (Digital Era Government) model, this will be a driver for success. In order for governments to take advantage of data and the analytics techniques that use them, they must change their organisational structures/practices, and both conceive of and use information and knowledge through a new lens. This means adopting new ways of thinking as part of the institutionalised conceptual and cognitive repertoire of the internal organisation and the way it interacts with external actors, from citizens and interest groups to other governmental stakeholders. This final observation is key and instrumental to our proposed framework.

Finally, a disclaimer on the trade-off between generality and granularity. While our analysis of public administration characteristics has been broad and mostly from the perspective of central government, the same dimensions of analysis can be operationalised at a different level (including from the perspective of a single public agency). There are very marked and important cultural and structural differences between countries that can only be dealt with at the level of concrete case studies and at the level of a conceptual framework.

To illustrate this, we offer two examples that focus on the issues of impacts and their measurement. First, indicators of cost savings in terms of human resources or improved effectiveness must take into account the fact that in certain countries, rules and regulations, as well as issues such as negotiations over labour contracts between the public sector and trade unions, can hinder and/or delay the exploitation of such gains. In such instances, it would be difficult for a strictly defined indicator of cost savings in terms of human resources to be accepted by all administrations in EU Member States. Second, to measure inter-operability and the degree of joined-up services, one must take into account the fact that the likelihood of achieving such objectives also depends on the structure of the state. It is reasonable to assume that such objectives would be more difficult to achieve in decentralised and federalist states. To accommodate these variations, the framework we have produced must therefore remain at a relatively high level of abstraction.

Governance mechanisms and the importance of evaluation. From the perspective of introducing digital innovation that requires an open governance approach, it is worth noting some challenges:

- Who participates in multi-level decision making?
    - How representative are the stakeholders involved in a network, with respect to all those who are possibly interested and/or affected?
    - Who is the gatekeeper, and who can solve the above question?
- Risk of self-referential closure in multi-level decision making networks:
    - Risk of technocratic drift (if dominated by experts).
    - Risk of a 'solution in search of a problem' (if dominated by IT experts and industry)
    - Risk of populism / demagogy (if dominated by user representatives).
- Blurred accountability:
    - Networked co-decision, but who is responsible if outcomes are not achieved and/or if something goes really wrong?
    - Need for strong evaluation and measurement to monitor performance.

A governance approach requires some mechanisms to define the expected outcomes and establish the accountability of different actors. In order to control against the hazard of over-investment, it is crucial to measure and evaluate the relative advantage of innovation versus carrying on business as usual. In general, the introduction of ICT into any industry faces the challenge of low product differentiation[14], switching costs[15], and technical compatibility (i.e. inter-operability)[16].

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[14] The ICT industry is driven by the economy of networks rather than by economies of scale; the ICT system of firm 'A' needs to be integrated with that of firm 'B' (i.e. a travel agent with an airline). This causes the production of ICT that can be supplied to both A and B. Further, there is positive feedback: the more an ICT product commands a large market share, the more likely it is that such a share will grow even bigger. This results in lower product differentiation, which has been proven to explain why, on average, the adoption of ICT tends to be slower (and even lower) than that of other technologies characterised by greater product differentiation.

[15] ICT brings with it several sources of switching costs: a) the need to bring paper records into a digital format; b) the need to integrate with legacy technological systems (both ICT and non-ICT); c) the need to interlink several ICT components (hardware, storage support, software for the elaboration of stored information, software for communication, etc.) These may lock-in the organisations using the ICT to only one supplier and, thus, either constrain change or impose higher costs. In addition, there are intangible switching costs in terms of reorganisation and the training of personnel.

[16] Technological inter-operability plays a much more prominent role in the adoption of ICT than in any other forms of technology. The value of any ICT is fundamentally linked to its ability to connect via a common technical standard with other electronic means of data storage and communication.

These issues are greatly compounded by the specific characteristic of the public sector[17]: (a) multi-layered and interlinked agents and players; and (b) the heterogeneity of users' needs and ways to address them. Heterogeneity also compounds the problem of low product differentiation. Switching costs are compounded by the fact that all the players listed depend on each other for the use of the same associated technology. The daunting challenge of inter-operability in this context is an order of magnitude greater than in any other industry value chain. All of these aspects make evaluation and measurement more challenging, but at the same time, more urgently required. Finally, to avoid under-investment due to a lack of incentives, multi-level governance mechanisms aimed at fostering innovation need to create the right incentives.

2.3 Technology dimension

2.3.1 Focus and approach

As noted in the introduction, this study focuses on the eight technologies/ applications described in Table 5 below[18].

Table 5. Selected technologies / applications.

Acronym	Description
AI	**Artificial intelligence**. This umbrella term 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.
BPA	**Behavioural and predictive analytics**. The process of using data mining, statistics and modelling to make predictions about future outcomes. Behavioural and predictive analytics lies at the crossroads of AI and Big Data. Historical data are used by machines to determine what behaviour can be expected in the future. This process can incorporate behavioural insights.
RPA	**Robotic process automation**. RPA is the AI-enabled automation of various aspects of government operations. It uses special software to automate routine clerical work such as data entry into a system. It mimics the actions of a human employee and interacts with applications in the same way that a human would.
IoT	**Internet of Things**. IoT is a General-Purpose Technology (GPT) that enables physical objects to be linked together through the use of embedded sensors, actuators and other devices that collect and transmit information about real-time activity within a given ecosystem network (e.g. transportation and mobility, energy, smart cities)
GSLD	**Geo-spatial and location data**. A GPT that provides geographical and location information on various data objects that are connected with a specific place or location, which can then be mapped.
DLED	**Distributed ledger (blockchain)**. A set of GPTs that enable information/data sharing and digital transactions within a distributed network involving government-to-government (G2G) interactions, as well as broader interactions involving government, societal and economic actors.

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[17]See, for example, an analysis that considers health care but is applicable to public sector more generally (Christensen and Remler, 2007).
[18] Open Government data and social media/collaboration platforms are not technologies *per se*, but are applications resulting from the combination of different technologies.

OGD	**Open Government data**. Application of a set of technologies enabling the realisation of policies promoting transparency, accountability and value creation by making government data available to all.
SM/CP	**Social media/Collaborative platforms**. It is the use of social media and other platforms to source information/insights from citizens and business and/or for co-creation and collaboration between government and all other actors of economy and society.

Source: elaborated by the authors.

The starting point for moving from e-Government to Digital Government Transformation is the application of new and emerging technologies. These cannot, however, be considered in isolation from other factors (considered in the previous two sections); from their possible combination; and from the specific characteristics of such technologies.

Full transformation is most likely to occur as a result of the combination of different technologies and innovations, since 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 insights and design responses to best address their needs. This process is enabled by increasingly ubiquitous and affordable personal technology and the wealth of data produced. We will further discuss the technologies/application presented in Table 5 above. These are assumed to support governments to: better understand their citizens in order to 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 and delivery models; operate more transparently and accountably, leading to increased government legitimacy.

The technologies presented in Table 5 are not to be considered as independent from one other, but rather as part of the digital transformation that is ultimately rooted in the creation, collection, use and advanced analysis of large amounts of data, driven by the potential of unprecedent computing power. For this reason, expressions such as 'data-driven society' and 'data-driven governments' are used to explain that digital transformation is based on the intensive use of data. Here, we introduce a brief description of the most relevant technologies, and discuss how they are used by governments to improve both internal processes as well as public services and policy design. Please note that we use the term 'technology' in a general sense to describe both the disruptive technologies and the application of them.

As mentioned above, the digital transformation in government does not originate from a single technology or the application of it, but rather from the combination of technologies which make it possible to harness the potential of large amounts of data. It can be argued that governments have never suffered from a lack of data; the problem was how to extract the value from such data. Governments now use computing technology to capture and harvest this data and ultimately extract value from it. To simplify, we can divide the technologies concerned into those that serve as source of data, and those that analyse data to improve services and policies. The former category includes the Internet of Things, geo-spatial data, Open Government data, social media/collaborative platforms and blockchain. The digital transformation of government occurs only when there is access to a constellation of different sources of information that can be linked together. In the second category, we include AI, predictive analytics and RPA. It is important to stress here that maximising the potential of these technologies requires important preparatory work: data must be sourced, structured, engineered, linked and integrated before it can be processed using innovative analytical techniques and finally embedded into the internal functioning of government organisations.

Let us consider the example of the RPA implemented by the Swedish municipality of Trelleborg to handle social assistance and welfare applications such as home care applications, sickness and unemployment benefits (Barcevičius et al., 2019). Administrative tasks such as the calculation of home care fees were automated and are now executed by a case handler RPA. For this to be possible, internal data and data about the applicant needed to be structured and engineered, while administrative processes had to be analysed and redesigned. This shows how Digital Government Transformation starts with the internal functioning of a government organisation. Changes in the internal functioning are horizontal to the types of innovation described earlier.

Box 1. Data gathering technologies: examples of use by governments.

The use of **IoT** technologies is not completely new, but governments are increasingly applying them across several broad domains including transportation, energy, smart cities, and defence as a powerful way of gathering and using data. IoT devices generate huge amounts of data, which can be combined with data from other devices and systems to deliver new insights. For this reason, analysts emphasise the potential of IoT to transform the public sector, by bringing together the major technical and business trends of mobility, automation and data analytics. Lastly, 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.

The collection of **geospatial data (GSLD)** has been accelerated by the application of IoT and geographical positioning technologies. Its full potential is becoming realised thanks to AI and Big Data analytics, cloud computing, and the expansion of wireless and broadband, among other technologies. Geospatial and location data, often coupled with other data, can provide a granular historical and predictive view for every location on the map. When analysed, this data can improve policymaking on complex localised situations and enables the provision of location-based services. GSLD requires localised data to be integrated with other data in order for a point on the map to yield actionable insights. It also requires data governance agreements, as per IoT.

The core tasks of **DLED technologies such as blockchain** are the registration, identification, verification and authentication of digital transactions. The literature explores potential cases for the application of this technology by public administrations, including personal records, land registry, supply chain management, contract and vendor management processes. The use of blockchain technology promises to reduce fraud, errors and the cost of paper-intensive processes. It can also increase security and privacy both for data sharing and digital transactions. This can ultimately foster transparency and trust over government data and transactions.

Open Government data (OGD) is expected to improve the overall quality of democratic systems and trust by increasing transparency, accountability and citizen engagement. Moreover, by opening up 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) and innovative citizen-centric services.

Box 2. Data analytics technologies: examples of use by governments.

The umbrella term **artificial intelligence (AI)** covers several technologies including machine learning, deep learning, predictive analytics, computer vision and natural language processing, among others. A number of studies have examined a variety of applications for AI in the public sector, from models used to predict the prices of awards for public infrastructure projects, to the use of Big Data from cities as a policy tool to advance the goals of urban development, and the use of AI for medical diagnosis and many other examples. Behavioural and predictive analytics, as a form of AI, can provide insights that improve policy design and enable the implementation of pre-emptive

measures. AI can also enable the provision of faster, better, personalised, and context-specific services. It can help to simulate situations and the effects of potential measures in real time. It must be noted, however, that the current AI practices/solutions in the public sector are in the early stages of process automation and predictive analytics.

Governments are already applying **robotic process automation (RPA)** to administrative tasks such as calculating benefits and taxes, anti-fraud checks and processing licensing applications, as well as in other sectors such as policing (e.g. fixed penalty processing, crime reporting), health (e.g. coding, diagnostics) and education (e.g. admissions and enrolments, student timetabling). In general, RPA can be used to implement numerous tasks and can often replace traditional government services. Aside from RPA, which denotes the use software robots with no physical presence, physical robots (humanoid and non-humanoid) are also being introduced into public service provision in some countries.

The introduction of disruptive technology is probably the central pillar for a digital transformation – but organisational, social and cultural factors are also necessary. Some of these cultural aspects relate specifically to these new technologies, with their potential only being realised through the introduction of new concepts and thinking. For instance, Big Data needs to be treated with new analytical techniques that require a change in the culture of modelling toward abductive, algorithm-based analysis (Veltri, 2017). Government research into citizens' needs, attitudes and behaviours has been based on limited sample methods, most of which (except experiments) are based on self-reported information that may be filtered and can suffer from biases. Big Data can yield real-time information about what people *really* do (e.g. transactional and activity-generated data) or think (e.g. social media). New analytical and data capacities can improve policy implementation by better targeting communications and provisions to different audiences, combining the power of Big Data analytics with insights from behavioural economics and the 'nudge' approach. Applying this potential requires a new culture of data gathering and engineering, as well as a paradigm shift in the way new insights are sought and used.

2.3.2 Prerequisites and challenges

At the core of the digital government innovations considered in this study is a shift towards a Data-Driven Public Sector (DDPS), outlined in Figure 5 below.

Figure 5. The Data-Driven Public Sector.
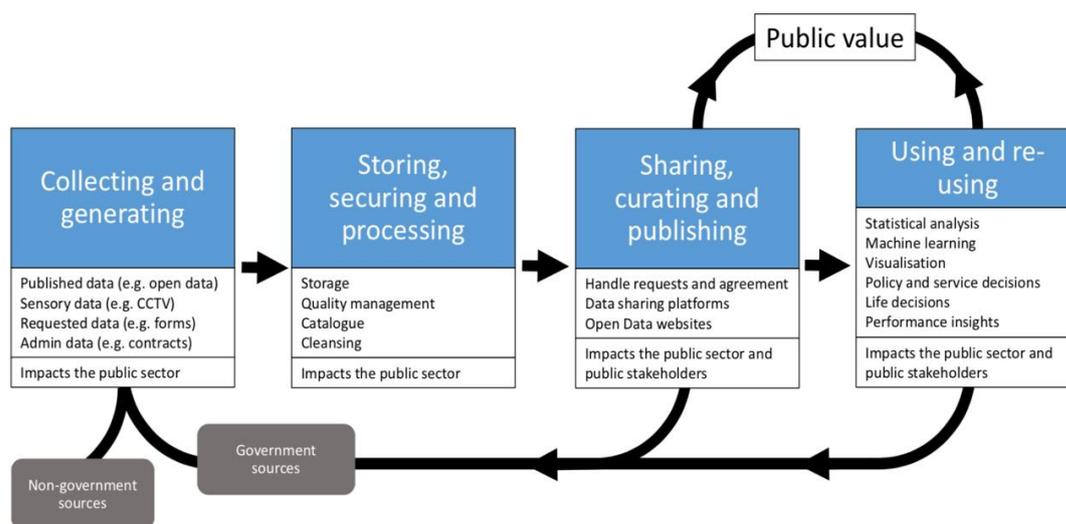
Source: van Ooijen, Welby and Ubaldi, 2019, p. 11.

Further forms of innovation exist that are not entirely driven by data, but data provide the core engine of those considered here. In this respect, a number of prerequisites and challenges that can be drawn from the OECD working paper mentioned earlier (van Ooijen, Welby and Ubaldi, 2019). Figure 5 above, taken from the OECD paper, is extremely effective in mapping the complexity of establishing a DDPS. It elucidates the value chain in a way that is not simply linear but recursive, incorporating a feedback loop within the necessary steps and indicating the creation of public value. After the first two steps, there is a loop between sharing and using/ re-using that, once launched, can retroactively feed and positively reinforce the first two steps. For the digital transformation promises of a DDPS to be realised, intense work is needed to make sure data are available and able to be put to use. This means work on internal and external processes that requires innovations in organisation and governance, combinations of data and analytical technologies, and eventually a conceptual shift – that is, changes in the organisation's cognitive and behavioural repertoires. Data must be sourced, linked and integrated, stored, structured and engineered, before use can be made of them via innovative analytics.

Figure 6. Challenges to fostering a Data-Driven Public sector.
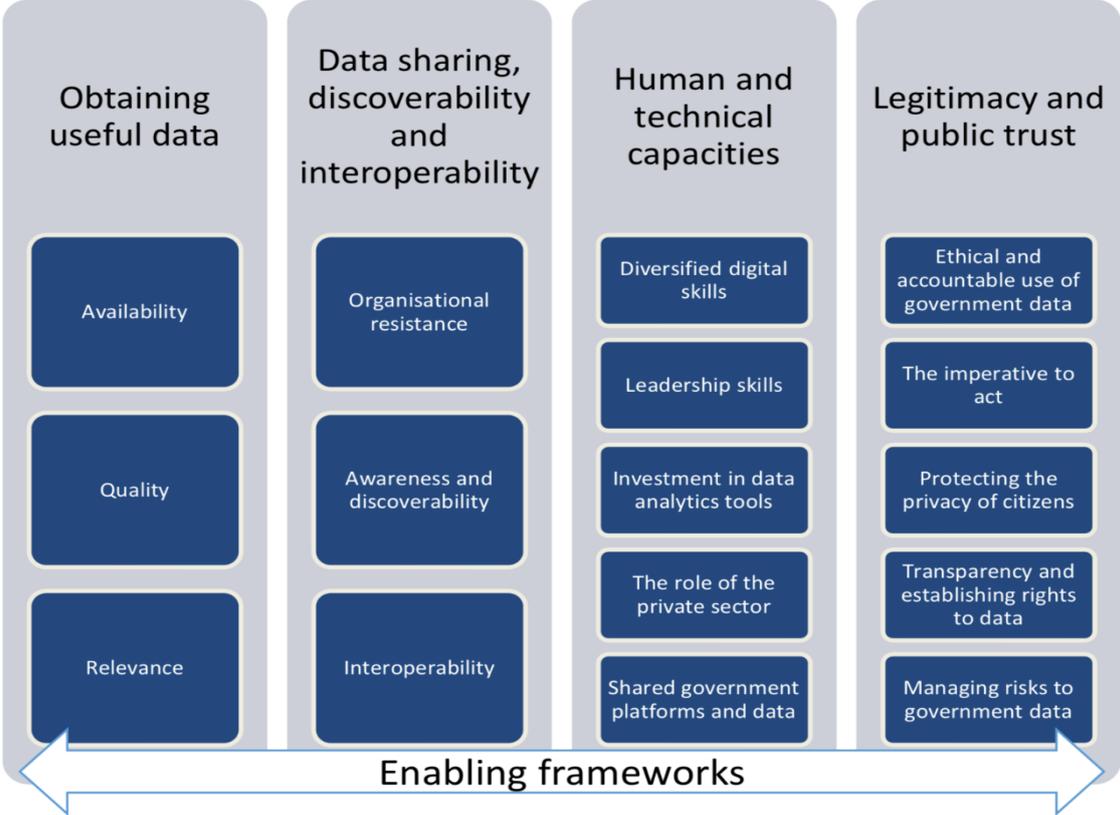
Source: van Ooijen, Welby, & Ubaldi, 2019, p.29.

From their analysis, the OECD researchers identified the challenges (barriers) to the creation of a DDPS summarised in Figure 6 above. These can be seen in terms of prerequisites specifically relating to the technologies involved, into which must be integrated an analysis of innovation antecedents and the other contextual factors presented in previous sections, although some overlaps exist between them.

As illustrated in the figure, there are four main challenges/ prerequisites. First, the availability and quality of data. Second, the conditions that make possible the sharing of data. Third, the availability of skills and capabilities, to which we would add the need for a reframing of conceptual and mental models. Fourth are issues concerning legitimacy and public trust in relation to the ethical use of data by public sector organisations, privacy, transparency and the risks that governments and citizens need to be aware of.

The second condition is clearly related to public administration models and structural characteristics; the third condition is related to the individual antecedents of innovation; whereas the fourth condition can be seen either as part of the regulatory environment or as an intervening factor that may foster or hamper digital government innovation. This is a very important factor that is worth considering in further detail to prepare for the discussion of possible side-effects presented in Chapter 4 of this report.

Concerns over feedback loops based on the surveillance of users using their personal data and extracting behavioural surplus have emerged with respect to the application of machine learning and other data analytics techniques (Zuboff, 2019). In the context of individuals' behavioural limitations and aggressive practices by industry, the EU Ethics Advisory Group has expressed concern over the relationship between personhood and personal data, the risks of discrimination as a result of data processing, and the risks of undermining the foundations of democracy (Ethics Advisory Group, 2018). Machine learning and deep learning algorithms are increasingly used and can produce outstanding results such as analysing images to detect potentially cancerous cells (Al-shamasneh and Obaidellah, 2017). At the same time, there are worrying examples of biased and discriminatory decisions (Pasquale, 2015; Ziewitz, 2015) such as wrong decisions on recidivism risks that discriminate racially, because differences in arrest rates between racial groups may be replicated by algorithms calculating such a risk (Chouldechova, 2017), or in hiring decisions where the underrepresentation of women in particular jobs leads the hiring algorithm to determine a rule that men are preferable candidates[19]. The roots of biases in ML and deep learning lie in the data, testing, and decision models used. It is not true that the scale of Big Data ensures its validity and accuracy – the quality of the data still matters (Domingos, 2012). If key data is withheld by design or chance, the algorithm's performance is weakened (Olhede and Wolfe, 2017). The implicit and often-made assumption that once we collect enough data, algorithms will not be biased, is not justified (Barocas and Selbst, 2016). Bias can arise in algorithms in several ways. First, the data collected may have been preferentially sampled, and therefore the data sample itself is biased (Olhede and Wolfe, 2018). Second, bias can arise because the collected data reflects existing societal bias (Caliskan et al., 2017). To the extent that society contains inequality, exclusion or other forms of discrimination, so too will the data (Goodman and Flaxman, 2017). Article 22 of the General Data Protection Regulation (GDPR) establishes the right to an explanation of a decision taken by an algorithm, and has spurred a debate on the possibility of introducing a legal requirement for algorithm transparency (Buiten, 2019; Goodman and Flaxman, 2017; Wachter et al., 2018). The GDPR represents the first step in regulating the protection of personal data, but many aspects remain controversial and not fully binding. The ways in which the GDPR will be applied in practice are still not clear. In this area, digital government should set examples and establish good practices of the way in which data are used for the public good. This represents a great challenge in achieving trust and legitimacy, and the lack of an adequate approach could give rise to the negative side-effects discussed in Section 2.5.4.

2.3.3 Summing up

The main points discussed above in relation to technology, some of which inform the framework proposed, are as follows:

- Technologies should not be considered in isolation.

- It is the combination of technologies and other innovations that offers the power to transform (although our framework we cannot depict all of the possible combinations, and we will thus need to simplify them).

- Among those technologies that comprise the focus of this study, two groups can be identified: those that serve as a source of data, and those that analyse data to

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[19] See for instance: 'Amazon scraps secret AI recruiting tool that showed bias against women' (Reuters, 10 October 2018: https://www.reuters.com/article/us-amazon-com-jobs-automation-insight/amazon-scraps-secret-ai-recruiting-tool-thatshowed-bias-against-women-idUSKCN1MK08G)

improve services and policies. The former group include the Internet of Things, geo-spatial data, Open Government data, social media/collaborative platforms and blockchain. The digital transformation of government will occur only when there is access to a constellation of different sources of information that can be linked together. In this second category, we include artificial intelligence, predictive analytics and robotic process automation. Only by combining the two groups can Digital Government Transformation be achieved within a Data-Driven Public Sector (DDSP)

- The value chain required to achieve a DDSP and fulfil the potential for Digital Government Transformation is complex. As a result, some technology-specific antecedents/prerequisites must be addressed in order that they do not become barriers:

  o Fragmentation of siloed IT systems and expertise.

  o The need for system integration (including the engineering and structuring of data).

  o The availability of data (internally to a single agency, from other public agencies, personal data).

  o Data sharing of sources both within and beyond government boundaries, complying with GDPR and considering the issues of privacy and security for the sake of public trust (see below).

Technological possibilities and regulatory/policy interventions. On the one hand new technologies (especially AI) are raising concerns in relation to the use of personal data and the potential human jobs and skills to be replaced by machines. On the other hand, policy and regulatory measures can either constrain technological innovation, or they can enable it by channelling it towards acceptable and sustainable solutions. Technological and institutional dimensions therefore interact and overlap when it comes to dealing with regulatory and ethical frameworks for AI and the risk of unemployment posed by the automation and robotisation of routine tasks. Violations of personal privacy, discrimination by algorithms, or massive unemployment due to robots displacing humans, could all cause a strongly negative backlash against digital transformation, especially if they concern government, which is the actor expected to set the best example. In this pessimistic scenario, public trust and legitimacy would plunge to all-time lows rather than being reinforced by the digital transformation of government. Hence, policy measures and regulations can actually support digital innovation by minimising potential negative effects. They can tackle issues such as job loss, lack of skilled personnel, ethical concerns and lack of trust over privacy and security issues. Policy-supporting measures could aim to reduce job losses and increase the availability of skills through retraining initiatives, while the introduction of an ethical regulatory framework for AI, together with measures on privacy and security, could offset the risk of low trust and legitimacy. A clear framework for the exchange, sharing and purchasing of data could speed up the adoption of technology and increase the potential for its promised effects to be realised. A clear legal framework that protects privacy and security would fully open up access to data. The lack of such a framework could turn into an important barrier. Restrictions on data flow and data sovereignty, particularly in relation to initiatives that use geolocation data, could seriously limit opportunities to take advantage of new technologies. Therefore, a GDPR-compliant regulatory framework should facilitate accessibility to data by governments.

2.4 DigiGov-F

In Section 2.4.1 of this chapter, we review the various antecedents previously discussed, bridging the perspectives of innovation and organisational change. By doing so, we illustrate the main external and internal factors included in the proposed conceptual framework. Section 2.4.2 presents a graphical representation of Digi-Gov-F and briefly explained. Finally, Section 2.4.3, in response to the requirement to systematise digital government within the literature on public sector innovation, we first present a conceptual map of digital government innovation.

2.4.1 Bridging innovation and organisational change

Figure 7 below integrates, in a syncretic manner, our earlier analysis of innovation antecedents, institutional settings and technology, with the organisational change perspective applied to the ICT-enabled transformation of government as presented, for example, by Weerakkody, Janssen and Dwivedi (2011). Our perspective adds external factors, and borrows from Weerakkody, Janssen and Dwivedi some insights on internal organisational change and on the move from the 'as is' to the 'to be' situation – in this case, by way of digital government innovation.

Figure 7. From antecedents to internal and external change factors.
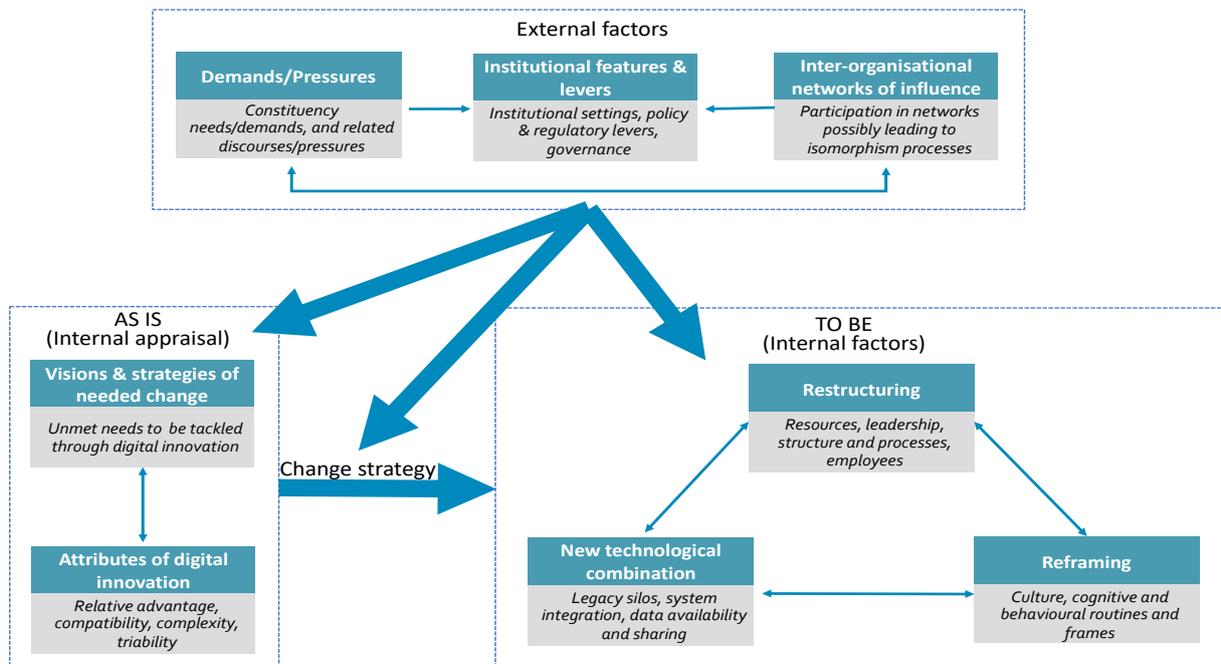
Source: elaborated by the authors.

In considering a hypothetical public agency, the starting point is considered to be an appraisal of the current situation as being not entirely satisfactory. Based on internal vision and strategy, a certain need of a given constituency may be identified as being not fully met. More generally, the agency may decide to become more responsive to its user base by reorganising itself from siloed functions to demand-driven horizontal task forces, while also pursuing a reduction in costs and increase in efficiency. The agency's internal vision and strategy will certainly be based on evidence, but will inevitably be influenced by external factors such as pressure from the media and politicians and/or responding to policy/ regulatory directives and levers. The decision to change may also be prompted by networks of influence leading to processes of convergence towards what other, similar organisation are doing, or what consulting companies say the organisation should do. A strategic appraisal leading to a strategy for change will entail the consideration of factual or perceived attributes of digital innovation (relative advantage, compatibility, etc.).

These will include some kind of ex-ante vision as to how it can achieve the desired transformation ('to be' state), with improved performance. An important motivating factor when considering an innovation's attributes will be the perception of how the innovation could increase the legitimacy of innovator's organisation. In this way, external pressures and influence can shape both the appraisal of the innovation's attributes and the strategy for change chosen by the agency. Should the innovation's relative advantage not be clear and supported by evidence, this could lead to the moral hazard of under- or over-investment. Policy and governance levers (incentives and top-down mandatory directives) can, however, positively impact the agency's motivation and offset the risk of moral hazard. Political leadership and public administration norms and values (considered part of the institutional setting) together with the presence of champions from previous successful experiences (organisational readiness) are also important factors. Networks and influence-shaping public discourse on innovation can increase the perceived legitimacy of an innovation, which may lead to its adoption as a result of institutional isomorphism. Strong societal demands and needs have a clear impact on how the relative advantage of an innovation is framed and, subsequently, evaluated.

When an innovation is adopted and the process of implementing change begins, internal change factors come to the fore. If we assume that the starting point is a siloed organisational structure and fragmented information systems and data storage, the challenging job of redesigning organisational processes and structure will go hand in hand with the integration of IT, as well as the engineering and structuring of data sources. This task becomes even more challenging when the digital innovation is not self-contained in a single public agency, but involves other actors within government and possibly also non-governmental actors and data sources. In this scenario, policy and regulation levers, together with governance mechanisms, are a strategic external input to provide both incentives for sharing and collaborating and the regulatory and ethical framework for the use of personal data. The availability (or lack) of slack resources, leadership and committed and skilled employees can function as a driver (or barrier) to these processes.

Aside from the tangible internal factors described above, equally important are changes in organisational culture towards sharing and collaboration and, in particular, to the organisation's cognitive and behavioural frames and routines. We refer here to the introduction of new concepts, as well as to normative and cognitive routines concerning the internal function and external environment. These help to reframe the definition of problems and their solutions, leading to new ways of thinking that change the thoughts or behavioural intentions underlying the development and deployment of policies and services. This can lead to improvements in the identification of the needs of constituents, as well as shortening the time required to develop, test, implement and diffuse a policy, and promoting the adoption of new languages and concepts and new methods to influence behaviour.

This reframing is important, since the digital transformation of government will only occur: (a) when there is access to a constellation of different sources of information that can be linked together; and (b) new analytical techniques are employed using a new and appropriate frame of mind. This is to say that the transformative potential of the new technologies is linked to the introduction of new concepts and new ways of thinking that challenge the assumptions that underlie processes, services and products. It also requires a change in the behavioural intentions that underpin policy development. For example, Big Data must be handled using new analytical techniques that require a change in the culture of modelling and entail extensive algorithm-based analysis (Veltri, 2017). Previously, research into citizens' needs, attitudes and behaviours has been based on limited sample methods, most of which (except experiments) relied on self-reported information that could suffer from biases. Big Data now provides real-time information about what people *really* do (e.g. transactional and activity-generated data) or think (social media). New analytical and data processing techniques can improve policy implementation by better targeting different audiences and combining the power of Big Data analytics with insights from behavioural economics and the 'nudge' approach.

To take advantage of this, the public sector must develop a new culture of data gathering and engineering (alongside improvements in its internal analytical capacity and a restructuring of the underlying sourcing and storing processes). There is also a need for a paradigm shift in the way new insights are sought and used. This must be combined with new approaches to data governance that ensure security and privacy. Finally, cognitive change is also required in relation to the way governments view collaboration and co-creation, in order to advance beyond hype and rhetoric. This entails creating trust and opening up to insights and contributions from outside government.

2.4.2 DigiGov-F

Figure 8 shows a graphical representation of the DigiGov-F 1.0 framework, which condenses all of the discussion presented in the previous sections. As such it requires only a very concise narrative illustration that highlights a few key points.

Figure 8. Graphical representation of DigiGov-F.
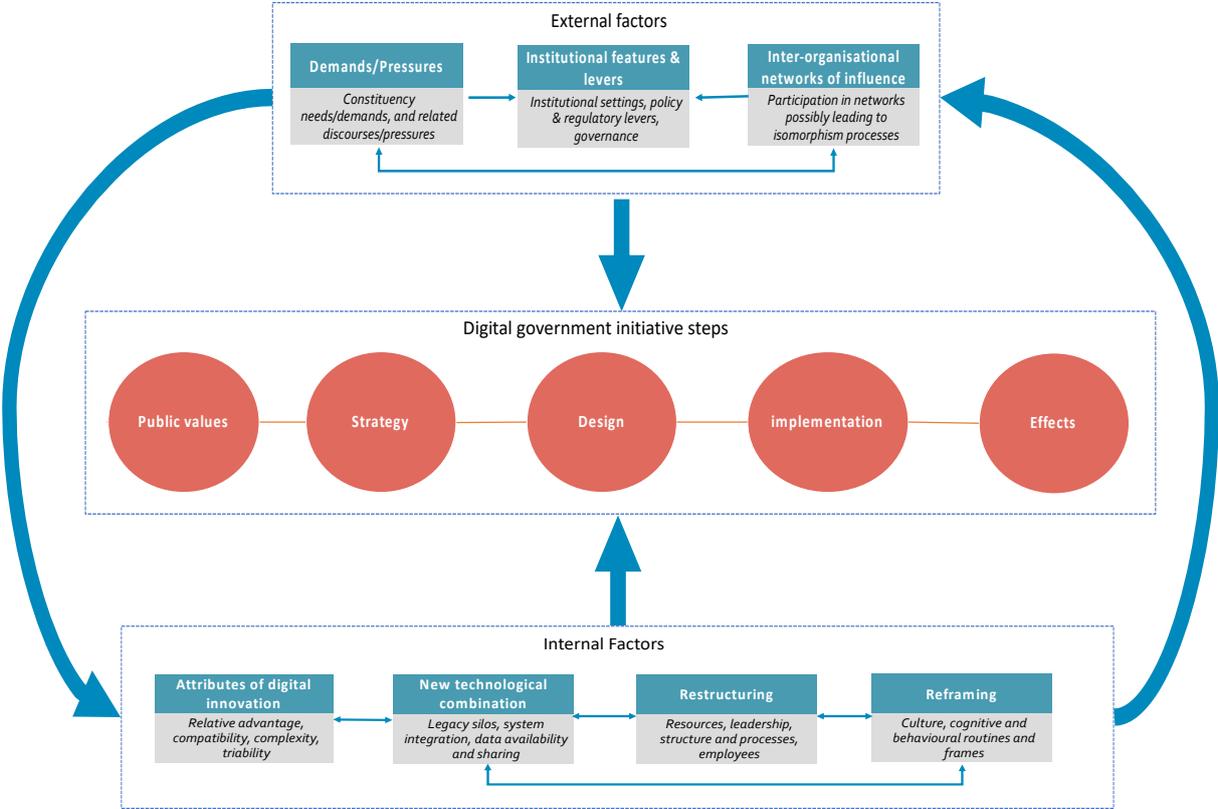
Source: elaborated by the authors.

Most importantly, DigiGov-F 1.0 is not a linear and prescriptive framework, and does not present a theory of causation connecting all factors following a deterministic logic. Figure 7 in the previous section simply mapped those elements considered in the previous chapter that merit attention when considering digital government transformations, noting probabilistic relations between them. These elements are included in the graphical representation of the conceptual framework, with only a general indication of their possible influence. The red circles at the centre of Figure 8 shows the steps involved in a digital government initiative. Above them are external factors; below, internal ones.

Once a strategy for change has been decided, we assume that the public values to be sought are the first priority to be set. From them flow the strategic objectives, design, implementation and eventually, when the initiative is embedded into business as usual, the effects.

The lines connecting the various steps in the centre have no arrows and only convey possible linkages without assuming any deterministic or linear flow. The red circles are placed linearly only because they are considered as different phases, one following the other.

In practice, there could be substantial lag between one phase and the next and, although this cannot be rendered graphically, the possibility cannot be excluded that at a certain time the initiative may be stopped and will therefore not reach the subsequent phases. We make the technology factor more visible not as a result of technological determinism but in light of the discussion presented in Section 2.3.

While the combination of technologies/applications adopted can contribute to the achievement of transformative effects, it cannot do so alone, but only if integrated and supported by other elements of the framework. The fact that strategic objectives are defined first and only afterwards is the combination of technologies selected may be a conceptual simplification (they may occur together), but it is adequate for our purposes.

2.4.3 Conceptual map of digital government innovations

Our conceptual map is not part of the conceptual framework, but is complementary to it. The map does not attempt to rank and label different forms of digital innovation as more or less transformative and impactful. The definition of Digital Government Transformation provided in the introduction to this report, and reproduced below, must be regarded as something that can be approached but probably never fully achieved.

DGT is the introduction into government operations of radical changes, alongside more incremental ones, within both internal and external processes and structures, to achieve greater openness and collaboration within and beyond governmental boundaries. DGT is enabled by the introduction of a combination of existing ICTs and/or new data-driven technologies and applications, and by a radical reframing of both organisational and cognitive practices. It may encompass various forms of public sector innovation across different phases of the service provision and the policy cycles to achieve key context-specific public values and related objectives including increased efficiency, effectiveness, accountability and transparency, in order to deliver citizen-centric services and policies that increase inclusion and enhance trust in government.

This definition serves as a benchmark to strive for, achievable to varying degrees and from different angles via various forms of digital innovation. Furthermore, the map is a conceptual, *ex-ante* instrument that can be put to use and tested empirically. Possible forms of digital innovation are organised conceptually in such a way that hypotheses about their transformative potential and impacts may be generated and then explored empirically.

To reconceptualise the phenomenon of DGT within the scope of public sector innovation, we build on the discussion presented in the previous sections. There, we define four types of public sector innovation: organisational innovation, service/policy innovation, governance innovation, and conceptual innovation. In doing so, we also attempt to align to some extent our typology with that of Janowski (2015).

The typology, illustrated graphically in Figure 9, combines two dimensions that should be considered as a continuum rather than binary, in order to accommodate the nuances that will surely emerge when the typology is applied to empirical cases. We call these two dimensions **'Innovation Depth'** and **'Innovation Reach'**.

Figure 9. Typology of digital government innovation.
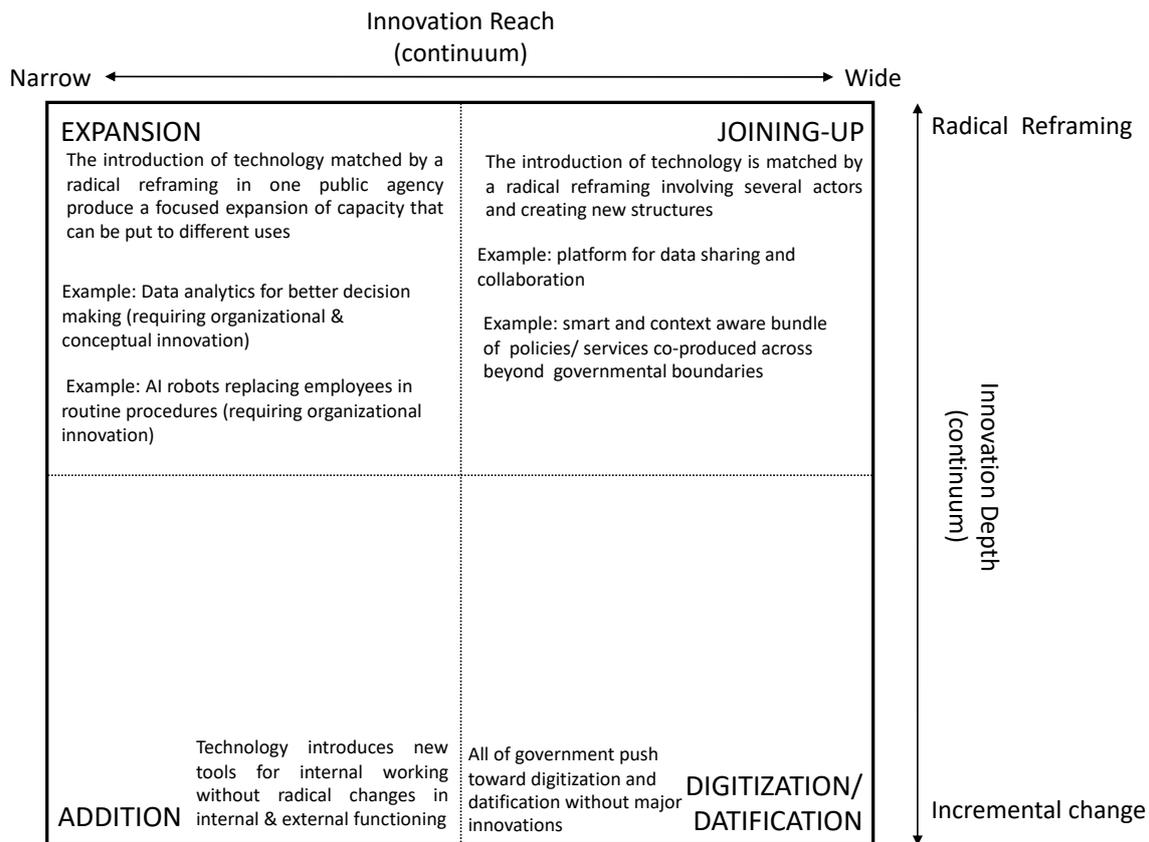
Source: Elaborated by the authors.

Innovation Reach, in practice, subsumes within itself what could be several distinct dimensions that cannot be accommodated within a simple and intuitive 2x2 matrix. Reach can be understood in at least three distinct ways, with regard to the domains affected by digital initiatives. First, it can be seen at the potential number of citizens affected; in this sense, it represents reach also in terms of potential. Second, it can be seen as referring to how many different players from different domains (e.g. different government verticals, civil society, industry, academia) both inside and outside government are involved, not as recipients of the services or policy produced by the innovation, but rather as stakeholders possibly collaborating and involved in various ways in the realisation of the innovation. Third, reach can be interpreted functionally with regard to the various phases of the service provision and policy-making cycle (design, implementation, evaluation, etc.). In our map, we use Innovation Width primarily to refer to instances where a combination of new technological capabilities is introduced on a large scale and affects stakeholders from different domains. We reasonably assume that this definition of reach coincides to some extent with the notion of reach that encompasses the pool of citizens and businesses potentially affected. Such a wide reach inevitably involves an open governance approach and probably repeated iterations of the service provision and policy making cycle.

Innovation Depth is the extent to which a digital government initiative is implemented alongside one or more types of public sector innovation (e.g. organisational, service/policy, governance and conceptual innovations). In other words, it represents the extent to which the implementation of a digital government initiative entails a reframing of internal and external functioning, or simply an addition to 'business as usual'. Reframing means changes in both tangible (structures and processes) and intangible (the institutionalised conceptual and cognitive repertoire for governmental action) aspects.

We define 'radical reframing' as the combination of all four types of innovation. 'Incremental change' refers to a situation in which no substantial innovation accompanies the introduction of new technologies. We consider conceptual innovation as being possibly the most crucial and strategic type. In defining the dimension of Innovation Depth in this way, we combine elements from public sector innovation literature and from Janowski (2015) in a syncretic manner. In a sense, the dimension of reframing also includes the internal organisation of governments and the ways in which they interact with external actors. These include citizens, interest groups, as well as other governmental stakeholders. Reframing also captures Janowsky's distinction between those changes to internal functioning that also affect external relationships, and those that do not. When reframing occurs, we can observe what we defined as 'transformation', 'expansion', 'contextualisation', and 'enablement', in decreasing order of the depth of reframing. When it does not occur, we see simple 'addition', defined by Janowsky (2015). This involves the introduction of new elements to internal working without radically affecting or changing practices and structures. As depicted in the figure above, when simple addition is applied to cross domains, we may observe copycat mirror digitisation, possibly as a result of pressure to conform with hyped trend, or to perform better in an international benchmarking exercise (institutional isomorphism).

The illustrative boxes below present three cases that we can preliminarily map based on the proposed typology. The Vilnius case (Box 3) links several domains and entails a reframing with regard to the use of data, the attempt to introduce behavioural changes, as well as in the way collaboration and data sharing are harnessed beyond the borders of the public actor involved. At the opposite end, the Trelleborg case (Box 4) appears limited to service provision. As such, the reframing involved is limited to the internal functioning of a single government agency. The Slovenian initiative in (Box 5) lies somewhere in between: to some extent it is sectoral, but it entails a clear reframing in the adoption of data-driven decision making.

Box 3. Transportation services in Vilnius (Lithuania).

In recent years, municipal agency Susisiekimo paslaugos (Transportation services) has undertaken multiple initiatives using data analytics to improve the provision of public transport in the city of Vilnius. Examples include an open data platform that allows the public to see all data relating to the use of public transport, heavy traffic conditions, sensor-enabled counting of passengers on municipal buses, and a partnership with private company Trafi that combines data on public transport with that from other modes of transport (including bikes, car-sharing and taxis), and uses real-time traffic and geo-spatial data to provide passengers with travel recommendations. Civic engagement has followed the initiatives to share municipal data: a group of coders called Code for Vilnius are using open data and IoT technologies to create open-sourced projects that improve the quality of public transport.

This is a truly integrated initiative covering service, policy and governance issues, and using Big Data and behavioural analysis in a new way. It targets several forms of interaction: Government-to-Citizens (G2C), Government-to-Business (G2B) and Business-to-Government (B2G).

The transformative elements include data-driven decision making, the opening and sharing of data to enable co-creation, and personalised service recommendations. The following new technologies are deployed: Open Data, Big Data analytics, geo-spatial data analytics, IoT, and machine learning algorithms.

The expected outputs and outcomes are: co-creation; improved public transport planning; behavioural change towards increased public transport use; reduced traffic congestion and improved air quality. These initiatives can improve the efficiency (lower costs of data collection for decision making) and effectiveness (geo-spatial and Big Data analysis allows better prediction of traffic patterns and issues) of policy design, while at the same time increasing the transparency of the municipality's choices. Their implementation can reduce the burden on the municipality through crowdsourcing

(efficiency), as well as improving personalised recommendations through data sharing (effectiveness), and fostering civic engagement (legitimacy). The use of Big Data can make evaluation quicker, less expensive, and more accurate, as well as fostering accountability and transparency.

Box 4. Automated social support and welfare in Trelleborg (Sweden).

Trelleborg municipality employs robotic process automation (RPA) in processes relating to welfare support, such as home care applications, sickness, unemployment benefits, tax and duties. Thanks to RPA, some administrative tasks such as the calculation of home care fees are now executed by a case handler program. In the future, the use of artificial intelligence will allow the case handler program to learn how to perform more complex tasks, widening the scope of process automation within the Swedish public sector. The success of the programme has led the National innovation agency, Vinnova, and the Swedish Association of Local Authorities and Regions, to create a partnership with Trelleborg municipality with the goal of implementing automation in other Swedish municipalities.

This is a more vertical and delimited innovation, mostly concerning the back office of service provision and targeting Government-to-Citizens (G2C) and Government-to-Government (G2G) interactions.

The transformative element is limited to process automation, and is realised by deploying AI and RPA.

The expected outputs and outcomes of the initiative are: faster processes and potential savings in labour costs; an increase in the amount of time employees can spend on core services and direct contact with citizens; and the improved effectiveness (fewer errors) of the services provided, resulting in reduced welfare-related costs. The initiative has no relevance for policy design, but affects implementation through the timely handling of applications and faster procedures; the freeing up of financial and human resources (efficiency); allowing employees to focus on core services and specifically on direct relationships, enabling services to become more personalised and effective (effectiveness); and ensuring the impartial and legally secure handling of applications (legitimacy).

Box 5. Using Big Data to improve the efficiency of public administration in Slovenia.

The use of Big Data analysis to improve the efficiency of HR is a pilot project aimed at exploring potential efficiency gains in public administration. It is part of the Slovenian national strategy for the promotion of data-driven decision making in public administration. The project began in 2017 within the Ministry of Public Administration, in collaboration with an external partner, EMC Dell. Anonymised internal data relating to employees, together with data on finance and procurement and some external data (weather and geographical) were used to pinpoint employees' behaviour patterns and average performance; to conduct predictive analytics on the use of facilities; and perform text analytics to identify purchasing behaviours across the ministry.

While limited to Government-to-Government (G2G) interactions, the Slovenian case is an 'all-of-government' initiative focusing on policy making and the overall innovation of public administration, with a governance dimension at least within government.

Its transformative element is data-driven decision making in public administration, realised via the deployment of Big Data analytics (predictive analytics, text analytics, etc.).

The expected outputs and outcomes of the initiative are: lower costs of public procurement, the increased efficiency of public administration, and the creation of a

favourable environment for economic development. The initiative improves policy design by: (a) lowering the cost of data collection for decision-making purposes (efficiency); (b) enabling the identification of organisational patterns and the pinpointing critical aspects, allowing public administration to formulate measures to improve its functioning (effectiveness); and (c) increasing the transparency of public administration through the adoption of data-driven decision making (legitimacy). Since being implemented, it has decreased the cost of public procurement and highlighted promising potential efficiency gains in many other aspects of the organisation (efficiency). Big Data analytics has provided a solid and effective basis for the process of prediction, planning policies and decision making at all managerial levels in public administration (effectiveness). It can also reduce the cost and increase the accuracy of evaluations, increasing accountability.

In concluding this section, it is worth stressing that the typology presented above is a theory-informed, conceptual typology that will have to be corroborated by empirical evidence.

It makes the assumption, derived from the literature and also from common wisdom, that the real potential of the various technologies and the innovation they enable springs from their combination and aggregation. One would expect, therefore, that moving toward the top-left quadrant would deliver greater effects than, for instance, different forms of expansionary innovation, and certainly compared to mere addition or digitisation/datification.

In creating this typology, we generate the testable hypotheses that the Tender Specifications stipulated as one of the objectives of the framework. In the best traditions of socio-economic research we are, however, ready to be surprised by the evidence.

Perhaps we may discover that a well-defined and delimited initiative focusing solely on service provision can deliver more tangible, better measurable, and higher effects?

Questions such as whether an intervention to which this framework is applied entails a radical reframing or constitutes a simple addition, and whether it can be described as a transformative or an enabling digital innovation, remain to be ascertained empirically through field work.

2.5 Effects

One of the objectives of the proposed framework, and of this study as a whole, is to pave the way for the assessment of the effects of digital government innovation and of Digital Government Transformation (where a set of innovations qualify as transformation). In this chapter, we present our high-level and very preliminary sketch of possible effects. This remains generic and flexible enough to be applied, after opportune operationalisation, to most digital government initiatives.

We present here the potential effects separately from the overall framework, both to reduce complexity and to ensure that no determinism can be read into our approach. Effects are not linked to specific technologies or factors, but are simply presented using the well-known distinction made in logical frameworks between outputs, outcomes and impacts. The question of what causes what in a domain in which everything is linked to everything else is beyond the scope of our framework and points instead in the direction of complexity approaches. Aside from complexity, several other methodological challenges surround the issues of evaluation and measurement. We discuss these briefly below.

Measuring and evaluating the effects of digital government initiatives, as with 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, for the monitoring of progress and project management, as well as understanding what works and why, for the purposes of learning and fine-tuning interventions. Depending on an organisation's aim in setting out to measure and evaluate the effects of its initiatives, various approaches can be taken – each with its own pros and cons. However, we want to stress a challenge that is specific to digital government transformations. Because traditional eGovernment projects have a start and end date, a fixed budget, and a time of deployment, they are more easily measurable than digital government transformation. The latter, in fact, is an ongoing process without a clear-cut end status; rather, it is a continuous process that renders any measurement and evaluation even more complicated (Mergel et al., 2019).

First, we must make a simple distinction between measurement and evaluation. Measurement is about counting 'what is'. It is the process by which the attributes or dimensions of a phenomenon are determined and counted. Evaluation, while requiring the measurement of relevant variables, is something different and more difficult than measurement. A measurement indicator may indicate that at the end of a given intervention Y (at time T1), variable X increased by 10% (compared to T0). This is an objective, statistical fact. It is a different matter to attribute the 10% variation entirely to intervention Y, and not to other factors. Evaluation, in its purest sense, is the making of a causal attribution and assigning to it a value (e.g. monetary). Hence, evaluation requires a theory of causation, or at least some *ex-ante* hypotheses about the possible effects of a given intervention. Evaluation can be seen as requiring three steps: (a) the formulation of causal hypotheses that can be extracted from existing theory or from cumulative empirical evidence, logic, practical experience and, if need be, even imagination; (b) a causal identification strategy; (c) the empirical testing of the hypotheses using measured variables to estimate causal parameters (Heckman, 2008). Only the formulation of initial hypotheses on effects and the subsequent formulation of measurement indicators are part of our framework. Although a causal identification strategy and empirical testing clearly lie outside the scope of this work, we briefly discuss different approaches below.

When the goal is simply to monitor an intervention, without attempting to fully establish a causal attribution, measurement indicators are sufficient. Even if measurement is just about counting, it should nonetheless be valid and reliable.

First, there is the conceptual dimension concerning the extent to which measures reduce complexity but remain well founded and correspond to the real world, and are relevant to the object being measured. This agenda is about validity, which (briefly) concerns the accuracy of measurements and the degree to which they accomplish the purpose for which they are intended. Conceptual progress is achieved when measurements are a better proxy for the underlying concept/phenomenon.

Second is a technical dimension that mostly concerns the calculation of measures and their reliability (consistency, precision and the repeatability of the selected measurement indicators). Progress here is measured by technical sophistication. Third is a politico-administrative dimension: measurement is also a social process, and we would add that it is often characterised by what has been termed institutional isomorphism (Codagnone et al., 2015) – that is, 'copycat' benchmarking indicators that are well established but possibly no longer valid. This dimension concerns who is responsible for producing the numbers and why; what reactions there are to the measurement; and what are the social mechanisms via which the measures acquire a 'taken for granted character' and become authoritative.

The underlying, theory-informed pillars of the proposed DigiGov-F will enable us to propose in its next iteration a set of indicators that address these three dimensions, together with a set of step-by-step guidelines on how to select and measure them.

Moving on to evaluation, we enter a domain riddled with disputes between different conceptions of causality (i.e. successionist versus generative causality)[20] and methodological approaches (Misuraca, Codagnone and Rossel, 2013)[21].

Compared to the issues of monitoring and measuring, things become more complicated if one asks the question: can observed effects be attributed solely to the intervention being evaluated? One way to approach this question is to apply counterfactual evaluation based on experimental or quasi-experimental design, using strictly quantitative and formalised methods (Holland, 1986; Shadish et al., 2002). Counterfactual Impact Evaluation (CIE) is widely used but has been criticised in some respects (Dawid, 2007; Ni Bhrolcháin and Dyson, 2007; Pawson and Tilley, 1997). First, it provides a causal description determining the 'effects of causes' but is unable to provide a causal explanation that explains the 'causes of effects'. Second, it has a strong internal validity, but its external validity may be limited and experiments must be repeated in different settings in order to generalise. (In relation to this, it is worth noting that the experiment we are conducting as part of the case studies is just a preliminary exploration, from which will arise no claim towards generalisation.) Third, in order to maintain strict protocols on the data-generating process, it disregards the actors that enact an intervention and which may play an important role.

If the objective of evaluation is to learn and understand how and why a given intervention did or did not work, a causal *explanation* of the 'causes of effects' is needed. Whereas counterfactual experimental evaluation simply analyses intervention and effect discretely and in isolation, understanding why and how requires the simultaneous consideration of a large set of variables, based on the perspective of "everything being linked to everything else". To this end, econometricians have built analytical models (solved with data) that are referred to as 'structural evaluation' (Heckman, 2008, 2010).

As an alternative to the formalised analytical (counterfactual and structural evaluation) or computational (modelling simulation) described above, there are mostly qualitative approaches inspired by a generative notion of causation, and generically referred to as 'theory-based evaluation'[22].

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[20] The notion of 'successionist' causation is traceable to David Hume (Hume, 1739). In this notion, causality is considered 'external' and unobservable: causal inference is about unobserved quantities from observed facts (statistics) controlling for unobserved ones. The notion of causality that is most opposed to the successionist approach is the 'generative' theory of causality (Harré, 1972). The generative theory sees causation as internal and seeks to explain the causal mechanisms; it looks at the causes of effects, also considering the views and actions of the involved actors.

[21] What follows is a short summary developed using a large body of evaluation literature, out of which we selectively report only a few of the sources used. We have looked at several alternative reconstructions and reviews (Henry, 2001; Patton, 1997; Pawson and Tilley, 1997; Shadish et al., 1991); key and fundamentals works on and of experimentalism (Campbell, 1957, 1969; Campbell and Stanley, 1963; Morgan and Winship, 2007; Shadish et al., 2002); but also some examples of pragmatist (i.e. (Patton, 1997; Patton, 1982; Weiss, 1976; Weiss, 1980, 1986); and constructivist (Guba and Lincoln, 1989), approaches. We have analysed in greater depth the counterfactual approaches in statistics (Rubin, 1974, 1986, 2007) and econometrics (Angrist and Pischke, 2009; Blundell and Dias, 2009; Heckman, 2001, 2005, 2008; Imbens and Wooldridge, 2009; Lee, 2005).

[22] As noted by Rogers (2008), theory-based evaluation has been variously referred to as 'programme theory', 'programme logic', 'theory of change' (Weiss, 1995), 'theory-driven evaluation' (Chen, 2005; Chen, 2006; Chen and Rossi, 1980; Coryn et al., 2011; Donaldson, 2007), 'realistic evaluation' (Pawson and Tilley, 1997), and

Although nuances exist between the different approaches that fall under this label, simply stated they link programme inputs and activities into a chain of intended or observed outcomes, and then use this model to guide the evaluation. Unlike counterfactual impact evaluation, theory-based evaluation programmes are not considered monoliths. Neither are the beneficiaries and stakeholders simply regarded as passive recipient and 'takers' of the programme 'treatments'. Their views are crucial to performing the evaluation. The views of policy makers, stakeholders, experts and programme participants are collected via interviews or as embodied in relevant documents (programme documents, multi-annual plans, research agendas, project documents) and treated as 'theories' of change and action. These are used as hypotheses to be triangulated with empirical evidence. Second, also differing from the counterfactual approach, context is not controlled for statistically, but it is instead viewed as key to understanding the interplay between programmes and effects. Again, contextual variables are 'measured' both from the perspective of the players involved and through available external sources of evidence (e.g. statistics, review of the relevant literature). Theory-based evaluation adopts qualitative or mixed qualitative and quantitative methods[23]. Despite its merits and progress, theory-based evaluation remains based on theoretically or logically derived assumptions that are only triangulated against mostly qualitative evidence. It therefore does not ensure the same level of empirical causal attribution provided by counterfactual methods. The approach nonetheless represents a good alternative when quantitative evidence for formalised method is lacking.

As is evident from our discussion so far, in what follows we cannot perform most of the complex types of analysis described above. Neither can we at this stage develop hypotheses and detailed logic models for all possible combinations of initiatives that may result from the diversity of technologies, types of innovation and domains of application that the framework needs to cover. As anticipated, it remains at a relatively high level. We must therefore stress that the potential effects described in this chapter are based simply on *ex-ante* assumptions that are highly uncertain and in need of empirical validation; we do not stake any claim as to the existence of a direct and linear causality between digital government initiatives and such effects.

As anticipated, using the findings from the literature review conducted by Barcevičius et al. (2019), we will distinguish between outputs, outcomes and impacts, following the definitions used by Mergel et al. (2019). We define here "output" to mean a quantitative result following Boyne's (2002) definition: "Outputs include the quantity of a service and its quality (as indicated for example by speed of delivery, and accessibility of provision, both in terms of geography and opening hours)." The result of digital transformation outputs therefore includes concrete and measurable services, products, processes or skills. Next, we define "outcome" (Bretschneider et al., 2004) as the effect that results from a new service, or from a change in processes or the quality of the organisation's relationships with others (such as increased simplicity, accessibility, quality, advantages, efficiency,

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'contribution analysis' (Mayne, 2001; Mayne, 2008; Mayne, 2011; Mayne, 2012). The application of such approaches has increased in the last 20 years, as documented in a recent systematic review (Coryn et al., 2011).

[23] Qualitative research has been the object of a long and controversial debate (Bryman, 2006; Denzin and Lincoln, 2005), as it is difficult to establish an equivalent to the three ''truths' of quantitative methods (validity, reliability, and generalisation). Several scholars hold that external confirmation of qualitative findings through well designed, purposive sampling, checking and triangulation of methods/sources can enhance the credibility and validity of qualitative research (Bryman, 2006; Denzin and Lincoln, 2005; Miles and Huberman, 1994; Seale and Silverman, 1997). For instance, ensuring the representativeness of selected cases and including the use of combined qualitative and quantitative methods can support generalisations (Bryman, 1988). Well-designed purposive sampling can offset the limits of not drawing the samples randomly and support the development of grounded theory (Glaser and Strauss, 1967). Since the 1990s, a new consensus has emerged over the complementary relationship between qualitative and quantitative perspectives, which recognises the different utility of each for the researcher. Studies that combine both qualitative and quantitative methods (mixed or ''Q2'' methods) are becoming more and more common (Brannen, 1992; Bryman, 1988, 2004; Bryman, 2006; Cresswell, 2007; Creswell, 2003; Tashakkori and Teddlie, 2003). In this sense, we end up with three distinct approaches to research: quantitative; qualitative; and what is variously called 'multi-method' (Brannen, 1992), 'multi-strategy' (Bryman, 2004), 'mixed methods' (Creswell, 2003; Tashakkori and Teddlie, 2003). Mixed methods research increasingly contributes to ''evidence-based'' policy including through evaluation studies that adopt such an approach (Veltri et al., 2014).

speed, inclusion, responsiveness, competitiveness, security, transparency). Following the distinctions made in Barcevičius et al., 2019, we also include in "outcomes" the results of innovations that contribute to the development of (better) policies and the digital environment. With regard to outcomes, we retain the three dimensions that were identified in the first version of the conceptual framework, and will define them in this chapter: productivity and efficiency; effectiveness, inclusion and sustainability; and legitimacy. We will include long-term "impacts", which include changes across the whole organisation or public administration; as well as the ways in which transformation leads to the creation of public value, or strengthens democratic principles (e.g. supporting citizen inclusion, regulation, legal and political frameworks) (Alford & O'Flynn, 2009). In brief, these include the ways in which digital transformation brings about a whole range of societal and environmental benefits that are experienced by different stakeholders and may not be as immediately visible as some of the outcomes that we will describe (e.g. the reduction of operational costs, personalised services), but are nevertheless important long-term results in the areas of social inclusion and civic participation[24].

Finally, in describing the outputs, outcomes and impacts generated by digital transformation, we will consider the stakeholders affected by such results. In line with the latest OECD report, 'The impact of digital government on citizen well-being' (2019), we stress that digital transformation has the potential to impact every aspect of our lives. Whilst this provides opportunities to improve lives, there is also a risk that it may disrupt things in ways that negatively impact people's well-being. We recognise that government, politics and civic participation are not actively recognised or acknowledged in some people's day-to-day lives. They may use public services such as schooling and transport infrastructure, or witness political discussion on the news, but by and large their lives are lived without direct exposure to the public sector or full awareness of its role. However, For others, however, the civic sphere is a constant feature of their lives, either through the active experience of accessing services or via citizen activism.

Figure 10. The results of digital transformation.

Source: elaborated by the authors.

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[24] https://ec.europa.eu/digital-single-market/en/news/impact-assessment-review-directive-200398ec-reuse-public-sector-information
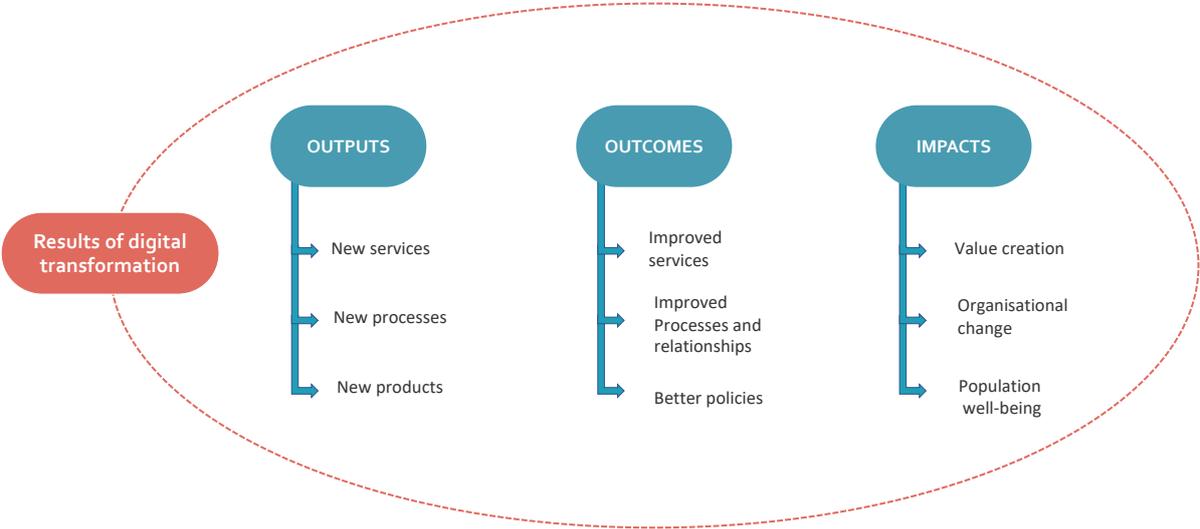
2.5.1 Outputs

The literature review conducted by Barcevičius et al. (2019) presents a long list of outputs of digital transformation in governments. These exist take the form of new services, new processes, new skills or new products. Our conceptual framework groups these into four main areas of outputs:

1. Internal processes
2. Governance
3. Policy Making
4. Service delivery

Internal processes. One of the triangulation most frequently cited in the literature is the creation of new processes that require no human involvement. Artificial intelligence is expected to take over tedious and repetitive tasks that are usually carried out by public sector employees. Other new technologies have already been adopted, producing diverse outputs that improve the internal processes of pubic administrations and government agencies. For instance, the German Patent and Trademark Office has applied RPA in order to direct individuals to the appropriate patent examiners, and to improve the distribution of patent applications. In 2018, Austria and Finland also explored automated solutions for patent pre-classification and distribution. Distributed ledger is another technology that has been used in process innovation. For example, the Danish blockchain project Vehicle Wallet is said to ease supply chain management processes by documenting a vehicle's entire lifecycle. One distributed ledger contains all data on the car, which remains accessible throughout the supply chain[25].

Governance. By generating new relationships and dynamics, involving actors and resources outside public organisations, and modifying the ways in which the value embedded in services is produced, technological innovations allow for bottom-up control over public services, as well as empowering citizens and other stakeholders to contribute to or lead the creation of public value. This is often recognised as one of the key features of digital government transformation. Janowski et al. framed this in terms of changing governance paradigms, which reshape citizen-administration relationships. The outputs produced in this area are not only of interest to stakeholders working in the public sector, but also to citizens, who are now able to participate more easily to the public sphere. These developments in civic engagement have been enabled by social media, mobile devices, Open and Big Data, data analytics, crowdsourcing, visualisation, gaming and other technologies. AI can power deliberation platforms, the aggregation of opinion and the validation of decisions. Information can be sourced from social media and analysed to identify problems and gauge public sentiments during the phases of agenda-setting/policy design. In other examples, AI robots are employed to spot anomalies in a congress member's spending, enabling citizens to gain more information about their politicians and make better-informed decisions. Some people are also excited about the prospect of blockchain-backed eVoting systems. Internet voting has shown some success in Estonia, Canada, Brazil, France and Switzerland; however, experiences in Norway also point to security concerns regarding election fraud. Blockchain could arguably help to address these security issues. Moreover, numerous OGD initiatives have been launched in various countries, and other proposals have been discussed. For instance, the UN advocates for the creation of "data commons" where free, public and government data can be accessed globally, to reduce the barriers to entry for anyone seeking to work with AI[26].

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[25] 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/

[26] http://workspace.unpan.org/sites/Internet/Documents/UNPAN98900.pdf

Commons can provide the technical framework for the collection, cleaning, labelling and use of AI tools and datasets. They can serve as a platform on which local, national, or international Open Data initiatives can be shared and integrated, in turn allowing researchers, civic coders and others from around the world to access data, find projects, discuss ideas, and contribute solutions.

Policymaking. According to numerous researchers, digitalisation may aid policy innovation. For example, Open Data, Big Data and predictive analytics provide opportunities both for the precise assessment of problems and for clarity as to policy options. AI computing, coupled with an abundance of data and computing power, enable governments to aggregate and examine information from a variety of sources. Some researchers argue that this also makes governments better at prediction and prevention – once the predictive analytics models become advanced enough. Predictive analytics allows the public sector to focus more on prevention instead of simply reacting to societal problems. These tools have been applied to develop targeted, personalised interventions and 'nudges' in healthcare, education and other social services of general interest. Police departments use predictive models to decide where they want their officers to patrol, while data mining and network analytics help to uncover tax fraud. Advanced analytics using AI and Big Data give policymakers the ability to test potential solutions in advance. This provides an opportunity to test policy options and discover unintended consequences, before undertaking a policy measure. AI and machine learning can improve budget allocation methods, and Big Data analysis helps to identify areas that need to be funded first. Data analytics may also help to improve public procurement.

Service delivery. Certain areas of service delivery are widely discussed in the literature, due to the extensive use of new technologies: health care, public safety and security. Due to the widespread adoption of online medical consultations, patient portals and other care delivery channels enabled by digital innovations, 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. Moreover, the adoption of disease surveillance systems that allow faster responses and greater accuracy in preventing the spread of infectious diseases. In relation to public safety, predictive technologies powered by machine learning enhance the ability of law enforcement authorities to predict crimes, and to identify both the perpetrators and victims: to anticipate where, when and by whom crimes are more likely to be committed. Numerous examples from the area of security also exist in the literature. In the aftermath of the earthquake in Emilia Romagna, Italy, real-time data was used to allocate housing solutions for victims[27]. Besides IoT, other digital technologies, often based on geo-spatial data, allow citizens to articulate their demands. For example, websites and apps that enable city residents to report incidents relating to municipal affairs, from issues with stray pets to public transport, by selecting a specific location on the map where the issue occurred. As shown by a case study conducted by RAND Europe[28], a partner of the consortium for this study, wearable technologies provide an opportunity to address several problems faced by law enforcement officers in an increasingly complex and technologically challenging environment. For instance, body-worn cameras (BWCs) have been proposed as a new way to reduce the use of force by the police, as well as assaults against officers.

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[27] UN Department of Economic and Social Affairs. (2018). UN E-Government Survey 2018. *United Nations.*
[28] https://www.rand.org/randeurope/research/projects/investigating-the-effects-of-body-worn-police-cameras.html

Figure 11. Examples of outputs of digital transformation.

OUTPUTS

1. Internal processes
- Automated repetitive tasks
- Blockchain for land register
- Patents pre-classification

2. Governance
- Deliberation platforms
- Blockchain-backed eVoting
- Social media analysis

3. Policy-making
- Personalised interventions
- Precise problem assessment
- Modelling for testing policies

4. Service delivery
- Disease surveillance systems
- Body-warn cameras for police
- IoT for transport services

Source: elaborated by the authors.

2.5.2 Outcomes

According to our earlier definition, outcomes are the results that are generated by the introduction of new services, processes or skills as a result of digital transformation in governments. Outcomes are often more difficult to measure or identify, due to the difficulty of building a causal link that ensures a specific outcome was caused by a particular output. However, despite the challenges of causation theory, some of the outcomes we introduce in this conceptual framework are easier to measure using certain indicators, while other are more complex and unobservable. Following the typology developed in the Inception Report and the first version of the framework, we will divide outcomes into three main categories: productivity and efficiency (PEF); effectiveness, inclusion and sustainability (EIS); and Legitimacy (LEG).

Productivity and efficiency. From an economic perspective, the primary impact of the use of ICT in government (including new digital technologies such as AI, blockchain and predictive analytics) is on productivity and internal efficiency. As reported by the Italian Digital Transformation Team[29], AI-transformed public administration has had direct and positive effects on the operations of the civil service, public services and policy making. From administrative operations to resource management, technology applications can reduce costs, ensure the timely delivery of public goods and services, and optimise the use of existing resources. A vast body of literature exists on the economics of ICT that is beyond our scope to review here. According to economic models that use a Cobb-Douglas production function, there are two main channels for the effects of digital transformation. Conceived as a form of investment, it might raise workers' productivity. Conceived as technological progress, it might improve the efficiency of a single organisation or of the general economic milieu[30]. The first case is trivial: investment in ICT means more

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[29] Digital Transformation Team. (2018). Digital transformation 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/

[30] Since productivity and efficiency are often wrongly used interchangeably, it is worth briefly recalling how they should be distinguished. Productivity is the ratio of the outputs produced to the inputs involved in the process of production. Efficiency is all about the comparison between what is *actually* being produced or performed with what *can* be produced using the same amount of resources. Technical efficiency defines the production frontiers

equipment for the labour force (capital deepening). Alternatively, these new factors of production might substitute workers at some stage of the production process, raising the productivity of other types of workers. In the second case, ICT could affect economic performance through a reorganisation of the production process, a widening of either the scale or the capital intensity of production, an improvement in the organisation's technology (so-called 'embodied technological progress'), or any other effect on the efficiency of a production unit taken as a whole. Alternatively, it could improve business conditions and the environment in which organisations operate, for example through networks or other externalities, improvements in human capital, knowledge, education, learning-by-doing phenomena, or through personalisation and the improved quality of products and services.

The main outcomes we can therefore expect from the introduction of advanced technologies are an increase in efficiency and productivity, due to a reduction in the number of hours taken to perform tasks or deliver services. Another important outcome that is possible, thanks to use of predictive analytics, is improved human resource planning and the optimal deployment of resources in real time. In a public hospital, for instance, predictive analytics can anticipate spikes in hospitalisation or personnel absenteeism, and resource allocation can be planed to cope at critical points. The literature review revealed many other examples of cost savings, such as dematerialisation, a reduction in errors (the case of Trelleborg), the reduced cost of public procurement (in Slovenia). However, increased efficiency and productivity apply not only to the internal processes of public administrations and service delivery, but also to the processes of policy making. Examples of more efficient policy making include the lower cost of data collection for decision making, real-time monitoring of implementation, and less expensive policy evaluation through the analysis of Big Data.

Effectiveness, inclusion and sustainability. Within this dimension we include outcomes that in some way improve the provision of public services, internal processes, the relationship between citizens and government, and the policies implemented. First, new technologies can improve the effectiveness of services both for citizens and business. Distributed ledgers, for instance, reduce administrative burden while increasing privacy and security. More efficient services can reduce waiting time for citizens. Broadly defined, AI can help predict and enable governments to implement pre-emptive and/or personalised policies, or to fine-tune service delivery. Improving the prediction and detection of problems can produce more effective policy decisions aimed at achieving inclusive outcomes, link them to service provision, and carry out smart, real-time steering and evaluation of the implementation. As shown by the Impact Assessment carried out on the review of the Directive 2003/98/EC on the re-use of public sector information, it is estimated that Open Data has the potential to save 7,000 lives yearly thanks to quicker responses in the event of cardiac arrest, and 1,425 lives from road traffic accidents (i.e. 5.5% of European road fatalities)[31]. More generally, geo-spatial and location data (GSLD) can be used to improve policymaking for complex localised situations and to offer location-based services. Big Data analytics can be used by governments to improve existing services and to draw on novel datasets to drive entirely new public services. Behavioural Predictive Analytics (BPA) allows a government to deliver better services; and, importantly, it provides the possibility for interventions to occur before problems develop, leading to both improved outcomes and savings.

In certain types of public service, such as health care, there are important outcomes that can be measured in order to assess the increased effectiveness achieved by digital transformation. Digital innovations hold the potential to improve the quality health care quality, especially when it comes to health care analytics, e-delivery, personalisation and

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of the maximum possible outputs that can be produced from each input level. Allocative efficiency is that mix of capital and labour that produce a given amount of output at minimum cost. Simply stated, an increase in productivity means 'doing more with the same resources', whereas an increase in efficiency means 'doing the same with less'.

[31] https://ec.europa.eu/digital-single-market/en/news/impact-assessment-review-directive-200398ec-reuse-public-sector-information

social media. For instance, the macro-level analysis of public health risks can enable well-targeted, pre-emptive action to avoid disease outbreaks. One study shows that the adoption of disease surveillance systems based on machine learning algorithms led to a reduction of more than 90% in outbreaks of norovirus in hospitals in Hampshire, UK[32]. Health care analytics can potentially lead to the discovery of more effective, personalised treatment for patients – predicting which treatments a patient is most likely to respond to, and spotting symptoms early[33]. Lastly, richer communication through social media and other ICT-based channels is associated with the empowerment of patients. For example, a study on the impacts of social media in the Danish public health care 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."'[34]

Legitimacy. Various contributions reviewed by Barcevičius et al. (2019) credit the new wave of technologies with having the potential to: increase participation and civic engagement; make government more responsive, transparent, and accountable; and introduce forms of eDemocracy and smart participatory democracy. As a result of these, one may expect an increase in trust towards government and in electoral participation. This can be achieved by creating real-time decision making, rapidly aggregating opinion data, and helping to introduce more direct forms of democracy that can reinforce and improve representative democracy. As we mentioned earlier, AI can enable the creation of deliberation platforms, the aggregation of opinion, and the validation of decisions. By applying machine learning to online and social media, governments can become more responsive to citizen sentiment, ushering in a new dimension in civic engagement. Information can be sourced from social media and analysed to identify problems and gauge public sentiments during the phases of agenda-setting/policy design. As one might expect, within this dimension, the causal chain is the longest, and the main end effect – 'trust in government' – is intangible and unobservable.

Figure 12. Examples of outcomes of digital transformation.

1. PEF
- Reduce errors and costs
- Speed up processes and services
- Less bureaucracy

2. EIS
- Targeted and personalised service
- Pre-emptive policy measures
- Real-time policy evaluation

3. LEG
- Increased citizens' participation
- Increased transparency
- More responsive government

OUTCOMES
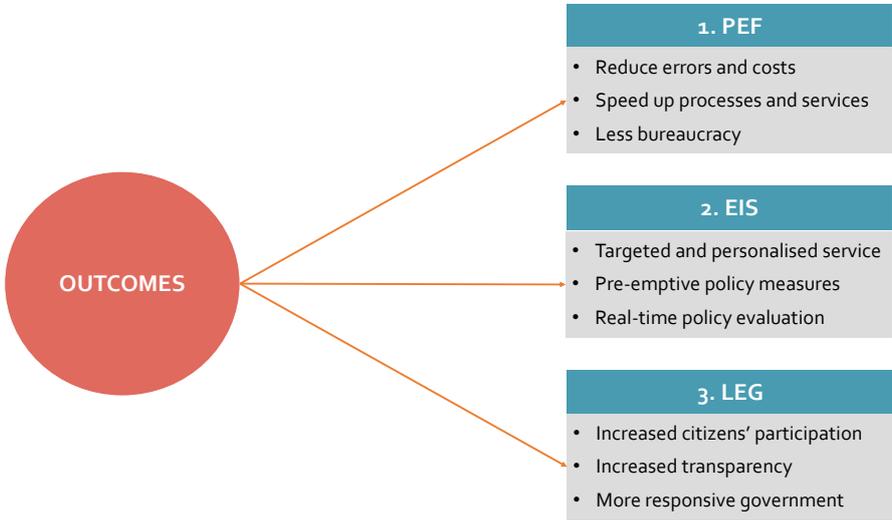
Source: elaborated by the authors.

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[32] Mitchell, C., 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.

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

[34] Bjørnes, C. (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.

2.5.3 Impacts

As expressed by some of the experts consulted by Mergel et al. (2019), the main aims of digital transformation are seen as being the achievement of broader impacts on public administration, on democracy and on the wellbeing of the population. In line with the OECD definition of digital government, we can briefly say that the aim of such transformations is the creation of public value through the use of digital technologies, as an integrated part of governments' modernisation strategies. First, the long-term impacts include sustainable changes across the whole organisation, creating a better image of the public sector as an efficient, inclusive and participatory organisation that provides better workplaces and better services. The key stakeholders affected by these long-term impacts are public sector employees, who would benefit from the better functioning of the whole organisation. Indirectly, such transformation would also impact the citizens and businesses that engage with the public administration.

However, the most interesting long-term impacts are arguably those that directly affect citizens and governments in their experience of civic engagement and public services. Some tangible long-term impacts deriving from digital transformation may include economic growth and social cohesion, as a result of the better, more effective and inclusive policies presented in the previous section. Others may be a reduction in pollution, as well as safer cities, as a result of improved services that make use of IoT, Big Data and other technologies. However, as suggested by some of the experts who attended the first workshop for this study, in order to maximise the relationship between the activities of digital government and the well-being of citizens, the focus should not be exclusively on the material benefits that come from the improved quality of services. It should also reflect the intellectual and emotional benefits derived from a different approach to a government's interactions with its constituents.

Figure 13. Examples of impacts of digital transformation.

1. Organisational change
- New image of public sector
- Better workplace
- Inclusive organisation

2. Value creation
- Strengthen democratic principles
- Transparent government
- More equal society

3. Citizens' well-being
- Personal security
- Civic engagement
- Subjective well-being
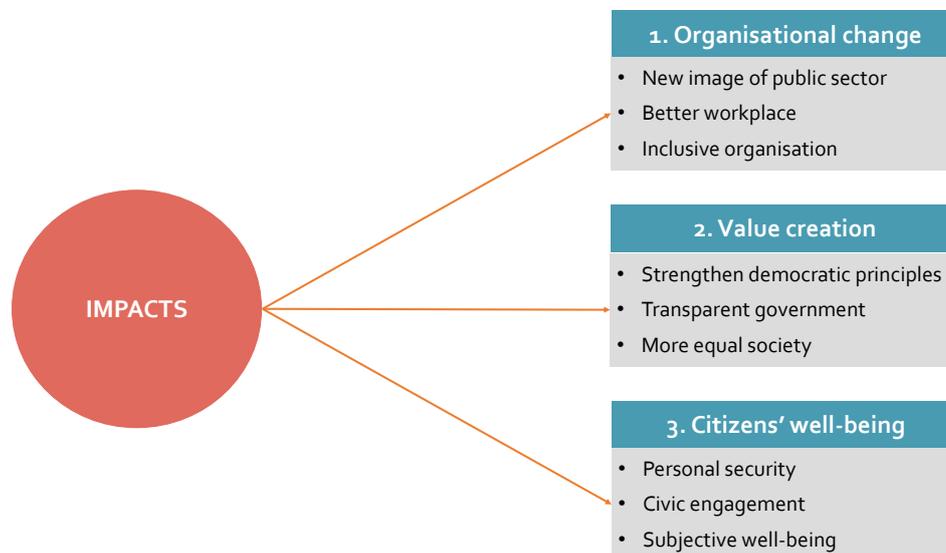
Source: elaborated by the authors.

2.5.4 Negative effects and side-effects

Here, we discuss some of the possible negative side-effects that emerge from the literature review conducted by Barcevičius et al. (2019). Positive effects can be maximised and negative ones minimised, as well as barriers removed, if the countervailing measures are effective. The final impact achieved therefore depends on what can be termed 'intervening factors' – namely, effective, ineffective or a lack of, countervailing measures.

Job losses to automation. The long-standing trend towards routine task automation[35] could be accelerated by AI and robotics[36], producing job losses in the public sector[37], which is a very large employer in EU countries. The automation and digitisation of governmental processes could lead to a significant reconfiguration of work and employment patterns, with implications in terms of new skills requirements, unemployment or intermittent employment, and the further polarisation of the labour force. Often, public administrations report that the labour savings made through automation enable them to redeploy staff to other tasks, including core tasks. Yet, in situations where there is less flexibility for governments redeploy staff to new jobs, or where the employees previously carrying out the tasks being routinised do not possess the skills necessary to perform other, more interactive or cognitively advanced tasks, the possibility of lay-offs cannot be ruled out. These may be offset if public sector employees are retrained to acquire the skills needed to become part of digital government transformation. This would, at the same time, reduce the risk of job losses and help to tackle the lack of skilled workers in public administration as a barrier to the full adoption of AI and the exploitation of the potential of Big Data. If employees are retrained and new roles created to attract skilled professionals, negative side-effects on employment may be contained. Meanwhile, the new skills developed internally or attracted from outside will increase the potential to reap all of the benefits of AI and other new technologies.

Unfairness, AI accountability and discrimination. Concerns also exist over a potential decrease in fairness, neutrality and accountability within the public sector as a result of the adoption of AI. Analysing independently and learning from their environments, advanced algorithms may introduce unconscious biases by excluding or failing to include some individuals from the outset, such as those who have the least and no access to technology, or by neglecting individuals based on their race.[38] Technological shortcomings may also occur due to the poor quality of technologies. If improperly controlled, digital tools employed by both private and public sectors can produce errors and bad decisions. For instance, research suggests that inaccurate facial recognition can produce biases against individuals[39]. It may lead to false identifications or a failure to recognise that prevents further, necessary actions. These mismatches increase opportunities for other negative effects, such as racial biases and targeting of specific groups. The adoption of such tools, often with very little public consent or knowledge, endangers the notions of democracy, civil liberties and human rights. This problem was the main topic of the 2018 UN World Economic and Social Survey, which called for greater transparency and accountability concerning AI-based decisions, to avoid the risk of reinforcing existing biases and forms of exclusion. These issues could potentially be avoided through the development and adoption of an AI ethical regulatory framework, which may in turn speed up adoption.

Privacy and data access. Many researchers also worry about the violations of privacy that could arise from digital government transformation and personal data sharing. Unlimited government access to personal data could result in an Orwellian society, limiting civic participation and undermining the strength of democracies. Scholars are increasingly noting instances in which government access to data results in privacy violations, damaging the overall image of the government. Governments are often criticised for prioritising the use of digital, data-driven technologies over privacy concerns. In Europe, the Swedish government experienced a leak of the population's personal vehicle data. This leak forced the Swedish government to restrict the outsourcing of private and sensitive data to third parties. In 2018, a hospital in Portugal received a fine for allowing indiscriminate access to, violation of and failure to ensure the continuing integrity and confidentiality of the personal data of users it processed. Other examples depict the

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[35] See the seminal work by Autor (2015; 2013; 2008).
[36] See for instance: Acemoglu & Restrepo, (2018); Aghion and Jones (2018).
[37] See, among others, Acemoglu and Restrepo (2017); Arntz et al. (2016). Bessen (2016; 2015); Bowles (2014); Chiacchio et al. (2018); Dauth et al. (2017).; Frey and Osborne (2017); Graetz and Michaels (2017).
[38] Pencheva, I. (2018). Big data and AI – A transformational shift for government: So, what next for research?
[39] Snow, J. (2018). Amazon's face recognition falsely matched 28 members of Congress with mugshots. https://www.aclu.org/blog/privacy-technology/surveillance-technologies/amazons-face-recognition-falsely-matched-28

intrusion into people's lives by both private and public sectors. These incidents call into question the amount of power that digital technologies give to governments, and how that power could impact democracies. Government access to personal data can result in a 'Big Brother' type of surveillance, eliminating checks on government behaviour. In many case, digital tools are employed with little public oversight, creating opportunities for the unethical use of personal data.

Private sector accountability. In the new era of digital transformation, the private sector has taken an undisputed lead. Some authors argue that the private sector's leadership in digitalisation threatens to create power asymmetries between public authorities and private companies. The literature on AI-enabled public services points to the issue of the private sector's domination of the development and delivery of public services. This increases information asymmetry, since governments purchase proprietary products and services that they do not understand and which they cannot build themselves. But the demand to continuously innovate prompts public authorities to collaborate with many private entities developing digital tools. As a result of this collaboration, the public sector is surrendering insights over government processes to the private sector. By 2014, the Danish Ministry of Tax had already admitted to having no control over more than 200 systems that used machine learning algorithms to inform policy making that directly affected citizens. Outsourced decision making with dubious accountability and regulation has proven to be an alarming theme in the transformation of government processes, leading to questions over the extent to which governments should involve private sectors.

2.6 How to use DigiGov-F

DigiGov-F contains elements that can be operationalised and used for implementation of digital government initiatives,[40] as illustrated in Figure 14 below.

Figure 14. Using DigiGov-F for implementation of digital government initiatives.
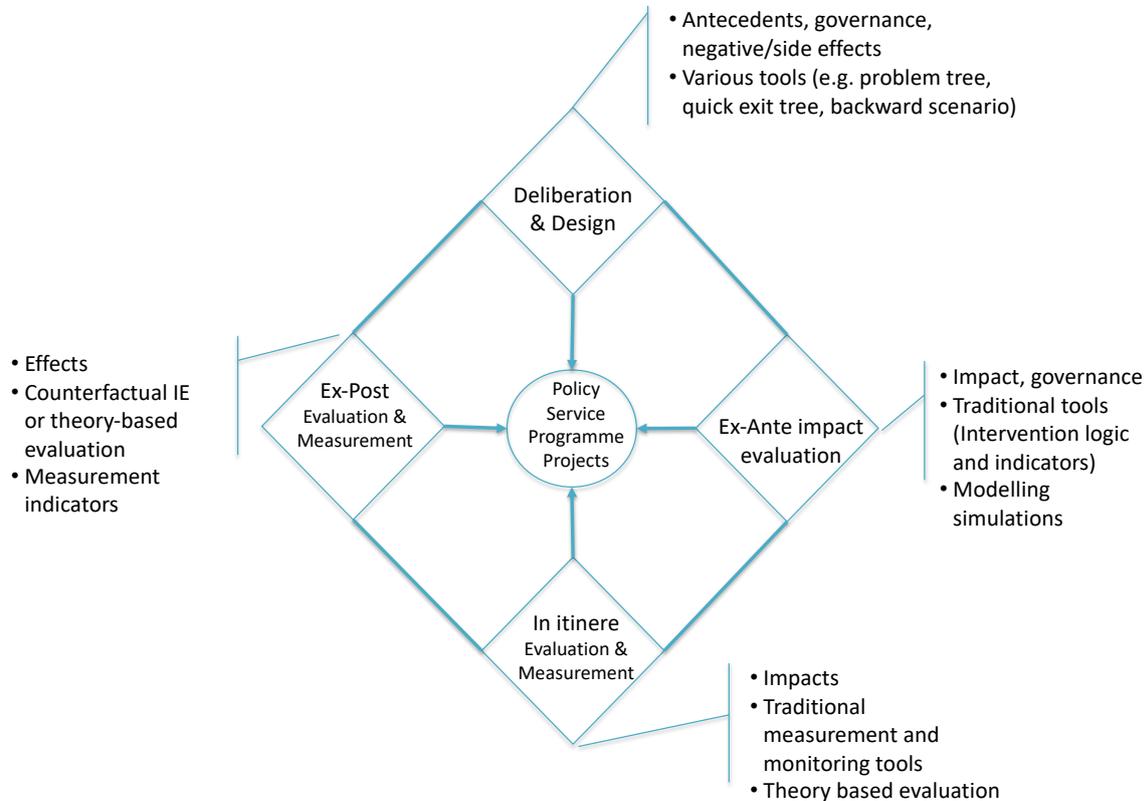
Source: elaborated by the authors.

DigiGov-F is not linear and does not adopt any particular perspective concerning the stages of digital government, the antecedents and any potential negative effects and side-effects. For this reason, it can be employed in the initial phase when first deciding between competing allocations (deliberation), and then designing the initiative. In the absence of any linear and deterministic hypothesis that explains moving from one stage to another, we cannot be sure that what was successful in one initiative, or prescribed normatively by various sources, will work in another context. During the *ex-ante* evaluation phase, the most innovative stakeholders may want to try a modelling simulation inspired by complexity theory and consider several of the components presented in DigiGov-F. Measurement indicators can be developed for *ex-ante*, *in itinere*, and *ex-post* evaluation and monitoring. Counterfactual or theory-based evaluation, as presented earlier, can also be adopted.

Our approach does not offer an alternative 'magic bullet' to the prescriptions of linear progression models, but rather a set of options inspired by methodological pluralism and by the recognition that, in the domain of Digital Government Transformation, we move within very complex ecosystems and are not under conditions of paradigmatic normality; it is not possible to provide unambiguous and prescriptive rules to predict the results of interventions.

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[40] This section has been inspired by previous work conducted by JRC in the area of measuring the impact of social Innovation as part of the ICT-Enabled Social Innovation (IESI) research project. See Misuraca et al, 2017.

2.6.1 Deliberation and design

When deciding whether or not to launch a digital government initiative, or choosing between different alternatives, it is not sufficient to look at good practice cases and champions. Just because a measure worked *there*, it does not necessarily follow that it will work *here*. One needs to consider the antecedents and determine if all the support factors are present. Below, we propose four tools with some exemplifications: problem tree; *ex-ante* failure scenario with simplified causal model; step-by-step and backward theory-based evaluation thinking; and quick exit tree

Problem tree. Figure 15 below shows an example of a problem tree and analysis of support factors for an intervention by the Municipality of Trelleborg that used robotic process automation (RPA) to improve welfare support services.

Figure 15. Problem tree: the Trelleborg case of using RPA for welfare support.
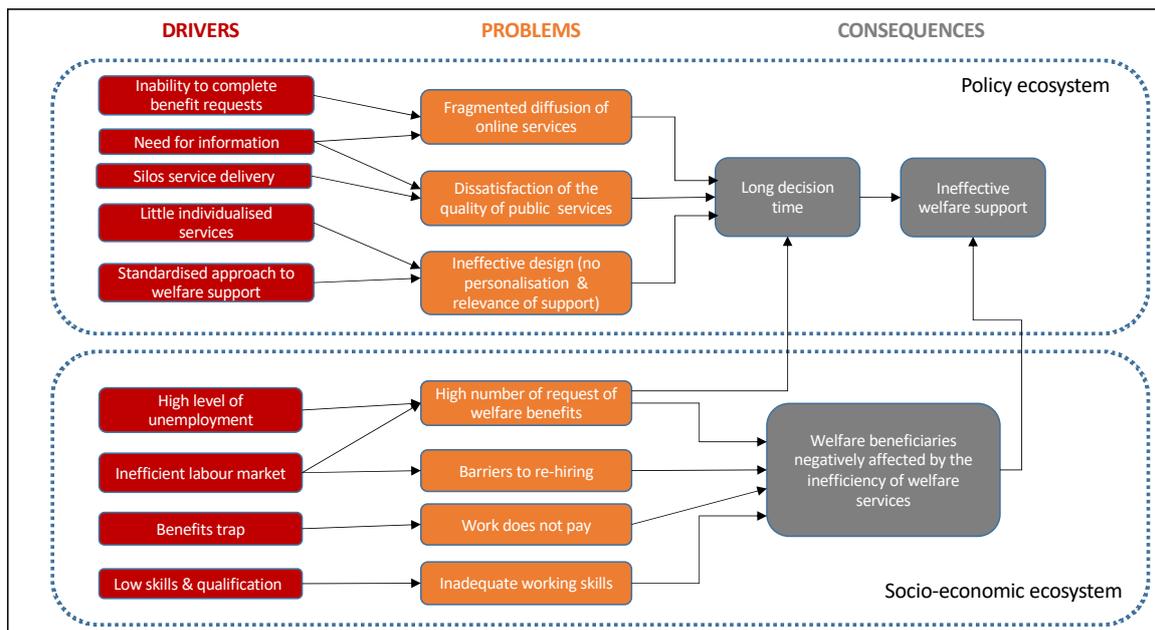
Source: elaborated by the authors.

From the problem tree above, we developed a configuration of the support factors that needed to be present in order to implement the Municipality of Trelleborg's initiative to introduce RPA into welfare support services, and for the initiative to stand a chance of producing the desired outcomes.

Figure 16. Support factors for the Trelleborg case of using RPA for welfare support.
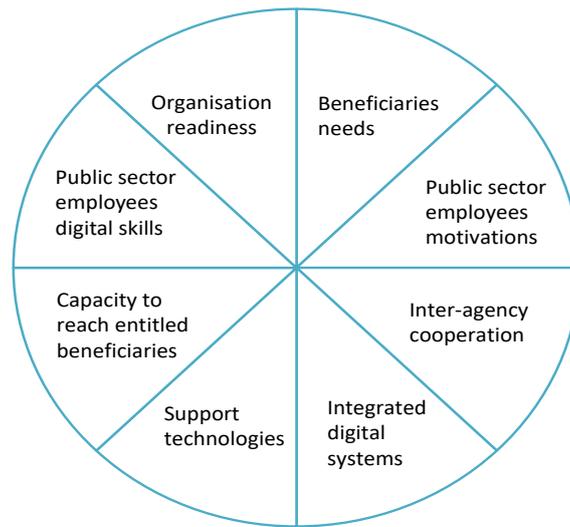
Source: elaborated by the authors.

***Ex-ante* failure scenario**. One alternative is to develop a simplified causal model of the intervention (such as the one depicted in Figure 17 below. Next, a group of policy makers, stakeholders and experts engage in the collective construction of an *ex-ante* failure scenario. They imagine that the intervention will fail, and from this reasoning they extract a list of factors that are necessary for the intervention to work. They must envisage that the intervention has been put in in place as planned, but that things have gone wrong – and must identify what could go wrong, and why, for the intervention to fail.

Figure 17. Simplified causal depiction for the Trelleborg RPA case.
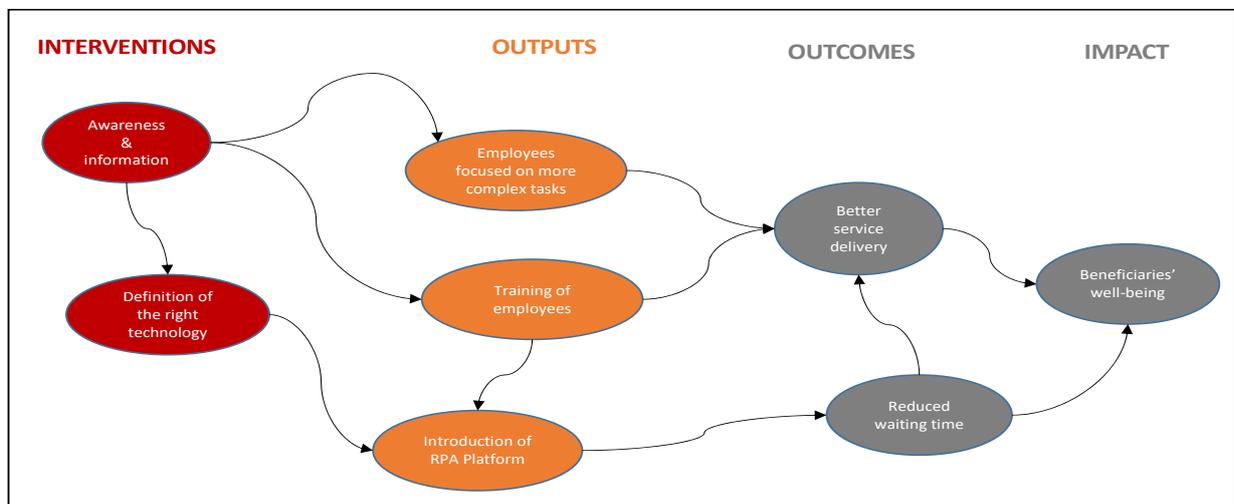
Source: Elaborated by the authors.

Step-by-step and backward theory-based evaluation thinking. This approach is also referred to as 'process tracing'. It aims to confirm the existence of a causal connection between start and finish, by checking a series of smaller causal steps in between, one by one, using the available evidence. Figure 18 below shows an example based on the data-driven water management project implemented in Denmark.

Figure 18. Backward thinking, based on the smart water network in Denmark.
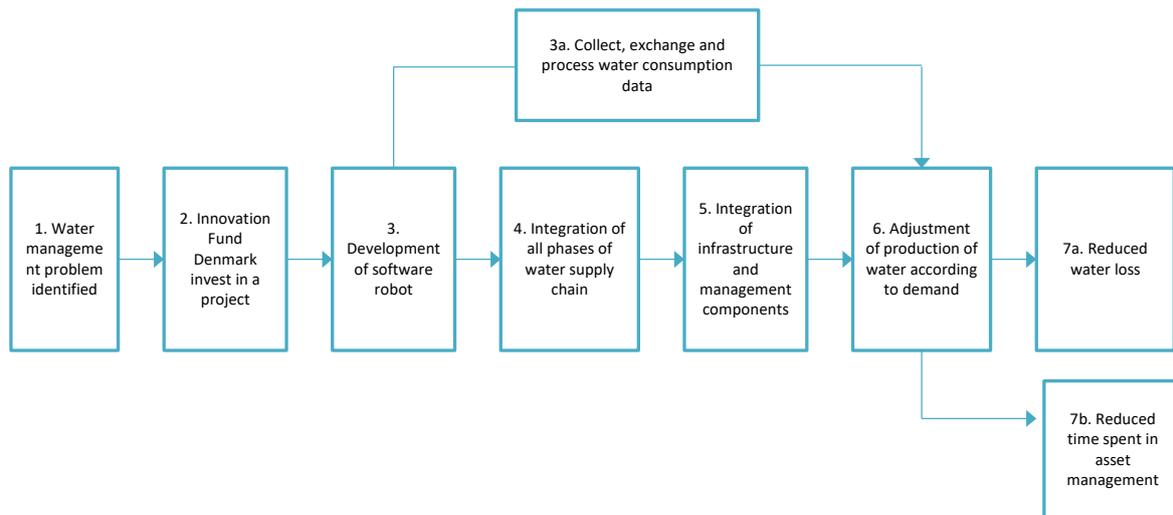
Quick exit tree. Decision trees are a familiar tool to help decision makers figure out what to do.

Figure 19. Quick exit tree for data-driven government initiative/strategy.
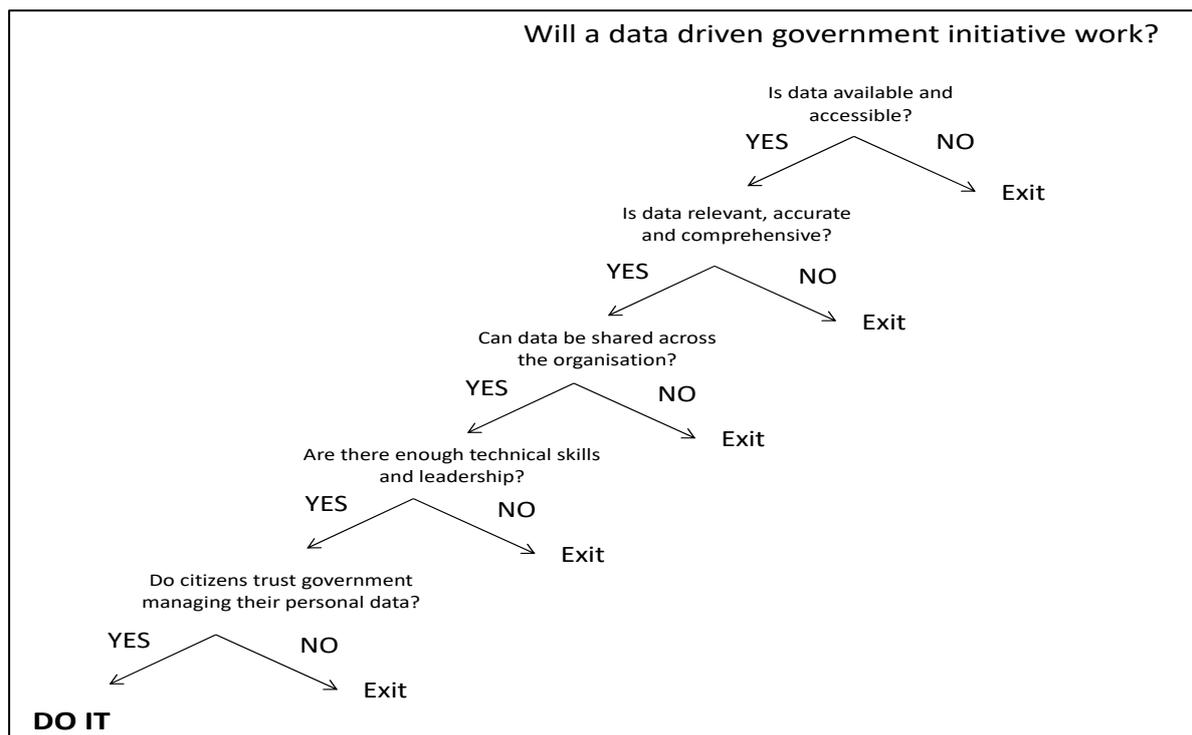
Within the more general category of decision trees, Quick Exit Trees (QETs) are simple tools used to eliminate options by answering binary Yes/No questions using evidence, logical reasoning, and judgement (usually involving stakeholders and experts in policy lab consultation). QETs provide clear-cut answers and may save efforts if 'No' comes up at the very beginning. In Figure 19 above we present an example of a QET for the Data-Centric Government Initiative and Strategy, which is based on the OECD working papers on the topic mentioned earlier (van Ooijen, Welby and Ubaldi, 2019). This instrument consists of a series of question on the presence or absence of conditions required for the intervention

to work. If the first answer is 'Yes', then one proceeds to the next; if the answer is 'No', one can stop and discard the intervention. The advantage of a QET is that it provides an unequivocal answer as to whether an intervention will work in a specific context. Achieving this, however, requires all of the possible conditions to be laid down in the tree, and for evidence and judgements to be gathered in order to answer all of the questions. In addition, the dichotomous nature of the answers provided by a QET does not allow for more nuanced answers or scores. It also requires that evidence is very robust in order to back a 'Yes' or 'No' answer.

2.6.2 Evaluation and measurement

Figure 20 below represents an *ex-ante* Intervention Logic for a data analytics intervention introduced in France to fight fraudulent activities.

Figure 20. Intervention logic: using data analytics to fight fraud in France.
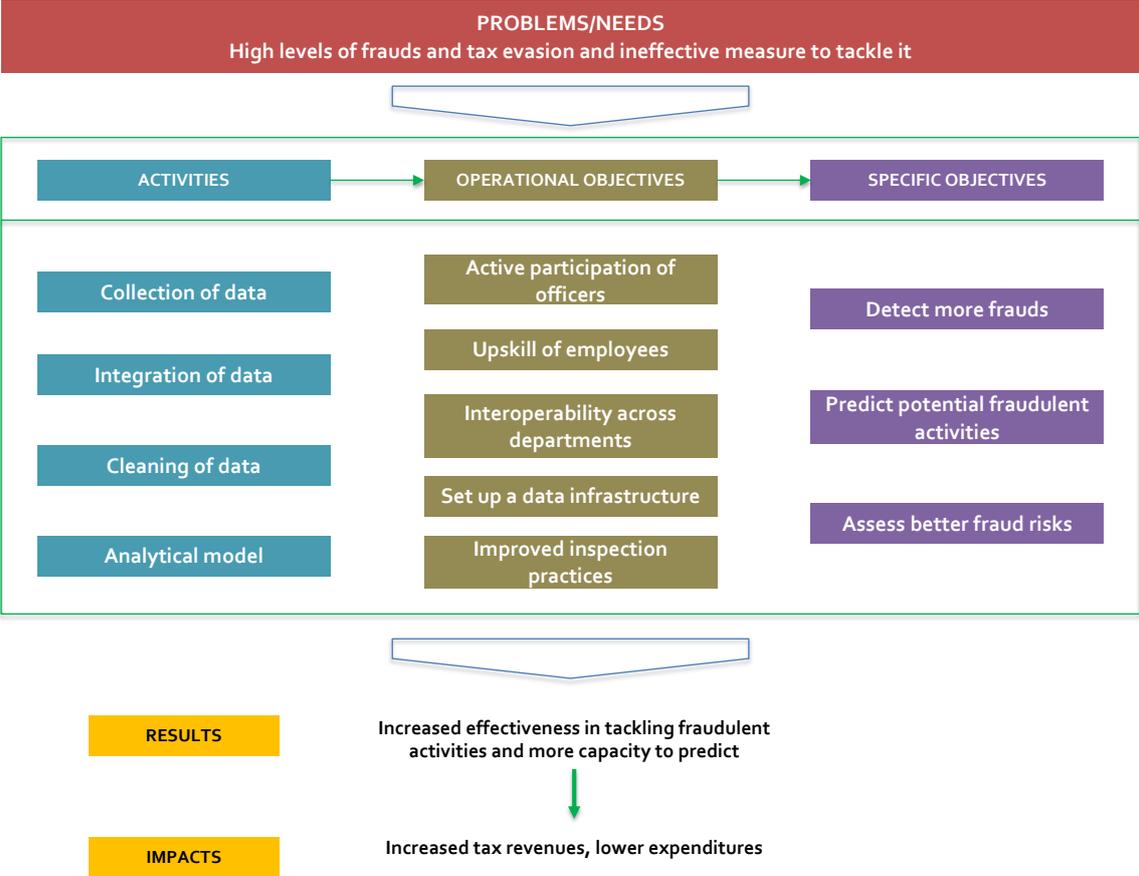
Source: elaborated by the author, based on OECD Working Paper on Public Governance No. 33 (p.24)

From a logic sketch of this kind, one can derive measurement indicators that can be used in more pragmatic *in itinere* or *ex-post* evaluation. Some of these could then be considered as outcome variables in a counterfactual evaluation. Figure 21 below provides a generic example of a set of indicators for the intervention described above.

Figure 21. Micro-level measurement tool for data-analytics to fight fraud in France.
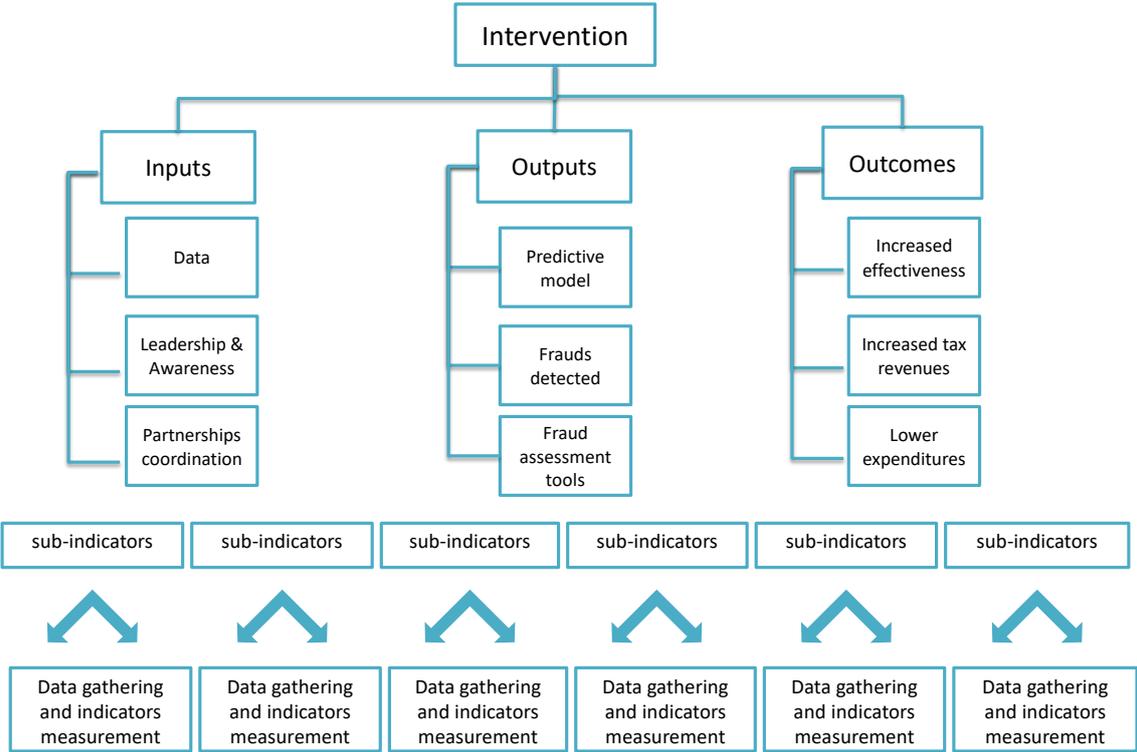
Source: elaborated by the authors, based on OECD Working Paper on Public Governance No. 33 (p.24)

In this domain, a tool developed in an earlier project by the JRC could be adapted and re-used to evaluate digital government initiatives, especially those addressing inclusion issues. The JRC has produced a tool which is available online, MIREIA eInclusion Intermediaries Impact Assessment Framework (MIREIA eI2-IAF, see Box 6 below), that practitioners can adapt for their specific purposes.

Box 6. MIREIA eInclusion intermediaries impact assessment framework.

The MIREIA eInclusion Intermediaries Impact Assessment Framework (mireia ei2- iaf) aims to measure the outputs, outcomes and impacts of eInclusion intermediaries.

It includes a theoretical model, as well as operational guidelines for the evaluation of practices. It allows the systematic collection of end users' micro-data through grassroots organisations, so that it can be aggregated at various levels, in order to facilitate the measurement of outcomes and the estimation of the impact on employment, education and social inclusion (Misuraca et al., 2014).

The framework was developed under the Mireia project, conducted by JRC-IPTS and DG CNECT, which aimed to create appropriate instruments to show how eInclusion intermediaries contribute to the achievement of EU policy goals.

As shown in Figure 22 below, the operational framework of MIREIA eI2-IAF and its related Toolkit consists of the following elements:

1. The **Impact Measurement Tool**, which comprises the following sub-components:

   - The **Context Analysis Checklist** helps intermediaries to better understand the context in which they are operating, and helps them to define (*ex-ante*) baselines, target group characteristics, and the size of the

interventions to be implemented, and to update such information on a regular basis to support *in-itinere* and *ex-post* evaluations.

- The **System of measurement indicators** assists intermediaries in monitoring and measuring their interventions (*in-itinere* and *ex-post*, but also in estimating *ex-ante* potential impacts) in relation to the resources allocated (inputs), the related services delivered to a target population (outputs), the direct and indirect outcomes generated, and the estimated contribution to specific and global impacts.

- The **Evaluation criteria** enable the assessment of the outcomes and impacts generated by each intervention (i.e. micro-level), and the aggregated specific impact of interventions carried out by an intermediary organisation (i.e. at meso-level). They also help to estimate the contribution of eInclusion intermediary interventions towards achieving global impacts in their respective contexts (i.e. macro-level) efficiently, effectively and sustainably.

2. **Methodological guidelines for impact evaluation** provide intermediaries with a scientific approach, based on counterfactual techniques, for evaluating cause-effect relationships between their interventions and the impacts they have generated. Although based on a micro-level approach, these guidelines serve to justify intermediaries' and policy makers' strategic choices and the planning and evaluation (ex-*ante*; *in-itinere* and *ex-post*) of their interventions (i.e. at meso and macro level).

Figure 22. MIREIA eI2 IAF: operational framework and related toolkit.
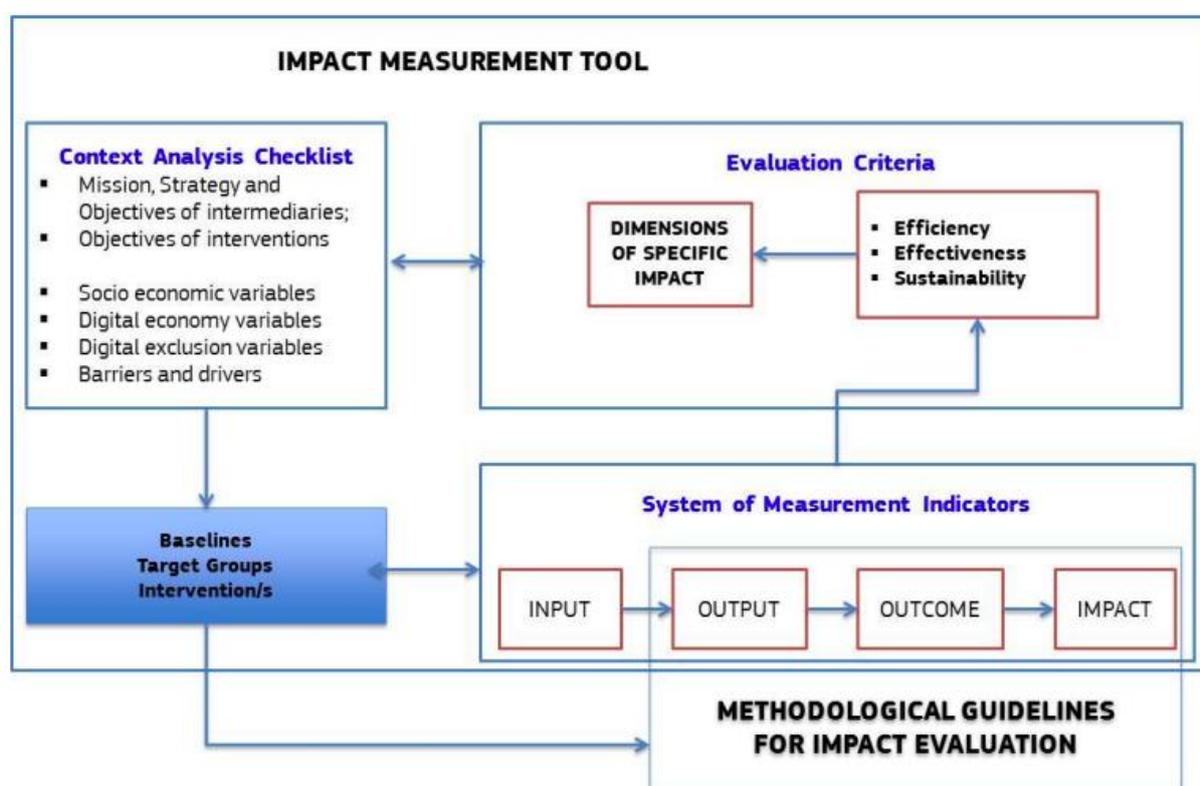
Source: European Commission (2014).

61

2.6.3 Mapping complexity through modelling simulation

The issue of complexity has surfaced several times earlier in this report, particularly in Section 2.4, which deals with effects. In what follows, we briefly discuss complexity in order to preliminarily scope possible future explorations. This discussion will be refined and systematised in the final report of this study, when we will present recommendations on future applied policy research that may advance our understanding of Digital Government Transformation and our capacity to explain why and how it succeeds or fails.

As stressed by Misuraca and Codagnone (2018) and by Misuraca, Geppert, and Codagnone (2017), which used the findings of a study that adopted the complexity approach to analyse and model social innovation, only recently has policy research and policy making begun to consider complexity and complexity theory. Often, policies do not deliver their full potential simply because they fail to fully consider all of the complexity angles involved. First, the various economic, social, and technological challenges addressed by the policies are themselves part of multiple complex and co-evolving ecosystems that involve many interacting interests and players. Second, and most importantly, policy makers and policy researchers are not always equipped with the right conceptual and analytical tools both *ex-ante* (when they design the interventions) and *ex-post* (when they evaluate them). The complexity of reality is not given full consideration, leading to misguided *ex-ante* assessments and designs as well as *ex-post* evaluations and policy recommendations. This is despite ample evidence that policy interventions often concern so-called 'wicked problems': issues that are characterised by multiple causes and which involve multiple actors and responsibility at many institutional levels.

Within multi-level governance architectures in which cooperation must be maintained among the networks of actors, under conditions of uncertainty regarding problem-solving and policy outcomes, complexity is very high. Complex systems are usually defined as consisting of a large number of elementary units that interact with each other, typically in a non-linear fashion. These interactions give rise to collective behaviour that cannot be simply inferred from the behaviour of the individual units. These are the so-called *emergent phenomena*. In other words, some collective behaviour cannot be predicted by looking at the individual elements that make up the system. Emergent properties/effects are characteristic of what are also termed Complex Adaptive Systems (CAS). From an epistemological point of view, the concept of emergent properties/effects represents an anti-reductionist view of reality. A set of entities at a certain level owes its existence to lower-level entities, but also presents a set of states/properties/regularity of its own, which may be studied independently.

The relationship between the micro and macro level upon which the concept of emerging effects hinges is captured more analytically by the notion of 'supervenience'. First, a higher-level structure depends ontologically on the lower-level one – that is, the former could not exist without the latter. Second, distinctions and variations within these higher-level phenomena/structures – different performances, different fitness, different function – are necessarily based on differences at the lower level, but the reverse is not true: different individual configurations can give rise to the same phenomenon at macro level.

Based on the considerations above, it follows that complex systems can be represented naturally, in mathematical terms, as networks. This network approach can be applied fruitfully in a variety of cases. In recent years, the consideration of complex networks has yielded important insights into the understanding of technological systems, financial and social networks, among others. In the study of complex, emergent, and self-organised systems, networks are becoming increasingly important as a universal mathematical framework, especially when massive amounts of data are involved. Networks are becoming the paradigm for uncovering the hidden architecture of complexity. The main benefit of studying complexity by means of the mathematical instrument of networks is the ability to measure – and therefore describe scientifically, in the sense of the 'hard' sciences – a variety of situations that were previously impossible to describe. Networks allow us to do this without imposing any *ad hoc* hypothesis. For example, concepts such as communities of people or their preferences can now be structured in the form of bipartite networks,

thereby providing a clear 'spectroscopy' of societal structure. This also applies to communities of companies and/or products. Networks not only describe the mechanisms of interaction between, for example, computers, people, ecological species, but they are also a powerful tool for information filtering.

Thanks to the theoretical advancements in the recent years, the capacity to analyse and forecast on the basis of incomplete data has been increased (Squartini et al., 2018) through the use entropy-based techniques (Cimini et al., 2019). Such techniques make it possible to model various phenomena, with a margin of error and uncertainty, depending on the size of the sample analysed. Furthermore, network methods can be combined with Agent-Based Models (ABM) to provide the most advanced form of Network Agent-Based Models (NABM). ABM are models with no representative agents, but which allow a large number of different agents with their own characteristic behaviours to be included into a model and allowed to interact via networks to produce emergent behaviours. NABM can simulate *ex-ante* the potential results of any policy intervention, and then validate the results *ex-post* using actual data. In the context of Big Data and data analytics, the potential to apply these methods at various phases of policy making is vast.

For all of the above reasons, and due to the possibility of emergent effects, the complexity approach is increasingly used in economics. The interaction between economics, society and policy interventions presents a level of complexity that should be modelled as the product of interactions between heterogeneous agents undertaking heterogeneous activities. Hence, the macro socio-economic system should be conceived as a Complex Adaptive System (CAS), in which myriads of agents with different interests and behavioural characteristics interact within inter-related domains (Arthur, 2013; Kirman, 2010). CAS are highly non-linear (often due to interactions) and are organised on many spatial and temporal scales. This inherent non-linearity leads to endogenous fluctuations and sudden regime changes from one type of regime to another. The properties of the system are modifiable as a result of interactions. The notion of CAS is particularly useful when one conceives of innovation in evolutionary terms (Dosi, 1988, 2013; Nelson and Winter, 1982). Recently, the evolutionary theory of innovation has been embedded into Agent-Based Models with truly remarkable results (Dosi et al., 2013; Dosi et al., 2015; Dosi et al., 2010), extending our understanding of the role of both innovation processes and technology policies on socio-economic dynamics (Dawid, 2006; Dawid et al., 2012; Dawid and Harting, 2012; Dawid et al., 2013; Dawid and Hellmann, 2014). This line of research converges naturally with the line of research that exploits ABMs to reveal the pro-cyclicality of the financial system in a Minskyan setting (Assenza and Delli Gatti, 2013; Assenza et al., 2015; Delli Gatti et al., 2011; Delli Gatti et al., 2008). Inspired by this, the JRC project i-Frame developed an application using an ABM to simulate the impact of some forms of ICT-enabled social innovation (see Misuraca and Codagnone, 2018).

Because ICT-enabled social innovation overlaps in several ways with the provision of public services and the design of public policies in the domain of Government Digital Transformation, it would appear to be a natural continuation of the present study to apply modelling inspired by the epistemology and theory of complexity. All of this chapter, and particularly Section 2.1, illustrates the many factors that shape public sector innovation and the complexities it entails. When these elements are integrated into the proposed framework, a level of potential complexity emerges so starkly that it is self-evident and requires no further illustration. Understanding and explaining why and how some effects materialise, while others do not, requires the approach of complexity in relation to evaluation. The possible applications of complexity within the present domain of interest are therefore relevant and manifold. Complexity-inspired models can be used to deal with users' adoption, or to understand the interactions between antecedents and effects, or to produce real-time, evaluative simulations that exploit the capabilities of Big Data analytics. Having briefly and preliminarily listed possible applications, below we discuss the various modelling approaches that could be used in future studies.

A model is a simplified representation of reality that can be adopted when reality itself is too complex to be analysed in granular detail.

Figure 23. Computer-based modelling simulations.
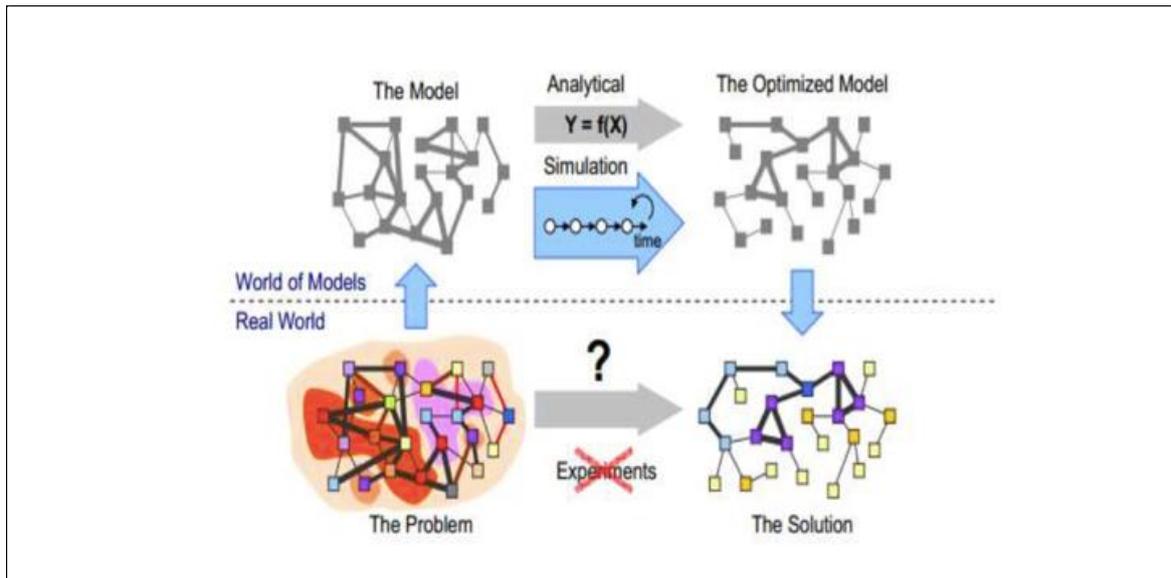
Source: elaborated by the authors.

As illustrated in Figure 23 above, when reality is too complex to study directly in view of various constraints (time, information, money, etc.), the experimental method may not be feasible. If some data are available and the problem at hand is not to complex, one may try to solve a model analytically, using data to estimate parameters; this is what traditional econometric models (as opposed to modelling tools) do. When reality is too complex to apply this approach, researchers resort to computer-based modelling simulations. In doing so, not all variables are of equal importance to the researcher, whose choices reflect *implicit* assumptions, rules and strategies used to solve problems that are *explicit* in the model. Based on this premise, in the following paragraph we present a synthetic comparison of different modelling approaches. The table below provides a synthetic comparison of different modelling tools.

Traditional economic modelling tools rest on an unrealistic characterisation of representative agents and the unrealistic assumption of general equilibrium. They do not take into account the heterogeneity of both agents and activities. System dynamics (SD) is based on a top-down and aggregated view that offers strong explanatory power, but nevertheless reflects the mental models of the modellers or the group model-building exercises. It is mostly applied in managerial studies and, more recently, also in policy studies. SD is a perspective and set of conceptual tools that enable the understanding of the structure and dynamics of complex systems. SD is often used to build management 'flight simulators': micro-worlds in which space and time can be compressed and slowed down in order to experience the long-term side-effects of decisions, as well as enabling speed learning, developing our understanding of complex systems, and facilitating the design of structures and strategies for greater success. State variables (stock and flows) are linked by algebraic differential equations. They are system-centred, and do not account for heterogeneity of agents and activities.

Table 6. Comparison of models.

Ontology	Representative agents	Process oriented top down	Constructivist top down	Bottom up Heterogeneous agents with empirically grounded Behavioural rules
Epistemology	Stochastic causation	Passive entities	mathematical and computer tools express expert knowledge and explicit the structures implicit in the social system modelled	Emergent properties resulting from micro-meso links but not in isolation
Methodology	Equilibrium Prices Vector	Chronological sequence of events	SD logical truths and generic structures identify constants in our social practices Can work with disequilibrium	Empirical validation (ex ante and ex post and using also experimental findings) Can work with disequilibrium
Heterogeneous agents and activities	No	No	No	Yes

Source: elaborated by the authors.

Discrete-event simulations use the concept of entities, resources and block charts to describe entity flow and resource sharing, with passive entities. Their focus is on 'processes' rather than 'agents'. In discrete-event simulation, the operation of a system is represented as a chronological sequence of events. Each event occurs at a point in time, and marks a change of state in the system.

Agent-Based Models (ABMs) is a bottom up approach populated by agents that are autonomous, pro-active, reactive, spatial aware, able to learn and possess social abilities. These agents 'live' in an environment and are driven by behaviour rules defined by 'state charts'. ABM is essentially a decentralised, individual-centric (as opposed to system-level) approach to model design. ABMs have been used in social simulations (Balke and Gilbert, 2014) to explicitly describe human decision-making. They range on a continuum from fairly simple interactions among agents to deliberative/cognitive representations. When designing an ABM, the modeller identifies the active entities and agents (these can be people, companies, projects, assets, vehicles, cities, animals, ships, products, etc.); defines their behaviour (main drivers, reactions, memory, states, etc.); places them in a certain environment; establishes connections; and runs the simulation. The global behaviour then emerges as a result of interactions between many individual behaviours. ABMs combine elements of game theory, complex systems, emergence, computational sociology, multi-agent systems and evolutionary programming.

Figure 24 below compares the three families of modelling simulation discussed above (traditional economic modelling tools are excluded from this comparison).

Figure 24. SD, discrete events and ABM.

	Continuous / aggregated	Discrete/ disaggregated
System-centric	System Dynamics	Discrete event (process centred)
Individual-centric		Agent based model
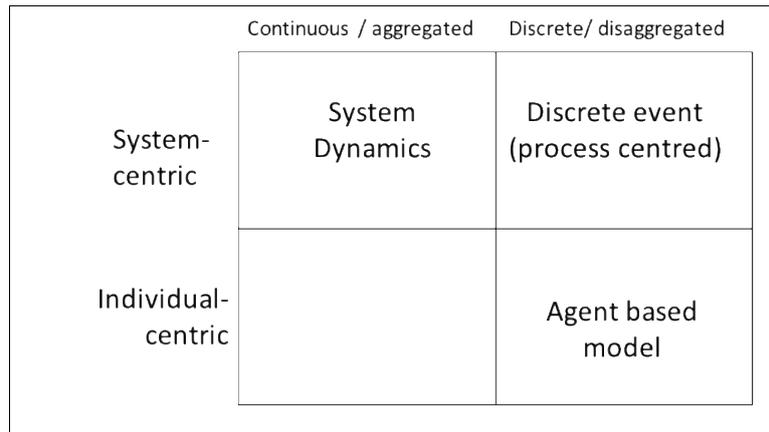
Source: adapted from Martin and Schlüter (2015).

The Table 7 below zooms in more specifically on the comparison between SD and ABM. In our view, such a comparison clearly reveals the superiority of ABM in dealing with Complex Adaptive Systems characterised by emerging effects and properties.

Table 7. SD and ABM compared.

	SD	**ABM**
Perspective	Top-down	Bottom-up
Main building block	Causal loop	Agent entities
Unit of analysis	System structure	Rule of agent behaviour
Level of modelling	Aggregate system behaviour	Individual agent behaviour
System structure	Pre-determined	Evolvable
Time handling	Continuous	Continuous or discrete

Source: adapted from (Martin & Schlüter, 2015).

ABMs are clearly preferable when dealing with situations characterised by the following: (a) identifiable and decentralised agents; (b) when the agents are varied or the environment is heterogeneous; (c) when the interaction between agents is local; (d) when agents are adaptive (and adapt their adaptation rules); (e) when individual behaviours (and destiny) matters; and (f) when agents have a spatial presence.

Currently, there is much talk of the hybridisation of SD and ABM – although this something that is easier said than done. In the literature, the two models are presented as iconic model paradigms in the sense that they are considered as exclusive alternatives for the analysis of complex systems from either a top-down/aggregated or bottom-up/disaggregated perspective (Swinerd and McNaught, 2012; Vincenot et al., 2011). To the best of our knowledge, such hybridisation has been used sequentially only when interfacing a social ecosystem (rendered using ABM) with a natural one modelled using SD (e.g. the condition of a lake) (Martin and Schlüter, 2015). If one starts from ABM model, then the inclusion of an SD module is equivalent to 'back-boxing' part of the system. Conversely, adding an ABM module to SD tools means opening a window into more realistic treatments of agent behaviour. Table 8 below compares the three possibilities: ABM, SD, and hybrid.

Table 8. Comparison of SD, ABM and a hybrid of the two.

	ABM	SD	Hybrid
Characteristic question	How do emergent system-level patterns develop from micro-level interaction (e.g. spatially, between individuals)?	How do stocks change or stabilise (given that rates are constant)?	how do changing process rates (impacted by decisions) affect dynamics?
Purposes	To identify mechanisms (specific interactions) that are responsible for emerging system-level patterns (disaggregated).	Which process/feedback is dominant?	How do changing stocks affect agent states/the distribution of traits?
Focus	Generating hypotheses, exploring micro-level behaviour (Epstein, 2008)	Investigating system-level dynamics (aggregated), stability properties of the system, loop dominance, explaining temporal dynamics, projection into the future	Investigating different micro- or system-level mechanisms that drive certain dynamics; generating hypotheses concerning system state-change (when does dominance of feedbacks change?) or structural development over time (when does an average trait of agents change?)
Tests for model calibration	Micro-level interactions between entities, network structure (heterogeneous characteristics of individuals/actors, temporal discrete behaviour), transient dynamics	Processes driving accumulation in stocks at (sub-)system level, stable-states, feedbacks (balancing, amplifying), non-linearities	Processes of restructuring in a system that can focus either on a structure affecting the processes, or processes affecting the structure
Suitable and traditional analysis tools, typical experiments	Statistical pattern-matching – can the model grow patterns that are found in reality?	Stability analysis – under which parameters can fixed points/equilibria occur? How stable are they?	Separate sub-system tests (paradigm-specific) and qualitative check for the coupled version
Type of outcome	Only through simulations, often with multiple repetitions because of stochastic elements: plotting group/system-level characteristics over time (average), evaluating a limited parameter range	Simple models via analytical tools (basins of attraction, bifurcation analysis, overall stability), and more complex via simulations	Via simulations, with a focus on either

Source: Adapted from (Martin & Schlüter, 2015).

3 Case studies/experiments

3.1 Highlights from case studies

This second part of the report presents the four case studies, together with a proposal for a revision of DigiGov-F (conceptual framework), in light of some key findings emerging from the cases.

We identified and conducted four case studies containing an experimental or quasi-experimental dimension, in order to illustrate the possible impacts of Digital Government Transformation. Each of the case studies covers different context (city management, education, privacy, policing), and their results have implications for most phases of the policy cycle. In analysing the cases and the findings of their experimental or quasi-experimental components, we pursue the twofold objective of validating and refining the conceptual framework, while at the same time exploring the real-life drivers and barriers in each case, as well as the outcomes actually produced, or that could potentially be achieved in the future.

The four cases are to be considered as explorations that zoom in closely on the 'nuts and bolts' of the practice of Digital Government Transformation – although one can hardly generalise from just these four cases. Nonetheless, taken singularly and in a cross-case comparison, the four cases provide interesting insights and lend themselves to the formulation of hypotheses for new research, or appear to confirm theories and hypotheses presented in the literature analysing the previous waves of eGovernment activities.

Seven main lessons can be extracted from the cases. These are used to various extents in the proposal for a revision of the conceptual framework presented in detail in Chapter 4 and only briefly outlined here.

(1) The limits of automation and of immediate productivity gains

Although they emerge from different domains, the Tvarkau Vilnių (Lithuania) case and the case of body-worn cameras (BWCs) in the UK both converge the observation that there are limits to automation using AI; that the achievement of results still requires human interaction; and that, as has been known for decades, productivity achieved through the use of ICT occur with a lag time – and only when combined with a change in organisation and culture (referred to in our framework as 'reframing'). Furthermore, both cases underscore the fact that outcomes are at times difficult to isolate at sectoral level, and should be considered at systemic level.

(2) The importance of investments and of a dynamic perspective in the framework

The cases show that in the short to mid term, duplication of efforts and stratification of delivery channels may actually increase, rather than decrease, the efforts and the costs of public administrations. When services are up and running, new needs emerge that require new investments and thus, a new iteration is needed to improve the service. The key implication for our framework is that greater emphasis needs to be placed on efforts and investments, and that a feedback loop should be built in to take into account of the dynamic and iterative process of Digital Government Transformation.

(3) The corroboration of the reframing perspective adopted in our framework

The cases corroborate the importance of reframing as defined in our framework, both as part of implementation and as one dimension of our taxonomy. The movement from eGovernment to Digital Government is a steady process that involves a number of practical issues pertaining to the implementation process and to the corresponding antecedents highlighted in our framework.

(4) The strategic importance and twofold nature of legitimacy and trust

Despite the potentially positive effects stemming from the use of technologies to deliver public services and improve operations, some important challenges must be addresses in

relation to trust and legitimacy. It can be concluded that legitimacy and trust are, at once, both an important process-level prerequisite and an end outcome.

(5)Greater focus is needed on user adoption and potential new forms of digital divide

From different angles, both the Tvarkau Vilnių (Lithuania) case and the online experiment point out the issue of user adoption as a specific focus for attention that will not come about automatically merely by adopting the best AI applications. In fact, these new technologies may actually generate new forms of digital divide, as evidenced in the online experiment. On the one hand, this underscores once more the importance, implicit in our network, of reframing the conceptual and cognitive routines to better focus on adoption. On the other hand, it suggests that the issue of adoption and of potential new forms of digital divide, should be given greater salience in a revised version of the framework.

(6) Realism about engagement, open governance and co-production

Tvarkau Vilnių (Lithuania) suggests that the claims heralded by supporters of open governance, co-production and civic engagement should be approached with caution. While an active portion of citizens will benefit from new technological possibilities, civic disengagement and lower political participation are secular trends in advanced democracies that cannot be reversed simply by deploying new and more potent technological means.

(7)The importance of non-monetary effects

Both the BWC case (UK) and the 'Kids Go Green' (Italy) case confirm the importance of outcomes beyond productivity and efficiency gains. Specifically, they point to the importance of effectiveness and legitimacy. Effectiveness gains appear more prominently in the BWC case, and appear to contribute to the important outcome of increasing legitimacy through better policing behaviour and better accountability. The Kids Go Green case shows that the project (a) fosters inclusion by improving learning processes and creating a community network (inclusion); (b) modifies the teaching approach by offering new and innovative methods (teaching approach); and (c) improves the digital skills of both children and teachers.

3.2 Case Study 1: Tvarkau Vilnių (Lithuania)

3.2.1 Introduction

3.2.1.1 Description of the context

Over the last decade, mobile applications to report non-emergency issues to local governments have grown in popularity around the world[41]. For example, FixMyStreet[42], developed by mySociety in 2007, has now expanded from the UK to Ireland, France, Switzerland, Slovenia, Belgium, New Zealand, Australia, Japan and other countries. Some alternatives include SeeClickFix[43] and PublicStuff[44] in the US, Verbeterdebuurt[45] in the Netherlands, FixMyCity[46] in Greece, and Tvarkau Vilnių[47] (English: "I fix Vilnius") in Lithuania.

These applications usually allow the public to report non-emergency issues in the city to the authorities responsible by uploading a picture of a problem and selecting the precise location where it has occurred on a map. The issues reported can include misplaced rubbish, potholes, issues with public transport routes or delays, parking violations, etc. Various departments within the local government then investigate the problems and, where

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[42] https://www.fixmystreet.com/
[43] https://seeclickfix.com/
[44] http://www.publicstuff.com/residents
[45] https://www.verbeterdebuurt.nl/
[46] http://glyfada.intelligentcity.gr/
[47] https://tvarkaumiesta.lt/

necessary, address them. The person who reported the issue is given a update on the actions taken by the public actor.

Such applications have been lauded for offering various democratic advantages. Some scholars argue that they make the government more accountable by giving citizens a tool to exert pressure on authorities to address public issues[48]. Local councils provide public responses to users' reports, enhancing the transparency of and trust in decision-making and resource-allocation processes[49]. These responses, combined with the reports submitted by other city residents, inform the public about their city[50] and can foster greater citizen engagement[51]. These applications allow city councils to involve the public in municipal administration, thereby enabling co-production[52]. Through co-production, municipalities gather more information than they could using only internal resources, increasing the efficiency of their work[53]. Using the information gathered about problems in the city, local governments can also design better policies and public services in line with the reported needs of citizens[54].

However, some scholars have criticised such applications. Most notably, Baykurt (2011)[55] argues that they encourage passive and individualistic rather than collective action by citizens. In such individualistic action, the government plays the role of a service provider and the citizen, a client. Even though citizens are actively involved in helping to create a cleaner and better city, the problems reported are trivial as applications provide no opportunity to request more necessary long-term services. Participation beyond the submission of a complaint is discouraged, because users are not informed what to do if their report is ignored or not addressed in a satisfactory way. This limits accountability, too: although the public can hold governments accountable with regard to whether or not the issue is fixed, they have no say in *how* it is fixed. Furthermore, these applications raise questions about social exclusion, because a level of digital literacy, as well as access to the internet and possession of a computer or smartphone are required in order to submit reports. Several empirical studies have indeed found lower take-up among low-income and ethnically diverse communities[56], as well as bias towards citizens with better education[57]. Scholars have even called into question the efficiency of these reporting methods, arguing that many of the reports submitted are either outdated or duplicated[58].

In the literature, both praise and criticism of these technologies often remain at the theoretical level, possibly because outcomes such as accountability, trust, transparency and citizen engagement are difficult to measure. Nevertheless, a few notable exceptions exist. After qualitatively analysing reports submitted to Urbanias – a site similar to FixMyStreet that operates in Brazil – Santos et al. (2012, p. 21, 24)[59] concluded that the site "is not used for discussions about the city's problems or broader issues of citizenship or even any form of mobilization or engagement… [the] website is excellent for generating reports/complaints, but… the website is basically effective for this purpose only". By contrast, based on a survey of users of FixMyStreet and similar applications, Rumbul (2016)[60] argues that these technologies help citizens feel that the government is responsive to their demands, and that they can hold it accountable.

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[48] Meijer et al. 2009 and Rumbul R. (2016) ICT and Citizen Efficacy: The Role of Civic Technology in Facilitating Government Accountability and Citizen Confidence. In: Mata, F. & Pont, A. (eds) ICT for Promoting Human Development and Protecting the Environment. WITFOR 2016. IFIP Advances in Information and Communication Technology, vol 481. Springer, Cham.
[49] Baykurt, 2011; Chun et al., 2010; Nam, 2012
[50] Meijer et al., 2009
[51] Dörk & Monteyne, 2011
[52] Linders, 2012
[53] Baykurt, 2011; Trimi and Sheng, 2008
[54] Chun et al., 2010; Nam, 2012
[55] https://firstmonday.org/ojs/index.php/spir/article/view/8811/7019
[56] Pak et al., 2017
[57] Helsper, 2008; Escher, 2011
[58] King and Brown, 2007
[59]https://www.academia.edu/16902775/_2012_Fix_my_city_an_eparticipation_analysis_of_the_Brazilian_Urbanias_initiative
[60] https://link.springer.com/chapter/10.1007/978-3-319-44447-5_20

Therefore, even if political participation using these apps or sites is of a limited nature, they can have spill-over effects that encourage citizen engagement in other ways. To explore these ways, Cantijoch et al. (2016)[61] ran a regression analysis of mySociety survey respondents and found that particularised or parochial interaction via online sites such as FixMyStreet is associated with "community efficacy", or a feeling that residents can impact their communities. However, this effect is significant only for multiple-time users, who already tend to be more politically active.

Given that the effects of these applications remain relatively little explored empirically, and the studies that do exist arrive at different conclusions, below we present an in-depth case study of Tvarkau Vilnių – an app used to report problems to the city council in Vilnius, Lithuania. In particular, we explore to what extent the use of Tvarkau Vilnių fosters greater citizen engagement and trust in municipal government. Over the next two sections, we provide further context about the platform, including how it came about and what technology supports it.

In Section 3.2.2, we explain the methodology used in our case study – including a randomised control trial, surveys, and interviews – to explore the effects of using Tvarkau Vilnių both for the municipality and for the public. We then present the results and discuss them according to different outcome dimensions highlighted in the conceptual framework, including productivity and efficiency; effectiveness, inclusion and sustainability; and legitimacy. We conclude by assessing the extent to which the conceptual framework helps us to understand this innovation, summarising the drivers and barriers relating to the successful implementation of Tvarkau Vilnių, and providing policy and research recommendations.

3.2.1.2 Tvarkau Vilnių

The Tvarkau Vilnių platform was originally launched in 2012 in order to streamline the process of gathering information from the public regarding issues in the city. Prior to 2012, Vilnius residents could call or e-mail the municipality regarding problems they observed, but the flow of information was irregular, and the municipality had to dedicate a lot of resources to respond to each inquiry and find the department responsible for addressing the issue concerned. Given that such a reporting method also required substantial effort from Vilnius residents, many issues remained unreported and unresolved. The city council, too, lacked the resources to identify all potential problems in the city in order to plan what needed to be fixed.

As a solution, the municipality first developed an interactive register of the city's problems[62]. To use this website, Vilnius residents had to register and sign in, select the type of the issue they wished to report, enter the address where it occurred, provide a description and (optionally) upload a picture. Each problem was given a unique ID and forwarded to a relevant council worker. Those who submitted reports could track their progress in real time and see the response from the municipality. Finally, users could also view reports submitted by others on a digital map of Vilnius.

Roughly 2,000 reports were submitted via the portal each year in 2013 and 2014, by a little under 1,000 unique users[63] (see Figure 26 below). Even though the public embraced the portal, there was room for improvement: the website was not designed to be used on mobile devices, meaning that those who reported issues could not do so immediately when they noticed a problem. Following requests for a more user-friendly tool, the municipality developed a mobile iOS application in 2015[64].

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[61] Cantijoch, M., Galandini, S. & Gibson, R. (2016). "It's not about me, it's about my community": A mixed-method study of civic websites and community efficacy. New Media & Society, 18(9), 1896–1915.

[62] www.vilnius.lt/problemos. For more information, see https://www.youtube.com/watch?v=j4VrIwwsZ2M.

[63] https://tvarkaumiesta.lt/statistics

[64] https://www.15min.lt/naujiena/aktualu/vilniaus-zinios/vilniuje-pranesti-apie-miesto-problemas-nuo-siol-galima-ir-mobiliaisiais-telefonais-793-487537

Through various hackathons and other events, the team working on Tvarkau Vilnių also came into contact with a group of volunteer developers calling themselves Code4Vilnius[65], who helped to develop an Android version of the mobile application, and continue to provide technical support on an *ad-hoc* basis.

Figure 25. Issues reported to Vilnius municipality through the Tvarkau Vilnių problem register and mobile application, 2012-2018.[66]
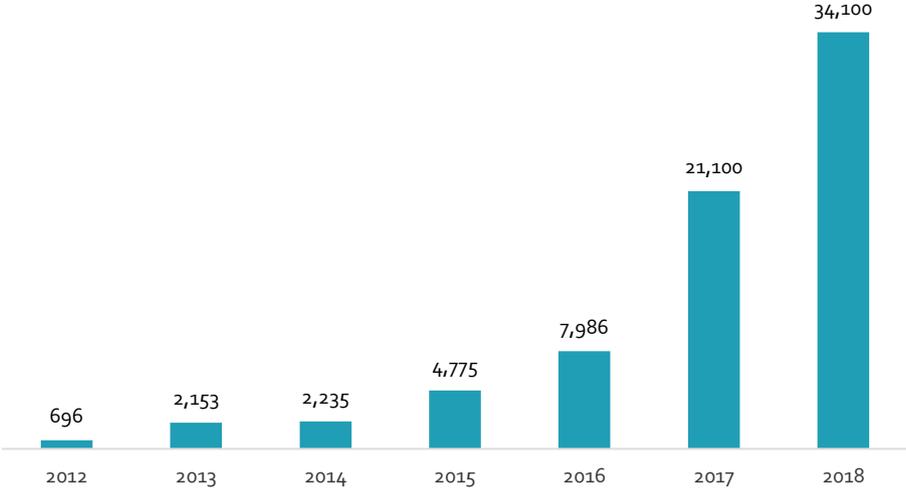
Following the development of Tvarkau Vilnių mobile applications for iOS and Android, between 2014 and 2015 the number of reports doubled, then nearly doubled again between 2015 and 2016 (see Figure 25 above). Take-up increased even further in 2017, when an option to submit reports anonymously was added. Users who submit reports using the mobile application are not required to include any identifying information. Users who notify the municipal administration through the website are asked to provide only their e-mail address. Nevertheless, Vilnius residents can register and provide their personal information if they so choose. Signing in allows users to edit their reports later on and report certain issues (for example, parking violations), for which identifying information is required, in order that the police can issue fines to the wrongdoer.

Anonymous reporting is one of the features that differentiates Tvarkau Vilnių from the more widely known FixMyStreet platform. In the UK, for example, FixMyStreet users must include their name and e-mail address when submitting a report. By default, the name will not be included in published reports, but will be entered into the municipal system. The creators of FixMyStreet argue that providing a name is necessary because (a) it is a mandatory field in most council systems; and (b) "When users are asked to provide contact details, the tone of their correspondence tends to be more constructive and less abusive."[67] For the purposes of our case study, however, a platform that allows anonymous reporting is more suitable because we incentivise participants to report issues through Tvarkau Vilnių. If reporting were not anonymous, we would be likely to experience a very high attrition rate. Furthermore, given that trust in the municipality is the key focus of our study, *whether* and *why* participants submit issues anonymously can provide insights about trust in public institutions.

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[65] https://atviras.vilnius.lt/iniciatyvos/code-for-vilnius
[66] https://tvarkaumiesta.lt/statistics. Note: the figure includes reported submitted by both registered and anonymous users.
[67] https://www.fixmystreet.com/faq

Anonymous reporting also influences the volume of issues submitted. Manchester – a city in the UK with a population almost equivalent to that of Vilnius[68] – has received just over 14,000 reports from city residents since 2008[69]. By contrast, in Vilnius, more than 34,000 reports were submitted during 2018 alone[70]. Given that Vilnius experiences a very high volume of problem submissions, we expect that the Tvarkau Vilnių platform will have greater influence as a source of information for a municipal administration dealing with non-emergency issues than other, similar applications. This allows us to highlight various effects of the use technology on public institutions.

Finally, the Tvarkau Vilnių case is interesting due to the institutional context in which the platform was created. In the US, similar platforms such as PublicStuff and SeeClickFix are run by private for-profit companies. In the UK, FixMyStreet is overseen by a private charity. By contrast, although municipal administration workers receive help from volunteer developers, the municipality itself is in primary charge of the platform. It is worth exploring why a public-private partnership was not chosen as a solution, given that such partnerships are prevalent when implementing digital tools in the work of governments (see D2). This case study could help to identify legal or institutional barriers to the creation of such partnerships. It could also identify risks relating to private sector involvement that might discourage public sector agencies from seeking out cooperation.

Having described the way in which the Tvarkau Vilnių platform came about and why it is worth studying, in the next section we provide more information about the technology that supports the platform.

3.2.1.3 Description of the innovation

Figure 26 illustrates the Tvarkau Vilnių system, summarising the main actors involved and the technologies used to enable the submission of reports to the municipality.

Starting from the top, when a person notices a problem and decides to report it using Tvarkau Vilnių, the Google Geolocation API[71] is used to automatically detect the person's location[72]. This means that when the user is asked to pinpoint the exact location where the problem occurred, they are taken to the area on the map that corresponds with their coordinates. The platform currently uses OpenStreetMap for its map services. Although Google Maps were used in the past, OpenStreetMap was eventually chosen as a cheaper alternative.

After the user submits a report, it travels to an open-source MySQL database management system (DMBS)[73]. The system is integrated with both the municipality's database, called @vilys (English: *Hive*), and with the Register of Administrative Offences[74]. The Register is an electronic database used by the police and other relevant institutions to process data and documents relating to administrative offences committed by natural and legal persons. A report is sent to the Register of Administrative Offences if the problem reported by a Tvarkau Vilnių user provides evidence that a law has been violated, and if the report includes enough information to identify the wrongdoer and the person reporting it.

For example, where a Tvarkau Vilnių user submits a report about a parking violation, the report will be forwarded to the Register if the vehicle's licence plate is visible in the photo, and Tvarkau Vilnių user provides his or her name, state-issued unique identification number, e-mail address and phone number.

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[68] In 2016, Manchester had a population of roughly 541,000 residents, compared to 544,000 in Vilnius. https://secure.manchester.gov.uk/info/200088/statistics_and_intelligence/438/population; https://osp.stat.gov.lt/statistiniu-rodikliu-analize?hash=4afc61cc-bdb7-435f-9041-f8ba09de5b24#/
[69] https://www.fixmystreet.com/reports/Manchester?zoom=11&lat=53.44247&lon=-2.23337&status=open,closed,fixed&sort=created-asc
[70] https://tvarkaumiesta.lt/statistics
[71] https://developers.google.com/maps/documentation/geolocation/intro
[72] Note that location detection is only available in the mobile application and not when submitting reports via the web portal.
[73] https://www.mysql.com/
[74] https://www.ird.lt/lt/paslaugos/informacijos-rinkmenos/administraciniu-nusizengimu-registras

This personal information is required by the Code of Administrative Offenses[75] in order to prepare a protocol about the offence. Once the police receive and review the report, if appropriate, they may issue an administrative penalty to the person who failed to comply with the law, hence addressing the problem.

Figure 26. Diagram of the Tvarkau Vilnių system.
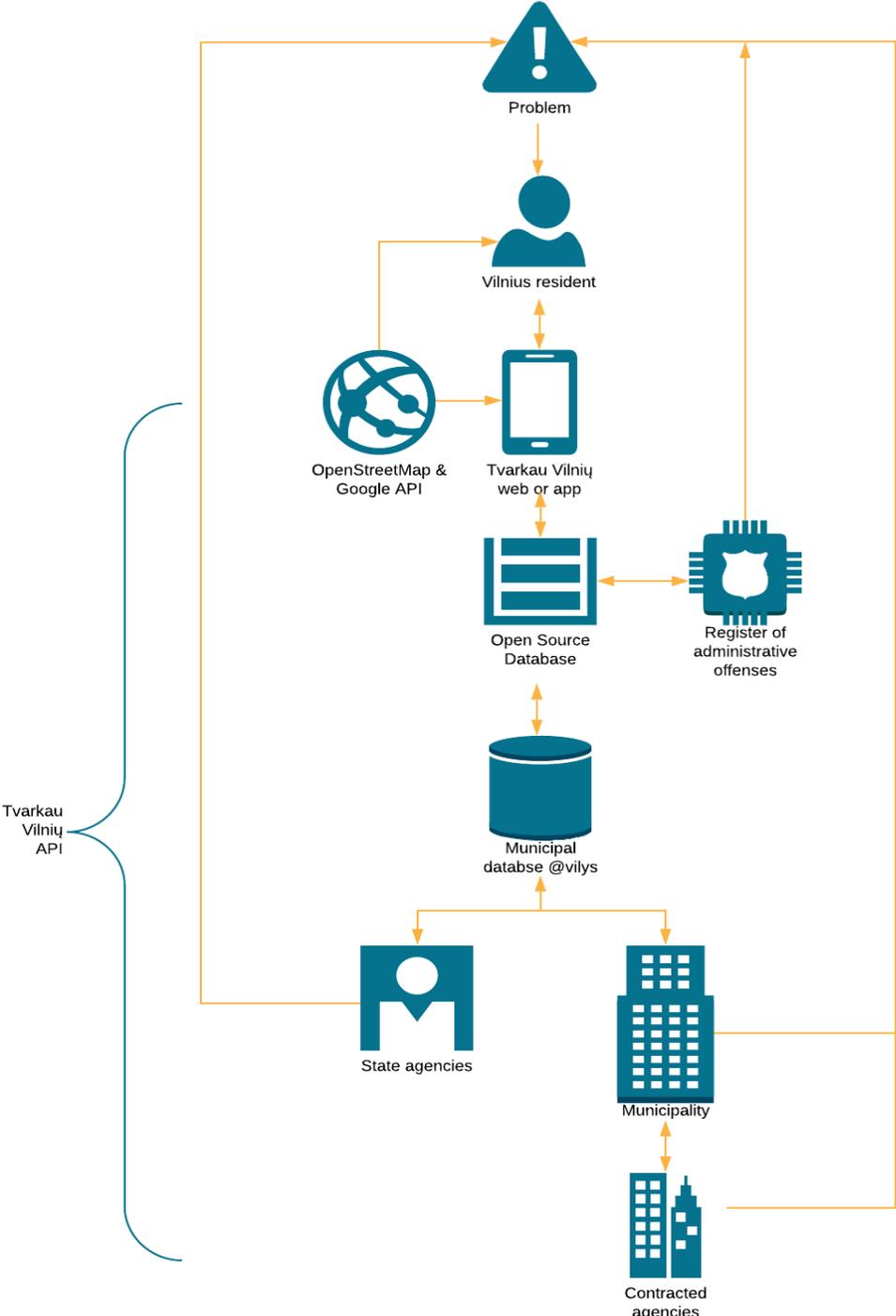
It is also important to note that pictures that include visible licence plate numbers are not published on the Tvarkau Vilnių map for the public to see. The Tvarkau Vilnių team has purchased number-plate recognition software which automatically hides licence plates before the report is publicly shared.

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[75] https://www.e-tar.lt/portal/lt/legalAct/4ebe66c0262311e5bf92d6af3f6a2e8b, article 609, paragraph 1.

If the report does not constitute an administrative offence, it travels to the municipal database. Here, the report is processed in order to determine which state agency or municipal department the report should be forwarded to. If the body responsible is a private entity contracted by the municipality, the report is first sent to council workers and then forwarded to the contractor. The entity tasked with dealing with the report then issues a response to the Tvarkau Vilnių user (hence, the arrows in the diagram point both ways). It then either addresses the issue, or includes it in the list of issues for potential inclusion in the following year's budget. Information is passed on using an API developed by the Tvarkau Vilnių team.

3.2.2 Approach and methodology

To explore how the use of Tvarkau Vilnių impacts citizen engagement and trust in the municipal government, we employ a mixed-methods approach. Our methodology consists of three tasks that integrate with each other: (a) interviews with key stakeholders; (b) a randomised control trial; and (c) interviews with participants in the experiment.

3.2.2.1 Interviews with stakeholders

To identify the main goals behind the development of Tvarkau Vilnių and understand how it affects municipal administration, we conducted interviews with key stakeholders (n=6) within the Vilnius municipal administration. These included interviews with top officials, in order to better understand the institutional factors that may serve as facilitators or barriers to technological innovations in the public sector, as well as representatives from the Group for Innovation and Technologies, who are primarily responsible for overseeing the Tvarkau Vilnių platform.

Interview questions focused primarily on the impacts – both positive and negative – of using Tvarkau Vilnių, in terms of service provision, the work of the administration and broader social effects (for example, with regard to how city residents perceive the municipality and their own role in the city's development). We emphasised the distinction between potential effects that might take place in the future, and effects that had already been realised.

3.2.2.2 Randomised control trial

While the interviews helped us to contextualise how and why the app was created, we conducted an experiment to explore how Tvarkau Vilnių affects its users, with a particular focus on trust in the municipal government. We hypothesised that using Tvarkau Vilnių would enhance the user's trust in the municipal government, because Tvarkau Vilnių users can see the problems they reported being fixed.

In order to carry out the experiment, we first recruited 680 people via social media sites, offering EUR 20 in exchange for filling out two surveys and participating in an online game. The first survey, among other things, was intended to measure baseline characteristics (on a scale of 0-10). These included:

- Trust in the municipal government.
- Assessment of the municipality's ability to solve problems effectively.
- Perception of the competence of municipal staff.
- Perception of the accessibility of municipal agencies.

Out of an initial sample of 680 people, 539 filled out the first survey. Respondents who had used Tvarkau Vilnių during the previous year were then disqualified. These participants were excluded because the inclusion of people who had used the site might undermine the treatment. This left us with a sample of 453 research participants, whom we randomly assigned to treatment and control groups. Their socio-demographic characteristics are summarised in the table below.

Table 9. Socio-demographic characteristics of treatment and control groups after randomisation.

		Treatment	Control
N		308	145
Average age		25.6	24.9
Gender	Male	28%	31%
	Female	72%	69%
Education	High school diploma or less	50%	53%
	Non-university tertiary education	8%	8%
	BA	27%	26%
	MA or PhD	14%	14%
Employment status	Working	28%	31%
	Student	67%	64%
	Others	5%	6%
Average trust in municipal government at baseline		6.8	6.5

We deliberately assigned twice as many participants to the treatment group because we expected greater attrition from the treatment group than from the control group. The treatment consisted of the following online game: after providing information about Tvarkau Vilnių, we asked the participants to use Tvarkau Vilnių at least once over the course of two months. Each time they used it, we asked them to fill out a form indicating what their reported problem was about and whether they submitted it with or without a picture. For every submission with a picture, participants received two points; every submission without a picture earned them one point. Twice over of the course of two months, we informed the respondents how they ranked against each other based on the total points they had received. The top 10 winners were promised 'symbolic gifts' for their participation, in addition to the EUR 20 remuneration for participating in the study.

Although incentivising the use of Tvarkau Vilnių was our primary goal, we included this gamification element in order to test whether the treatment effect would be stronger among those who submitted more reports.

As illustrated in Figure 27 below, the vast majority of participants submitted one Tvarkau Vilnių report. Meanwhile, the control group was informed that the first players in the online game are participating very actively, and so the control group would no longer be required to participate in the game. Note that neither the treatment group nor the control group were aware that they were participating in an experiment.

Figure 27. Number of Tvarkau Vilnių reports submitted by research participants.

After the online game was completed, we sent both groups (treatment and control) a second survey. This consisted of questions about various digital services in Vilnius; the same perception questions about the municipality as in the first survey; and, if the respondent had used Tvarkau Vilnių over the previous two months, they were also shown questions about Tvarkau Vilnių. Ultimately, we sought to estimate whether trust in the municipality would change differently between the treatment and control groups over the course of the two months (for discussion of RCT results, see Section 3.2.3).

As expected, we experienced attrition in both treatment and control groups. Out of 308 people who were initially assigned to the treatment group, 167 took the second survey; out of the 145 people who were assigned to control, 126 took the second survey. This provided us with a final sample of 293 research participants. In order to ensure internal validity, we ran a logistic regression to check for differential attrition, the results of which are summarised below.

Table 10. Regression results in relation to differential attrition.

		DV: dropped out of the study (Y/N)
Treatment (ref.: Control)		**6.072*****
		(1.817)
Age		0.975
		(0.018)
Male (ref.: Female)		0.953
		(0.242)
Education (ref.: High school diploma or less)	Non-university tertiary	1.769
		(0.908)
	BA	0.782
		(0.244)
	MA or PhD	0.693

		(0.341)
Employment status (ref.: Working)	Student	0.875 (0.313)
	Others	0.926 (0.483)
Gross income per month (ref.: EUR 0–500)	EUR 501–1,000	1.524 (0.397)
	EUR 1,001+	1.835* (0.672)
Constant		0.248** (0.164)
Observations		389
Pseudo R²		0.107

Note: coefficients are odds ratios. Values in parentheses represent robust standard errors; * denotes significance at 10%, ** represents significance at 5% and *** significance at 1%. Reference categories are specified next to each variable.

The results of the regression show that those who were assigned to the treatment group were more likely to drop out of the study. This makes sense, given that they were required to participate in the online game whereas the control group was not. The only other variable that is significant is income, which shows that those in the EUR 1,001+ income bracket were more likely to drop out of the study than those in the EUR 0–500 bracket. This again makes sense because for those earning more, monetary reward might be a lesser motivator.

The final treatment and control groups are nevertheless very similar. We state this based on the regression results above (no other variables are significant, and income is significant only with 90% confidence), as well as on a comparison of the socio-demographic characteristics of the final groups (see Table 11 below).From this we conclude that, with respect to socio-demographic characteristics, attrition was random. Hence, we maintain internal validity by running the analysis on the final treatment and control groups without imputing data from the dropouts.

Table 11. Socio-demographic characteristics of the treatment and control groups at the end of the study.

		Treatment	Control
N		167	126
Average age		26.2	25.1
Gender	Male	30%	29%
	Female	70%	71%
Education	High school diploma or less	52%	48%

	Non-university tertiary education	7%	8%
	BA	25%	29%
	MA or PhD	16%	15%
Employment status	Working	30%	29%
	Student	64%	64%
	Other	6%	6%
Average trust in municipal government at baseline		6.8	6.5

3.2.2.3 Qualitative information from the participants

Quantitative tools are useful for measuring technology effects and deducing differences between people who use certain technologies and those who do not. But in order to understand the *experiences* people have while engaging with technology, qualitative methods are much more useful. Surveys and experiments are limited in telling us how people *feel* when they receive a response from the authorities regarding the issue they reported, which is paramount when exploring whether Tvarkau Vilnių fosters citizen engagement or undermines it.

To complement our experiment, we provided multiple opportunities for research participants to share their insights. First, respondents were encouraged to leave comments regarding specific questions in both surveys. In the first survey, these questions centred on participants' opinions about various digital services (both private and public) in Vilnius and their influence on respondents' quality of life. In the second survey, the questions related to the participants' opinions about Tvarkau Vilnių and the responses they received from the municipality. The treatment group also had an opportunity to comment on their experiences each time they filled out a form informing us that they had submitted a Tvarkau Vilnių report. Finally, after the experiment we also reached out to the top 10 game winners via email or phone to ask why they participated in the game so actively, how the reports they submitted made them feel, and whether using Tvarkau Vilnių had changed their opinion about the municipal government. The qualitative information collected is used to complement our findings in the following section.

3.2.3 Results and discussion

In this section, we present our findings. These are relevant to both the city of Vilnius and to other cities planning to use ICT tools similar to Tvarkau Vilnių. We structure our discussion according to the main outcomes discussed in the conceptual framework Thus, we begin with productivity and efficiency, move on to effectiveness, inclusion and sustainability; and end with legitimacy. Please note that the main implications of this case study are also discussed in relation to the conceptual framework in Section 4. Box 7 below provides a very brief summary of the main findings presented in the upcoming paragraphs.

Box 7. Main findings of Case Study 1, Tvarkau Vilnių (Lithuania).

- **Citizens are willing to contribute** to joined-up service delivery; however, a systemic effect in terms of higher trust and legitimacy in institutions is only likely if participants can monitor implementation and feel that their contribution makes a difference. In other words, this study shows that the mere fact of using the

platform does not directly enhance trust in municipal government: impactful results are necessary.

- **Personal data management** is an increasingly sensitive issue. If not carried out properly, it may undermine even the most well-meaning ICT-based solution, as this case shows. Our study shows that the use of the platform has increased significantly since anonymous reporting was introduced. Most of the respondents (62%) opted to submit their reports anonymously, and indicated that they would be less likely to submit reports if they had to provide their name.

- **Despite the potential efficiency gains** stemming from this innovation (e.g. reduced administrative burden for citizens), in the short term the platform risks increasing rather than decreasing the efforts and costs of the public administration, which must now deal with more input channels than it did previously.

3.2.3.1 Productivity and efficiency

Efficiency gains achieved by the Tvarkau Vilnių platform depend on whose perspective we consider. There are clear gains for city residents. Because the process of submitting a report to the municipality has been streamlined, city residents no longer need to identify which department is responsible and look for its contact information; they can pinpoint the exact location where a problem has occurred using their phones, and add a picture for clarification. These functions make it easier and more time-efficient for residents to report problems, motivating more of them to take part. As one of our respondents explained, before using the app she knew that there were ways to report problems, but thought that she had to go via the municipality's e-government portal, and look for something there. After trying Tvarkau Vilnių, the path to report problems was, as she put it, "several times shorter".

The mobile application in particular makes it easier to report problems: once the Android application was launched in 2014, the number of unique registered users of Tvarkau Vilnių almost doubled from 983 to 1,746, and has continued to grow steadily ever since (see Figure 28 below)[76].

Figure 28. Unique registered Tvarkau Vilnių users, 2012-2019.[77]

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[76] https://tvarkaumiesta.lt/statistics
[77] https://tvarkaumiesta.lt/statistics
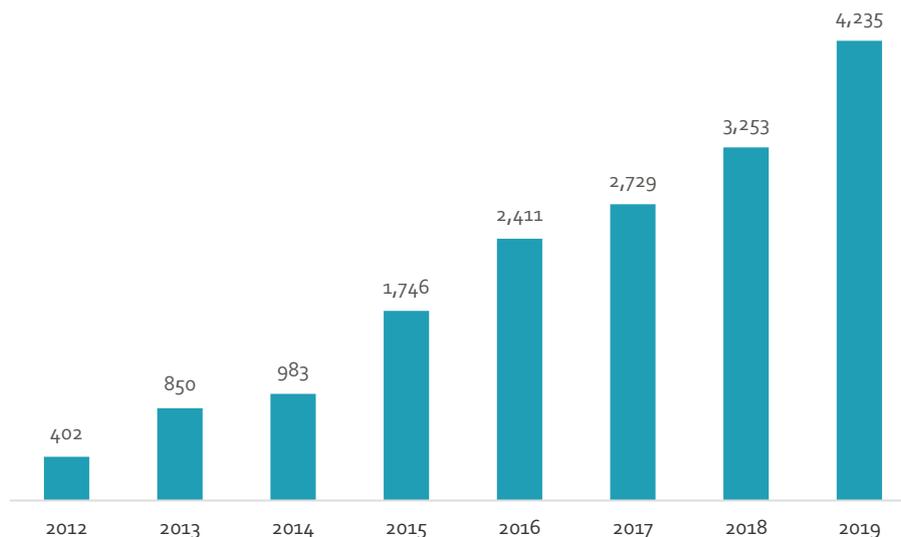
Efficiency gains for the municipality are not as clear-cut. On the positive side, according to the Tvarkau Vilnių team, one of the greatest benefits of the platform is that it automates the process of finding the people responsible for fixing a particular issue. In the past, when reports were submitted through e-mail or phone calls on an *ad-hoc* basis, it would take longer for various departments to find the agency or person who could address the problem, creating inefficiencies. Now, the platform asks the user what type of problem he or she is reporting, and automatically routes the issue to the desired department[78]. To that end, the development team is working further to create problem sub-types, as well as a function to route problems to a particular eldership depending on the geolocation of the report.

Furthermore, the crowdsourcing aspect of the initiative allows the municipality to collect much more information about problems in the city than it could gather by relying on internal resources only. Cooperation with Code4Vilnius volunteers also lowers the cost of running the platform itself. In this sense, the platform also increases the productivity of municipal agencies.

On the downside, the municipality suffers from the poor quality of the reports submitted. For example, users sometimes duplicate reports accidentally when they inform the municipality about an issue that has already been submitted. The Tvarkau Vilnių team also noted a few notorious cases in which the same user not only submitted tens of identical reports, but also asked friends to do the same, hoping that the volume of the reports about the same issue would pressure the municipality into taking action. Instead, such behaviour simply creates a backlog of reports, lowering the chances that the municipality will respond on time. The Tvarkau Vilnių team argued that they cannot block such spammers because the same users also report other issues that may be useful to the municipality. To address this problem, some applications in other countries[79] have a dedicated person responsible for reviewing reports before they are directed to the departments responsible or published online. However, representatives from the municipality argued that this solution is too expensive in Vilnius because the sheer volume of reports submitted (in 2019, exceeding 40 000[80]) would require an entire team dedicated to reviewing reports.

Due to a backlog, not all reports are solved promptly. For example, in 2019 less than two-thirds of all submissions were addressed on time.[81] In addition to spam, other factors contribute to the backlog. For example, users do not know if the same problem has already been reported, leading to the possibility that they might unintentionally submit duplicate reports (in FixMyStreet, people are immediately taken to a map displaying all reports of that kind, so that they can see if something has already been reported in the same location). To illustrate this point, one of our respondents said that he "only later saw that someone else had already submitted the same problem" because the mobile application lacks a map displaying previously submitted problems.

Furthermore, Tvarkau Vilnių users do not receive a notification when the municipality responds to their report: they can only see this response if they actively check their report. Therefore, almost of respondents those respondents in our survey who had submitted at least one Tvarkau Vilnių report did not know if it had been resolved (see Figure 29 below). Users who had not actively checked for a response might assume that their report had been ignored, and submit another report of the same kind.

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[78] With the exception of issues that need to be addressed by private companies contracted by the municipality. In these cases, municipality employees are still involved in passing on the issue to the agency responsible.
[79] For example, see https://aisel.aisnet.org/cgi/viewcontent.cgi?article=1071&context=ecis2016_rp
[80] https://tvarkaumiesta.lt/statistics
[81] https://tvarkaumiesta.lt/statistics

Figure 29. Proportion of survey respondents who reported that their Tvarkau Vilnių reports had/had not been resolved (n=194).
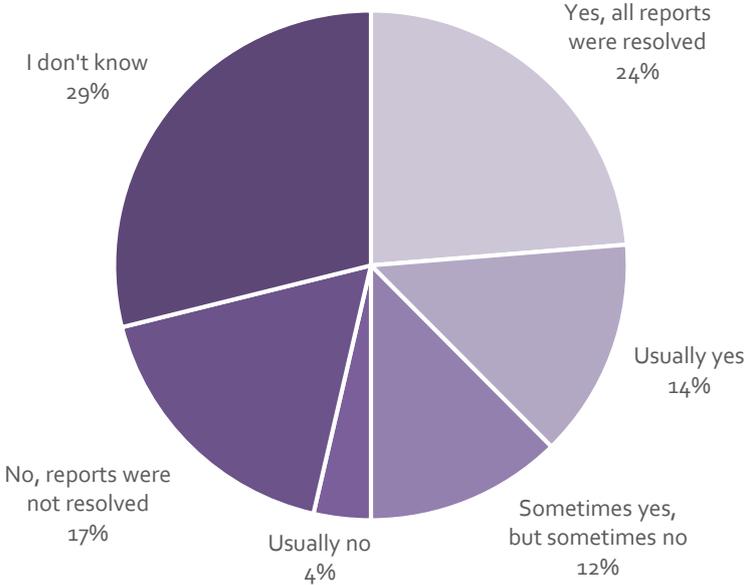
Note: the figure includes only those respondents who had used Tvarkau Vilnių at least once during the preceding two months before taking the survey.

To enhance the productivity of the platform, Tvarkau Vilnių team has considered introducing elements of machine learning and Big Data analysis. For example, computers could automatically generate responses to the issues based on the keywords mentioned in the report. Big Data analytics would help to make sense of all the reports submitted, yielding insights about the most pressing issues which could in turn inform budget allocation and urban planning. Nevertheless, several challenges must be addressed before such ideas can become reality. From a technical point-of-view, reports are submitted using mostly open-ended text, which is difficult for machines to analyse. Furthermore, the introduction of such innovations requires substantial up-front investment, which is difficult to justify given the lack of information on how cost-effective these technological advances would be. Finally, these technologies would make some municipal employees redundant, and might therefore face some internal resistance. Nevertheless, the municipality has already robotised some processes in other departments, for example, regarding the filling out of forms. According to the head of Vilnius City administration, previous waves of automation by the municipality have not led to workers being laid off, because the institution is already understaffed. Instead, employees were reassigned to tasks that could not be automated.

3.2.3.2 Effectiveness, inclusion and sustainability

We now turn to address the claims concerning social exclusion found in the literature in relation to platforms like Tvarkau Vilnių. To reiterate, these platforms have been criticised (with some empirical evidence[82]) for limiting civic participation among those members of the public who lack access to the internet, as well as those who are less educated or of lower socio-economic status.

Our case study was only able to assess these claims to a certain extent in the context of Vilnius. Because we recruited research participants via social media sites, by default all of them had a computer/smartphone and access to the internet. We cannot therefore explore how Tvarkau Vilnių affects those without digital access. Furthermore, according to our survey results, the vast majority of the research participants possessed more than basic

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[82] Pak et al., 2017; Helsper, 2008; Escher, 2011

digital skills, limiting our ability to explore how those with lower digital literacy interact with Tvarkau Vilnių.

Nevertheless, given such criticism of platforms like Tvarkau Vilnių, if those with greater socio-economic capital are more likely to submit reports, we would expect to see a greater number of reports submitted in more affluent areas of the city. Using a visual exploration of the reports submitted in 2019 (see the maps in Figure 30 below), it appears that the number of submissions closely reflects population density. Nevertheless, without equivalent visual data on median incomes in each of the city's neighbourhoods, it is difficult to say with any certainty whether or not Tvarkau Vilnių users are more likely to submit reports in areas where residents typically earn more.

Figure 30. Reports submitted via Tvarkau Vilnių, 2019[83] (left) and Vilnius population density (right)[84].
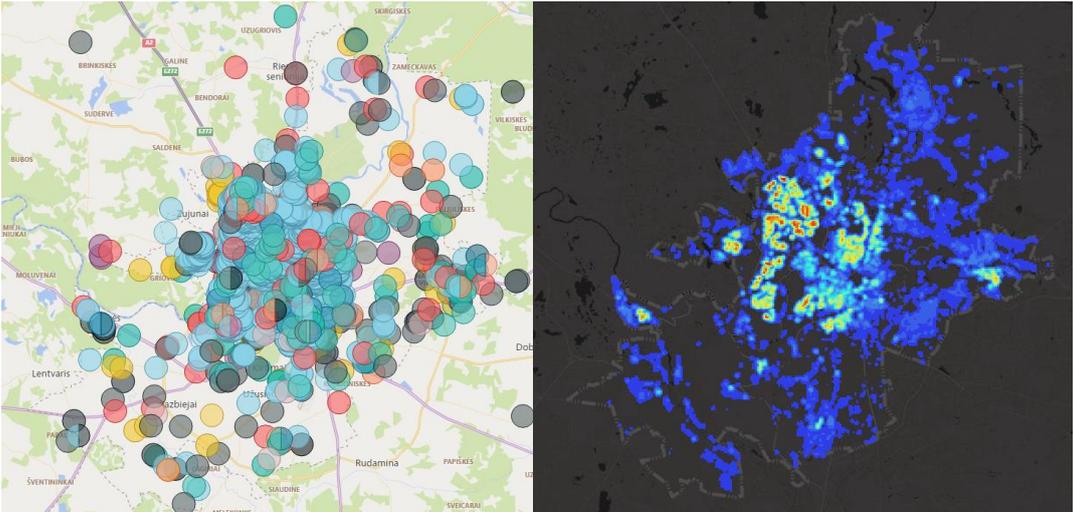
Instead, we asked our research participants (in both the treatment and the control group) whether they planned to use Tvarkau Vilnių (among other digital services) in the future. We then ran a logistic regression analysis, estimating the impact of belonging to various income brackets on the intention to use Tvarkau Vilnių in the future, and controlling for various demographic characteristics (see column 1 in Table 12 below)[85].

Table 12. Regression results regarding the characteristics of people who plan to use Tvarkau Vilnių in the future, and who reported finding Tvarkau Vilnių simple to use.

	(1) DV: plans to use Tvarkau Vilnių in the future (Y/N)	(2) DV: Simplicity of using Tvarkau Vilnių (ordinal)
Treatment (ref.: Control)	5.027*** (1.433)	
Age	1.043* (0.025)	1.018 (0.030)
Male (ref.: Female)	1.307	0.811

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[83] https://tvarkaumiesta.lt/statistics

[84] https://maps.vilnius.lt/teritoriju-planavimas#layers

[85] Note that we cannot assess the impact of income/socio-economic status on actually using Tvarkau Vilnių, because all research participants in the treatment group were asked to do so.

		(0.416)	(0.330)
Education (ref.: High school diploma or less)	Non-university tertiary	0.998 (0.657)	1.289 (0.986)
	BA	1.241 (0.444)	**2.888**** (1.466)
	MA or PhD	0.731 (0.460)	1.933 (1.416)
Employment status (ref.: Working)	Student	1.265 (0.561)	1.602 (0.943)
	Other	0.752 (0.496)	0.612 (0.534)
Gross income per month (ref.: EUR 0–500)	EUR 501–1,000	0.817 (0.256)	0.789 (0.332)
	EUR 1,001 +	**0.324**** (0.152)	0.311* (0.189)
Method of submitting reports to Tvarkau Vilnių (ref.: Android app)	iOS app		**0.202***** (0.105)
	Web		0.622 (0.292)
	Web and app		0.502 (0.307)
Constant		0.203** (0.164)	
Observations		254	133
Pseudo R²		0.135	0.082

Note: Coefficients are odds ratios. Values in parentheses represent robust standard errors for equation 1, and standard errors for equation 2; * denotes significance at 10%, ** represents significance at 5% and *** significance at 1%. Reference categories are specified next to each variable. Approximate likelihood-ratio test of proportionality of odds across response categories has been performed for equation 2 with no significant results (prob.> X^2 = 0.458).

The treatment effect appears to be both the most significant and has the largest impact. This is intuitive: given that participants in our treatment group were asked to use Tvarkau Vilnių and the control group was not, this finding simply means that people who have tried using Tvarkau Vilnių are more likely to use it in the future than those who have not.

Regarding income, one of the brackets, EUR 1,001+, is significant – meaning those with this level of income are less likely to say they will use Tvarkau Vilnių in the future than

those who earn EUR 0–500 (the reference category). This contrasts with findings elsewhere in the literature that associate the use of problem-reporting aps with higher socio-economic status.

Given the lack of significant results in other income brackets and education categories, we also tested the impact of income on the perceived simplicity of using Tvarkau Vilnių (see column 2 in Table 12 above)[86]. Our goal here was to see if there is a pattern that associates the perceived usability of Tvarkau Vilnių with a particular level of income or education. Here, we find that people in the higher income bracket (EUR 1,001+) are more likely to say that Tvarkau Vilnių is difficult to use than people in the lowest income bracket, but only at 90% confidence. If people in the lowest income bracket are more likely to use Tvarkau Vilnių in the future and they find it simpler to use, this suggests that, contrary to findings in the literature, this technology is not biased toward people with higher socio-economic status. However, we also find that participants with a Bachelor's degree rate Tvarkau Vilnių as easier to use than those with only a secondary school diploma. It would appear, therefore, that the concerns in the literature have some validity in our case, and it is possible that people with higher incomes do not plan to use Tvarkau Vilnių in the future for reasons other than accessibility. Possibly, these findings could indicate that people in higher income brackets have different (and potentially more demanding) expectations with regard to simplicity, interface and user experience. This could be an interesting avenue for future research.

If Tvarkau Vilnių is more difficult to use for people with lower levels of education, it is important for the municipality to design a platform that is accessible to everyone. To make the platform more accessible, the Tvarkau Vilnių team plans to update the iOS app, which currently displays information in the same way as the web page. This is especially important, given that research participants who used the iOS version of the app found it significantly more difficult to use than Android users (see Table 12 above). Nevertheless, even though some groups find the platform more difficult to use than others, the vast majority of respondents still rated Tvarkau Vilnių as being easy to use (see Figure 31 below), showing that the platform is relatively effective in simplifying reporting for citizens.

Figure 31. Tvarkau Vilnių user-friendliness ratings.
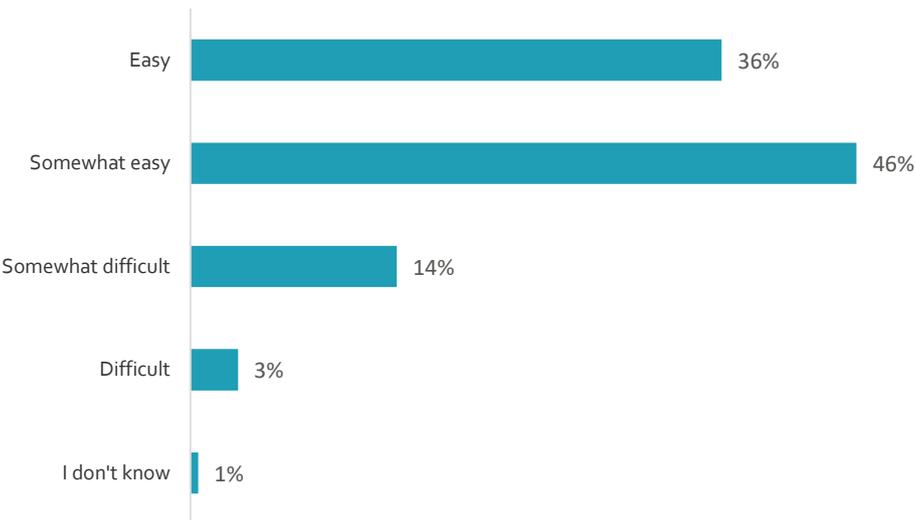
Although overall the platform is perceived as being user-friendly, Tvarkau Vilnių remains relatively little-known in Vilnius compared with other digital services. This is one of the strongest themes observed among comments from our research participants[87]:

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[86] We employ an ordinal logistic regression with a dependent variable (simplicity of use), which is coded in the following order: difficult to use; somewhat difficult; somewhat easy; easy.
[87] Translated by the authors.

"The application is easy to use, but I personally didn't know that it exists, so perhaps it would be necessary to inform the public about its existence".

"It is important that more citizens learn about this app. The whole summer, these stairs were broken and moving dangerously. As soon as I learned about the app, I immediately reported the problem and, to my surprise, it was fixed within two days. There just needs to be more information about this app."

"I have some course-mates who could submit reports or give suggestions on how to popularise the app… I asked around and none of them have heard of Tvarkau Vilnių".

The municipality's administrative office, however, is not focusing on making the platform more popular for two reasons. First, they believe that the best way to spread the word is to let people recommend Tvarkau Vilnių to their friends. This idea is supported by comments from our participants, who said that they would let their friends know about the application if they saw their own problems fixed. Secondly, the municipality already faces a backlog of reports (see Section 3.2.3.1 on productivity and efficiency), so their priority is to speed up the processing of reports that have already been submitted rather than encouraging the submission of new ones.

This calls into question the sustainability of the service: if the municipality struggles to process incoming reports when relatively few people know about the platform, would the system collapse if every city resident used it? To avoid such an outcome, the Tvarkau Vilnių development team is considering limiting the ability of users to submit reports anonymously. Their reasoning is that prior to 2017 when anonymous reporting was enabled, there were fewer submission and they were of better quality.

Although 62% of our survey respondents submitted Tvarkau Vilnių reports anonymously – revealing a clear preference for this type of reporting – we decided to ask them directly if they would continue to report problems if they were required to log in. We specified that their name would not be displayed in public, but that the municipality would be able to associate every report with the name of the person who reported it. Presented with such a question, 68% of the respondents said that they would submit reports if they were required to log in, while 32% said they would not (see Figure 32 below).

Figure 32. Proportion of respondents who said they would/would not submit Tvarkau Vilnių reports if required to log in.
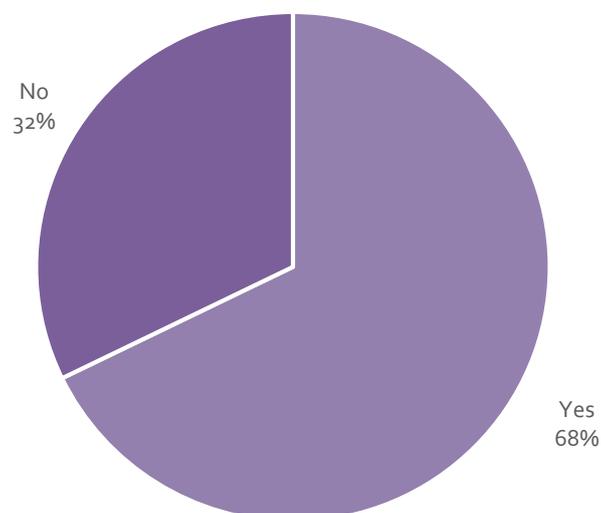
We then investigated the demographic profiles of those participants who said they would be less likely to submit reports if they could not do so anonymously. This is important: if a particular group of people were to be discouraged, their views would be less likely to be taken into account when making city planning decisions. We ran a logistic regression with a dependent variable set to 1 if respondents said they would not submit a report if required to login, and 0 if they said they would. As explanatory variables we included trust in the municipality, age, gender, education, employment status, and income. The results are summarised in Table 13 below.

Table 13. Regression results in relation to participants who would not use the platform if they were requested to log in.

		DV: would NOT submit reports if required to log in (Y/N)
Trust in municipality		**0.767****
		(0.089)
Age		0.945
		(0.038)
Male (ref.: Female)		2.539*
		(1.233)
Education (ref.: High school diploma or less)	Non-university tertiary	**7.456****
		(7.601)
	BA	0.828
		(0.515)
	MA or PhD	2.000
		(1.788)
Gross income per month (ref.: EUR 0–500)	EUR 501–1,000	**0.361****
		(0.185)
	EUR 1,000+	1.626
		(1.247)
Constant		10.447*
		(12.776)
Observations		109
Pseudo R^2		0.138

Note: Coefficients are odds ratios. Values in parentheses represent robust standard errors; * denotes significance at 10% and ** represents significance at 5%. Reference categories are specified next to each variable.

The results show that certain groups of people would be discouraged by such a change. In relation to demographic characteristics, those in the EUR 0–500 income bracket would be

less likely to submit reports than those in the EUR 501–1,000 income category. People who have acquired non-university tertiary education only would also be less likely to submit reports compared to holders of high school diploma (the latter group includes those currently pursuing BA). It is difficult to provide a clear explanation as to why these groups would be less willing to provide their name, unless we assume that such profiles are more likely to submit reports of lower quality. However, without any data on the quality of reports we cannot test such a claim.

We also find that those with lower trust in the municipality would be less likely to submit reports if they had to provide their name. While this is unsurprising, the finding is important because people who lack trust in the municipal government might already be less likely to engage with it, so disabling anonymous reporting might limit their participation through Tvarkau Vilnių too. This is further supported by another survey question asking respondents to specify why they chose to submit reports anonymously (see Figure 33 below). A quarter of respondents said that they do not trust their personal data to be handled properly, and one-fifth were worried about someone finding out that they reported a problem.

Figure 33. Reasons why participants reported problems anonymously.
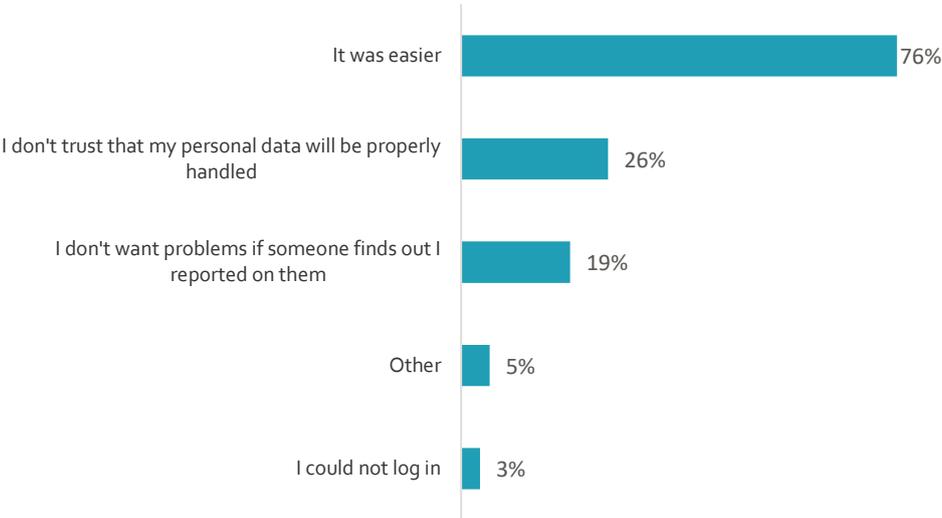
These respondents' concerns have some validity. According to various news articles[88] and the Tvarkau Vilnių development team, cases have emerged in which the people against whom a claim was filed have gained access to the names of those who reported parking violations. This occurs when the accused disputes the fine issued by the police and requests evidence, which includes information about witnesses or injured parties. According to the Code of Administrative Offences, this information must be provided to the accused - but it illustrates how national laws can be at odds with personal data protection regulations in the realm of technology.

When reporting parking violations, the Tvarkau Vilnių application requires users to provide their names, state-issued identification numbers and email addresses, and includes the following disclaimer[89]:

> "Your personal information is necessary to provide legal grounds for your report. Municipal workers will have access to your data and it may be passed onto public authorities responsible for issuing administrative fines."

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[88]   https://www.delfi.lt/news/daily/lithuania/pranese-apie-pazeidima-taciau-nukentejo-pats-prabilo-dar-vienas-vilnietis.d?id=73817700
[89] Translated by the authors.

Nevertheless, the disclaimer fails to mention that users' personal information might also be passed onto the vehicle owner if he or she objects to the fine. The municipality should therefore clearly indicate with whom users' personal data might be shared, and under what circumstances. Such information, combined with an explanation of how data are used and protected in general, might help foster greater trust in the municipality and hence limit the exclusionary impact of disabling anonymous reporting.

While we have discussed one of the challenges that threatens the sustainability of the platform – the backlog of incoming reports – it is also worth asking if the Tvarkau Vilnių institutional setup is sustainable. As previously mentioned, the municipality cooperates with volunteer developers from Code4Vilnius, who mostly help with the Android application. This cooperation helps the municipality cut down on resources and involves citizens in its initiative – both of which are, in themselves, benefits. However, the Tvarkau Vilnių team noted that the public perceives the platform as being completely in the hands of the municipality and are hence disappointed if some of their proposed changes or improvements are not addressed quickly. Meanwhile, the relationship between the municipality and the volunteers is not formalised, so the municipality cannot expect volunteers to adopt the proposed changes faster, because they are working during their free time.

In a similar vein, it is worth exploring why the platform is not run by a private organisation, as similar platforms are in the US. The simplest answer is that no company came forward with a design for a platform like Tvarkau Vilnių before the municipality started to develop it. However, the Tvarkau Vilnių team also expressed some hesitation towards outsourcing. For example, when asked whether the platform is based on FixMyStreet or other open resources, the development team responded that they had created the platform "from scratch" because they wanted to maintain the know-how in order to be able to fix any problems that might arise in the future.

This hesitation might in part be influenced by the experience of another municipal agency in Vilnius, which contracted a private company to develop a mobile app related to public transportation. After two years of work, the agency nevertheless ended up launching a new call for bids to develop the same application over again, because the existing contractor refused to provide the access keys necessary to make updates to the application – essentially forcing the municipal agency to contract the same provider every time updates were needed. The contractor claimed that such access keys were their intellectual property, and the contract did not specify that they must be passed on to the municipal agency.[90]

Given that Vilnius municipality is still in its early days of providing digital services (Tvarkau Vilnių is one of six mobile applications overseen by the municipal government[91]), a lack of information about contracting with the private sector in the sphere of technology, as well as few legal precedents, might serve as barriers for public-private partnerships. That is not to suggest that such partnerships never happen. For example, the head of Vilnius City administration described a partnership with a private company that incorporates all information about different modes of transport into a single application[92]. However, he also noted that the municipality and the private company are still in the process of negotiating who will ultimately own the platform and the data generated from people's trips, underscoring the importance of legal terms and contracts for a city that attempts to adopt digital innovations with the help of the private sector.

[90] https://m.diena.lt/naujienos/vilnius/miesto-pulsas/ismanieji-vilniaus-sprendimai-issvaistyti-pinigai-904821
[91] http://emiestas.lt/?cat=21
[92] The municipality provides its open data, API, and the information necessary to sell public transport tickets through the platform, whereas the private company supplies the municipality with the coordinates from which most trips originate. This helps the municipality to understand how most people get to public transport stops, and has informed decisions on where to build new footpaths.

3.2.3.3 Legitimacy

Tvarkau Vilnių provides a new way for citizens to participate in governance. Yet are the people who use Tvarkau Vilnių the same ones who already engage with government through other means, as suggested in relation to a similar case by Cantijoch et al. (2016)[93]? Or does the platform encourage civic engagement from other residents too? Furthermore, what are the impacts of this engagement in terms of trust in municipal government, and the accountability of public bodies? Given the limited literature assessing these effects empirically, we now turn to the main results of the randomised control trial.

Table 14. Regression results in relation to intention-to-treat (ITT) effect.

	(1) **DV: Trust in municipal government**	**(2)** **DV: Index of opinion about the municipality**
Treatment (ref.: Control)	-0.178 (0.197)	0.091 (0.145)
DV at baseline	**0.692***** (0.051)	**0.711***** (0.048)
Constant	2.379*** (0.740)	2.032*** (0.343)
Observations	293	293
R²	0.446	0.520

Note: Both equations were estimated ordinary least-squares (OLS) regressions. Values in parentheses represent robust standard errors to adjust for heteroscedasticity; * denotes significance at 10% and ** represents significance at 5%. Reference categories are specified next to each variable.

The table above summarises the intention-to-treat (ITT) effect. We first tested the effect of asking participants to use Tvarkau Vilnių on the extent to which they trust the municipal government (on a scale of 0-10). We controlled for the level of trust in the municipal government they indicated during the first survey (baseline measure). Next, we created an index of opinions about the municipality, comprising an average of four measures – trust in the municipal government; the municipal government's ability to effectively solve problems; accessibility of the municipal government; and how competent the staff of municipal administration are – each of which was measured on a scale of 0-10. In the second column, we show the ITT effect on this index, also controlling for the baseline measure. We do not include demographic characteristics as controls because both treatment and control groups are largely similar.

The results show that our treatment – namely, incentivising the participants to use Tvarkau Vilnių – did not have a significant effect on (a) their trust in the municipal government, nor (b) their perceptions of municipal government more generally.

As explained before, we reasoned that using Tvarkau Vilnių should enhance people's trust in the municipal government if they see that their problems are being fixed. However, what if only some of the problems were fixed, while others were not? Could this explain why we

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[93] Cantijoch, M., Galandini, S. & Gibson, R. (2016). "It's not about me, it's about my community': A mixed-method study of civic websites and community efficacy. *New Media & Society* 18(9), 1896–1915.

see no association between the treatment and trust in the municipality? In order to test this hypothesis, we explore the data visually.

The figure below presents four graphs, which respectively address (clockwise from top left) change in the participants' trust in the municipality; change in the participants' perception that the municipality solves problems effectively; change in the participants' perceptions concerning the accessibility of municipal agencies; and change in the participants' perception of the competence of municipal staff. These change variables were derived by, for example, subtracting the rating participants assigned to their trust in the municipal government during the first survey from the corresponding figure given in the second survey. The Y axis of each graphs represents one of the four variables, while the X axis shows the ratings participants gave to the responses they received from the municipal administration via Tvarkau Vilnių. Note that each dot can represent more than one observation. The orange line represents the line of best fit.

Figure 34. Change in perceptions concerning the municipality plotted against the ratings assigned by participants to the responses received from the municipal administration.
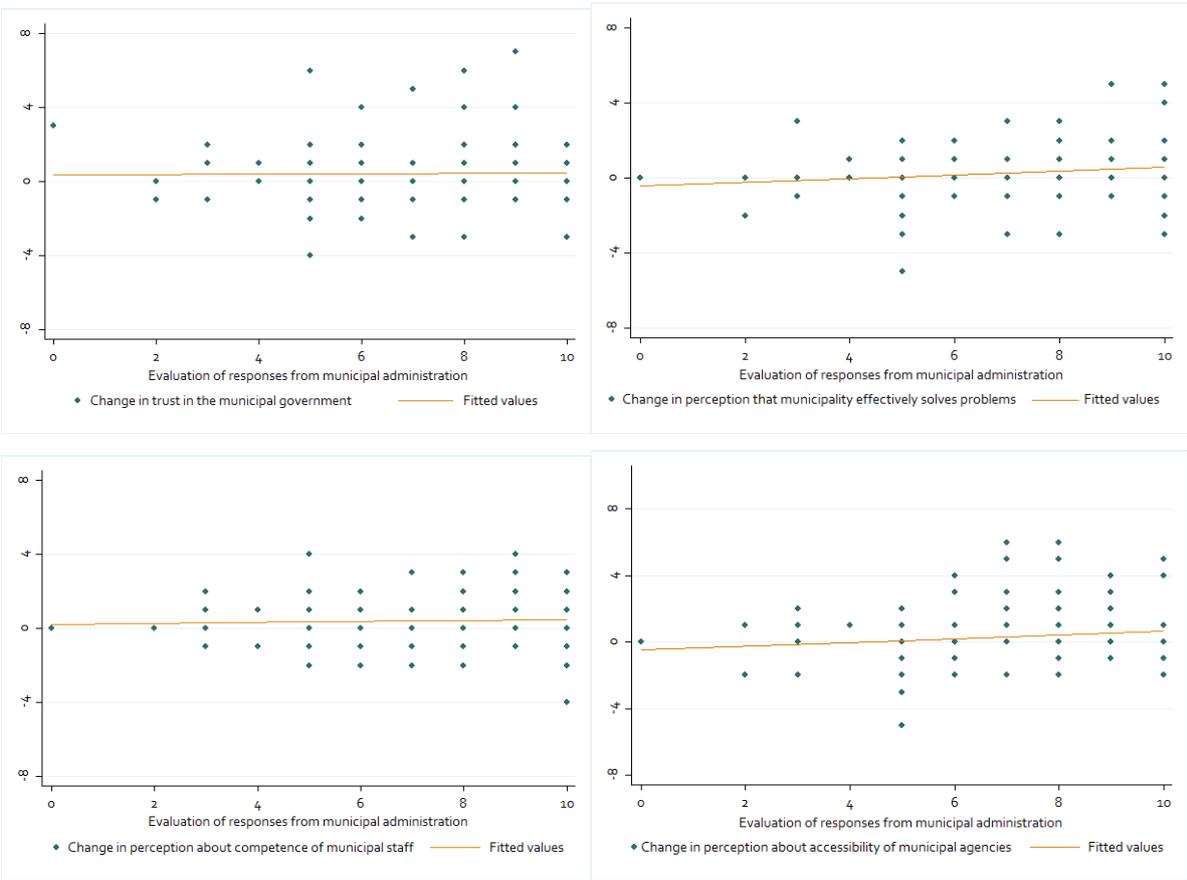
The lines of best fit in all four graphs have positive slopes (meaning that the more favourably the participants evaluate the municipality's responses, the more their perceptions tend to change for the better). However, the slopes in each case are shallow (meaning that the impact is small). With regard to trust, the line appears almost flat – meaning that there little or no relationship between how people rated the responses they received from the municipal administration, and how much their trust in municipal government changed. The same applies to changes in people's perception of the competence of the staff working for the municipal administration. There is slightly more evidence that positive evaluations of responses from the municipality can change people's perception that the municipal government solves problems effectively, and that it is accessible. These findings need to be contextualised. Most of our respondents submitted only one Tvarkau Vilnių report. Therefore, observing even a slight impact on the way in which people perceive the municipal administration is noteworthy, especially given that

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some respondents did not receive satisfying responses. Based on comments from research participants, they gave poor ratings to responses they perceived to be generic. For example, some respondents wrote[94]:

> "Regarding public transportation issues, the municipal government responded using very vague phrases – 'we are investigating passenger flows, the frequency of buses, etc.'. I wish the response had been brief, clear and concrete. For example, regarding the pavement I received a concrete response, so I'm happy with it".

> "The report about the abandoned vehicle was examined, but [the municipal government] responded that it is parked on private property. Meanwhile my neighbour approached a different agency, which probably informed the vehicle owner, and he moved the car. So I think that often responses are standardised and the problems are passed on to other institutions. And whether the problem gets solved depends on the effectiveness of those institutions".

These comments also point to the issue of accountability, discussed in the literature in relation to other platforms similar to Tvarkau Vilnių. Respondents care about the responses they receive. and whether or not their problems are fixed. One way to express dissatisfaction with the response is by submitting another identical report, which – while creating inefficiencies for the municipal government – nevertheless demonstrates civic engagement.

As already discussed, platforms such as Tvarkau Vilnių are criticised for not providing enough space for meaningful civic engagement because report submissions reinforce an individualistic client-provider type of relationship with the municipality , rather than promoting collective action.[95] These scholars argue that online deliberation forums and spaces that offer the possibility of positive solutions - for example, where to build a community park – allow deeper participation in the governing process. In response, we asked our survey respondents whether they would use such spaces, and other features of similar platforms encountered in the literature. Figure 35 (below) illustrates their responses.

Figure 35. Number of respondents who say they would use various platform features found in the literature.

Ability to indicate whether your report is urgent	83%
Ability to vote which reports the municipality should prioritise	82%
Ability to respond to the municipality's response about your reports	77%
Ability to not only report problems, but also submit questions, opinions, express gratitude	74%
Ability to report problems not only in Vilnius, but also in other cities using the same application	73%
Ability to submit Tvarkau Vilniu report through Facebook Messenger	59%
Ability to receive 'civic points' like in a game and compete with other users	54%
Ability to discuss ways to solve problems with other Tvarkau Vilniu users	51%

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[94] Translated by the authors.
[95] Baykurt (2011).

Half of respondents indicated that they would discuss ways to solve problems with other users. The more popular features included the ability to indicate to the municipality whether the report is urgent, and the opportunity to vote on which reports the municipality should prioritise. The results show that Tvarkau Vilnių users do not perceive the platform as a space for discussion, but they would be willing to deepen their engagement in other ways.

Finally, comments from our respondents indicate that the submission of the report itself is a form of civic participation, and that the responses received from the municipality enhanced the participants' feeling that they can contribute to making the city better. Asked why they submitted reports, some respondents said:

> "I won't deny that the monetary reward was one of the incentives, but the main reason was the desire to express my opinion and thoughts; the hope that perhaps someone will take into account my opinion as a Vilnius resident."

> "I want to help change the city. I understand that an ambulance doesn't come if no one calls, and it's the same with the city. If no one reports that the pavement looks like after a war, then we shouldn't hope it will get fixed."

> "I was most interested in receiving responses to my reports. Although I didn't receive responses to all my reports, it's nice feeling to be able to contribute to making your city, or at the very least your immediate environment, better and cleaner."

These quotes illustrate that crowdsourcing in the form of using Tvarkau Vilnių can foster connections between the users and the wider city. This contrasts with the claim that these platforms encourage only individualistic relationships.

3.3 Case Study 2: Body-worn cameras in policing (UK)

3.3.1 Introduction

3.3.1.1 Description of the context

The use and prominence of body-worn cameras (BWCs) in policing has increased rapidly in recent years[96]. For example, the "President's Task Force on 21st-Century Police" initiated by Barack Obama cited BWCs as one of its priority, and as one of the technologies having a (potentially) transformative impact on policing.[97] Moreover, in addition to several pilots in the UK, which are the focus of this case study, the use of BWCs has been piloted since 2007 by police forces across Europe.

BWCs – small cameras worn on a police officers' body – are one of the fastest-growing technologies in law enforcement (especially in the US).[98] BWCs are used to record encounters between the public and the police.[99] They tend to rely on the storage of vast amounts of data, which requires secure, high-capacity data storage, as well as capabilities within each force to either store or transfer the data, and the capability either within the police force or other law enforcement agencies to analyse the data.[100] BWCs are increasingly used together with virtual forms of storage such as the cloud, to allow large amounts of data to be stored without the need for numerous hard drives.[101] BWCs have a direct impact on daily policing practices through the recording of public-police encounters, but also affect the wider environment within which policing occurs, by placing demands on, for example, the IT infrastructure.[102]

The reasons for the introduction of BWCs differ between organisations and countries, but the majority relate to expectations that the use of BWCs will potentially make policing safer by reducing assaults against officers as well as spurious complaints. It is also expected that they will make police more accountable by reducing the inappropriate use of force, and that they will generate better-quality evidence for prosecutions. For example, the West Yorkshire Police and Crime Commissioner (PCC)[103] made the business case for BWCs by highlighting their benefits in areas such as increasing the number of early guilty pleas, providing increased support to victims and witnesses, and resolving public complaints more efficiently.[104] In Sweden, an official statement by the Swedish police in a Swedish newspaper highlighted that the decision to roll out BWCs had been influenced by the perception among the police that they would reduce or prevent violence against police

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[96] The BWC case study was written and quality assured by RAND Europe. The case study authors are Emily Ryen Gloinson, Katherine Stewart, Stijn Hoorens, and Salil Gunashekar. The authors would like to thank the many stakeholders who kindly agreed to be interviewed as part of this case study. The authors are grateful to the quality assurance reviewers at RAND Europe, Dr Advait Deshpande and Dr Camilla d'Angelo, for their critical review of this case study. The authors would also like to thank Dr Alex Sutherland for his helpful advice throughout the course of the study.

[97] President's Task Force on 21st-Century Policing (2015). Final Report of the President's Task Force on 21st-Century Policing. Washington, DC: Office of Community Oriented Policing Services.

[98] Merola, L., Lum, C., Koper, C. S., & Scherer, A. (2016). Body worn cameras and the courts: A national survey of state prosecutors, Report for the Laura and John Arnold Foundation. Fairfax, VA: Center for Evidence-Based Crime Policy, George Mason University.

[99] Rogers, C., & Scally, E. J. (2018). Police use of technology: insights from the literature. International Journal of Emergency Services, 7(2), 100-110.

[100] Rogers, C., & Scally, E. J. (2018). Police use of technology: insights from the literature. International Journal of Emergency Services, 7(2), 100-110.

[101] INT01; INT02; INT03: INT04: INT05; INT09 (throughout this case study, interviewee inputs are cited using the using anonymous interview identifiers 'INT01', 'INT02', etc.)

[102] Rogers, C., & Scally, E. J. (2018). Police use of technology: insights from the literature. International Journal of Emergency Services, 7(2), 100-110.; Also see INT06; INT03; INT05; INT08.

[103] Police and Crime Commissioners (PCCs) are publicly elected officials that are responsible for the totality of policing across police force areas in England and Wales, holding both the Chief Constable and the force to account. Association of Police and Crime Commissioners. 2019. 'Role of the PCC.' Association of Police and Crime Commissioners [online], 2019. As of 27 January 2020, available at: https://www.apccs.police.uk/role-of-the-pcc/.

[104] https://www.westyorkshire-pcc.gov.uk/media/92443/item_6_report_on_bwv.pdf

officers.[105] Similarly, in the Netherlands,[106] an evaluation of five regional police forces found that police officers employed BWCs because they perceived that they could reduce the use of force against the police and improve police-citizen relations.[107]

While there has been a rapid growth in the market for BWCs due to these perceived benefits, several barriers still exist to the use BWCs in policing. The necessary equipment, which includes cameras, hardware and back-end software, can be costly.[108] These costs may increase with further requirements that equipment fulfil advanced functions) for example, the live-streaming of video or auto-uploading).[109] Furthermore, with public and police concerns around the legitimacy of BWCs and a dislike of being filmed, issues around data protection and ethics are also cited as barriers to the implementation of BWCs.[110]

The decision to adopt BWCs may influenced by a number of organisational factors. A study was conducted to examine some of these, drawing on responses from 823 agencies in the US.[111] It found that the use of technology, and to a lesser extent the number of specialist units in an organisation (as a proxy for organisational complexity) and formalised procedures (as a proxy for organisational control over officer behaviour), were associated with the decision of an agency to use BWCs. Agencies with larger budgets and those able to engage in collective bargaining were less likely to use BWCs, which was attributed to increased leverage to reject pressure to use technology, which agencies may perceive as limiting police officer discretion. According to the study, other factors, such as educational requirements, measures of vertical differentiation (measured by salary differences) and occupational differentiation (measured by relative number of civilian workers) showed no significant relationship to the decision to use BWCs.[112]

Box 8. The Rialto trial of BWCs in policing in the U.S.

The Rialto trial in the United States constituted one of the earliest outcome evaluations of an experiment with BWCs in the Rialto (California) Police Department in 2012.[113] The study measured the impact of cameras on officer behaviour, specifically the effect of videotaping police-public encounters on incidents of the police's use of force and complaints. The trial found that with BWC use the likelihood of force decreased by half compared to those officers that did not wear BWCs and the number of complaints against officers decreased from 0.7 complaints per 1000 contacts to 0.07 per 100 contacts.[114]

3.3.1.2 Body-worn cameras in the UK

Forty-three regional police forces operate across England and Wales, while Scotland and Northern Ireland each have a single police force covering the entirety of their territory.

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[105] Polisen. 2018. 'Polisen inleder försök med kroppskameror.' *Polisen*, 22 February 2018. As of 27 January 2020, available at: https://polisen.se/aktuellt/nyheter/2018/februari/polisen-inleder-forsok-med-kroppskameror/; INT06

[106] Van Ham, T., Kuppens. J. & H. Ferwerda. (2011). 'Mobiel cameratoezicht op scherp.' Bureau Beke, 2011. As of 8th April 2020, available at: https://www.bureaubeke.nl/doc/2011/2011-06-21%20Cameratoezicht_op_scherp_definitief.pdf

[107] An interviewee (INT03) also noted that the implementation of BWCs was facilitated by increased willingness among officers in the Netherlands to record what they do, and increasing support among the public for surveillance.

[108] Joh, E.E. (2016). Beyond surveillance: Data control and body cameras. *Surveillance & Society*; Also see INT04

[109] van Schelle, F. (2018). Never forget a face? The rise of 'live' body-worn cameras. *Biometric Technology Today*. 4, 5-7.

[110] See INT07; INT08

[111] Nowacki, J.S. & Willits., D. (2016). Adoption of body cameras by United States police agencies: an organisational analysis. *Policing and Society 28*(7), 841-853.

[112] Nowacki, J.S. & Willits., D. (2016). Adoption of body cameras by United States police agencies: an organisational analysis. *Policing and Society 28*(7), 841-853.

[113] Ariel, B., Farrar, W. A., & Sutherland, A. 2015. The effect of police body- worn cameras on use of force and citizens' complaints against the police: A randomized controlled trial. *Journal of Quantitative Criminology*, **31**, 509–535.

[114] Ariel, B., Farrar, W. A., & Sutherland, A. 2015. The effect of police body- worn cameras on use of force and citizens' complaints against the police: A randomized controlled trial. *Journal of Quantitative Criminology*, **31**, 509–535.

Policing in England and Wales is governed by the Home Office, which answers to Parliament and the British public.[115] In Scotland and Northern Ireland, primary responsibility for the police rests with the Scottish Government and the Northern Ireland Department of Justice, respectively.[116] Responsibility for delivering policing services is devolved to regional forces, with the responsibility for each force resting with either a Chief Constable or Commissioner. In addition, Police and Crime Commissioners (PCCs) are elected officials who set the direction of the force and hold the police to account.[117] In Scotland and Northern Ireland, the Scottish Police Authority and the Northern Ireland Policing Board oversee policing and hold the respective Chief Constables accountable.[118]

The police also work closely with two independent partners for the purposes law of enforcement. The Crown Prosecution Service (CPS) is a public agency that makes decisions independently of government and the police, and prosecutes criminal cases based on evidence gathered and provided by the police.[119] The College of Policing is an independent professional body that provides an operational function for the police and determines frameworks for standards relating to operations and training, qualifications, development, skills and the knowledge base.[120]

The first pilots of the use of body cameras took place in the UK in the early 2000s, and included a pilot involving head cameras in Plymouth in 2007 (Home Office, 2007), and the first major quasi-experimental study by a UK police force in Hampshire in 2011.[121] By 2017, 71% of UK police forces had adopted BWC technology.[122] In 2017 alone, the UK police spent £22,703,235 and 47,922 body worn cameras were bought (in 2010, £2.2 million was spent on 2,834 cameras).[123] It is worth noting that the growth in the market has not been accompanied by a growth in the number of providers of BWCs – in 2017, there were seven providers in the UK, and the market is dominated by two providers (which held 76% of the market in 2017).[124]

This increase in the use of BWCs has been accompanied by the trialling and rolling out of BWCs in a number of other contexts, most commonly for security guards and enforcement officers across public and private organisations. BWCs have been piloted in recycling centres, by traffic wardens, and by the Driver and Vehicle Standards Agency in the UK[125], security guards in healthcare[126], the Environment Agency[127], bailiffs[128], transport[129], and

[115] http://www.hse.gov.uk/services/police/organisation.htm
[116] https://www.justice-ni.gov.uk/topics/policing-and-community-safety
[117] http://www.hse.gov.uk/services/police/organisation.htm. In London, the Mayor's Office for Policing and Crime (MOPAC) fulfils this function for the Metropolitan Police, while the City of London Police is overseen by the City of London Corporation.
[118] http://www.hse.gov.uk/services/police/organisation.htm
[119] https://www.cps.gov.uk/about-cps
[120] https://www.college.police.uk/About/Pages/default.aspx
[121] Ellis, T., Jenkins, C. & Smith, P. (2015). Evaluation of the introduction of personal issue body worn video cameras, Operation Hyperion) on the Isle of Wight: final report to Hampshire Constabulary. Portsmouth, England: Institute of Criminal Justice Studies, University of Portsmouth.
[122] https://bigbrotherwatch.org.uk/wp-content/uploads/2017/08/Smile-Youre-on-Body-Worn-Camera-Part-II-Police-II.pdf
[123] https://bigbrotherwatch.org.uk/wp-content/uploads/2017/08/Smile-Youre-on-Body-Worn-Camera-Part-II-Police-II.pdf
[124] Other providers in the UK include Edesix, Pinnacle, B-Cam, Veho and Vievu. See: https://bigbrotherwatch.org.uk/wp-content/uploads/2017/08/Smile-Youre-on-Body-Worn-Camera-Part-II-Police-II.pdf)
[125] http://www.digitaljournal.com/pr/3687931
[126] https://www.cambridge-news.co.uk/news/cambridge-news/addenbrookes-body-worn-cameras-rosie-14470368
[127] hhttps://www.gov.uk/government/news/body-worn-cameras-to-help-fight-fisheries-and-waste-crimes
[128] https://www.bbc.com/news/business-49064504
[129] https://www.standard.co.uk/aHR0cHM6Ly93d3cuc3RhbmRhcmQuY28udWsvbmV3cy90cmFuc3BvcnQvYm9keWNhbXMtbGVhZC10by1tYWpvci1yZWR1Y3Rpb24taW4tYXR0YWNrcy1vbi12aXJnaW4tdGdJaaW4tdHJhaW5zLXN0YWZmLWEzOTY0MzExLmh0bWw=;xKl4DMj5ZRpIFmrtw3yeC7Pe6TgqBg5l4k2bLCOOzr4=

in universities.[130] Discussions have also been held within the NHS in the UK to look at the potential for rolling out BWCs for paramedics and nurses.[131]

The main aim of BWCs in these contexts is to reduce incidents of abuse, as well as physical and verbal aggression against staff. BWCs have also been used for other purposes such as training by the military in the US and the Netherlands, and by civilians for private security purposes.[132]

The use of BWCs in the UK is guided by a set of voluntary standards developed by the College of Policing. These include seven principles that provide a strategic underpinning for force policy.[133] Broadly, these relate to the visibility of BWCs, the legality of BWC use, the guidelines regulating an officer's discretionary use of cameras, data storage and use, and how to ensure that BWC use is proportional and legitimate. The use of BWCs must comply with common law, but also with data protection guidelines under General Data Protection Regulation and the Code of Practice on the Management of Police Information, which guides the collection and recording, evaluation, common process, and retention, review and disposal of police information.[134] In addition, following the Regulation of Investigatory Powers Act for surveillance, BWCs must be used overtly – verbal, audio and visual cues are given to indicate that a camera is on.[135] In terms of data storage and use, non-evidential recordings must be destroyed after 31 days. In addition, BWCs only support and cannot replace other forms of evidence gathering.[136] Police forces are required to consult their local communities on the use of body-worn video in order to ensure that its use is proportional to the impact at the local level.[137] Lastly, victims (not suspects) are allowed to request that cameras are switched off.[138] This guidance is complemented by the Surveillance Camera Code of Practice, which also details how privacy impact assessments should be carried out.[139] When considering the roll-out of surveillance cameras, the purpose of the system has to remain justifiable, a consultation has to take place with those who are most likely to be affected, and the impact on their privacy must be assessed.[140]

The adoption and roll-out of BWCs in the UK has gained traction over recent years despite of what has been perceived as a fragmented technology and data-sharing landscape.[141] While the standards governing the use of BWCs are decided by the College of Policing, the purchase and roll-out of technologies, and the adherent management and storage of data from these technologies, are decided by each force.[142] Similarly, the technology and data are managed by the chief police officer in each force according to the Code of Practice on the management of records issued under Section 46 of the Freedom of Information Act 2000, creating a system of devolved control.[143] Nonetheless, four interviewees in the UK felt that the use of BWCs in their force was fairly similar to that of other forces.[144]

[130] https://www.sheffield.ac.uk/polopoly_fs/1.767058!/file/CCTVPrivacyImpactAssessment2018.pdf; https://www.estates.manchester.ac.uk/services/security/ourservices/cctvmonitoringbodyworncamerainformation/; https://www.dur.ac.uk/ig/dp/guidance/bwv/
[131] https://www.theguardian.com/society/2019/may/01/body-cameras-protect-hospital-staff-patients-violence-mental-health-wards.
[132] https://www.marketresearchfuture.com/reports/body-worn-camera-market-2972; http://www.digitaljournal.com/pr/3687931
[133] Guidance updates and replaces the Home Office (2007) Guidance for the Police Use of Body-Worn Video Devices.
[134] https://www.app.college.police.uk/app-content/information-management/management-of-police-information/collection-and-recording/
[135] https://www.app.college.police.uk/app-content/information-management/management-of-police-information/collection-and-recording/; Also see INT03
[136] http://library.college.police.uk/docs/college-of-policing/Body-worn-video-guidance-2014.pdf
[137] http://library.college.police.uk/docs/college-of-policing/Body-worn-video-guidance-2014.pdf
[138] https://www.sciencedirect.com/science/article/pii/S0267364915001454
[139] https://www.gov.uk/government/publications/surveillance-camera-code-of-practice
[140] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/282774/SurveillanceCameraCodePractice.pdf
[141] https://publications.parliament.uk/pa/cm201719/cmselect/cmhaff/515/515.pdf
[142] https://publications.parliament.uk/pa/cm201719/cmselect/cmhaff/515/515.pdf
[143] https://www.app.college.police.uk/app-content/information-management/management-of-police-information/common-process/
[144] INT01; INT02; INT03; and INT04

This devolved control over the technology in the UK is different from other EU contexts. For example, the Swedish[145] and Dutch police[146] both use a centralised model. An interviewee from Sweden noted that the devolved model for technology adoption is similar to the governance model that was used by the Swedish government until 2015[147], in which national boards had an administrative function and the roll-out of technologies was decided regionally. However, according to the interviewee, it was felt that in the previous structure roles of responsibility were unclear and lacked coordination, and was therefore replaced with a centralised structure for data management, storage and the governance of police technology. The interviewee noted that such a centralised system ensured stronger oversight and trust in compliance with regulatory standards, but that the speed of adoption was slowed down by a more centralised and bureaucratic system.

In the UK, several initiatives have been implemented at national level to improve coordination and interoperability. The National Law Enforcement Data Programme combines the functions of the Police National Computer and the Police National Database into a single technology platform to support law enforcement with current and connected information.[148] The 'Network Code' aims to create national standards for forces to follow when they either upgrade or purchase an IT system.[149] The Emergency Services Network Programme was intended to provide the emergency services with an advanced communication system, but has experienced significant delays that have complicated the roll-out of the programme.[150] Several systems are therefore currently being developed to ensure greater interoperability between the systems and processes for technology adoption and data sharing between UK police forces.

3.3.1.3 Description of the innovation

BWCs are small cameras that contain at least one microphone as well as internal data storage for simultaneous audio and video recording.[151] They are typically located on the officer's chest, head or shoulder, with camera mounting on the chest being the most common.[152] A mapping study by the United States Department of Justice found that some cameras also offer other functions such as infra-red illumination, and tend to provide either recording or live streaming functions.[153] For example, some commercially available BWCs offer cloud storage that is managed by the BWC vendor for a recurring fee, while others use hardware that is purchased and maintained locally at police stations.[154]

Each camera can record between 16 and 168 gigabytes of data. They tend to differ in terms of their capability to take still photos and video in low light conditions, and offer battery life of between 3 and 15 hours when recording.[155] In terms of data capture, many BWCs are bundled with back-end software that can include capabilities such as searching, categorising and tagging.[156] The back-end software may also be able to generate multiple types of reports for officers (e.g. daily or historical), perform automated deletion of

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[145] INT06; Eneman, M. (2019). Exploring the emerging body-worn camera practice within the Swedish police. . Research-in-Progress Papers. 70. As of 11 September 2019, available at: https://aisel.aisnet.org/ecis2019_rip/70

[146] INT02

[147] INT06

[148] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/721542/NLEDP_Privacy_Impact_Assessment_Report.pdf

[149] https://publications.parliament.uk/pa/cm201719/cmselect/cmhaff/515/515.pdf

[150] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/721542/NLEDP_Privacy_Impact_Assessment_Report.pdf

[151] https://www.ncjrs.gov/pdffiles1/nij/grants/250382.pdf

[152] https://www.ncjrs.gov/pdffiles1/nij/grants/250382.pdf

[153] https://bigbrotherwatch.org.uk/wp-content/uploads/2017/08/Smile-Youre-on-Body-Worn-Camera-Part-II-Police-II.pdf; https://islanddailytribune.info/body-worn-camera-market-growth-enhancements-and-global-developments-2019-pannin-technologies-digital-ally-vievu/54198/

[154] Find differences in the UK. source: https://www.ncjrs.gov/pdffiles1/nij/grants/250382.pdf

[155] https://www.ncjrs.gov/pdffiles1/nij/grants/250382.pdf

[156] https://www.ncjrs.gov/pdffiles1/nij/grants/250382.pdf

recordings that are set to expire, and provide data analytics on an incident[157] (a facility that also varies between different types of BWC[158]).

3.3.2 Approach and methodology

3.3.2.1 Objectives

This case study draws from existing experiments on body cameras to explore the implementation of a digital technology such as this in the context of policing. While the literature encompasses a large body of empirical work, it has been noted that to date, it has not focused in great depth on the different contexts in which BWCs have been implemented, and therefore (especially in light of contradictory results in some studies) the factors that may influence the extent to which their use is effective. Piza et al. (2019) note that procedural aspects of technology are interrelated, and that procedural and human factors need to complement the technology itself in order to maximise its benefits.[159] In this regard, while divergent results have been observed in BWC studies, they are typically not accompanied by observations and discussion of the contextual factors that help to explain these divergent findings.[160] The authors compare this to the literature on CCTV: whereas the literature relating to BWC has involved a wider range of outcome measures, and the studies are considered to have greater methodological rigour compared to equivalent literature on CCTV (which mostly looks at deterrent effects and is difficult to randomise, given its fixed location), the CCTV research has done more to look at heterogeneity: factors that promote or mitigate the observed effects. In relation to BWCs, there is limited evidence relating to the experience of downstream criminal justice partners and wider stakeholders.[161]

This view is shared by others. As Flight (2018) notes, while there have been many studies relating to the outcomes of body cameras, few have sought to actively investigate the mechanisms underlying the observed impacts, or to assess why the cameras are effective, under what conditions, and for whom.[162] Flight also notes that all major reductions in complaints and the use of force observed in the existing research evidence relate to evaluations in the United States, whereas those in the UK and Canada have observed smaller reductions. There are good reasons, therefore, for hypothesising that organisational or cultural factors specific to a country or policing context may affect the ways in which BWCs are used (and in turn their effectiveness).

This case study aims to add to this literature by focusing closely on the dynamics of camera implementation in a single context – the UK – drawing on the evidence from a number of empirical trials and the wider literature. The aim of this is to explore the dynamics and impact of embedding a digital technology in a specific context; in turn, this identification of key factors will serve to highlight factors that may be similarly important in other policing contexts.

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[157] https://ric-zai-inc.com/Publications/cops-p311-pub.pdf
[158] https://www.ncjrs.gov/pdffiles1/nij/grants/250382.pdf
[159] Piza, E.L., Welsh, B. C., Farrington, D.P., & Thomas, A.L. (2019). CCTV surveillance for crime prevention: A 40-year systematic review with meta-analysis. *Criminology & Public Policy* 18(1), 135-159.; Ariel, B., Sutherland, A., Henstock, D., Young, J., Drover, P., Sykes, J., Megicks, S. & Henderson, R. (2016)."Contagious accountability" a global multisite randomized controlled trial on the effect of police body-worn cameras on citizens' complaints against the police. *Criminal Justice and Behavior* 44(2), pp.293-316.; Flight, S. (2018). Opening up the black box: Understanding the impact of bodycams on policing. *European Law Enforcement Research Bulletin*, 4. As of 02 September 2019, available at: https://bulletin.cepol.europa.eu/index.php/bulletin/article/view/321; Owens and Finn, 2017. Body-worn video through the lens of a cluster randomized controlled trial in London: Implications for future research. *Policing: A Journal of Policy and Practice* 12(1), 77-82.
[160] Piza, E.L., Welsh, B.C., Farrington, D.P. & Thomas, A.L. (2019). CCTV surveillance for crime prevention: A 40-year systematic review with meta-analysis. *Criminology & Public Policy*, *18*(1), 135-159
[161] Todak, N., Gaub, J.E. & White, M.D. (2018). The importance of external stakeholders for police body-worn camera diffusion. *Policing: An International Journal* 41(4), 448-464.
[162] Flight, S. (2018). Opening up the black box: Understanding the impact of bodycams on policing. European Law Enforcement Research Bulletin, 4. As of 02 September 2019, available at: https://bulletin.cepol.europa.eu/index.php/bulletin/article/view/321

3.3.2.2 Methodology

To prepare the case study, an initial review of existing syntheses was conducted to identify evaluations and pilots implemented in the EU.[163] Secondly, an English-language search was conducted for published literature catalogued by Google Scholar, Scopus and Google.com since June 2018 (the date of the literature search conducted for Lum et al. (2019)[164]), using variations of the following search string:

> ("body-worn cameras" OR "body-worn video" OR "body camera" OR "body video" OR "body cameras" OR "bodycam" OR "body-cameras" OR "wearable camera" OR "wearable cameras" OR "wearable video" OR "BWCs") AND (police OR crime OR justice OR "law enforcement" OR "police officer" OR "police authorities" OR officers OR "police departments") AND (outcomes OR experiment OR trial OR evaluation OR study OR review OR research OR pilot OR evidence)

From this, any EU-based experimental and quasi-experimental evaluations were identified, and the full texts reviewed. These primarily included evaluations from the UK, but also a small selection of papers from the Netherlands, Finland and Sweden. Additional UK evaluations were identified from the full-text review. The experimental and quasi-experimental data for each pilot were reviewed and summarised, and factors relating to the wider implementation and administrative consequences of BWCs were identified.

In addition, nine interviews were carried out with expert stakeholders with knowledge of BWCs in the UK policing context. These included individuals from police forces identified through the "acknowledgements" sections of the UK evaluation reports; interviewees suggested by an expert adviser previously involved in academic research relating to BWCs; and other individuals identified through UK news reports as having been involved in decisions relating to or implementation of BWCs at a UK police force. Interviewees were offered anonymity to encourage frank discussion in relation to their views on the utility of BWCs. For this reason, they are cited throughout this report as 'INT01, INT02…' and so on.

Data from the interviews and the review of experimental data were reviewed together to explore the organisational and administrative consequences of BWCs in relation to each framework effect.

3.3.2.3 Limitations

This case study, like others, has a number of limitations, and its findings need to be interpreted bearing these caveats in mind. Foremost, that as a case study based upon existing pilots and literature, this study will share the limitations of the underlying data. In the case of the UK experimental pilots, these include limitations such as low sample sizes, low or unknown compliance with protocols surrounding the use of BWCs, and insufficient numbers of particular incident types (such as violent crime) to effectively measure any change as a result of BWCs. These are discussed under each pilot below. None of the pilots explored whether the changes observed were sustained over a longer period of time post-trial, and therefore it is unclear whether some observed outcomes (such as officer's adherence to protocol or reduced use of force) could have been affected by the "Hawthorne effect" (i.e. that research subjects change their behaviour as a result of being observed by researchers, in a way that does not necessarily endure after the observation period).[165]

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[163] Cubitt, T.I., Lesic, R., Myers, G.L. & Corry, R. (2017). Body-worn video: A systematic review of literature. *Australian & New Zealand Journal of Criminology* 50(3), 379-396; Maskaly, J., Donner, C., Jennings, W.G., Ariel, B. & Sutherland, A. (2017). The effects of body-worn cameras (BWCs) on police and citizen outcomes: A state-of-the-art review. *Policing: An International Journal of Police Strategies & Management* 40(4), 672-688. ; Lum, C., Stoltz, M., Koper, C.S. & Scherer, J.A. (2019). Research on body-worn cameras: What we know, what we need to know. *Criminology & Public Policy* 18(1), 93-118.

[164] Lum, C., Stoltz, M., Koper, C.S. & Scherer, J.A. (2019). Research on body-worn cameras: What we know, what we need to know. *Criminology & Public Policy* 18(1), 93-118.

[165] Wickström, G. & T. Bendix. (2000). The "Hawthorne effect" – what did the original Hawthorne studies actually show? *Scandinavian Journal of Work, Environment & Health* 26(4), 363-367.

Similarly, there are wider challenges in relation to the study of BWCs that should be taken into account. These include, for example, difficulties in the monitoring of criminal justice outcomes from the use of BWCs given long timelines and small samples; an unclear causal relationship for some observed outcomes (for example, whether observed reductions in citizen complaints and the use of force are the result of behavioural changes by citizens or by officers); and for other non-linear relationships between target outcomes (for example, more effective detection leading to an apparent increase in crime).

3.3.3 Results and discussion

In this section, we summarise a series of pilot experiments conducted across the UK and the European Union relating to the use of BWCs in policing. For each pilot, we present information on the scope and background, the design of the study, the key results, and (where available) the limitations of the study. Please note that the main implications of this case study are also discussed in Section 4, in relation to the conceptual framework. In the box below we provide a very brief summary of the main findings that are presented in the following paragraphs.

Box 9. Main findings of Case Study 2: use of BWCs (UK).

- **Productivity gains in terms of cost and time savings** (e.g. reduced workload for police officers) are contrasted with the presence of large quantities of BWC data that may give rise to time-consuming measures. Therefore, maximising efficiency and productivity outcomes depends on the ability to mitigate limitations in the technology itself.

- **Although BWCs might have contributed** towards making policing more effective by reducing crime (e.g. through better evidence for prosecutions), it is difficult to conduct research into the longer-term impacts of this innovation on crime. There are also some risks associated with the expectation that BWC footage will always be available in court, and that this footage is generally infallible.

- **There is general support** for the use of BWCs, both among UK police officers and citizens. However, further evidence on the impact of this innovation on police and citizen behaviour is inconclusive. While police wearing BWCs are less likely to be assaulted than officers without them, and qualitative interviews suggest that cameras may improve police behaviour as their actions are recorded, there is only anecdotal evidence to support these claims.

Table 15. Overview of quasi-experimental and experimental BWC pilots in the UK and a small selection of examples in the European Union.

Where	When	Scope	Study design	Key results	Key limitations

Isle of Wight (UK)[166]	2013-2014	Measuring the impact on crime rates and complaints against police	160 cameras issued to frontline officers
			
			A survey, observation, and semi-structured interviews with police officers
			
			A survey of the public
				• Incidence of crime: some reduction, but BWC-affected crimes increased in Hampshire. Incidents converted into crime increased after BWCs used for domestic assault. Non-significant increase in incidents converted into crime for other offences
				
				• Reduction in minor complaints and serious complaints against police. No change observed in complaints of assaults or procedural complaints
				
				• Increase in public awareness of BWCs
				
				• High levels of support for BWCs for evidence gathering, identifying criminals, increasing convictions, improving training and police disciplinary procedures
				
				• Increase in public belief that the police should wear cameras
				
				• Officer opinion:
				
				   o High level of agreement that it would help in gathering evidence, identifying criminals and reducing complaints
				
				   o Low confidence that cameras would reduce assaults on police
				
				   o High confidence that BWCs would reduce complaints against police
				
				   o Frontline police officers generally more positive about BWCs
					• Crime figures are a relative rather than absolute measure
					
					• Not clear what instruction was given to police concerning the mandatory use of cameras
					
					• Study recorded large discrepancies between different teams in relation to the use of BWCs

[166] Ellis, T. Jenkins, C. & Smith, P. (2015). Evaluation of the introduction of personal issue body worn video cameras, Operation Hyperion) on the Isle of Wight: final report to Hampshire Constabulary. Portsmouth, England: Institute of Criminal Justice Studies, University of Portsmouth. As of 2 August 2019, available at: https://port.ac.uk/media/contacts-and-departments/icjs/downloads/Ellis-Evaluation-Worn-Cameras.pdf

Where	When	Scope	Study design	Key results	Key limitations
London Metropolitan Police (UK)[167]	2014-2015	Impact on complaints against the police, frequency of 'stop and search' incidents and criminal justice outcomes	Metropolitan Police administrative data to measure change with regard to the number of complaints and the number and type of stop and searches, as well as the proportion of arrests and charges for incidents, in order to measure change in criminal justice outcomes. Also included a survey of officers, observations and interviews and a survey of the existing general Public Attitude Survey (PAS) of residents carried out by MOPAC (the Mayor's Office for Policing and Crime)	• Stop and search: no significant difference between treatment and control groups, and no change in officers' self-reported behaviour • Arrests: no significant impact on arrests for violent crimes • Greater availability of evidence, or the use of cameras to collect evidence • Charge rates following arrests: no significant impact (influenced by barriers in the justice pipeline) and no significant impact on the decision to arrest or charge for domestic abuse • Some reduction in overall complaints against the police, and reduction in reports of oppressive behaviour • High level of public support for the use of BWCs. Agreement that BWCs would make officers more accountable and more likely to follow correct procedure • Perception that there could be potential evidential benefits • Officers with BWCs felt more protected against complaints. However, no difference between treatment and control groups with regard to their self-reported perception of public behaviour; procedural justice in policing; use of force; compliance with protocols; or the belief on the part of officers that their behaviour would be challenged	• Some boroughs had shorter trial periods than others • Use of cameras in the treatment groups varied widely • Not all officers in the treatment group were given a camera, and there was some shortage of training

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[167] Grossmith, L., Owens, C., Finn, W., Mann, D., Davies, T & Baika, L. (2015). 'Police, Camera, Evidence: London's cluster randomised controlled trial of Body Worn Video'. As of 11 September 2019, available at: https://whatworks.college.police.uk/Research/Documents/Police_Camera_Evidence.pdf

Where	When	Scope	Study design	Key results	Key limitations

Essex (UK)[168]	2014	Impact of BWCs on domestic violence responses	Randomised control design
			
			Used police administrative data to study the outcomes of incidents and conducted a post-trial officer survey and 15 interviews
				• No difference in the number of incidents
				• No significant difference in sanction detention
				• Charging rates were higher among the treatment group
				• Officer opinion:
				  o 50% felt BWCs were 'a good bit of kit'
				  o 20 out of 37 respondents in the officer survey disagreed with the statement that 'they felt uncomfortable using the camera'
				  o Small number of officers report a change in approach to situations after viewing their own footage
				  o 50% split in the number of officers who wanted to be issued with a camera after the trial
					• Low use may have had an impact
					• Officers from treatment and control groups attended incidents together, leading to possible spill-over effects.

Community policing teams and Environmental Warden services in Renfrewshire, Scotland (UK)[169]	2009-2010	Impact of the use of BWCs on multiple policing outcomes, including crime rates, early guilty pleas and numbers of complaints against police	Police and administrative data to compare year-on-year change in crime rates, complaints against police, and proportion of early guilty pleas Survey with the local community	• Reduction in crime rates in study area and comparison area (might be partially due to the introduction of a new community policing model when the BWCs were introduced) • Early guilty pleas: small reduction • Police perception and complaints: insufficient numbers for analysis • Public opinion: nearly half of respondents felt safer, and greater numbers felt that BWCs reduced crime and anti-social behaviour	• Lack of reporting on the use of cameras • Lack of transferability to a different context

[168] Owens, C., Mann, D., & McKenna, R. (2014). The Essex body worn video trial: The impact of body worn video on criminal justice outcomes of domestic abuse incidents. Ryton-on-Dunsmore, Coventry, England: College of Policing. As of 2 August 2019, available at: https://bwvsg.com/wp-content/uploads/2013/07/BWV_ReportEssTrial.pdf

[169] ODS Consulting (2011). 'Body Worn Video Projects in Paisley and Aberdeen Self Evaluation.' ODS Consulting [Online], July 2011. As of 2 August 2019, available at: https://bwvsg.com/wp-content/uploads/2013/07/BWV-Scottish-Report.pdf

Where	When	Scope	Study design	Key results	Key limitations
				• Cost savings: some estimated potential savings	
Grampian police, Aberdeen (UK)[170]	2010	Impact of the use of BWCs on multiple policing outcomes, including crime rates, early guilty pleas, and numbers of complaints and assaults against police	Three-month pilot Compared year-on-year change in one local area and compared it to wider Aberdeen area Citizen's Panel for Aberdeen was also consulted for public opinion.	• Crime rates: reduction in local area of 26% compared to 1% in wider area. • Early guilty pleas: some effect • Assaults against police: not enough data • Complaints against police: insufficient numbers • Public opinion: less than half had heard about BWCs. Same numbers thought BWCs would make them safer, and more believed that BWCs would make their community safer • Some police officers felt that BWCs contributed to them not being assaulted • Cost savings: some savings as a result of BWCs	• Use of cameras not reported • Lack of transferability of data to a different context
Devon and Cornwall Constabulary, Plymouth (head cameras) (UK) [171]	2006-2007	Testing the use of head cameras by police officers in the city of Plymouth	Data on crime and complaints during the study period compared to the previous year Survey of the public and officers, and some interviews with officers	• Some reduction in violent crime, but external factors are likely to have influenced this • Some increase in detection rate for violent crime and domestic violence, but overall impact on violent crime inconclusive • Small increase in detection attrition rate • Differences in responses to violent incidents • Longer average time to solve a crime • Some anecdotal evidence of cameras leading to early guilty pleas • Some reduction in complaints • Public opinion:	• Officers were able to choose when they used a head camera - the police officers choosing to book out the cameras may generally have been more proactive, which may explain differences in policing outcomes.

[170] ODS Consulting (2011). 'Body Worn Video Projects in Paisley and Aberdeen Self Evaluation.' ODS Consulting [Online], July 2011. As of 2 August 2019, available at: https://bwvsg.com/wp-content/uploads/2013/07/BWV-Scottish-Report.pdf
[171] James, Z. & Southern, R. (2007). 'Plymouth Head Camera Project: Public Relations Evaluation.' University of *Plymouth,* Social Research and Regeneration Unit.

Where	When	Scope	Study design	Key results	Key limitations

				o High awareness of general use of cameras in the UK, but lack of awareness of use in Plymouth
				
				    o Half felt that cameras prevent violence
				
				    o More said they would feel safer
				
				    o Three-quarters felt that cameras were a very good idea
				
				    o Half of victims surveyed were positive about the use
				
				• Officer opinion:
				
				    o Half of officers felt discomfort with cameras
				
				    o Some officers not convinced that BWCs would save time
				
				    o Found the quality of evidence to be the most positive aspect
				
				• Some evidence that less time was spent on administrative processes for officers, with more time spent on foot and mobile patrol.	

West Midlands (UK)[172]	June-December 2014	Impact of BWCs on the use of force by police officers	Six-month randomised control trial Officers were instructed to use a recording in all situations that would usually cause them to make a notebook entry	• 35% reduction in the use of force, although some variation in relation to different types of force	• Small scale of the study; the authors could not provide clear estimates of the size of effects

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[172] Henstock, D. & Ariel, B. (2017). Testing the effects of police body-worn cameras on use of force during arrests: A randomised controlled trial in a large British police force. *European Journal of Criminology* 14(6), 720-750.

Where	When	Scope	Study design	Key results	Key limitations
			Measured use of force by drawing on administrative data routinely recorded by police		

City of London Police (UK)[173]	2014-2015	Impact on perceptions of BWCs and complaints against police	Survey of frontline officers before and after the introduction of BWCs
			
			Qualitative interviews before and after the trial period
			
			Administrative data relating to complaints and early guilty pleas were analysed
				• Small increase in hearings resulting early guilty pleas
				
				• Some reduction in the number of complaints against police
				
				• Officer opinion:
				
				  o Positive about the value of BWCs
				
				  o Strong agreement about the utility of BWCs for evidence-gathering, chances of conviction, reduction in complaints against officers, and identifying criminals
				
				  o Mixed agreement on whether BWCs would reduce crime
				
				  o Mixed answers on the impact of BWCs on an officer's life
				
				  o Mixed views on whether BWCs would reduce complaints
				
				  o Survey results were mixed in relation to the impact on civilian interactions
					• Decrease in the total number of hearings for early guilty pleas may have been caused by external factors
					
					• Complaints and early guilty plea data could not distinguish between officers

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[173] Morgan, J. & Silverstone, D. (2017). 'Trialling body-worn video cameras for City of London Police: officer perceptions and justice outcomes. A report for City of London Police'. As of 11 September 2019, available at: https://www.londonmet.ac.uk/media/london-metropolitan-university/london-met-documents/professional-service-departments/engagement/pr-and-communications/press-release-pdfs/Trialling-body-worn-video-cameras-for-City-of-London-Police-officer-perceptions-and-justice-outcomes.pdf

Where	When	Scope	Study design	Key results	Key limitations
Multiple UK locations (UK)[174]		Testing the earlier results of the Rialto experiment in different police settings, and to providing sufficient statistical power to test the impact on the (relatively rare) incidence of complaints in different settings	10 randomised control trials conducted across eight police forces in six jurisdictions Randomisation according to individual shifts	• No significant difference between the treatment and control arms on the use of force by police • Increase in the use of force among the treatment group at some sites – secondary analysis showed that this was related to compliance with the protocol on use of BWCs. May also have been related to BWCs only being switched on during escalating encounters • Police perception and complaints: 93% reduction in complaints	• Mixture of officers using and not using BWCs could have spill-over effects on behaviour change more widely ('contagious accountability')

Regional unit in Amsterdam, Dutch National Police (Netherlands)[175]	2017-2018	Determining whether body cameras should become standard kit for police officers	Randomised control trial supplemented with questionnaires and in-depth interviews
			
			Analysis conducted on internal registration of violence against the police and log files
				• Crime, assault and charge rates: BWCs had a positive impact on decreasing violence against police officers.
				
				• Officer opinion:
				
				  ○ Overall, officers were satisfied with the performance of BWCs
				
				  ○ Some complaints about battery life and accessibility of recordings, as well as set-up being perceived as cumbersome
					• Findings based on anecdotal evidence

[174] Ariel, B., Sutherland, A., Henstock, D., Young, J., Drover, P., Sykes, J., Megicks, S. & Henderson, R. (2016). "Contagious accountability" a global multisite randomized controlled trial on the effect of police body-worn cameras on citizens' complaints against the police. *Criminal Justice and Behavior* 44(2), 293-316; Ariel, B., Sutherland, A., Henstock, D., Young, J., Drover, P., Sykes, J., Megicks, S. & Henderson, R. (2016b). Wearing body cameras increases assaults against officers and does not reduce police use of force: Results from a global multi-site experiment. *European Journal of Criminology* 13(6), 744-755.; Ariel, B., Sutherland, A., Henstock, D., Young, J., Drover, P., Sykes, J., Megicks, S. & Henderson, R. (2016c). Report: Increases in police use of force in the presence of body-worn cameras are driven by officer discretion: A protocol-based subgroup analysis of ten randomized experiments. *Journal of Experimental Criminology* 12(3), 453-463.; Ariel, B., Sutherland, A., Henstock, D., Young, J., Drover, P., Sykes, J., Megicks, S. & Henderson, R. (2018). Paradoxical effects of self-awareness of being observed: Testing the effect of police body-worn cameras on assaults and aggression against officers. *Journal of Experimental Criminology* 14(1), pp.19-47.

[175] Flight, S. (2019). *Focus: Evaluatie pilot bodycams Politie Eenheid Amsterdam 2017-2018*. The Hague: Politie & Wetenschap [Online] 2019. As of 2 October 2019, available at: https://www.politieenwetenschap.nl/cache/files/5d95bafc1c739PW93A.pdf

Where	When	Scope	Study design	Key results	Key limitations
			Some non-participant observation and training	• Administrative impact: although not generalisable due to the active discouragement of the use of BWCs in the Amsterdam unit by senior leadership, the video recordings were rarely used and few recordings were made by the police	
Helsinki Police Department (Finland)[176]	2015-2015	Investigating aspects that had been highlighted during the trial of 30 cameras in national police forces	Reported on legal and normative frameworks applicable to BWCs	• Identified relevant national and international legislation • BWCs were also found to affect transparency, proximity to service users, neutrality and securing fundamental and human rights	• N/A

Malmö Police (Sweden)[177]	2018	Pilot project aimed at reducing the use of force and threat against the police and improving the collection of evidence.	Six qualitative semi-structured interviews
			
			Web-based survey of police officers
				• Officer opinion:
				  o Training methods were well received
				  o Some wanted clearer guidelines on the use of BWCs
				  o BWCS were found to be easy to use
				  o Some felt the use of BWCs was cumbersome, but explained by being unused to using them
				  o Some found it difficult to know when to switch on the cameras
				  o Mounting of the cameras was a prevalent challenge
				  o Felt that the cameras could have a positive impact on citizen interactions
					• Small-scale study and anecdotal evidence

[176] Poliisihallitus (2017). *Selvitys haalarikameroiden käyttöönotosta poliiisissa*. Työryhmän loppuraportti 2/2017. Poliisihallitus: Helsinki.

[177] Jonsson, E. & Wimmerdahl, E. (2018). *Från Polisens Synsvinkel: Hur poliser i Malmö upplevar kroppskameror som verktyg i det dagliga arbetet*. Malmö Universitet, June 2018. As of 10th October 2019, available at: https://muep.mau.se/bitstream/handle/2043/25374/Kandidatuppsats%20Emelie%20och%20Evangelinn.pdf?sequence=1&isAllowed=y.

Where	When	Scope	Study design	Key results	Key limitations
				o Felt that the cameras could have an impact on the integrity of both police and citizens o Majority did not think BWCs had an impact on their role o Some concerns relating to the use of BWCs for evidence-gathering o Some noted that BWCs could be integrated with other technologies	

Drawing on information from the various experimental and quasi-experimental BWC pilots presented in the previous section, this section discusses BWCs in relation to three different key effects of digital transformation. In line with the core aims of the overall study, these key effects have previously been identified in the context of assessing how ICT-enabled innovations (i.e. BWCs in the present case study) can (potentially) transform the way governments deliver (public) services (in this case, policing). The effects specifically relate to the following elements of the conceptual framework, DigiGov-F, developed in another work package of the overarching study: (a) productivity and efficiency; (b) effectiveness, inclusion and sustainability; and (c) legitimacy. These effects comprise the "outcomes" elements articulated in the conceptual framework, i.e. the (potential) "effects" that are produced because of digital transformation in governments (e.g. through the introduction of new services or processes). Below, we present a discussion of the evidence regarding the outcomes of the use of BWCs in policing against these three specific effects.

3.3.3.1 Productivity and efficiency

Productivity and efficiency (as characterised in the DigiGov-F conceptual framework) relates to the potential for digital technologies to introduce efficiencies into processes, often by replacing or augmenting human activity. In the case of BWCs, this relates to the potential for the use of cameras to enable new forms of working or efficiencies in policing processes. However, the literature to date has focused heavily on outcome measures and has involved less discussion of the impact of cameras on the organisation and administration of policing. Box 10 provides an overview of some of the key findings in relation to the productivity and efficiency outcomes of the use of BWCs in policing.

Box 10. Key findings related to productivity and efficiency outcomes of the use of BWCs in policing.

- So far, opportunities to understand the overall impact of BWCs on system-wide productivity are limited.

- BWCs might result in reduced workload for police officers, e.g. by reducing the time it takes to deliver footage to the police station for enquiries, to write reports on incidents, and the duration of police involvement in lengthy court cases.

- Efficiencies and improvements may increase as further technical functions are made available.

- The presence of large quantities of BWC data may give rise to time-consuming measures (particularly for downstream criminal justice partners).

- Certain infrastructure and processes are necessary to make the most of the functionality of BWCs.

- Interoperability of BWC software with existing and legacy systems may be a barrier.

- Maximising efficiency and productivity outcomes depends on the ability to mitigate limitations in the technology itself.

- Positive efficiency and productivity outcomes might result in cost and time savings (although the relationship is not linear).

Productivity is usually defined as the most efficient use of inputs to maximise the outputs of any process: for example, using the smallest possible amount of materials and manpower (inputs) to create the largest possible number of products (outputs) in a factory. In this regard, a prominent driver for the use of digital technologies is often the perception that their use will increase the efficiency of administrative and backroom processes within

organisations, by allowing processes to be conducted at a higher speed, or to be automated entirely.[178]

However, in the context of policing, as in the wider public sector, this relationship is not always straightforward. O'Hara notes three key ways in which the input-output relationship is complicated by the nature of police work.[179] First, because efficiency does not necessarily mean effectiveness: high rates of arrest (high outputs), for example, may not necessarily be a more efficient or meaningful use of policing inputs if they relate to easy-to-convict, low-impact crimes, and if this use of police time comes at the expense of solving more complex, high-impact crimes (lower but arguably more valuable outputs). (O'Hara notes this may be exacerbated by a need to "demonstrate" effectiveness to a public audience through policing statistics.) Second, because the overall efficiency of policing can only be measured at system level (i.e. including subsequent criminal justice processes), and any efficiency gain for one component may not be reflected in overall productivity if a lack of coordination between components means improvements in policing (e.g. the generation of video evidence) are not used effectively elsewhere in the system (e.g. the use of that video in a court of law) and vice versa. Third, because funding structures may act as a disincentive to higher productivity: a low arrest rate may be used as a case for higher funding.[180] To these, we might also add potential feedback cycles between efficient processes and target outputs: while efficiency gains in backroom processes may, for example, result in more police on the streets (often a prominent political pledge in the UK), an increased police presence may result in the detection of more crimes, therefore generating additional paperwork and requiring more time to deal with those detections.

Impact of BWCs on the efficiency of internal processes

While understanding the overall impact of BWCs on system-wide productivity is beyond the scope of this study, we can explore how the use of cameras may affect the efficiency of existing police processes, whether positively or negatively. While this has not been a focus of the existing literature (which has tended to focus on outcomes), some examples from previous pilots have demonstrated potential savings through the use of BWCs to reduce time it takes officers to carry out regular policing activities, as well as speeding up processes.

For example, Rowe et al. (2017), in a study of a UK police force, observed that a traffic officer, by using a camera to record the scene of a minor accident, could avoid the need to close the road. Likewise, an officer could use a BWC to record footage from a CCTV camera that might otherwise take several days to be delivered to the police station for use in enquiries.[181] The authors also observed officers using footage to write reports after the fact, including one case in which a report was requested two months after the incident. In this case, the officer was able to check the footage in order to write his statement. In an evidence session to the Scottish Parliament on the use of BWCs, police stakeholders also noted potential time savings as a result of officers needing to spend less time in court, because the availability of video replaces the need for an in-person statement. In turn, this reduces the need to change shifts or cancel leave to accommodate court schedules.[182] This point was echoed by UK police force interviewee, who felt there had been a "huge knock-on effect" on

[178] Hoorens, S., Gunashekar, S., Stewart, K., Knack, A. & Deshpande, A. (2019). *Game-changing technologies: Transforming production and employment in Europe.* Brussels, Belgium: Eurofund, 2019. As of 3 October 2019, available at: https://www.eurofound.europa.eu/publications/report/2020/game-changing-technologies-transforming-production-and-employment-in-europe; see also Timan, T. (2013). *Changing landscapes of surveillance: Emerging technologies and participatory surveillance in Dutch nightscapes.* Enschede, Netherlands: University of Twente. As of 3 October 2019, available at: https://ris.utwente.nl/ws/files/6059635/thesis_T_Timan.pdf

[179] O'Hara, P. (1984). 'Introduction'. Public Productivity Review. Vol. 8, No. 3, Symposium: Productivity in Law Enforcement?, pp. 199-206. https://www.jstor.org/stable/3380462

[180] O'Hara, P. (1984). 'Introduction'. Public Productivity Review. Vol. 8, No. 3, Symposium: Productivity in Law Enforcement?, pp. 199-206. https://www.jstor.org/stable/3380462

[181] Rowe, M., Pearson, G. & Turner, E. (2017). Body-worn cameras and the law of unintended consequences: Some questions arising from emergent practices. *Policing: A Journal of Policy and Practice* 12(1), 83-90.

[182] Scottish Parliament (2017). Official report: Justice Sub-Committee on Policing 15 June 2017. Available at: http://www.parliament.scot/parliamentarybusiness/report.aspx?r=11022&i=100698&c=2011531

workload through the reduced need for police involvement in lengthy court cases.[183] Another interviewee from a UK police force noted that they felt the use of cameras had reduced the time spent on complaint investigations, as the video could be used up front in place of written testimony.[184]

In 2017, the UK Home Office tabled plans to potentially allow police to conduct interviews with witnesses and suspects at the scene or "on the spot", rather than requiring them to attend a police station (although the authors note the need to ensure that such interviews are still conducted by specially trained officers where necessary, for example in cases of sexual assault).[185] The Home Office is reconsidering 2017 consultation on using body-worn video to enable the interviewing of witnesses in the field using BWCs, and is currently backing a pilot to test this in Hampshire.[186] In the Plymouth head camera pilot, there was some evidence that use of the cameras made some processes (such as post-arrest processing) more efficient (Home Office, 2017). An interviewee from a UK police force felt that the use of BWCs to take statements could significantly reduce costs as it would no longer be necessary to spend £400 on bringing a suspect into the police station.[187]

Such efficiencies and improvements to existing processes may also increase if more advanced technical functions become available. For example, Bowling and Iyer (2019) give the example of a BWC company developing AI solutions to potentially "tag and flag" camera footage, for example to automatically detect various activities (such as entering a building or undertaking a chase), and to tag parts of the footage to enable quick curation, selection and editing at a later stage, as well as automatically redacting sensitive information, transcribing spoken dialogue in videos to text, and even drafting an accompanying police report on the basis of the footage.[188] An interviewee noted that BWC footage can also be used to flag footage that might lead to early guilty pleas for the CPS, making processes more efficient.[189]

However, it is not a given that the use of cameras will make processes more efficient. Notably, the presence of large amounts of additional data may represent a time-consuming element in its own right, particularly for "downstream" criminal justice partners, who have additional evidence to factor into criminal justice processes. While police officers interviewed in the Isle of Wight pilot were generally positive about BWCs, this positivity was observed to a lesser extent in personnel taking over the post-incident investigation processes, because it "had caused further complications for the processing of hand-over files".[190] The authors also noted a quote from the then-Director of Public Prosecutions about the wider provision of body camera footage to the CPS[191] of "…*the provision to CPS staff of excessive video material, much of which has no immediate relevance to the prosecution in question. Lengthy recordings have been known to arrive without any indication as to what part of the recording should be viewed*".[192]

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[183] INT05

[184] INT04

[185] Bowling, B. & Iyer, S. (2019). Automated policing: the case of body-worn video. *International Journal of Law in Context* 15(2), 140-161.

[186] https://www.telegraph.co.uk/news/2018/11/30/traditional-police-notebook-gives-way-body-worn-video-police/; https://www.telegraph.co.uk/news/2018/11/30/traditional-police-notebook-gives-way-body-worn-video-police/: Also see INT08

[187] INT08

[188] Bowling, B. & Iyer, S. (2019). Automated policing: the case of body-worn video. *International Journal of Law in Context* 15(2), 140-161.

[189] INT08

[190] Ellis, T., Jenkins, C. & Smith, P. (2015). Evaluation of the introduction of personal issue body worn video cameras, Operation Hyperion) on the Isle of Wight: final report to Hampshire Constabulary. Portsmouth, England: Institute of Criminal Justice Studies, University of Portsmouth. As of 2 August 2019, available at: https://port.ac.uk/media/contacts-and-departments/icjs/downloads/Ellis-Evaluation-Worn-Cameras.pdf

[191] In the UK criminal justice system, decisions to prosecute suspects are taken by the CPS on the basis of evidence provided to them by police authorities.

[192] Ellis, T. Jenkins, C. & Smith, P. (2015). Evaluation of the introduction of personal issue body worn video cameras, Operation Hyperion) on the Isle of Wight: final report to Hampshire Constabulary. Portsmouth, England: Institute of Criminal Justice Studies, University of Portsmouth. As of 2 August 2019, available at: https://port.ac.uk/media/contacts-and-departments/icjs/downloads/Ellis-Evaluation-Worn-Cameras.pdf

Merola et al. (2016) report that in a survey of prosecutors' offices in the US, 54% of lead prosecutors felt that BWCs would increase case preparation time, while 56.2% felt it would make it more burdensome or difficult.[193] Thirty per cent of lead prosecutors felt it would lead to delays in case processing or other court delays. Similarly, an interviewee in the UK argued that one of the biggest challenges in the use of BWCs is the devices create one of the largest datasets that law enforcement has ever dealt with.[194] However, strong support was also recorded for their evidentiary value. Concerns about the time required to sift through BWC footage was also highlighted by Todak et al. (2018) in interviews with court stakeholders.[195]

As noted by O'Hara (1984), improvements in the efficiency of one aspect of policing practice may not affect overall productivity if this cannot be effectively integrated with the wider system in which the process is embedded.[196] In this regard, the ability BWCs to make processes more efficient may also depend on having the right infrastructure and processes to make the most of their functionality. For example, during the Metropolitan Police randomised control trial, the authors noted a lack of organisational support for some elements of proper implementation. Inadequate training meant gaps in process, for example with officers (incorrectly) believing they needed to write word for word what was said at a scene, thus increasing paperwork.[197] In the City of London pilot, the authors noted that officers were not taught how to send data to the CPS (although some were doing so on an *ad hoc* basis, for example by developing a document that provided instructions for a prosecutor to access a recording)[198]. The authors concluded that further research should look into how these processes have developed and become formalised since the trialling of the technology. In the Isle of Wight pilot, the authors recommended that the "implementation of a single business process needs to be considered along the occurrence/crime/investigative continuum, so that officers' difficulties with adapting to the requirements of digital evidence are addressed".[199] Todak et al. (2018) interviewing prosecutors about their experiences with BWCs, noted that some prosecutors felt that some protocols for reviewing and processing BWC evidence had not been fully fleshed out, causing tension between them and sending agency.[200] One UK PCC interviewee noted that efforts to develop a single platform with criminal justice partners had not developed as they had hoped, and that the transfer of video footage within the criminal justice system was less than optimal, due to issues such as this.[201] Similarly, an interviewee in the UK noted that a lack of strong infrastructure might lead to outsourcing of entire IT provision in police forces, potentially leading to conflicts between the police and the private company, as well as issues of IT compatibility and data protection.[202]

[193] Merola, L., Lum, C., Koper, C.S. & Scherer, A. (2016). Body-worn cameras and the courts: A national survey of state prosecutors, Report for the Laura and John Arnold Foundation. Fairfax, VA: Center for Evidence-Based Crime Policy, George Mason University.

[194] INT04

[195] Todak, N., Gaub, J. E. & White, M.D. (2018). The importance of external stakeholders for police body-worn camera diffusion. *Policing: An International Journal* 41(4), 448-464.

[196] O'Hara, P. (1984). 'Introduction'. Public Productivity Review. Vol. 8, No. 3, Symposium: Productivity in Law Enforcement?, pp. 199-206. https://www.jstor.org/stable/3380462

[197] Grossmith., L, Owens, C., Finn, W., Mann, D., Davies, T. & Baika, L. (2015). 'Police, Camera, Evidence: London's cluster randomised controlled trial of Body Worn Video'. As of 11 September 2019, available at: https://whatworks.college.police.uk/Research/Documents/Police_Camera_Evidence.pdf

[198] Morgan, J. & Silverstone, D. (2017). 'Trialling body-worn video cameras for City of London Police: officer perceptions and justice outcomes. A report for City of London Police'. As of 11 September 2019, available at: https://www.londonmet.ac.uk/media/london-metropolitan-university/london-met-documents/professional-service-departments/engagement/pr-and-communications/press-release-pdfs/Trialling-body-worn-video-cameras-for-City-of-London-Police-officer-perceptions-and-justice-outcomes.pdf

[199] Ellis, T. Jenkins, C. & Smith, P. (2015). Evaluation of the introduction of personal issue body worn video cameras, Operation Hyperion) on the Isle of Wight: final report to Hampshire Constabulary. Portsmouth, England: Institute of Criminal Justice Studies, University of Portsmouth. As of 2 August 2019, available at: https://port.ac.uk/media/contacts-and-departments/icjs/downloads/Ellis-Evaluation-Worn-Cameras.pdf

[200] Todak, N., Gaub, J.E. & White, M.D. (2018). The importance of external stakeholders for police body-worn camera diffusion. *Policing: An International Journal* 41(4), 448-464.

[201] INT05

[202] INT04

In addition to human processes, a similar concern concerns the interoperability of BWC software with existing and legacy IT. As already discussed, UK police forces are organised autonomously, with IT purchases often made at local force level, and involving the use of multiple criminal justice databases to store different types of information.[203] An interviewee highlighted the fact that this differs from (for example) the Australian context. In Australia, due to the great physical distances between police forces, there has been a centralised push for the implementation of technology to ensure integration and connectivity.[204] The interviewee also noted that the model of devolved control in the UK system would benefit from a single, standardised system facilitating the cross-force roll-out of technologies, as well as a system that can be easily used in collaboration with the CPS.

In the case of body cameras, as noted by one author, the use of disparate databases for parts of the criminal justice process (such as separate ones for emergency calls and for investigations) may also hinder the later integration of BWC data (such as location and facial recognition data) with the current systems used for investigations.[205]

At a more basic level, the use of the cameras to improve processes may also depend on the limitations of the technology itself and the mitigation of technical errors. For example, some studies have observed issues with regard to data transfer[206], battery life[207], bulky equipment[208], audio or visual quality, loss of data such as user ID and date/time due to technical malfunction, human user error[209], other technical faults[210], as well as a lack of associated infrastructure such as docking stations[211]. The lack of infrastructure (e.g. connectivity) may also hinder the full spectrum of use, for example the use of footage "on the spot" or live-streaming to backroom officers. One police officer's account cited in Ellis et al (2015) noted that his equipment had failed while he was conducting a search that the civilian later alleged to have been racially motivated, which led to accusations from seniors that the equipment had been switched off on purpose.[212]

Nonetheless, one UK police interviewee, while acknowledging that it was difficult to quantify and attribute change to cameras alone, felt that cameras had made a "huge impact" on productivity at their force, due to a reduction in complaints.[213]

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[203]https://publications.parliament.uk/pa/cm201719/cmselect/cmhaff/515/515.pdf;
https://www.app.college.police.uk/app-content/information-management/management-of-police-information/common-process/
[204] INT03
[205] Ariel, B., Sutherland, A., Henstock, D., Young, J., Drover, P., Sykes, J., Megicks, S. and Henderson, R. (2016). "Contagious accountability" a global multisite randomized controlled trial on the effect of police body-worn cameras on citizens' complaints against the police. *Criminal Justice and Behavior* 44(2), pp.293-316.
[206] Lister, S., Burn, D. & Pina-Sanchez, J. (2018). 'Exploring the impacts of police use of body-worn video cameras at incidents of domestic abuse'. N8 Policing Research Partnership. Available at: https://n8prp.org.uk/exploring-the-impacts-of-police-use-of-body-worn-cameras-at-incidents-of-domestic-abuse/
[207] Grossmith, L., Owens, C., Finn, W., Mann, D., Davies, T. & Baika, L. (2015). 'Police, Camera, Evidence: London's cluster randomised controlled trial of Body Worn Video'. As of 11 September 2019, available at: https://whatworks.college.police.uk/Research/Documents/Police_Camera_Evidence.pdf
[208] *Ibid.*
[209] Ellis, T. Jenkins, C. & Smith, P. (2015). Evaluation of the introduction of personal issue body worn video cameras, Operation Hyperion) on the Isle of Wight: final report to Hampshire Constabulary. Portsmouth, England: Institute of Criminal Justice Studies, University of Portsmouth. As of 2 August 2019, available at: https://port.ac.uk/media/contacts-and-departments/icjs/downloads/Ellis-Evaluation-Worn-Cameras.pdf
[210] Owens, C., Mann, D. & McKenna, R. (2014). The Essex body worn video trial: The impact of body worn video on criminal justice outcomes of domestic abuse incidents. Ryton-on-Dunsmore, Coventry, England: College of Policing. As of 2 August 2019, available at: https://bwvsg.com/wp-content/uploads/2013/07/BWV_ReportEssTrial.pdf
[211] Grossmith. L., Owens, C., Finn, W., Mann, D., Davies, T. & Baika, L. (2015). 'Police, Camera, Evidence: London's cluster randomised controlled trial of Body Worn Video'. As of 11 September 2019, available at: https://whatworks.college.police.uk/Research/Documents/Police_Camera_Evidence.pdf
[212] Ellis, T., Jenkins, C. & Smith, P. (2015). Evaluation of the introduction of personal issue body worn video cameras, Operation Hyperion) on the Isle of Wight: final report to Hampshire Constabulary. Portsmouth, England: Institute of Criminal Justice Studies, University of Portsmouth. As of 2 August 2019, available at: https://port.ac.uk/media/contacts-and-departments/icjs/downloads/Ellis-Evaluation-Worn-Cameras.pdf; Joh, E.E. (2016). Beyond surveillance: Data control and body cameras. *Surveillance & Society* 2016) Forthcoming.
[213] INT14

The impact of BWCs on policing costs

In considering the potential impact of BWCs on productivity, another pressing concern relates to the potential of BWCs to lower costs within the criminal justice system, thereby reducing the resources (inputs) required to achieve the target outcomes.

Naturally, the use of BWCs comes with the initial up-front costs of the technology itself: the cost of the hardware and software, as well as associated infrastructure costs (for example, additional data storage). Data storage costs have been previously cited as a reason for reluctance of police forces to adopt BWCs[214] and thus may be an "unrecognised" influence on the nature and length of video footage captured by police.[215] (This was echoed by an interviewee who felt that the main cost of implementation was the storage of data, but that this was small in relation to the efficiencies actually achieved[216]). Another interviewee felt that the initial cost-benefit analysis business case for the cameras perhaps "needed more refinement and development" at the time, but that they had proceeded due to the wider benefits of the cameras (e.g. evidentiary value); they found that the published research on BWCs provided some evidence for these benefits.[217]

However, as discussed in the previous section, the use of cameras to make certain processes (such as providing evidence to criminal justice partners) more efficient, as well as potential reductions in the time required to deal with complaints or assaults against officers may result in savings of time or cost. In the two UK pilots (Aberdeen and Renfrewshire) for which the authors conducted a cost analysis, both estimated that the savings generated at system level as a result of increased early guilty pleas outweighed the initial costs to the police themselves of the BWC equipment and installation.

However, as discussed above, the nature of policing may mean that such relationships with cost are not linear. Increases in everyday policing activities (for example, due to a reduction in the amount of time spent in court) may have cost and time implications of their own. Two studies reviewed by Lum et al. (2019) found that the time spent dealing with complaints went down as a result of BWCs (implying cost savings), although one study found that the use of BWCs resulted in a higher number of arrests and a decline in discretionary warnings, with a consequent increase in the processing time required.[218] One interviewee felt that there had been cost savings through a reduction in complaints, but that more time was spent on analysis and disclosure activities (although they felt this was for the right reasons).[219]

The introduction of BWCs may also have cost implications downstream for criminal justice partners. Merola et al. (2016) in a survey of prosecutors' offices in the US found that, when asked about the resources needed to engage with camera footage, 65.4% reported the need for tech upgrades, while 46.3% highlighted the need to hire tech support personnel or for technical training.[220] Fewer respondents reported need to hire additional support personnel (36.7%) or additional prosecutors (22.4%). One interviewee from a UK police force noted that criminal justice partners have been part of national changes to the processes surrounding the management and sharing of data. Investments have been made in technology and effective IT connections between the CPS and police forces in order to use and view video footage, and to handle the integration of footage from the 43 regional forces across England and Wales.[221]

[214] Piza, E.L., Welsh, B.C., Farrington, D.P. & Thomas, A.L. (2019). CCTV surveillance for crime prevention: A 40-year systematic review with meta-analysis. *Criminology & Public Policy* 18(1), 135-159.

[215] Joh, E.E. (2016). Beyond surveillance: Data control and body cameras. *Surveillance & Society*, 2016) Forthcoming.

[216] INT04

[217] INT05

[218] Lum, C., Stoltz, M., Koper, C.S. & Scherer, J.A. (2019). Research on body-worn cameras: What we know, what we need to know. *Criminology & Public Policy* 18(1), 93-118.

[219] INT01

[220] Merola, L., Lum, C., Koper, C.S. & Scherer, A. (2016). Body worn cameras and the courts: A national survey of state prosecutors, Report for the Laura and John Arnold Foundation. Fairfax, VA: Center for Evidence-Based Crime Policy, George Mason University.

[221] INT04

Piza et al. (2019) note that studies may also underestimate the financial benefits of BWCs, for example by failing to fully consider reductions in use of force, which have not been systematically investigated.[222] The authors note that the existing literature provides estimates of the cost of crime, which could potentially be integrated into a future cost-benefit analysis of camera use alongside associated costs (such as the cost of hospital treatment as a result of assaults), as well as other outcome measures suggested by Lum et al. (2015), such as officer compliance with standards, citizens' willingness to call the police, police managerial systems, and the resolution of citizens' complaints.[223]

3.3.3.2 Effectiveness, inclusion and sustainability

Effectiveness, inclusion and sustainability is characterised in the DigiGov-F conceptual framework as outcomes that relate to the effectiveness of the services delivered (e.g. improvements in the provision of public services, internal processes, the relationship between citizens and the government). Box 11 provides an overview of some of the key findings in relation to effectiveness, inclusion and sustainability outcomes from the use of BWCs in policing.

Box 11. Key findings relating to effectiveness, inclusion and sustainability outcomes of the use of BWCs.

- Training and innovative uses of BWCs (for example, to review the behaviour of an officer's dog, use camera data in performance reviews, or to highlight potential gaps in policy) might have some impact on effectiveness, inclusion and sustainability. However, despite some examples of BWC use in training, it is unclear to what extent such measures are being used in practice.

- Although BWCs may have contributed towards making policing more effective by reducing crime, it is difficult to conduct research on the longer-term impact of BWCs on crime.

- BWCs can aid in the production of better-quality evidence for prosecutions by increasing the likelihood of early guilty pleas, the number of incidents that result in criminal charges, or to recall exact quotes or developments during an incidence. Cameras can also be used actively to scan a room or get a better view of the victim. However, it is difficult to measure the longer-term impact of these outcomes.

- Some risks are associated with the expectation that BWC footage is always available in court, and that such footage is generally infallible.

- BWCs can be used to enable advanced policing functions, e.g. BWC footage and live streams can be used as evidence for coroners, to provide a link to mental health practitioners who can review or provide support during an incident, or for intelligence purposes.

- In the future, the use of BWCs could be integrated with artificial intelligence, Big Data, facial recognition technologies and natural language processing, although technological and ethical barriers still exist.

The potential benefits of BWCs suggested in the literature may relate to their potential to reduce and deter crime, whether through direct deterrent effects, better-quality evidence leading to better criminal justice outcomes, or the use of BWCs to increase the capabilities of officers themselves. We discuss the evidence relating to these points below.

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[222] Piza, E.L., Welsh, B.C., Farrington, D.P. & Thomas, A.L. (2019). CCTV surveillance for crime prevention: A 40-year systematic review with meta-analysis. *Criminology & Public Policy* 18(1), 135-159.
[223] Lum, C.M., Koper, C.S., Merola, L.M., Scherer, A. & Reioux, A. (2015). Existing and ongoing body worn camera research: Knowledge gaps and opportunities. George Mason University.

Use of BWCs in training

A further way in which BWCs may have an impact on aspects of effectiveness, inclusion and sustainability relates to their potential use in training, which could (in theory) make police officers more effective at their work.

Although the use of BWCs in training has not formed a prominent aspect of UK trials, it has been observed in some studies[224], sometimes in innovative ways. For example, Rowe et al. (2017) observed the police, after carrying out a property search using a new piece of equipment, employing the footage immediately afterwards as a means to demonstrate the technology to their colleagues. Koen and Willis (2019) meanwhile noted an example of a police dog handler using the footage to review their dog's behaviour.[225] One quasi-experimental study found no notable difference between a group of officers who undertook training with BWCs and a control group, in terms of aspects such as reflective thinking, peer learning or attitudes towards training. The study did, however, find the treatment group more likely to say that they had identified mistakes and recalled more instances of learning.[226] However, as noted by Lum et al. (2019), the effects of this training on learning outcomes or police behaviour have not been widely tested.[227]

Similarly, despite examples of the use of BWCs in training, it is not clear how widely such training using BWCs is carried out in practice. One interviewee from a UK police force felt that training was a highly under-utilised area of use for BWCs and that they had not seen it occurring in practice. They attributed this to people feeling uncomfortable with subjecting others to what they saw as criticism, and felt that BWCs would only be used in this way in the presence of a good leader and staff open to this type of training.[228]

In a survey of officers interviewed for the City of London pilot, none felt that BWCs would be useful in training.[229] In a study of the implementation of BWCs in a US police department, Koen et al. (2018) found that BWC footage was used for training in some cases where alternative video sources (e.g. from YouTube) were not available. BWCs did not otherwise greatly affect the training programme or performance management process.[230]

Conversely, one UK police interviewee reported using video extensively for training within their organisation to highlight gaps in policy or training (using non-evidentiary footage). In particular, it was used to review defensive tactics, and for one-to-one learning and reflective

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[224] For example, Ellis, T., Jenkins, C. & Smith, P. (2015). Evaluation of the introduction of personal issue body worn video cameras, Operation Hyperion) on the Isle of Wight: final report to Hampshire Constabulary. Portsmouth, England: Institute of Criminal Justice Studies, University of Portsmouth. As of 2 August 2019, available at: https://port.ac.uk/media/contacts-and-departments/icjs/downloads/Ellis-Evaluation-Worn-Cameras.pdf;
Grossmith, L., Owens, C., Finn, W., Mann, D., Davies, T. & Baika, L. (2015). 'Police, Camera, Evidence: London's cluster randomised controlled trial of Body Worn Video'. As of 11 September 2019, available at: https://whatworks.college.police.uk/Research/Documents/Police_Camera_Evidence.pdf; Owens, C., Mann, D. & McKenna, R. (2014). The Essex body worn video trial: The impact of body worn video on criminal justice outcomes of domestic abuse incidents. Ryton-on-Dunsmore, Coventry, England: College of Policing. As of 2 August 2019, available at: https://bwvsg.com/wp-content/uploads/2013/07/BWV_ReportEssTrial.pdf; Rowe, M., Pearson, G. & Turner, E. (2017). Body-worn cameras and the law of unintended consequences: Some questions arising from emergent practices. *Policing: A Journal of Policy and Practice* 12(1), 83-90.
[225] Rowe, M., Pearson, G. & Turner, E. (2017). Body-worn cameras and the law of unintended consequences: Some questions arising from emergent practices. *Policing: A Journal of Policy and Practice* 12(1), 83-90; Koen, M.C. & Willis, J.J. (2019). Making sense of body-worn cameras in a police organization: a technological frames analysis. *Police Practice and Research* 1-17.
[226] Phelps et al. (2018) in Lum, C., Stoltz, M., Koper, C.S. & Scherer, J.A. (2019). Research on body-worn cameras: What we know, what we need to know. *Criminology & Public Policy* 18(1), 93-118.
[227] Lum, C., Stoltz, M., Koper, C.S. & Scherer, J.A. (2019). Research on body-worn cameras: What we know, what we need to know. *Criminology & Public Policy* 18(1), 93-118.
[228] INT01
[229] Morgan, J. & Silverstone, D. (2017). 'Trialling body-worn video cameras for City of London Police: officer perceptions and justice outcomes. A report for City of London Police'. As of 11 September 2019, available at: https://www.londonmet.ac.uk/media/london-metropolitan-university/london-met-documents/professional-service-departments/engagement/pr-and-communications/press-release-pdfs/Trialling-body-worn-video-cameras-for-City-of-London-Police-officer-perceptions-and-justice-outcomes.pdf
[230] Koen, M.C., Willis, J.J. & Mastrofski, S.D. (2018). The effects of body-worn cameras on police organisation and practice: A theory-based analysis. *Policing and Society* 29(8), 964-984.

practice.[231] The interviewee felt that this had made an impact on officers' behaviour, and noted that the training department was now "dependent" on body camera footage to sign officers off as sufficiently competent to go on individual patrol. It was also used by managers for performance reviews.

The barriers to the use of BWC footage in training were usually reported as involving concerns over embarrassing individual officers.[232] Koen et al. (2018) also note that, in the context of policing, the use of BWC footage for performance monitoring is also hindered by the difficulty of establishing clear and systematic performance quality goals.[233]

More effective policing to reduce crime

One of the implicit aims of the introduction of cameras is to reduce crime through better policing. However, the nature of the criminal justice system – in which prosecutions may take place over an extended period, and may result from only a small sub-set of policing activities – means that conducting controlled or empirical research on the longer-term impact of BWCs on crime is difficult, and has not featured prominently in the existing literature.

In the UK, three pilots – the Isle of Wight, Aberdeen and Renfrewshire – attempted to estimate the overall impact on crime, by comparing the change in overall crime rates in the pilot areas to that of the wider region. In all three, reductions in crime were recorded in both the treatment and control areas, but reductions were larger in the treatment areas. However, a further study in the US context, which compared the number of emergency calls from street segments being patrolled by officers wearing cameras to those patrolled by officers without, found an increase in calls from areas of "low crime density level", but no effect in crime "hotspots".[234]

Lum et al. (2019) also reviewed evidence relating to other "proactive" behaviours by police, such as proactive stopping and searching of citizens, misdemeanour arrests, and traffic enforcement.[235] As with arrests, results were mixed: three studies found the police initiated more proactive behaviours when using BWCs, while one found no significant impact; one study found evidence of a reduction in the incidence of stop-and-frisk in the US, but another found no effect; and one study found no impact on traffic stops.

Use of BWCs to generate better evidence to aid prosecutions

A more direct link between the use of cameras and service innovation may be the production of better-quality evidence for use in prosecutions. However, as with overall crime rates, the nature and length of the criminal justice process may make empirical research difficult, with the result that little research has been carried out in relation to criminal investigations, despite the ability to generate of evidence often being a key factor in decisions to adopt BWCs.[236] Bowling and Iyer (2019) note that in the UK context, no records appear to be kept with regard to the use of BWC footage in trials, so no data is available to test a direct link between the use of BWC evidence and the administration of justice or sentencing.[237]

However, other evidence does exist from the UK pilots concerning the impact of BWCs on evidence. The pilots in Renfrewshire and Aberdeen provide evidence that the use of cameras may enable an increase in early guilty pleas (a view also expressed by one PCC interviewee[238]). An officer providing evidence to the Scottish Parliament later noted that an

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[231] INT04

[232] Koen, M.C., Willis, J.J. & Mastrofski, S.D. (2018). The effects of body-worn cameras on police organisation and practice: A theory-based analysis. *Policing and Society* 29(8), 964-984.; see also INT01

[233] Koen, M.C., Willis, J.J. & Mastrofski, S.D. (2018). The effects of body-worn cameras on police organisation and practice: A theory-based analysis. *Policing and Society* 29(8), 964-984.

[234] Ariel, B. (2016b). Increasing cooperation with the police using body worn cameras. *Police Quarterly* 19(3), 326-362.

[235] Lum, C., Stoltz, M., Koper, C.S. & Scherer, J.A. (2019). Research on body-worn cameras: What we know, what we need to know. *Criminology & Public Policy* 18(1), 93-118.

[236] Malm, A. (2019). Promise of police body-worn cameras. *Criminology & Public Policy*, *18*(1), 119-130.

[237] Bowling, B. & Iyer, S. (2019). Automated policing: the case of body-worn video. *International Journal of Law in Context* 15(2), 140-161.

[238] INT05

internal review of cases submitted to the prosecuting service over a 13-month period found that 91% of cases involving BWC evidence resulted in early guilty pleas, compared to the national average of 40%. Similarly, 51% of such cases were dealt with at the court of first instance, compared to 31% nationally.[239] Anecdotal evidence of the utility of cameras in providing quality evidence was noted in the Plymouth trial (Home Office, 2007).

While there was no significant difference in the Met Police pilot between the control and treatment group with regard to arrests for violent crime, a higher proportion of violent incidents attended by the BWC-equipped group were flagged as having evidence (28%, compared to 0.2% in the control group), which might imply that more evidence was available due to the use of cameras. In a survey, officers using BWCs also reported greater confidence that they were capturing good-quality evidence than the control group.

The Essex pilot found no differences between treatment and control for the proportion of incidents recorded as crimes, or for rates of arrest. However, a significantly higher proportion of incidents attended by the treatment group resulted in criminal charges, compared with other types of sanction. No significant difference in charge rates occurred between control and treatment in the Met pilot, although the authors note that this may have been the result of barriers to the use of BWC evidence by criminal justice partners, or potentially the pursuing of fewer but stronger cases by the police.

In the same vein, existing research and the interviews offer only anecdotal and qualitative evidence about the utility of cameras in the prosecution process. One interviewee with experience in a UK police force[240] felt that BWCs allowed officers to have the "best" evidence at their fingertips, and that they made discussions between police and prosecutors a lot simpler, more direct and "streamlined". They felt that some cases, particularly those involving assaults on officers, were only brought to court because of video evidence.

Similarly, Merola et al. (2016), in their survey of prosecutors' offices in the US, found that 79.5% of prosecutors supported the use of BWCs, with strong support for the notion that it would help the prosecution more than defence and would improve the ability to prosecute cases.[241] 58.3% felt that it would help increase rates of conviction, while 62.3% felt it would increase the likelihood of plea bargains. Fewer than 10% of lead prosecutors disagreed that it would lead to these results. These findings were echoed by interviews undertaken by Todak et al. (2018) with stakeholders in the US courts, in which many felt that cameras provided clear evidence when otherwise the court would have to rely on the officer's word.[242] One UK police interviewee felt that there was a consistently positive view of the use of BWCs across criminal justice partners, as all agreed on the value of video as evidence.[243]

In studies of BWC implementation, Koen et al. (2018) and Owens, Mann and McKenna (2014) found that officers used BWC footage in reporting, including reviewing it to help them capture detail about the incident (such as suspects' physical reactions) and recall exact quotes.[244] In particular, in Koen et al.'s (2018) study of the implementation of cameras in a US police department, officers were observed to be using camera footage for "complex" cases that would attract scrutiny from supervisors and during legal proceedings, for example

[239] Scottish Parliament (2017). Official report: Justice Sub-Committee on Policing 15 June 2017.
[240] INT03
[241] Merola, L., Lum, C., Koper, C.S., & Scherer, A. (2016). Body worn cameras and the courts: A national survey of state prosecutors, Report for the Laura and John Arnold Foundation. Fairfax, VA: Center for Evidence-Based Crime Policy, George Mason University.
[242] Todak, N., Gaub, J.E. & White, M.D. (2018). The importance of external stakeholders for police body-worn camera diffusion. *Policing: An International Journal* 41(4), 448-464.
[243] INT04
[244] Koen, M.C., Willis, J.J. & Mastrofski, S.D. (2018). The effects of body-worn cameras on police organisation and practice: A theory-based analysis. *Policing and Society* 29(8), 964-984.; Owens, C., Mann, D. & McKenna, R. (2014). The Essex body worn video trial: The impact of body worn video on criminal justice outcomes of domestic abuse incidents. Ryton-on-Dunsmore, Coventry, England: College of Policing. As of 2 August 2019, available at: https://bwvsg.com/wp-content/uploads/2013/07/BWV_ReportEssTrial.pdf

to avoid prosecutors seizing on discrepancies between their statement and the other evidence in later court proceedings.[245]

Some studies provided evidence of officers proactively using cameras to collect better evidence, rather than simply filming encounters. In the Essex pilot, a few officers noted that they deliberately used their cameras to scan the room in order to capture better evidence, or they positioned them to get the best view of the victim. One officer reported standing back to record an intervention by colleagues[246]. One interviewee who had worked with a UK police force noted that video footage allowed the police to translate comments made in non-English languages and to identify whether they were potentially abusive (for example, homophobic or racist language that might aggravate a charge in the UK system).[247] Such opportunities might not be possible without a camera if the officer present did not speak the language.

In particular, the utility of cameras in producing better evidence was highlighted in studies focusing on the use of cameras in response to domestic violence incidents. In the Essex pilot, officers with BWCs highlighted the utility of cameras in capturing context, visible injuries and emotion, thus enhancing impact and displaying things that are difficult to capture in written statements.[248] The potential value of "emotion" on tape was also mentioned by an interviewee in the City of London and Met pilots, as was the capturing the level of aggression of someone accused of a domestic violence incident.[249] Officers interviewed by Lister et al. (2018) also noted that video evidence could be more impactful than written statements, for example if children were visibly upset on the video.[250] They also found that police officers felt BWCs to be a useful tool to help reassure victims and witnesses and record evidence in the immediate aftermath of incidents of domestic abuse. The "reviewability" of the evidence also meant that officers could identify relevant evidence from video that they had failed to notice at the scene, and the nature of video meant that it would provide evidence even if victims and witnesses later chose not to testify. In this regard, the authors noted that BWCs were seen as a "support" mechanism with regard to discretionary decisions, such as whether to make an arrest, as well as being a safeguard against counter-narratives later in the process. An interviewee also felt that witnesses are more comfortable giving statements via BWCs, as it reduces the necessity to come in to the police station to give a statement.[251] Lum et al. (2019) also cite a further study from the United States which found evidence that camera use may have a positive impact on the prosecution of cases involving intimate partner violence.[252]

However, some evidence also points to a potential drawback of BWCs: that the availability of high-quality video evidence in some cases may introduce an expectation on the part of courts and juries that such evidence will always be available – and thus implicitly raise doubts about the strength of cases without such evidence. (A similar concern in relation to forensic evidence is known as the "CSI effect", after the popular television show.)

[245] Koen, M.C., Willis, J.J., & Mastrofski, S.D. (2018). The effects of body-worn cameras on police organisation and practice: A theory-based analysis. *Policing and Society* 29(8), 964-984.

[246] Owens, C., Mann, D. & McKenna, R. (2014). The Essex body worn video trial: The impact of body worn video on criminal justice outcomes of domestic abuse incidents. Ryton-on-Dunsmore, Coventry, England: College of Policing.

[247] INT03

[248] Owens, C., Mann, D. & McKenna, R. (2014). The Essex body worn video trial: The impact of body worn video on criminal justice outcomes of domestic abuse incidents. Ryton-on-Dunsmore, Coventry, England: College of Policing.

[249] Morgan, J. & Silverstone, D. (2017). 'Trialling body-worn video cameras for City of London Police: officer perceptions and justice outcomes. A report for City of London Police'. As of 11 September 2019, available at: https://www.londonmet.ac.uk/media/london-metropolitan-university/london-met-documents/professional-service-departments/engagement/pr-and-communications/press-release-pdfs/Trialling-body-worn-video-cameras-for-City-of-London-Police-officer-perceptions-and-justice-outcomes.pdf

[250] Lister, S., Burn, D. & Pina-Sanchez, J. (2018). 'Exploring the impacts of police use of body-worn video cameras at incidents of domestic abuse'. N8 Policing Research Partnership. As of 2 October 2019, available at: https://n8prp.org.uk/exploring-the-impacts-of-police-use-of-body-worn-cameras-at-incidents-of-domestic-abuse

[251] INT08

[252] Lum, C., Stoltz, M., Koper, C.S. & Scherer, J.A. (2019). Research on body-worn cameras: What we know, what we need to know. *Criminology & Public Policy* 18(1), 93-118.

Merola et al. (2016), in a survey of prosecutors' offices in the US, found that 66.9% of respondents felt jurors would come to expect BWC evidence.[253] The risk that something like the "CSI effect" could undermine cases without video evidence was also cited as a risk by officers interviewed by Todak et al. (2018), as well as by Koen and Willis (2019) – although the majority of interviewees in the latter study felt that this risk to officer "credibility" was outweighed by the overall benefits of BWCs.[254] In a study on the use of cameras in domestic violence incidents by a UK police force, Lister et al. (2018) noted that some victims were reluctant to be filmed, but were also afraid that declining to do so would harm the prospects for their case.[255]

A related risk raised by stakeholders is that the view of video as "infallible" could also be counterproductive if valuable context is left out of video (also noted by INT02). Bowling and Iyer (2019) note that the UK Independent Police Complaints Commission (IPCC) has warned about undue weight being given to BWC footage, given that it might leave out key bits of context before or after the filming, whereas officers' accounts may offer reasons for their decisions and additional details about the encounter that are not captured on video.[256] For this reason, the authors stress the importance of training to ensure that officers integrate BWCs into their policing practice in a way that doesn't undermine the quality of evidence. (The College of Policing guidelines note that video should complement rather than replace officer notes.) Merola et al. (2016) in a survey of prosecutor's offices in the US found that 48.7% had concerns about videos not necessarily reflecting the full events in a case.[257]

On the other hand, some stakeholders have raised concerns that relying on both camera footage and accompanying personal accounts of incidence may also introduce difficulties with regard to prosecution, by allowing defence lawyers to seize upon inconsistencies such differences between the video testimony of the (distressed) victim at the scene, and later in formal statements.[258] Merola et al. (2016), in a survey of prosecutors' offices in the US, found that 44% agreed with the statement that the use of BWCs could introduce discrepancies between video and officer evidence that could be exploited by the defence.[259] In a study on the use of cameras in the handling of domestic violence incidents by a UK police force, Lister et al. (2018) noted the risk that a jury might judge a victim who didn't appear to be sufficiently "distressed" in a video recording, thus exacerbating stereotypes about victimhood.[260]

[253] Merola, L., Lum, C., Koper, C.S. & Scherer, A. (2016). Body worn cameras and the courts: A national survey of state prosecutors, Report for the Laura and John Arnold Foundation. Fairfax, VA: Center for Evidence-Based Crime Policy, George Mason University.

[254] Todak, N., Gaub, J.E. & White, M.D. (2018). The importance of external stakeholders for police body-worn camera diffusion. *Policing: An International Journal*, *41*(4), 448-464; Koen, M.C. & Willis, J.J. (2019). Making sense of body-worn cameras in a police organization: a technological frames analysis. *Police Practice and Research*, 1-17.

[255] Lister, S., Burn, D. & Pina-Sanchez, J. (2018). 'Exploring the impacts of police use of body-worn video cameras at incidents of domestic abuse'. N8 Policing Research Partnership. Available at: https://n8prp.org.uk/exploring-the-impacts-of-police-use-of-body-worn-cameras-at-incidents-of-domestic-abuse/

[256] Bowling, B. & Iyer, S. (2019). Automated policing: the case of body-worn video. *International Journal of Law in Context* 15(2), 140-161.

[257] Merola, L., Lum, C., Koper, C.S. & Scherer, A. (2016). Body worn cameras and the courts: A national survey of state prosecutors, Report for the Laura and John Arnold Foundation. Fairfax, VA: Center for Evidence-Based Crime Policy, George Mason University.

[258] Lister, S., Burn, D. & Pina-Sanchez, J. (2018). 'Exploring the impacts of police use of body-worn video cameras at incidents of domestic abuse'. N8 Policing Research Partnership. Available at: https://n8prp.org.uk/exploring-the-impacts-of-police-use-of-body-worn-cameras-at-incidents-of-domestic-abuse/

[259] Merola, L., Lum, C., Koper, C.S. & Scherer, A. (2016). Body worn cameras and the courts: A national survey of state prosecutors, Report for the Laura and John Arnold Foundation. Fairfax, VA: Center for Evidence-Based Crime Policy, George Mason University.

[260] Lister, S., Burn, D. & Pina-Sanchez, J. (2018). 'Exploring the impacts of police use of body-worn video cameras at incidents of domestic abuse'. N8 Policing Research Partnership. As of 2 October 2019, available at: https://n8prp.org.uk/exploring-the-impacts-of-police-use-of-body-worn-cameras-at-incidents-of-domestic-abuse/

Use of BWCs to enable advanced policing functions

While cameras have primarily been used in pilots to date as a straightforward recording device to capture a specific incident on camera for posterity, there have been some examples of their use for other or more advanced functions.

In the trial of BWCs use by the Metropolitan Police Service, Grossmith et al. (2015) noted other examples of the use of cameras by officers. These included to provide "quick" evidence to coroners; capturing the behaviour of individuals experiencing a mental health crisis, to support the response of health teams; and using footage as a source of intelligence.[261] For example, one interviewee with experience of the UK policing context noted that officers used BWCs during searches to record the layout of the premises, which could then be used by intelligence analysts.[262] The interviewee felt that there had been changes since the introduction of BWCs with regard to the way officers used them. For example, BWCs were used to record footage of statements given at the scene, to write up later. A second interviewee noted that BWCs had changed the way police interacted with partner agencies such as mental health services, as they could share footage from medical episodes (for example, in relation to mental health) with specialist practitioners who could make decisions for care, and provide medical help at the right time.[263]

One interviewee with knowledge of police use of body cameras noted that during one pilot, cameras had also been used to live-stream footage to police headquarters.[264] The interviewee felt this was one of the most promising ways to deploy cameras, although it was dependent on having a good live connection, which was not always available. Similarly, the utility of such a function would depend on someone viewing the footage who had the right training to act appropriately. One example the interviewee provided was of an officer who was in a building that was on fire, who was warned about a store of propane by an officer viewing the live stream. Another example was an incident in which an officer viewing the live stream noticed that a crowd at an incident were becoming aggressive, and was thus able to call in backup more quickly than the officer on the ground.

In the longer term, the integration of other technologies with BWCs could enable more advanced functions. For example, Rogers and Scally (2017) note that BWCs may also enable the live-streaming of crime scenes, which could allow experts to view footage remotely and advise the officers at the scene in real time[265]; one interviewee noted this had previously been piloted in the Dutch trial.[266] One UK police interviewee felt that the next generation of BWCs would include the ability to analyse data in real time, such as facial recognition or geospatial data.[267] Examples of the potential integration of advanced technologies with BWCs are provided below.

a) Using artificial intelligence to handle BWC data and automate policing processes

Artificial intelligence (AI) is the ability of an algorithm or computer-controlled machine to observe its environment, learn, and take intelligent actions based on the knowledge and experience gained.[268] In policing, it has been suggested that AI technologies could be used to process large amounts of data and automate mechanical processes for decision-making, detection and control.

[261] Grossmith, L., Owens, C., Finn, W., Mann, D., Davies, T. & Baika, L. (2015). 'Police, Camera, Evidence: London's cluster randomised controlled trial of Body Worn Video'. As of 11 September 2019, available at: https://whatworks.college.police.uk/Research/Documents/Police_Camera_Evidence.pdf
[262] INT03
[263] INT04
[264] INT02
[265] Rogers, C. & Scally, E.J. (2018). Police use of technology: insights from the literature. *International Journal of Emergency Services* 7(2), 100-110.
[266] INT02
[267] See also van Schelle, F. (2018). 'Never forget a face? The rise of 'live' body-worn cameras.' *Biometric Technology Today* 4*, 5-7.* Bowling, B. & Iyer, S. (2019). Automated policing: the case of body-worn video. *International Journal of Law in Context* 15(2), 140-161.
[268] http://publications.jrc.ec.europa.eu/repository/bitstream/JRC113826/ai-flagship-report-online.pdf

With regard to BWCs, for example, this could include: real-time monitoring of video streams to decide whether a BWC should record (e.g. according to the status of a police car or its emergency lights, if the GPS location of the officer indicates she is on her way to a high-risk call, and/or according to the officer's heartrate), or to flag suspicious behaviour or circumstances (for example, immediately initiating a link to police command if an officer fires a weapon).[269] The use of AI technologies could also automate many of the flagging and editing processes that are currently performed by humans, such as reconstructing the layout of a crime scene and attaching tags and descriptors to the various objects and scenarios caught on video (such as adding a flag to a video as a situation escalates, for later review), as well as the automated redaction of faces or sensitive data.[270] Whereas some of these functions are starting to be built into existing camera functionality – for example, US police body cameras can use AI software to categorise video captured by BWCs[271] – the use of AI technology linked to body cameras may face certain ethical and technical barriers.

b) Integrating facial recognition and AI technologies with BWCs to constitute part of the real-time face recognition infrastructure

Facial recognition technologies recognise a subject through his/her facial image using deep-learning technology to map facial features based on biometric data.[272] Several different types of facial recognition exist, including face matching, detection, and re-identification. Facial recognition uses algorithms to match a person's face to one held in a database; face detection identifies the presence of a face; and face re-identification spots recurrences of the same face. Facial recognition is often combined with and employed through AI systems that can learn from previously matched faces for greater automation and increased accuracy. It can be used, as one interview noted, to speed up the processing of evidence and track the movement of an individual over time.[273]

Facial recognition is currently used for video surveillance with eGates in some airports, to login to mobile phones and computers, and for safety purposes by a ride-sharing company in the Middle East[274]. The technology has, however, run into issues in the UK due to ethical concerns over its use. For example, although facial recognition has been deemed lawful by the courts, a shopper in South Wales brought a legal challenge against the police for using facial recognition technology, based on privacy and equality concerns.[275]

However, many commentators (including some of the stakeholders we interviewed) suggest that a clear trajectory for BWCs will be the integration of facial recognition capabilities, to enable police to immediately identify or validate the identity of a suspect, or to undertake proactive policing.[276]

Similarly, as with static CCTV, the use of facial recognition may run into significant challenges in terms of ethics and public opinion. Interviewees noted that there is a public

[269] https://www.ibmbigdatahub.com/infographic/body-worn-camera-analytics-helping-fight-crime; Bowling, B. & Iyer, S. (2019). Automated policing: the case of body-worn video. *International Journal of Law in Context* 15(2), 140-161.

[270] https://www.mckinsey.com/~/media/mckinsey/featured%20insights/artificial%20intelligence/applying%20artificial%20intelligence%20for%20social%20good/mgi-applying-ai-for-social-good-discussion-paper-dec-2018.ashx; see also: INT08; *Biometric Technology Today* (2017).' Facial recognition boost police bodyworn camera systems.' *Biometric Technology Today* 8, 11-12.

[271] https://www.inc.com/will-yakowicz/axon-artificial-intelligence-software-lapd-body-camera-footage.html; https://www.bwctta.com/resources/commentary/view-body-worn-camera-auto-triggering-technologies;

[272] Glabally, J., Ferrara, P., Haraksim, R., Psyllos, A., Beslay, L. 2019. 'Study on the Face Identification Technology for its Implementation in the Schengen Information System.' Luxembourg: Joint Research Centre, April 2018. As of 2 October 2019, available at: http://publications.jrc.ec.europa.eu/repository/bitstream/JRC116530/sis_face-jrc_science_for_policy_report_22.07.2019_final.pdf.; https://bigbrotherwatch.org.uk/wp-content/uploads/2018/05/Face-Off-final-digital-1.pdf

[273] https://bigbrotherwatch.org.uk/wp-content/uploads/2018/05/Face-Off-final-digital-1.pdf

[274] van Schelle, F. (2018). 'Never forget a face? The rise of 'live' body-worn cameras.' *Biometric Technology Today* 4, 5-7.

[275] Rees, J. (2019). 'South Wales Police use of facial recognition ruled lawful.' BBC News 4 September 2019. As of 2 October 2019, available at: https://www.bbc.co.uk/news/uk-wales-49565287.

[276] van Schelle, F. (2018). 'Never forget a face? The rise of 'live' body-worn cameras.' *Biometric Technology Today* 4, 5-7. Also see INT08, INT05, INT04.

backlash against the use of facial recognition because it is seen as state surveillance[277]; that the public are reluctant to see the role of BWCs move beyond being a "natural extension" of the police officer[278]; that facial recognition might not provide added value because the police often deal with known suspects and facial recognition technology would be costly[279]. The use of facial recognition technologies has also encountered wider issues in relation to the accuracy of its data. Facial recognition technology struggles with processing data in "complex" environments, and the use of BWCs will require live streaming and wireless connectivity to ensure that facial recognition tools can be used in real time.[280] Moreover, recognition rates tend to create more false positives for races other than white, while simultaneously facial recognition tends to work less well on people of colour and women.[281]

c) Using natural language processing (NLP) to automatically capture spoken and written text, thereby saving time on video review and transcription

Automated text generation or NLP is the use of computational techniques or artificial intelligence to understand, produce and learn human language content.[282] NLP is largely driven by computational statistics and models that try to capture language, text, and sentiments.

For the police, the use of NLP to analyse body camera footage may reduce the hours and resources required for video management, review, and transcription.[283,284] For example, NLP can automate the recording of licence plates and other text captured on body-camera footage or the automated transcription of conversations. Further ahead, software may also be able to automate the generation of draft police reports based on video footage.[285]

However, there are both operational and societal barriers to the use of NLP, both at large in policing and together with BWCs. Developments in NLP in the areas of sentiment and facial analysis lag behind textual analysis.[286] There are also challenges overall in ensuring that NLP provides a correct interpretation of the subject matter, and that the models are built with inherent biases. These challenges are even greater for NLP that is based on audio, video or speech.[287] Furthermore, while NLP may reduce the cost of transcribing interviews, developments are likely to rely on a hybrid approach that incorporates human intervention to check the interpretation of the text, requiring the employment of personnel who have the appropriate capabilities to carry out such analysis.[288] Significant challenges also exist in terms of AI being able to interpret the context and reasoning related to the language.[289] The use of NLP by the police using BWCs is therefore likely to rely on whether it helps them to achieve adequate textual output in an efficient way.[290]

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[277] INT01

[278] INT02

[279] INT04

[280] van Schelle, F. (2018). 'Never forget a face? The rise of 'live' body-worn cameras.' *Biometric Technology Today.* 4, 5-7.

[281] Open Data Science (2018). 'The Impact of Racial Bias in Facial Recognition Software.' *Open Data Science* 15 October 2018. As of 2 October 2019, available at: https://medium.com/@ODSC/the-impact-of-racial-bias-in-facial-recognition-software-36f37113604c.; Introna, L. & Nissenbaum, H. (2010). 'Facial Recognition Technology: A Survey of Policy and Implementation Issues.' New York: New York University: The Centre for Catastrophe Preparedness and Response. As of 2 October 2019, available at: https://eprints.lancs.ac.uk/id/eprint/49012/1/Document.pdf#; See also INT07.

[282] Engineering and Physical Sciences Research Council. n.d. 'Natural Language Processing.' EPSRC [Online] n.d. As of 2 October 2019, available at: https://epsrc.ukri.org/research/ourportfolio/researchareas/natlangproc/.

[283] https://www.ibmbigdatahub.com/sites/default/files/infographic_file/Flipping-Camera-Footage-infographic-Final.pdf

[284] https://www2.deloitte.com/us/en/insights/focus/cognitive-technologies/natural-language-processing-examples-in-government-data.html#endnote-sup-2

[285] https://uk.axon.com/case-studies/insights/our-leader-s-views-on-ai-research/

[286] Ruder, S. (2019). 'The 4 Biggest Open Problems in NLP.' *Ruder* 15 January 2019. As of 2 October 2019, available at: http://ruder.io/4-biggest-open-problems-in-nlp/

[287] Ruder, S. (2019). 'The 4 Biggest Open Problems in NLP.' *Ruder* 15 January 2019. As of 2 October 2019, available at: http://ruder.io/4-biggest-open-problems-in-nlp/

[288] https://www.houseofbots.com/news-detail/4607-1-understanding-the-term-nlp-and-what-are-the-challenges-on-its-way

[289] https://www.technologyreview.com/s/602094/ais-language-problem/

[290] https://arxiv.org/pdf/1703.09902.pdf

d) Using Big Data analytics to predict, prevent and measure crime based on information from BWCs and other sources

Big Data analytics refers to the strategy of analysing large amounts of data (often using AI) often produced at a high speed from diverse sources such as sensors, machines, satellite imagery, digital pictures and video, and GPS signals.[291] In policing, Big Data analytics can be used to analyse data automatically captured from BWCs and other sources such as licence plate readers, informational databases and geospatial data. It may be able to measure qualitative risks in single incidents, predict future criminal activity, and make predictions based on an individual's network by connecting facial recognition with other sources. Big Data analysis can be used to carry out mass surveillance and constitutes part of the DNA collection processes of the police.[292]

The nature of wearable cameras means that vast amounts of data on police-public interactions can be potentially recorded and analysed at a later date using Big Data analytics. However, the use of camera footage as Big Data has not been explored in depth in the literature, and no interviewees could provide examples of this being used in practice, with the exception of an interviewee who reported that metadata from cameras was being used to analyse usage patterns, to see which parts of the force were using them and what types of were was being stored and used.[293] In the UK context, guidelines on the swift deletion of data not marked as evidence may also introduce key barriers to the use of footage for wider analysis.

However, a more immediate use of Big Data analytics in relation to camera footage may be its application for wider research into police interactions. Since the widespread adoption of BWCs, a number of researchers have used body camera footage in the US as a dataset for wider academic research about police behaviour; for example, researchers have used body camera footage as a dataset to examine how the race of the citizen affects the language used by police during traffic stops.[294]

3.3.3.3 Legitimacy

Legitimacy, as characterised in the DigiGov-F conceptual framework, refers to outcomes that relate to the potential to increase participation and civic engagement and make government more responsive, transparent, and accountable.

This is highly relevant to the most common justification for the use of BWCs: that they help to increase accountability and governance of policing operations by introducing the ability for third parties to review incidents to assess the appropriateness of behaviour on the part of both the police and the public. One study details four ways in which BWCs can achieve this: the deterrence of oppressive behaviour due to the fact of filming; greater compliance (conscious or unconscious) with process and procedure, with the result that the public perception of fairness and procedural justice improves; increased civility on the part of the public; and protection of the police from groundless allegations.[295] Box 12 provides an overview of some of the key findings relating to legitimacy outcomes of the use of BWCs in policing. These are examined below.

[291] European Commission. n.d. 'Big Data.' *European Commission* n.d. As of 2 October 2019, available at: https://ec.europa.eu/digital-single-market/en/policies/big-data.

[292] https://digitalcommons.law.uw.edu/cgi/viewcontent.cgi?article=4797&context=wlr

[293] INT01

[294] Voight, R., Camp, N.P., Prabhakaran, V., Hamilton, W.L., Hetey, R.C., Griffiths, C.M., Jurgens, D., Jurafsky, D. & Eberhardt, J.L. (2017). Language from police body camera footage shows racial disparities in officer respect. *Proceedings of the National Academy of Sciences* 114(25), 6521-6526.

[295] Owens, C. & Finn, W. (2017). Body-worn video through the lens of a cluster randomized controlled trial in London: Implications for future research. *Policing: A Journal of Policy and Practice* 12(1), 77-82.

Box 12. Key findings relating to legitimacy outcomes of the use of BWCs.

- Strong support and internal legitimacy for the use of BWCs has been recorded among UK police officers, although some felt that BWCs can present some administrative difficulties and increase their workload.

- Evidence on the impact of BWCs on complaints, as a proxy for police behaviour, is mixed. When positive effects are observed, these do not continue in the long term, offering little evidence on the sustainability of positive outcomes.

- There is some evidence that BWCs can affect citizen behaviour, although evidence is mixed. For example, police with BWCs are less likely to be assaulted than other officers without BWCs. BWCs may also reduce spurious complaints against officers, although there is only anecdotal evidence to support this.

- The impact of BWCs on officer adherence to procedure and protocols shows mixed results. Qualitative interviews with officers suggest that cameras can change their behaviour.

- However, the police have not always been positive about BWCs. Some officers felt bound by strict procedures and unable to use their own discretion to adapt practice.

- Strong public support in support of the use of BWCs has been recorded. Some studies also highlight that BWCs can enable the public to better understand the perspective of the police.

Internal legitimacy of BWCs

A significant portion of research on BWCs has focused on the perceptions and feelings of officers towards their use, often through survey-based research. In the UK pilots, strong support for the use of BWCs was recorded among officers, often on the grounds that it would help to protect them against complaints.[296] In a synthesis of wider research, Lum et al. (2019) found that in many studies, officers' feelings towards BWCs improved over time (either positively or towards a neutral stance), possibly because officers come to see the cameras as protecting them from complaints, or because they felt BWCs would improve their own behaviour (although a couple of studies also found scepticism on this latter point).[297]

Some surveys also have found positive feelings among police towards the role of BWCs in helping to gather reliable evidence. An interviewee in the UK felt that cameras had been very positive for workforce morale since they had been implemented, and were accepted as a good investment.[298] Meanwhile, surveys that recorded negative sentiment among officers tended to focus on specific concerns: for example, that BWCs presented administrative difficulties (specifically, downloading data) and increased workload; concern that recording may make officers more hesitant to react in some situations; as well as concern that footage would be used against officers themselves. One interviewee noted that police officers have traditionally worked on their own, and therefore away from the scrutiny enabled by digital

[296] Ellis, T., Jenkins, C. & Smith, P. (2015). Evaluation of the introduction of personal issue body worn video cameras, Operation Hyperion) on the Isle of Wight: final report to Hampshire Constabulary. Portsmouth, England: Institute of Criminal Justice Studies, University of Portsmouth. As of 2 August 2019, available at: https://port.ac.uk/media/contacts-and-departments/icjs/downloads/Ellis-Evaluation-Worn-Cameras.pdf;
Grossmith, L., Owens, C., Finn, W., Mann, D., Davies, T. & Baika, L. (2015). 'Police, Camera, Evidence: London's cluster randomised controlled trial of Body Worn Video'. As of 11 September 2019, available at: https://whatworks.college.police.uk/Research/Documents/Police_Camera_Evidence.pdf; Morgan, J. & Silverstone, D. (2017). 'Trialling body-worn video cameras for City of London Police: officer perceptions and justice outcomes. A report for City of London Police'. As of 11 September 2019, available at: https://www.londonmet.ac.uk/media/london-metropolitan-university/london-met-documents/professional-service-departments/engagement/pr-and-communications/press-release-pdfs/Trialling-body-worn-video-cameras-for-City-of-London-Police-officer-perceptions-and-justice-outcomes.pdf
[297] Lum, C., Stoltz, M., Koper, C.S. & Scherer, J.A. (2019). Research on body-worn cameras: What we know, what we need to know. *Criminology & Public Policy* 18(1), 93-118.; see also INT01, INT02.
[298] INT05.

technologies, and that the reaction to BWCs was similar to that towards other digital technologies such as mobile phones with tracking capabilities.[299]

Spencer and Cheshire (2017), in a review of the implementation of BWCs among a UK police force over the course of a decade, noted that a significant piece of learning was that in order to effectively embed the technology within the policing context, users need to "recognise the need" for BWCs and "want to use it".[300] An initial pilot using head-mounted cameras was considered unsuccessful, with officers finding them uncomfortable (with impractical wiring), potentially making them self-conscious when patrolling. The pilot also involved cumbersome administrative requirements, including the need to download video to two CD-ROMs. This put off the majority of users, who were unconvinced of the benefits. However, a small group remained keen on the technology, and were transformed over time into a formal BWC "champion" group internally, demonstrating their use to colleagues, providing credibility and assurance, and "product testing" the new BWCs once a decision was taken to develop their use. In this regard, the authors note that the "momentum of acceptance" increased as more "good news stories" were disseminated among the workforce. (One interviewee also noted the importance of "early adopters" in the roll-out of BWCs in another UK police force.[301])

The simplicity of the infrastructure and user-friendly practices were seen by the authors as key to increasing the confidence of officers in the use of BWCs. In this regard, the authors felt a common "journey" in relation to the technology (albeit at different speeds for different individuals) began with initial reluctance, followed by acceptance of the presence of BWCs but a position that they would not use it; then a move towards "I will use it if I have to"; followed by a preference for patrolling with a camera, and finally feeling invested in the technology to the extent that they look forward to better technology.[302]

With the exception of a couple of papers, the existing literature does not focus in much depth on the impact of BWCs on management methods and working culture, and how these may influence officers' use and reaction to BWCs. Interestingly, two studies reviewed by Lum et al. (2019) found a relationship between positive sentiment towards BWCs and officers' positive perceptions of organisational justice, although this relationship was not observed when one of the studies was repeated in a different agency, or by another, separate study.[303] One study found that officer "burnout" was greater among officers using BWCs, who also felt they had less organisational support.[304]

The impact of BWCs on officer behaviour

Research to date which has focused on the accountability of officers has often done so by using public complaints as a proxy, although it can be difficult to tell if improvements are the result of improved officer behaviour or a reduction in the number of spurious complaints (the latter are discussed below).

As noted previously, protection from complaints is often cited by officers as a key benefit of cameras, or as a potential source of time and cost savings. However, the evidence in relation to the impact of BWCs on complaints is mixed. In the UK pilots, a drop in complaints was recorded in Plymouth and in the Isle of Wight compared to the wider region as a control, but with differences in the type of complaint (with no change for procedural or assault-related complaints compared to the previous year). In the Metropolitan Police trial, the researchers observed an overall reduction in complaints, but with some pilot boroughs displaying (non-significant) higher rates of complaints than control sites. Interestingly, in the global multi-site study by Ariel et al. (2016), complaints reduced significantly compared

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[299] INT03

[300] Spencer, D. & Cheshire, R. (2017). Ten years of body worn video in Northamptonshire police. *Policing: A Journal of Policy and Practice* 12(1), 116-119.

[301] INT03.

[302] Spencer, D. & Cheshire, R. (2017). Ten years of body worn video in Northamptonshire police. *Policing: A Journal of Policy and Practice* 12(1), 116-119.

[303] Lum, C., Stoltz, M., Koper, C.S. & Scherer, J.A. (2019). Research on body-worn cameras: What we know, what we need to know. *Criminology & Public Policy* 18(1), 93-118.

[304] Adams I. & Mastracci, S. (2018) in Lum, C., Stoltz, M., Koper, C.S. & Scherer, J.A. (2019). Research on body-worn cameras: What we know, what we need to know. *Criminology & Public Policy* 18(1), 93-118.

to the previous year for both the control and treatment group, which the authors hypothesise may be the result of "contagious accountability": a general effect of improved behaviour across the organisation through the adoption of new norms as a result of the adoption of BWCs.[305]

Similarly, in a wider review of (quasi-)experimental evidence, Lum et al. (2019) found 22 studies that measured the impact of BWC on citizen complaints, as a proxy for officer behaviour. While the majority found a relationship between the use of BWCs and reduced numbers of citizen complaints, a smaller number of studies demonstrated unclear or non-significant results[306]; Owens and Finn (2017) note that while various studies show a reduction in complaints, the extent of the reduction varies. This may be the result of study design or of differences in contextual factors.[307]

Other studies have made use of administrative data or other measures to examine the use of force by officers. In their global multi-site trial, Ariel et al (2016b) found no significant difference in the use of force among officers in treatment and control groups when averaged across 10 trials, which the authors suggest may be the result of BWCs "inflaming" already-tense encounters.[308] Examining the data from one UK site (West Midlands) in greater detail, Henstock and Ariel (2017) found that the use of force declined in treatment compared to control, but differently across different types of force: treatment groups had lower odds of physical restraint and non-compliant handcuffing, but an increase in compliant handcuffing. There was no difference in "more aggressive" uses of force (albeit with small sample sizes). Faced with this counterintuitive result, the authors suggest that BWCs could produce unintended consequences by increasing tension in certain (but not all) situations, leading to the officer making an early intervention of compliant handcuffing before the situation escalates; that the increase is explained by officers being more diligent in their reporting of compliant handcuffing as a use-of-force event in light of the camera's presence; or that it is the result of greater police adherence to procedure as a result of "being observed", thereby increasing the instances in which they feel compelled to make an arrest where otherwise they may have let the behaviour slide.

Similarly, Lum et al. (2019) found 16 studies that measured the reported use of force by officers, with mixed evidence.[309] Four experimental and one quasi-experimental study found reductions in the use of force among officers wearing BWCs (compared to a non-BWC control group), with a follow-up study finding the effect was sustained over time. However, four other experimental studies and a further four quasi-experimental studies found no significant differences between officers wearing BWCs and those without, with the direction of the non-significant effect not consistent across these latter studies.

Even among those studies that have observed a positive effect of camera use on (a proxy for) officer behaviour, the majority used only short timeframes to examine the use of force, thus offering little evidence in relation to the sustainability of the effect observed. One exception is Koslicki et al. (2019), who used a time series analysis to test whether the effect on use of force in a US police force was sustained after an initial period, based on administrative use-of-force reports.[310] After the first month of implementation there was a non-significant drop in the use of force incidents. This was followed by a steady, significant increase for every month that followed, until the use of force reached pre-BWC levels after

[305] Ariel, B., Sutherland, A., Henstock, D., Young, J., Drover, P., Sykes, J., Megicks, S. & Henderson, R. (2016). "Contagious accountability" a global multisite randomized controlled trial on the effect of police body-worn cameras on citizens' complaints against the police. *Criminal Justice and Behavior* 44(2), 293-316.

[306] Lum, C., Stoltz, M., Koper, C. S. & Scherer, J. A. (2019). Research on body-worn cameras: What we know, what we need to know. *Criminology & Public Policy* 18(1), 93-118.

[307] Owens, C. & Finn, W. (2017). Body-worn video through the lens of a cluster randomized controlled trial in London: Implications for future research. *Policing: A Journal of Policy and Practice* 12(1), 77-82.

[308] Ariel, B., Sutherland, A., Henstock, D., Young, J., Drover, P., Sykes, J., Megicks, S. & Henderson, R. (2016b). Wearing body cameras increases assaults against officers and does not reduce police use of force: Results from a global multi-site experiment. *European Journal of Criminology* 13(6), 744-755.

[309] Lum, C., Stoltz, M., Koper, C.S. & Scherer, J.A. (2019). Research on body-worn cameras: What we know, what we need to know. *Criminology & Public Policy* 18(1), 93-118.

[310] Koslicki, W.M., Makin, D.A. & Willits, D. (2019). When no one is watching: evaluating the impact of body-worn cameras on use of force incidents. *Policing and Society* 1-14.

three years. The authors hypothesise that use of BWCs may influence the immediate behaviour of officers, but that this effect may diminish as use of BWCs becomes normalised.[311] On the other hand, a follow-up to the Rialto study found that the fall in the rate of complaints against the police and police use of force recorded in the initial study was sustained at the four-year follow-up.[312]

In considering the potential impact of cameras on the behaviour of officers, a key question is the discretion afforded to officers in relation to the use of the camera. For example, should it be used in all situations (raising potential privacy concerns[313]), or only in those in which the officer considers there to be a potential need for evidentiary footage, thus potentially allowing officers to use discretion over which of their behaviours are recorded, thereby undermining the accountability effects of wearing a camera.[314] One interviewee noted that the discretionary use of cameras in the Netherlands was game-changing. It increased the use of BWCs seven-fold, because the police "knew that it was their recording" and that they could control its use.[315] In the UK context, guidance by the College of Policing states that use of BWCs is discretionary; this is similar to the model followed in Sweden[316] and the Netherlands[317]. Whereas in the US, some law enforcement interactions must be recorded as a matter of protocol for "all calls of service" relating to law enforcement (while pausing the use of BWCs during a lunch break, for example).[318] [319] In the Isle of Wight pilot (where no guidance was given to officers about their use), the researchers noted a high disparity in the use of the cameras by officers: some used them proactively (e.g. providing commentary and context during the recording), while others simply switched it on at start of incident, and off at end.[320] The authors note that sites at which the project leader was on site made greater use of cameras, thus noting the importance of leadership in setting norms for their proper use. A secondary analysis of the global multi-site trial notably found a difference in line with the discretion afforded to officers in turning on their camera: officers who were given greater discretion over when the BWC unit was recording were more likely to use force than officers who had less discretion, and the use of force actually increased among the high-discretion treatment cohort compared to the control group. The authors suggest this may be the result of officers choosing to turn on the cameras only in hyper-aggressive situations in which force is likely (thus introducing a bias).[321] For this reason, the authors conclude that mandating the use of cameras throughout an entire shift may be a way of addressing concerns about this counterintuitive effect, with the accompanying verbal warning acting as a "nudge" for both parties towards civility.

One interviewee with experience in a UK police force felt that recording everything was impracticable and could heighten tensions in a situation, when officers might otherwise use

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[311] The authors also note that, in general, research in this area may be limited by the 'Hawthorne effect': that research subjects are aware of being observed by the researchers, and therefore moderate their behaviour.

[312] Sutherland, A., Ariel, B., Farrar, W. & De Anda, R. (2017). 'Post-experimental follow-ups—Fade-out versus persistence effects: The Rialto police body-worn camera experiment four years on.' *Journal of Criminal Justice, 53*, 110-116.

[313] Bowling, B. & Iyer, S. (2019). Automated policing: the case of body-worn video. *International Journal of Law in Context* 15(2), 140-161.

[314] Taylor 2016 in Cayli, B., Hargreaves, C. & Hodgson, P. (2018). Body-worn cameras: determining the democratic habitus of policing. *Safer Communities* 17(4), 213-223.

[315] INT02.

[316] INT06.

[317] INT02.

[318] Bowling, B. & Iyer, S. (2019). Automated policing: the case of body-worn video. *International Journal of Law in Context* 15(2), 140-161; https://constitutionproject.org/wp-content/uploads/2016/12/BodyCamerasRptOnline.pdf

[319] These include: calls for service, traffic stops, arrests, searches, interrogations, and pursuits (https://constitutionproject.org/wp-content/uploads/2016/12/BodyCamerasRptOnline.pdf)

[320] Ellis, T. Jenkins, C. & Smith, P. (2015). Evaluation of the introduction of personal issue body worn video cameras, Operation Hyperion) on the Isle of Wight: final report to Hampshire Constabulary. Portsmouth, England: Institute of Criminal Justice Studies, University of Portsmouth. As of 2 August 2019, available at: https://port.ac.uk/media/contacts-and-departments/icjs/downloads/Ellis-Evaluation-Worn-Cameras.pdf

[321] Ariel, B., Sutherland, A., Henstock, D., Young, J., Drover, P., Sykes, J., Megicks, S. & Henderson, R. (2016c). Report: Increases in police use of force in the presence of body-worn cameras are driven by officer discretion: A protocol-based subgroup analysis of ten randomized experiments. *Journal of Experimental Criminology* 12(3), pp.453-463.

discretion.[322] Similarly, the interviewee felt that their police force could not deal with the amount of data generated by a mandatory recording policy, given the need to also upload and store this data within eight hours, in order to be ready for the next tour of duty.[323]

The impact of BWCs on citizen behaviour

In addition to potentially improving officer behaviour, one mooted benefit of the use of BWCs is a potentially moderating influence on citizen behaviour: if citizens are aware they are being filmed, it is argued that they will be less likely to act in aggressive or illegal ways.

In the UK, there was some evidence from the Aberdeen pilot that during the trial period, BWC-equipped officers were less likely to be assaulted than other officers operating without BWCs. However, in the global multi-site trial, Ariel et al. (2016) found that assaults against police increased on average in the treatment group, albeit with heterogeneous results across pilot sites.[324] A later sub-analysis by Ariel et al. (2018) hypothesised that this might be the result of officers feeling more constrained in their actions while wearing a BWC, resulting in more instances in which force is used against them (rather than, for example, being halted as a result of escalation by the officer at an earlier stage).[325] In interviews with officers concerning the use of BWC footage in domestic violence incidents, Lister et al. found that some (but not all) officers also felt that aggressors would "calm down" when they realised they were being filmed, which helped to defuse tension.[326] In relation to the Metropolitan Police RCT, Owens and Finn (2017) noted that the view of officers they consulted was that responses by the public to the presence of a BWC were influenced by alcohol consumption and by a person's familiarity with the criminal justice system.[327]

In a study of the implementation of BWCs in a US police department, Koen et al. (2018) found that of the 23 officers they interviewed, 20 reported that they felt that BWCs had improved citizen behaviour. They attributed this to both the citizen's awareness of their own behaviour being recorded, ad to reassurance on the part of the public of their increased safety from police abuse as a result of the camera's presence.[328] Lum et al. (2019) found nine studies that examined the impact of BWCs on citizen compliance with police, including for example violence against officers, resisting arrest, and injuries sustained by officers.[329] While six studies found no significant differences with regard to compliance with officers using BWCs and those without, one other pilot observed an increase in assaults against police officers wearing BWCs compared to a control group.[330]

A related outcome of the use of cameras may be a reduction in the number of spurious complaints against officers, as video footage can be used to easily defend an officer from an allegation that is baseless, thus reducing the administrative resources spent dealing with complaint processes. While it is difficult to tell from quantitative data alone whether observed reductions in complaints are the result of improved officer behaviour or of fewer groundless complaints being progressed, some qualitative evidence from the pilots gives weight to the latter. Anecdotally, the use of camera footage to quickly assess and disregard baseless

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[322] INT03.

[323] INT03.

[324] Ariel, B., Sutherland, A., Henstock, D., Young, J., Drover, P., Sykes, J., Megicks, S. & Henderson, R. (2016). "Contagious accountability" a global multisite randomized controlled trial on the effect of police body-worn cameras on citizens' complaints against the police. *Criminal Justice and Behavior* 44(2), 293-316.

[325] Ariel, B., Sutherland, A., Henstock, D., Young, J., Drover, P., Sykes, J., Megicks, S. & Henderson, R. (2018). Paradoxical effects of self-awareness of being observed: Testing the effect of police body-worn cameras on assaults and aggression against officers. *Journal of Experimental Criminology* 14(1), 19-47.

[326] Lister, S., Burn, D. & Pina-Sanchez, J. (2018). 'Exploring the impacts of police use of body-worn video cameras at incidents of domestic abuse'. N8 Policing Research Partnership. Available at: https://n8prp.org.uk/exploring-the-impacts-of-police-use-of-body-worn-cameras-at-incidents-of-domestic-abuse/

[327] Owens, C. & Finn, W. (2017). Body-worn video through the lens of a cluster randomized controlled trial in London: Implications for future research. *Policing: A Journal of Policy and Practice* 12(1), 77-82.

[328] Koen, M.C., Willis, J.J. & Mastrofski, S.D. (2018). The effects of body-worn cameras on police organisation and practice: A theory-based analysis. *Policing and Society* 1-17.

[329] Lum, C., Stoltz, M., Koper, C.S. & Scherer, J.A. (2019). Research on body-worn cameras: What we know, what we need to know. *Criminology & Public Policy* 18(1), 93-118.

[330] Toronto Police (2016) in Lum, C., Stoltz, M., Koper, C.S. & Scherer, J.A. (2019). Research on body-worn cameras: What we know, what we need to know. *Criminology & Public Policy* 18(1), 93-118.

complaints was observed in multiple UK pilots[331]. Similarly, in a study of the implementation of BWCs in a US police department, Koen et al. (2018) found that police officials reviewed the camera footage before the complaint was filed officially, meaning some complainants would withdraw their complaint before the formal procedure was launched, if the official considered the complaint to be unsupported.

The impact of BWCs on officer adherence to procedure and protocols

As Koen et al. (2018) note, the use of BWCs enables organisations to hold officers accountable against rules and procedures, enabling the smooth processing of incidents (regardless of whether said rules are themselves the most efficient).[332] In addition to influencing officers' use of force, some have suggested that cameras may result in a more nuanced form of accountability: the ability of supervisors and authorities to review footage at a later date may mean that police officers are more likely to follow rules and procedures more strictly.

As a nuanced concept, this has primarily been explored to date by examining differences in policing behaviours between treatment and control groups. Lum et al. (2019) identified 14 studies that examined the impact of BWCs on the number of arrests and/or citations (warnings) made by police.[333] The results in relation to this measure were mixed, with some studies finding fewer arrests among officers wearing BWCs, while others found more arrests when compared to a control group, and some found no significant impact. In the UK pilots, two trials – the Isle of Wight and the Metropolitan Police – examined the difference in the number of stop-and-searches conducted by BWC-equipped officers, but found no significant differences between the BWC and control groups and, in the case of the Met's pilot, heterogeneous results across the pilot sites.

Qualitative evidence from the pilots adds further nuance to this outcome. Officers interviewed by researchers for the UK pilots provided examples of how cameras changed their behaviour. Officers in the Metropolitan Police trial spoke about how, being aware of the potential for footage to be reviewed, they would "perform" for the camera: for example, by asking questions to which they knew the answer, just to get the answer on tape, or by stating loudly "stop kicking me" when restraining someone to flag this behaviour for the camera.[334] Officers interviewed for the Essex pilot felt that cameras increased accountability and made them more mindful of their behaviour, and some indicated that they would be more likely to arrest suspects when using a BWC, due to feeling they would otherwise need to justify their inaction.[335] Conversely, in the Metropolitan Police trial, officers using BWCs were *less* likely to agree in a survey that they needed a stronger justification for actions than the control group; the authors suggest that rather than affecting decision-making, this may indicate that officers with BWCs may in fact feel more confident if challenged.

In an ethnographic study of BWC implementation in a UK police force, Rowe et al. (2017) observed a subtle shift in behaviour among officers when a camera was turned on, with officers apparently more aware of their language and volume. For example, one officer reported legalistic reasons for a traffic stop while a camera was recorded, but spoke more freely about factors involving the driver's age and vehicle condition after the recording

[331] Owens C. & Finn, W. (2017). Body-worn video through the lens of a cluster randomized controlled trial in London: Implications for future research. *Policing: A Journal of Policy and Practice* 12(1), 77-82; Spencer, D., & Cheshire, R. (2017). Ten years of body worn video in Northamptonshire police. *Policing: A Journal of Policy and Practice* 12(1), 116-119; see also INT04 and INT05.

[332] Koen, M.C., Willis, J.J. & Mastrofski, S.D. (2018). The effects of body-worn cameras on police organisation and practice: A theory-based analysis. *Policing and Society* 1-17.

[333] Lum, C., Stoltz, M., Koper, C.S. & Scherer, J.A. (2019). Research on body-worn cameras: What we know, what we need to know. *Criminology & Public Policy* 18(1), 93-118.

[334] Owens, C. & Finn, W. (2017). Body-worn video through the lens of a cluster randomized controlled trial in London: Implications for future research. *Policing: A Journal of Policy and Practice* 12(1), 77-82; Owens, C., Mann, D., & McKenna, R. (2014). The Essex body worn video trial: The impact of body worn video on criminal justice outcomes of domestic abuse incidents. Ryton-on-Dunsmore, Coventry, England: College of Policing. As of 2 August 2019, available at: https://bwvsg.com/wp-content/uploads/2013/07/BWV_ReportEssTrial.pdf

[335] This feeling was not apparent in the trial results when compared to the control group, which the authors note may be due to a concurrent focus by the force on positive action in domestic abuse cases during the pilot period.

stopped, which the researcher interpreted as a "performance".[336] Similarly, in a study of the implementation of BWCs in a US police department, Koen et al. (2018) found that a number of officers reported that cameras made them more "legalistic" or reluctant to act leniently (such as letting off people with a warning in the case of minor offences), given that these decisions could now be scrutinised by others (including their superiors).[337] While none of the 23 officers they interviewed reported that BWCs had "fundamentally" changed the way they dealt with civilian interactions, half reported that they were more aware and cautious with regard to how they communicated when on camera, with a quarter taking care not to use profanities.

However, this has not always been received as a positive step by officers. During the Metropolitan Police RCT, the authors noted resistance from officers who believed they should have more discretion over the activation of BWCs, as well as feeling that the use of BWCs would lead to a "drop in morale" as a result of officers feeling bound to follow strict procedures.[338] In the Essex RCT, the authors observed a feeling among officers that later scrutiny of footage by solicitors or other colleagues might be done unfairly, given the benefit of hindsight.[339] One officer interviewed by Rowe et al. (2017) reported that BWCs could "turn you into a robot"; other interviewees reported feeling constrained and scripted. The authors also note the risks this could have for intelligence gathering, by making interactions with the public more "artificial" in nature.[340] In this regard, some researchers have spoken about the growth of a "police media economy" in which police officers have to accommodate media work and "create representations of their encounters".[341] In comparing the positive view of officers in the Met trial (of BWCs as a tool to reduce complaints) with officers concerned about a "hindsight police" in the Essex trial, Owens and Finn (2017) assess that these contrasting findings show the importance of context. Whereas officers in the Met trial found BWCs a supportive and empowering technology, in Essex it was introduced during scrutiny over the force's response to domestic violence, leading to a different reaction.[342] As the authors conclude, "the rationale for providing [BWC] to officers, and how that is communicated, is likely to affect officers' reactions to it."

Equally, some officers interviewed in the UK pilots also raised concerns about the negative impact of BWCs in limiting the officer's ability to use their discretion to adapt practice to the nuances of the specific context at hand. For example, in an ethnographic study of the use of BWCs in a UK police force, Rowe et al. (2017) observed the propensity for BWCs to limit discretion on the part of officers, for example by leading them to make arrests even in situations where officers believed it to be a waste of resources.[343] (Conversely, some officers acknowledged that BWCs would limit the unlawful use of "stop and search" powers.) Similarly, officers reported that in addition to reducing the disproportionate use of force, they might be more reluctant to use force at all, for fear of it looking bad on camera – thus putting them at risk. In the Essex pilot, some officers noted they had to speak carefully to

[336] Rowe, M., Pearson, G. & Turner, E. (2017). Body-worn cameras and the law of unintended consequences: Some questions arising from emergent practices. *Policing: A Journal of Policy and Practice* 12(1), 83-90.

[337] Koen, M.C., Willis, J.J. & Mastrofski, S.D. (2018). The effects of body-worn cameras on police organisation and practice: A theory-based analysis. *Policing and Society* 1-17.

[338] Grossmith, L., Owens, C., Finn, W., Mann, D., Davies, T. & Baika, L. (2015). 'Police, Camera, Evidence: London's cluster randomised controlled trial of Body Worn Video'. As of 11 September 2019, available at: https://whatworks.college.police.uk/Research/Documents/Police_Camera_Evidence.pdf

[339] Owens, C., Mann, D. & McKenna, R. (2014). The Essex body worn video trial: The impact of body worn video on criminal justice outcomes of domestic abuse incidents. Ryton-on-Dunsmore, Coventry, England: College of Policing. As of 2 August 2019, available at: https://bwvsg.com/wp-content/uploads/2013/07/BWV_ReportEssTrial.pdf

[340] Rowe, M., Pearson, G. & Turner, E. (2017). Body-worn cameras and the law of unintended consequences: Some questions arising from emergent practices. *Policing: A Journal of Policy and Practice* 12(1), 83-90.

[341] Gates, K. (2016b) in Bowling, B. & Iyer, S. (2019). Automated policing: the case of body-worn video. *International Journal of Law in Context* 15(2), 140-161.

[342] Owens & Finn (2017). Body-worn video through the lens of a cluster randomized controlled trial in London: Implications for future research. *Policing: A Journal of Policy and Practice* 12(1), 77-82.

[343] Rowe, M., Pearson, G. & Turner, E. (2017). Body-worn cameras and the law of unintended consequences: Some questions arising from emergent practices. *Policing: A Journal of Policy and Practice* 12(1), 83-90.

victims about talking in front of the camera, in case the victims didn't actually want the police to act upon something they disclosed on camera.[344]

In discussing the possible effects of turning police into "machines", Bowling and Iyer (2019) also raise the concern that limiting discretion on the part of officers may also serve to reinforce bias inherent in existing protocols, a challenge also seen in automation based on biased datasets or otherwise discriminatory existing practices. For a discussion of this issue with regard to predictive policing, see Meijer and Wessels (2019).[345] In relation to this, they acknowledge the view of Hartzog et al. (2015) that "inefficiency is an effective safeguard against perfectly enforcing laws that were created with implicit assumptions of leniency and discretion": in other words, "perfect and consistent law enforcement" may in some cases in fact be in tension with fair outcomes. However, the authors and others (such as Koen et al., 2018) note that such uniformity in process may also serve to reduce potential bias on the part of the officers, for example in their treatment of different racial groups.

The effect of BWCs on the public view of the police

In the UK pilots which sought to examine the effect of BWCs on the public view of the police (Isle of Wight, Metropolitan Police and Plymouth), strong support for the use of BWCs was recorded on the part of the public.

Lum et al. identified two studies that discussed the impact on citizens' fear of crime. One of these focused on citizens, the other on victims of crime. Both found that BWCs increased the feeling of safety among respondents.[346] However, as Lum et al. note, there may be important differences between different demographic and ethnic groups in this regard, in line with a number of other surveys that have found differences in citizens' perception of the benefits of BWCs. Some surveys have reported lower support for BWCs among non-white respondents, younger respondents and respondents with a more negative perception of police performance and procedural fairness. One UK police interviewee noted that they had engaged heavily with minority groups during the roll-out of cameras to discuss their benefits, and that community members in the area had asked the police to record every stop-and-search incident in the area by default (stop and search has been criticised in the UK for being used disproportionately against minority groups[347]).[348]

Some interviewees also discussed the potential role of video footage in helping the public to understand the perspective of the police: for example, two interviewees noted that footage of an officer being attacked with a knife had been played in the media, and became a talking point for members of the public.[349] Another UK interviewee[350] felt that footage from BWCs could help the police to counter "unfair" press, and build understanding on the part of the public by making them think about what they would do in the same situation (which he noted was particularly important in the case of firearms incidents). The interviewee suggested that greater use of the footage in news media and in schools could help to change attitudes towards the police and build confidence in their role.

Finally, in the table below, we summarise some of the common drivers and barriers to the use of BWCs identified in the literature and expanded on in Section 3.3.3.

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[344] Owens, C., Mann, D. & McKenna, R. (2014). The Essex body worn video trial: The impact of body worn video on criminal justice outcomes of domestic abuse incidents. Ryton-on-Dunsmore, Coventry, England: College of Policing. As of 2 August 2019, available at: https://bwvsg.com/wp-content/uploads/2013/07/BWV_ReportEssTrial.pdf

[345] Bowling, B. & Iyer, S. (2019). Automated policing: the case of body-worn video. *International Journal of Law in Context* 15(2), 140-161.

[346] Lum, C., Stoltz, M. Koper, C.S. & Scherer, J.A. 2019. Research on body-worn cameras: What we know, what we need to know. *Criminology & Public Policy* 18(1), 93-118.

[347] BBC News (2017). 'Stop-and-search ethnic disparity 'troubling''. BBC News [online], 12 December 2017. As of 20 September 2019, available at: https://www.bbc.com/news/uk-42311538

[348] INT04

[349] INT04; INT08.

[350] INT01.

Table 16. Overview of some barriers and drivers to the use of BWCs in policing.

DRIVERS	BARRIERS
- Collecting evidence[351] - Reporting issues more efficiently[352] - Formalised procedures - Improving working environment for officers - Cost reductions[353] - More effective use of resources - Defence behaviour and practice - Improved rates of detection - Quality and quantity of evidence[354] - Increased support for victims and witnesses[355] - Reduces police use of force[356] - Reduced number of victims attending court[357] - Reduces violence against police[358] - More emotional weight than written statements[359] - Proactive monitoring and police/crime prevention behaviours[360] - The public welcoming their use[361] - Perceived to increase accountability and transparency of police[362] - Reduce public complaints[363]	- Equipment is costly[364] - Technical limitations[365] - Organisations with larger budgets - Doubts among the police over too much importance being placed on video as a source of evidence[366] - Data protection issues[367] - Ethics[368] - Dislike amongst civilians and police of being filmed[369] - Costs of data storage and equipment[370] - Lack of knowledge and skills among police officers on how to use BWCs[371]

[351] Malm, A. (2019). Promise of police body-worn cameras. *Criminology & Public Policy 18*(1), 119-130.

[352] Merola, L., Lum, C., Koper, C.S. & Scherer, A. (2016). Body worn cameras and the courts: A national survey of state prosecutors, Report for the Laura and John Arnold Foundation. Fairfax, VA: Center for Evidence-Based Crime Policy, George Mason University.

[353] INT08

[354] Koen, M.C., Willis, J.J. & Mastrofski, S.D. (2018). The effects of body-worn cameras on police organisation and practice: A theory-based analysis. *Policing and Society,* 29(8), pp. 968-984; Owens, C., Mann, D. & McKenna, R. (2014). The Essex body-worn video trial: The impact of body worn video on criminal justice outcomes of domestic abuse incidents. Ryton-on-Dunsmore, Coventry, England: College of Policing. As of 2 August 2019, available at: https://bwvsg.com/wp-content/uploads/2013/07/BWV_ReportEssTrial.pdf

[355] Lum, C., Stoltz, M., Koper, C.S. & Scherer, J.A. (2019). Research on body-worn cameras: What we know, what we need to know. *Criminology & Public Policy 18*(1), 93-118.; Lister, S., Burn, D. & Pina-Sanchez, J. (2018). 'Exploring the impacts of police use of body-worn video cameras at incidents of domestic abuse'. N8 Policing Research Partnership. As of 2 October 2019, available at: https://n8prp.org.uk/exploring-the-impacts-of-police-use-of-body-worn-cameras-at-incidents-of-domestic-abuse See also INT08

[356] *Ibid.*

[357] Lister, S., Burn, D. & Pina-Sanchez, J. (2018). 'Exploring the impacts of police use of body-worn video cameras at incidents of domestic abuse'. N8 Policing Research Partnership.

[358] https://polisen.se/aktuellt/nyheter/2018/februari/polisen-inleder-forsok-med-kroppskameror/: INT06

[359] Morgan, J. & Silverstone, D. (2017). 'Trialling body-worn video cameras for City of London Police: officer perceptions and justice outcomes. A report for City of London Police'.

[360] Piza, E.L., Welsh, B.C., Farrington, D.P. & Thomas, A.L.,(2019). CCTV surveillance for crime prevention: A 40-year systematic review with meta-analysis. *Criminology & Public Policy* 18(1), 135-159.

[361] See INTO3; INT08; INT0

[362] Ariel, B., Sutherland, A., Henstock, D., Young, J., Drover, P., Sykes, J., Megicks, S. & Henderson, R. (2016). "Contagious accountability" a global multisite randomized controlled trial on the effect of police body-worn cameras on citizens' complaints against the police. *Criminal Justice and Behavior* 44(2), pp.293-316.

[363] Ariel, B., Farrar, W.A. & Sutherland, A. (2015). The effect of police body-worn cameras on use of force and citizens' complaints against the police: A randomized controlled trial. *Journal of Quantitative Criminology* 31, 509–535.; Lister, S., Burn, D. & Pina-Sanchez, J. (2018). 'Exploring the impacts of police use of body-worn video cameras at incidents of domestic abuse'. N8 Policing Research Partnership.

[364] Joh, E.E, (2016). Beyond surveillance: Data control and body cameras. *Surveillance & Society* Forthcoming; Also see INT04

[365] Flight, S. 2019. *Focus: Evaluatie pilot bodycams Politie Eenheid Amsterdam 2017-2018*. The Hague: Politie & Wetenschap [Online] 2019. As of 2 October 2019, available at: https://www.politieenwetenschap.nl/cache/files/5d95bafc1c739PW93A.pdf

[366] INT02, INT04

[367] INT04

[368] INT08; INT07

[369] INT04

[370] INT08; INT07

[371] INT08

3.4 Case Study 3: Privacy and trust in new digital public services (Germany and Spain)

3.4.1 Introduction

Unlike the other three case studies, the present one does not focus on the introduction of a specific public sector innovation in a particular context[372]. Instead, it aims to explore, through hypothetical scenarios, a key issue in relation to the process of Digital Government Transformation: the relationship between privacy and trust, as it relates to new digital public services. This case study, which has been conducted as an online experiment in two countries (Germany and Spain), focuses on the introduction of digital public services in four different policy domains (transport, health, security and voting) and on the relationship between citizens' privacy and trust. The four hypothetical scenarios used in the case study are based on real-life case studies in which the central issue was the use of a disruptive technology to transform existing public services. Even though the policy domains and the scenarios slightly differ, one to another, the focus of the research is the same. More specifically, the objectives of this case study are:

1. To explore the trade-offs that citizens make between privacy and the benefits that stem from the use of new digital public services in various domains;

2. To identify under what conditions citizens are willing to adopt new digital public services; and

3. To understand what role trust in the public sector plays in the adoption of such services.

This section introduces the key elements of the case study. First, relying on the literature review conducted by Barcevičius et al. (2019), we provide a description of the policy context and the relevance of the topic. Second, we provide a brief review of the literature on this issue, namely the surveys and opinion polls already conducted on the issues of privacy, security and trust. Third, we explain how this case study relates to the DigiGov-F conceptual framework.

3.4.1.1 Description of the context

The last ten years have seen significant technological advances, both in the private and the public sector, that rely on the extensive use of personal data. The uptake of digital technologies has progressed at an incredible pace. Moreover, the way in which data is collected, processed and accessed no longer resembles the methods that were used around two decades ago. These rapid changes have given rise to a number of concerns relating to data protection and privacy, as citizens sometimes perceive a lack of control over the personal data they provide online[373]. In response, back in 2012 the European Commission began the process of reforming data protection across the EU, which ultimately led to the introduction in 2015 of the General Data Protection Regulation (GDPR)[374].

Concerns over Privacy are not a new phenomenon in the literature on eGovernment. However, the intense reliance of many new technologies on personal data has caused many researchers to worry about the risk of privacy violations that could come with a new wave of Digital Government Transformation and personal data sharing. Several cases have already demonstrated that these worries are justified. For instance, the Swedish government experienced a leak of its population's personal vehicle data. This forced the Swedish government to restrict the outsourcing private and sensitive data to third parties[375].

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[372] The study was written by Cristiano Codagnone (Open Evidence), Giovanni Liva (Open Evidence).
[373] Special Eurobarometer 431, available at:
https://ec.europa.eu/commmfrontoffice/publicopinion/archives/ebs/ebs_431_en.pdf
[374] Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation).
[375] Joinup (2017). Following security breach, Sweden shores up outsourcing rules. https://joinup.ec.europa.eu/news/following-security-breach-sw

Meanwhile in 2018, a hospital in Portugal received a fine for indiscriminate access to, violation of and failure to ensure the continued integrity and confidentiality of, processed personal user data[376]. These and other examples depict an intrusion into people's lives by both public and private sectors, and have led the literature to explore the potential for data to be misused, as an increasing number of different actors gain access to personal information[377]. When government datasets are made publicly available, personal information may be disclosed and thus subject to open profiling or data mining for various private purposes[378]. Violations of data privacy arising from both the public and private sectors demonstrate that concerns over privacy and security are justified – a situation that may hinder the digital transformation of the public sector.

The literature also identifies instances of 'information asymmetry', where governments purchase proprietary products and services that they do not understand and are not able to build for themselves[379]. But the demand to continuously innovate prompts public authorities to collaborate with many private entities that develop digital tools in order to seize the opportunities presented by Big Data. As a result of these collaborations, the public sector is already losing government processes and insights to private sector. In 2014, the Danish Ministry of Tax admitted to having no control of over more than 200 systems that used machine learning algorithms for policy making that directly affected citizens[380]. Scholars also suggest that so-called 'smart' cities are becoming overly dependent on private companies[381]. Government access to personal data can also result in 'Big Brother'-type surveillance, leading to a type of government created not by people, but by algorithms[382]. The use of AI in facial recognition, sensor networks or social media tracking are widely popular with many governments[383].

As we move towards the wider use of AI and other technologies that rely heavily on personal data to develop algorithms that improve services, transparency and the ethical use of data have become critical issues. This is a key challenge for governments, as such concerns can become a serious barrier to digital transformation, mainly because a successful adoption of new technologies requires the trust and confidence of citizens.

The issue of trust in e-government is not new. There is extensive literature discussing the fact that, despite their advantages, e-government applications may be met with fear and even outright rejection by the public[384]. Some authors have shown that one of the reasons for this rejection is that some citizens still do not trust e-government services, and that this has an impact their broader adoption[385]. Trust in e-government services is a complex relationship that includes many issues, but, as highlighted in D2, it is one of the most significant barriers to the successful digital transformation of governments[386].

The trade-off between the benefits from improved digital services and privacy, which this case study aims to explore, is the focus of attention for several scholars, particularly in relation to the private sector. Internet and tech companies have long attempted to

[376] 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/
[377] European Commission (2017). Quality of public administration: a toolbox for practitioners. Luxembourg. ISBN 978-92-79-72146-5
[378] Scassa, T. (2014). Privacy and open government. *Future Internet*, *6*(2), 397-413.
[379] Medhora, P.R., Awad, B., Boettger, S. et al. (2018). Data Governance in the Digital Age. *Centre for International Governance Innovation*.
[380] Popova, I. (2018). The good, the bad and the unintended of public sector. *Digitalized Management*.
[381] Bass, T. et al. (2018). Reclaiming the Smart City. Personal Data, Trust and the New Commons. Nesta. https://media.nesta.org.uk/documents/DECODE-2018_report-smart-cities.pdf
[382] European Commission (2018). eGovernment Benchmark 2018. Securing eGovernment for all.
[383] Whittaker, Meredith et al. (2018). AI now report 2018. AI Now Institute, New York University.
[384] 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.
[385] 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.
[386] Khasawneh, R.T., Rabayah, A. & Abu-Shanab, E.A. (2013). E-government acceptance factors: trust and risk. The 6th International Conference on Information Technology.

personalise their services and offer tailored content and advertisements. However, it seems that this increased personalisation comes at the cost of privacy.

As shown by Shoshana Zuboff[387], the nature of targeted advertising and recommendations means that businesses know who their customers are and what they are interested in – and much of this information is extracted with little informed consent from the consumer. There is an ongoing debate as to whether consumers, if appropriately informed, would be willing to give up personal data in exchange for better and more personalised services. The majority of tech companies justify their data collection practices through the notion of a trade-off, depicting an informed public that understands the opportunities and costs of giving up its data, and makes the positive decision to do so. Contrary to this view, some authors claim that tech companies give policymakers false justifications for allowing the collection and use of all kinds of consumer data – often in ways that the public find objectionable[388]. In fact, the majority of people do not want to lose control over their personal information, but also believe that this loss of control has already occurred. This is what Zuboff called the "habituation phase", when users have already benefitted and become used to a service, so that it becomes a great cost for them to opt out[389]. However, the problem begins with the issue transparency, as users are often not aware of that their personal data is being harvested, and are never presented with a real choice. As reported by the Special Eurobarometer 487a, only 13% of citizens fully read companies' privacy statements[390]. This is often because these are long and difficult to read. Psychological research, in a famous article entitled "If it's hard to read, it's hard to do" shows that the more difficult instructions are to read, the less motivated people are to read them[391]. But when explicitly asked, users say that they do care about their personal data, and are not ready to trade them for free services. The results of an opinion survey in Special Eurobarometer 431[392], conducted in 2015, support this argument. In the survey, a majority (52%) disagreed with the view that they don't mind providing personal information in return for free services online. Less than a third (29%) agreed with this statement.

When it comes to the public sector, the most hotly debated issue is security. Difficult public policy decisions must often be made in relation to the broader security of the public versus individual freedoms and liberties such as privacy[393]. This debate is highly polarised, with those from the civil liberties community strongly arguing against any infringement of privacy and liberty, while those from the security and policing community arguing that in many cases, the end justifies the means. However, this debate does not apply exclusively security issues –the government and other agencies collect personal data in order to improve digital public services in the same way that the private sector does. Despite having different objectives from the private sector, and not being led by profit maximisation, citizens express similar privacy-related concerns when it comes to the collection of personal data by the public sector.

3.4.1.2 Existing literature on privacy and trust

Existing attempts to provide a base of evidence to understand users' preferences in relation to privacy are largely based on opinion polls, surveys or qualitative research, each of which has its limitations. Since the 1970s, Dr Alan Westin has carried out various privacy-related surveys. Between 1978 and 2004, more than 30 surveys were conducted by Dr Alan Westin in relation to general privacy, consumer privacy, medical privacy and other related areas.

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[387] Zuboff, S. (2015). Big other: surveillance capitalism and the prospects of an information civilization. *Journal of Information Technology* 30(1), 75-89.

[388] https://www.asc.upenn.edu/sites/default/files/TradeoffFallacy_1.pdf

[389] Zuboff, S. (2019). *The Age of Surveillance Capitalism*. London: Profile Books Ltd.

[390] https://ec.europa.eu/commfrontoffice/publicopinionmobile/index.cfm/Survey/getSurveyDetail/surveyKy/2222

[391] Song, H. & Schwarz, N. (2008). If it's hard to read, it's hard to do: Processing fluency affects effort prediction and motivation. *Psychological Science* 19(10), 986-988.

[392] https://ec.europa.eu/commfrontoffice/publicopinion/archives/ebs/ebs_431_en.pdf

[393] Robinson, Neil, Dimitris Potoglou, Chong Woo Kim, Peter Burge, and Richard Warnes, Security, At What Cost? Quantifying people's trade-offs across liberty, privacy and security. Santa Monica, CA: RAND Corporation, 2010. https://www.rand.org/pubs/technical_reports/TR664.html

Based on these, privacy indices were created to summarise the results and illustrate trends[394]. These indices usually place people into one of three segmented categories, depending on their responses to various privacy segmentation questions asking them to indicate their level of agreement with a series of statements, such as these from a 2003 Harris Poll[395]:

- Consumers have lost all control over how personal information is collected and used by companies.

- Most businesses handle the personal information they collect about consumers in a proper and confidential way.

- Existing laws and organisational practices provide a reasonable level of protection for consumer privacy today.

The General Privacy Concern Index from Westin's 1990 and 1991 Consumer Privacy Survey identified the following classifications[396]:

- **Privacy Fundamentalists** – people who are generally distrustful of organisations asking for their personal information, and who are worried about the accuracy of computerised information. About 25% of the (US) public are privacy fundamentalists.

- **Privacy Pragmatists** – people who weigh the benefits of various consumer opportunities and services, protection of public safety or enforcement of personal morality against the degree of intrusiveness of personal information sought. Of the (US) population, 57% fits into this category.

- **Privacy Unconcerned** – people who are generally trustful of organisations collecting their personal information and are ready to forgo privacy claims to secure consumer service benefits or public order values. About 18% of the (US) population fits into this category.

While these explanatory descriptions of certain segments of respondents are imposed by researchers, the surveys attempt to understand what drives their responses – and what the impact of being placed into one of these categories means in terms of a person's willingness to surrender their privacy to obtain commercial or public benefits. These indices have become popular as benchmarks and as a means to classify respondents in other countries, too. In 1994, the same methodology was used to generate a distrust index, which classified respondents as having 'low' (26%), 'medium' (38%), 'high' (31%) or 'no' (5%) distrust, according to their answers to a series of questions about levels of trust in government and the private sector[397].

In addition, the previously mentioned Special Eurobarometer was conducted in 2018 on behalf of the European Commission. This recorded citizens' perceptions regarding data protection in the European Union[398]. The report shows that across the EU, half of the population is aware that government agencies collecting their citizens' personal data for the purposes of national security. The largest group of respondents (46%) said the that these data collection activities had a negative impact on their level of trust in government, while 40% said they had no impact on their level of trust. Around one-tenth (11%) said the impact on trust of such data collection had been positive. Interestingly, these attitudes vary relatively little according to socio-demographic characteristics.

[394] Kumaraguru, P. & Cranor, L.F. (2005). Privacy indexes: A survey of Westin's studies, Pittsburgh: Institute for Software Research International, Carnegie Mellon University, CMU- ISRI-5-138.

[395] Taylor, H. (2003).'"Most People Are "Privacy Pragmatists" Who, While Concerned about Privacy, Will Sometimes Trade It Off for Other Benefits: The Harris Poll No. 17',. Available online at http://www.harrisinteractive.com/harris_poll/index.asp?PID=365

[396] Kumaraguru, P. & Cranor, L.F. (2005). Privacy indexes: A survey of Westin's studies, Pittsburgh: Institute for Software Research International, Carnegie Mellon University, CMU- ISRI-5-138.

[397] Westin, A., Harris, L. & Associates (1994). Equifax-Harris Consumer Privacy Survey: Tech rep. Conducted for Equifax Inc, 1994.

[398] https://ec.europa.eu/commfrontoffice/publicopinion/archives/ebs/ebs_431_en.pdf

In terms of respondents' attitudes towards disclosing personal data, the same survey reported that over seven out of ten respondents agreed that providing personal information is an increasing part of modern life. A majority of people (56%) agreed that their national government asks them for an increasing amount of personal information.

As can be seen from the brief summary above, the current methods used to collect data on individuals' attitudes towards the trade-offs they make between privacy and the benefits of improved digital services, may be seen as blunt instruments. The results variously show majority support or opposition to various measures intruding on privacy, and only offer further insight into what motivates these responses via the use of simple follow-up questions.

3.4.1.3 The experiment and the conceptual framework

The present case study employs a discrete choice approach using stated preferences. This aims to elicit real preferences concerning the trade-offs users make between benefits and privacy. The use of this approach may allow a refined, bottom-up understanding of the importance individuals place on these factors. The details of the methodology will be discussed in Section 3.4.2. Meanwhile, in the present section we explain the rationale and the scope of the experiment.

Rather than conducting a case study focusing on a specific public sector innovation in a single country, we decided to conduct an online experiment in two EU Member States, covering four digital innovations in different policy domains. The results obtained therefore allow us to compare different innovations, domains and countries in order to detect potential differences. Germany and Spain were selected, due to the different levels of trust in institutions among their national populations. As reported by the latest Standard Eurobarometer 90 (Public Opinion in the European Union), 54% of German citizens tend to trust the national government; in Spain, the corresponding figure is just 19%. Differences between the two countries are also remarkable in relation to trust in regional or local authorities (78% in Germany tend to trust them, versus 36% in Spain); the national parliament (58% versus 15%); and the national public administration (71% versus 37%). Nonetheless, trust in the internet[399] is similar (30% versus 25%)[400].

While highly specific in nature, the design of the present case study is informed by certain elements of the DigiGov-F conceptual framework. In the hope of exploiting the potential of new technologies to improve public services, governments sometimes sacrifice accountability in relation to privacy and data protection. As Di Maggio and Powell[401] note, governments (like all organisations) need to feel legitimate in their environment, in the sense of meeting societal expectations. Relying on Weber's analysis of governmental bureaucracy[402], we can state that governments sometimes pursue tangible performance objectives (i.e. the improvement of public services through the use of advanced technologies) while failing to pursue other symbolic objectives such as legitimacy and the trust of their citizens. The search for legitimacy and trust is an important dimension to consider. On the one hand, it can represent a significant barrier to digital transformation; on the other, it constitutes one of the potential positive effects that new technologies can produce, beyond efficiency and effectiveness.

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[399] This is used by standard Eurobarometer surveys and it refers to the level of trust of people in the sources found online and it provides an indication of the confidence that users have about using internet.
[400] https://ec.europa.eu/commfrontoffice/publicopinion/index.cfm/survey/ getsurveydetail/instruments/standard/surveyky/2215
[401] Di Maggio, P. & Powell, W. (1991). The New Institutionalism in Organizational Analysis. Chicago: University of Chicago Press.
[402] Weber, M. (1970). From Max Weber: Essays in Sociology, ed. H.H. Gerth and C. Wright Mills. London: Routledge & Kegan Paul.

In the current context of declining trust in both government and democracy[403], governments need to do much more to increase their legitimacy and demonstrate their impact on citizens' wellbeing. They have a chance to do this today via smarter policies, better-targeted services, greater openness and increased engagement. Public confidence – that is, the extent to which the general public trusts institutions to act competently and in support of the wider public interest – must be restored. Therefore, engaging stakeholders and citizens in the debate on privacy and data protection is crucial to achieving good outcomes. One example of this is represented by the use of facial recognition technologies by police. In the US, politicians have repeatedly pressed officials over the federal government's use of facial recognition, while civil rights activists are pushing for an outright ban on the technology on the grounds of protecting privacy. A prominent argument is that citizens don't expect to be surveilled in their daily activities, and the practice should be made more transparent in order to trigger an open discussion between government and citizens over such a sensitive issue.

Despite the positive effects stemming from the use of technologies to deliver public services and improve operations, some important challenges must be addressed in relation to trust and legitimacy. In seeking to achieve the benefits of the use of technology, governments must not neglect these key concerns. First, clear and transparent communication on the use of new, data-centric technologies by government, public agencies and officials is the starting point for building relationships of trust with citizens in the era of digital transformation. Second, the potential of such technologies for contextualisation and personalisation should be used to produce better policies and services that achieve desirable outcomes, while avoiding discrimination and the infringement of privacy or democratic freedom. Reconciling these demands requires new forms of innovation, as well as collaboration between government agencies, businesses, non-profit organizations, universities, citizens and other actors – both in terms of policy formulation, and in the provision, consumption and intermediation of public service delivery.

Many researchers are concerned about the privacy violations that could come with Digital Government Transformation and personal data sharing. Unlimited government access to personal data could result in an Orwellian society, limiting civic participation and undermining the strength of democracies. Scholars are increasingly noting instances in which government access to data has given risen privacy violations, damaging the overall image of the government. Governments are often criticised for prioritising the use of data-driven digital technologies over the safeguarding of privacy. The leak of vehicle data in Sweden has heightened concerns over a combined intrusion into people's lives by both the private and public sectors. Incidents such as this also call into question the amount of power given to governments by digital technologies, and how that power could impact democracy. Government access to personal data can result in 'Big Brother'-type surveillance, eliminating checks on government activities. In fact, much of the time digital tools are employed with little public oversight, laying open the possibility for the unethical use of personal data.

Through the use of an online experiment conducted in two Member States, this case study aims to address these fundamental issues, which go beyond the classical and widely discussed effects of Digital Government Transformation such as efficiency and effectiveness. By exploring the trade-offs that citizens make between privacy and the benefits that stem from the use of new digital public services in different domains, as well as examining the role that trust plays in the adoption of new digital services, we hope to promote fruitful discussions between governments and civil society, and pave the way for further research in this field.

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[403] As reported in Richardson and Emerson (2018), the 2017 World Values Survey documented a worrying shift in attitudes toward democracy: while in the 1960s, around three-quarters of respondents said it was essential to live in a democracy, less than one-third of millennials believe this today; OECD data on citizens' trust in government across its member states show that the level in 2014 was just 41.8%, as compared to 45.2% in 2007 (http://www.oecd.org/gov/trust-in-government.htm).

3.4.2 Approach and methodology

This chapter describes our methodology for applying stated preference techniques to the challenge of understanding the trade-offs people make when confronted with choices about their privacy. We began by conducting a brief review of the literature on the topic. Following on from this, we devised a set of choice contexts in through which to present the experimental methodology, in order to circumvent the difficulties of presenting respondents with abstract and difficult-to-define concepts. Finally, we deployed this experimental methodology with online panels in Germany and Spain, each panel being socio-economically representative of the country's population.

The online questionnaire was divided in three parts:

1. First, participants were asked various socio-demographic questions: age, gender, education, social class, living in a rural or urban area, internet use.

2. The second part was devoted to the discrete choice experiment.

3. The third and final section consisted of questions relating to trust, privacy and liberty.

The experiment aimed to address three research questions: (a) exploring the trade-offs that citizens make between privacy and the benefits stemming from the use of new digital public services in different domains; (a) identifying under what conditions citizens are willing to adopt new digital public services; and (iii) understanding what role trust in the public sector plays in the adoption of such services. We designed the experimental task to address all of these issues, by identifying four dimensions we wished to examine.

First, we assessed whether a respondent's preference for a specific new public service based on the use of data varies depending on the domain it operates (Dimension 1). The four areas included are: transport, health, security and voting. Patil et al. (2015), for instance, found variations between areas, and reported that people were more willing to share their data in the domain of health[404].

Second, we assessed whether the respondent's preference is affected by the type of organisation that has access to citizens' data. Robinson et al. (2015), for instance, found that people were not willing to share personal data beyond the specific public service that was responsible for collecting it (in this case, the Identity and Passport Service)[405]. In that case, the authors reported a negative impact of sharing data within the private sector. Our experiment compares attitudes to data being used by a public authority, by a non-profit organisation, and by a for-profit private company (Dimension 2). We would expect that if data is shared with the for-profit companies, users' willingness to adopt the service would decrease. In some cases, however, the option of a non-profit organisation taking care of the data might be unrealistic. Thus, we include two options in relation to public authorities (e.g. belonging to different levels or to different departments/services).

The third dimension refers to the type of data shared. This includes an option that only requires citizens to share basic data, and another that involves sharing more sensitive data or keeping it for longer.

Lastly, the fourth dimension concerns the benefits that citizens or society may gain from the system being implemented. Here, we present one case that involves an individual benefit that applies only to the citizen, while a second case presents a societal benefit that involves the whole society, and indirectly the citizen.

The post-experimental questionnaire included questions relating to trust and privacy. The responses to these were used to interpret the experimental results and to address some of the research questions above. The first set of questions in this questionnaire relate

[404] Patil, S., Patruni, B., Lu, H., Dunkerley, F., Fox, J., Potoglou, D. & Robinson, N. (2015). Public Perception of Security and Privacy. Results of the comprehensive analysis of PACT's pan-European Survey. RAND Corporation.
[405] Robinson, N., Potoglou, D., Kim, C.W., Burge, P. & Warnes, R. (2015). Security at what cost? Quantifying people's trade-offs across liberty, privacy, and security. RAND Corporation.

specifically to privacy (see Table 17), and were used to build a privacy index[406], while the second set relate to trust (see Table 18) and are used to build a distrust index[407]. In the upcoming section, we provide a more detailed explanation of how these indices were built, using the responses to these questions.

Table 17. Questions on privacy.

#	We would now like to present you with some general statements about privacy and ask you to indicate how much you agree or disagree with them (on a scale from 1 to 5).
1	Consumers are losing control over how personal information is collected and used by private companies.
2	Citizens are losing control over how personal information is collected and used by Governments.
3	Most businesses are handling the personal information they collect about consumers in a proper and confidential way.
4	Governments are handling the personal information they collect about citizens in a proper and confidential way.
5	Existing laws and organizational practices are currently providing a reasonable level of protection for consumer privacy.

Table 18. Questions on trust.

#	Please indicate the extent to which you agree or disagree with the following statements (on a scale from 0 to 4 - "strongly agree" to "strongly disagree")
1	Technology has almost got out of control (it can produce many unintended negative consequences)
2	Government can generally be trusted to look after our interests
3	The way one votes has no effect on what the Government does
4	In general corporations benefit us more than they harm us

Discrete choice experiment

Discrete choice experiments (DCE) provide a methodological toolkit for understanding and predicting how individuals make decisions between discrete (mutually exclusive) alternatives. DCE is a quantitative technique for eliciting individual preferences and understanding what specifically influences their choices. It requires respondents to state their choice in relation to sets of hypothetical alternatives. Each alternative is described by several characteristics, known as attributes Responses are used to infer the value the respondent places on each attribute.

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[406] Taylor, H. (2003). 'Most People Are "Privacy Pragmatists" Who, While Concerned about Privacy, Will Sometimes Trade It Off for Other Benefits: The Harris Poll No. 17'. Available online at http://www.harrisinteractive.com/harris_poll/index.asp?PID=365
[407] Kumaraguru, P. & Cranor, L.F. (2005). Privacy indexes: A survey of Westin's studies, Pittsburgh: Institute for Software Research International, Carnegie Mellon University, CMU-ISRI-5-138.

This method has its theoretical foundation in random utility theory. It relies on the assumptions of economic rationality and utility maximisation (Hall et al., 2004). In stating a preference, the individual is assumed to choose the alternative that yields his/her highest individual benefit, known as utility. Moreover, the utility yielded by an alternative is assumed to depend on the utilities associated with its composing attributes and attribute levels (Lancaster, 1966). In other words, Y_{iq} is the utility of individual *q* for the *i*th alternative, and is assumed to be a function of its attributes:

$$Y_{iq} = X_i \beta_i + \varepsilon_{iq}$$

where X_i is a vector of attributes for the *i*th alternative accompanied by a set of weights, β_i, that establish the relative contribution of each attribute to the utility associated with the *i*th alternative, and ε_{iq} is the residual capturing the unobserved variation in the characteristics of different options and any measurement errors.

DCEs are used to determine the significance of the attributes that describe a good or service and the extent to which individuals are willing to trade one attribute for another. In the present case, the DCE enables us to explore the trade-offs citizens make between privacy and the benefits that stem from the use of new technologies within various e-government domains, and to identify under what conditions citizens are more willing to adopt e-government services.

In our case, the services presented in each area (i.e. an e-government system based on citizens' data) are characterised by three attributes: data access, type of data shared, and benefits (Dimensions 2, 3 and 4 in Table 19). Dimension 2 has three levels, while Dimensions 3 and 4 have two.

Table 19. Experiment dimensions.

Dimension/attribute	Levels
1. **Area**	• **A1**: Transport • **A2**: Security • **A3**: Health • **A4**: Participation
2. **Data access**	• **D1**: Public authority • **D2:** A non-profit organisation • **D3:** A for-profit private company
3. **Type of data shared**	• **T1:** Basic data • **T2:** More sensitive data/longer storage time
4. **Benefits**	• **B1:** Direct benefit (directly involving the citizen) • **B2:** Indirect benefit (benefitting society as a whole)

Therefore, if every combination of levels for each of the three attributes (D2, D3, D4) is available, we have 3×2×2 = 12 possible options to choose from. Participants are presented with two of these options at a time and asked to choose their preferred one. In addition to the pair of options, in each choice, participants are presented also with the third option of opting out (i.e. choosing the option "I would prefer that none of these systems is implemented"). Participants are asked to make 12 consecutive selections. Based on respondents' preferences regarding these pairings, the importance of each level in their decision will be identified. Table 20 below lists the 12 possible options.

Table 20. The 12 options available in the DCE.

option 1	D1	T1	B1
option 2	D1	T1	B2
option 3	D1	T2	B1
option 4	D1	T2	B2
option 5	D2	T1	B1
option 6	D2	T1	B2
option 7	D2	T2	B1
option 8	D2	T2	B2
option 9	D3	T1	B1
option 10	D3	T1	B2
option 11	D3	T2	B1
option 12	D3	T2	B2

Once we had generated the 12 hypothetical alternatives using all attributes included in the study, we combined them to create 12 choice sets (pairs of options). A full factorial design was ruled out in favour of a fractional factorial design, because a full factorial design would have contained too many possible alternatives. This would have been unmanageable in practice for individuals to complete, or for a blocked questionnaire format to handle.

In selecting the fractional factorial design, we ensured a balanced design in which each level of attribute occurs equally often. In addition, we ensured a minimal overlap, as according to the literature, each attribute level is only meaningful in comparison to others within the choice set[408]. In other words, no information is obtained on an attribute's value when its levels are the same across all alternatives within a choice set.

Following these principles, and based on the 12 options above, we built 12 combination of options, or choice set, between which the participants choose. Note that a third option (opt-out) is always present in each of the choice sets.

Table 21. The 12 choice sets selected.

	CHOICE SET
1	Option 1 vs Option 8
2	Option 2 vs Option 7
3	Option 3 vs Option 10
4	Option 4 vs Option 9
5	Option 5 vs Option 4
6	Option 6 vs Option 3
7	Option 7 vs Option10
8	Option 8 vs Option 9
9	Option 11 vs Option 6
10	Option 11 vs Option 2
11	Option 12 vs Option 1
12	Option 12 vs Option 5

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[408] Mangham, L.J, Hanson, K. & McPake, B. (2009). How to do (or not to do)… Designing a discrete choice experiment for application in a low-income country. *Health Policy and Planning 24(2).*

After performing the experimental task, participants were asked a number of questions relating to privacy and trust. These provided further insights to use in interpreting the results. First, they were asked a set of five questions on their concerns about privacy, based on the General Privacy Concern Index from Westin's 1990 and 1991 Consumer Privacy Surveys (presented in Section 3.4.1). The participants' responses to these questions allowed us to divide them into the three groups and described earlier: Privacy Fundamentalists (i.e. high concern); Privacy Pragmatists (i.e. moderate concern); and Privacy Unconcerned (i.e. low concern). Second, participants were asked another set of four questions based on the distrust index developed by Westin in the 1994 Equifax-Harris Consumer Privacy Report to separate participants into three groups based on their level of trust in institutions and corporations[409].

3.4.2.1 Selection of cases studies

The selection of four hypothetical case studies, to which participants were randomly allocated, was based on real case studies from various countries. The key element of all case studies is the introduction of a new technology to improve a public service. The four areas selected were: transport, health, security and voting. For each area, we developed a hypothetical scenario, which was presented to the participants as a vignette.

A) Public transport

This scenario is based on an initiative by Transport for New South Wales (TfNSW) in Australia to provide open data from Sydney train commuters, collected via the smartcard used for public transport (the Opal card)[410]. Data about public transportation services can provide valuable information to researchers and municipal officials tasked with improving city services[411]. However, like other forms of open data, such information can compromise citizens' privacy if 'anonymised' travel patterns are re-identified[412]. To mitigate this risk, in March 2017, TfNSW collaborated with Australia's largest data and innovation group, Data61, to release open data about citizens' use of Sydney's public transport network, protected using privacy-preserving techniques. One drawback of using privacy-preserving mechanisms is that they can often reduce the utility of a dataset. In this instance, the application of differential privacy means that researchers cannot analyse users' trips and journeys, because their 'tap-ons' and 'tap-offs' are not linked. Despite this trade-off, it is clear that the release of Sydney's Opal data has the potential to yield some tangible social benefits. It also illustrates how governments can apply differential privacy to safeguard citizens' personal data. Privacy is the utmost priority for all of TfNSW's Open Data, and no information is released that can identify any individual in the Opal 'tap on' and 'tap off' Open Data. This means that any data that is, or can be, linked to an individual's Opal card has been removed.

As a result of the programme 'TfNSW Opal data released for public use', as noted by Culnane et al., 2017[413]), researchers and developers can now access and use the data to "innovate and gain insights for a huge variety of benefits for customers and organisations". "The open data gives a detailed view of when passengers are arriving at or leaving the station, which could also help local councils, government authorities and service providers to better plan local works and services provision in the neighbourhood." Furthermore, "researchers will also be able to incorporate the easily accessible data into planning, analysis and modelling at a level that has never been available before." Small businesses could benefit from the data by knowing when local train stations are frequented and staff their premises according, rather than relying on an "anecdotal, trial-and-error process."

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[409] Kumaraguru, P. & Cranor, L.F. (2005). Privacy indexes: A survey of Westin's studies, Pittsburgh: Institute for Software Research International, Carnegie Mellon University, CMU-ISRI-5-138.

[410] https://www.sgsep.com.au/maps/thirdspace/sydney-visualising-opal-data/

[411] https://media.nesta.org.uk/documents/DECODE-2018_report-smart-cities.pdf

[412] Culnane, C., Rubinstein, B.I.P. & Teague, V. (2017). 'Privacy Assessment of De-identified Opal Data: A report for Transport for NSW.' arXiv preprint arXiv:1704.08547.

[413] Ibid.

Based on this case, the participants were presented with the following scenario:

Imagine that the local authority has implemented a new system for the public transport, in which each citizen has a personalised electronic card that must be used each time the person gets on and off. The authorities are studying the implementation of a system to analyse this data, with the aim to improve the management of the public transport. There is a consultation to ask citizens what system they prefer. Please select the option that you like the most.

The hypothetical alternatives between which respondents are asked to choose, combine the elements displayed in Table 22.

Table 22. Attributes and levels relating to the transport scenario.

Attributes	*Levels*
Data access	• **D1**: The data is stored and analysed by the local authority. • **D2**: The data is stored and analysed by a research group on urban planning. • **D3**: The data is stored and analysed by the private company in charge of the IT system.
Type of data shared	• **T1:** The system collects data on your trips in an anonymised way (i.e. the tap on and tap offs cannot be linked and your individual trips cannot be identified). • **T2:** The system collects data on your trips linked to your personal identification.
Benefits	• **B1:** This system manages to reduce your travel time. • **B2:** This system manages to cut emissions.

Table 23. Example of a choice set for the transport scenario.

Option #1	**Option #2**	**Opt-out**
DATA ACCESS	DATA ACCESS	
The data is stored and analysed by the local authority.	The data is stored and analysed by the private company in charge of the IT system.	*I would prefer that none of these systems is implemented.*
TYPE OF DATA SHARED	TYPE OF DATA SHARED	
The data collected refers to your trips linked to your personal identification.	The data collected refers to your trips in an anonymised way (i.e. the tap on and tap offs cannot be linked and your individual trips cannot be identified).	
BENEFITS	BENEFITS	
This system manages to reduce your travel time.	This system manages to cut emissions.	

B) Health

This scenario is based on an application developed by the MD Anderson Cancer Center at the University of Texas, and IBM Watson[414]. This application, called the Oncology Expert Advisor (OEA), uses massive amounts of patient data and medical literature to assist oncologists with evidence-based care decisions on first-line therapy that are tailored to each patient. In the context of cancer care and research, the OEA is being trained to take in complex structured and unstructured information from a variety of real-world sources – patient records, physician notes, laboratory results – and weigh these patient attributes against its ever-expanding corpus of medical knowledge, oncology literature and treatment guidelines to propose appropriate evidence-based treatment options, based on each patient's unique disease profile. This application has proved to be a successful way to rapidly assess the best treatments for an individual patient, based on the latest evidence. The overall accuracy of the application's recommendations in the cases of 200 test patients with leukaemia was over 80%[415].

While personalised treatment is still very much in the trial stage, it has significant potential due to the vast quantities of patient genomic data that is coming online via several initiatives[416].

Based on the above case, the participants in the experiment were presented with the following scenario:

> *Imagine that the Ministry of Health wants to implement a new programme that uses artificial intelligence to pool and analyse large amounts of patient data. There is a consultation to ask citizens what system they prefer. Please select the option that you like the most.*

The hypothetical alternatives between which respondents will be asked to choose, combine the elements displayed in Table 24.

Table 24. Attributes and levels relating to the health scenario.

Attributes	Levels
Data access	• **D1**: The data is stored and analysed by the public authorities. • **D2**: The data is stored and analysed by a medical research foundation. • **D3**: The data is stored and analysed by the private company in charge of the IT system.
Type of data shared[417]	• **T1:** The system collects data related to your basic health: blood group, allergies, diabetic group, etc. • **T2:** The system collects data related to all your health conditions, including disabilities, cancer, mental health, sexual health, and addictions.
Benefits	• **B1:** This system manages to personalise the treatments that you are receiving • **B2**: This system helps advance healthcare research

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[414] http://www.tmc.edu/news/2014/08/ibm-watson-joins-md-anderson-in-cancer-fight/

[415] Stein, A. (2014). IBM Watson Joins MD Anderson in Cancer Fight Texas Medical Center. Retrieved 28 June 2017 from http://www.tmc.edu/news/2014/08/ibm-watson-joins-md-anderson-in-cancer-fight/

[416] Tito, J. (2017). Destination unknown: Exploring Artificial Intelligence in Government. Centre for Public Impact. Retrieved from https://publicimpact.blob.core.windows.net/production/2017/09/Destination-Unknown-AI-and-government.pdf

[417] Based on Patil, S., Patruni, B., Lu, H., Dunkerley, F., Fox, J., Potoglou, D. & Robinson, N. (2015). Public Perception of Security and Privacy. Results of the comprehensive analysis of PACT's pan-European Survey. RAND Corporation, Santa Monica, California, and Cambridge, UK.

Table 25. Example of a choice set for the health scenario.

Option #1	Option #2	Opt-out
DATA ACCESS	DATA ACCESS	
The data is stored and analysed by the public authorities.	The data is stored and analysed by the private company in charge of the IT system.	*I would prefer that none of these systems is implemented.*
TYPE OF DATA SHARED	TYPE OF DATA SHARED	
The system collects data related to all your health conditions, including disabilities, cancer, mental health, sexual health, and addictions.	The system collects data related to your basic health: blood group, allergies, diabetic group, etc.	
BENEFITS	BENEFITS	
This system helps advance healthcare research.	This system manages to personalise the treatments you receive.	

C) Security

This scenario is based on a system of facial recognition used by the police and implemented in some regions in China[418]. Police have used sunglasses including built-in facial recognition since 2018 to check travellers and car registration plates against the government's blacklist, which includes criminals, journalists, political dissidents and human rights activists, among others. Powered by artificial intelligence (AI), the new technology provides police with instant and accurate feedback compared with the lag and static nature of facial recognition carried out via CCTV. This novelty has led to growing concerns that China is developing a sophisticated surveillance state that will lead to intensifying crackdowns on dissent. However, those who back the proposal in China (such as the CEO of the company implementing the technology) say that people should not be worried about privacy concerns because China's authorities were using the equipment for "noble causes", catching suspects and fugitives from the law. The technology was quickly praised by authorities for helping to identify several individuals who had previously committed crimes, from human trafficking to traffic infringements.

Automated Facial Recognition has also been used by UK police in South Wales, which had trialled this technology for a number of years before the implementation and has consistently defended it, saying that it has been used to help detect and prevent crime. However, the use of facial recognition technology South Wales Police, which is able to match a person's likeliness to a pre-defined database of images, was challenged in the High Court[419]. The civil rights group, Liberty, contended that the system indiscriminately captured data on people in public places, and that its use was not proportionate. Liberty claimed that the data captured is similar to obtaining an individual's DNA or fingerprints and says that each frame captured by a camera can identify up to five faces.

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[418] https://www.nytimes.com/2018/07/08/business/china-surveillance-technology.html?module=inline
[419] https://www.bbc.com/news/uk-wales-49565287

The judges found that although amounted to interference with the right to privacy, there was a lawful basis for it, and the legal framework used by the police was proportionate. Similarly, in the US, citizens and politicians recently raised concerns about the new technology. A bipartisan group in Congress is working on legislation that could regulate the use of facial recognition by the private sector, federal government, and law enforcement[420]. At the same time, this issue has been debated recently in Europe. EU leaders are considering a ban on the use of facial recognition in public spaces for up to five years until safeguards to mitigate the technology's risks are put in place[421].

Based on the cases above, the participants were presented with the following scenario:

> *Imagine that the police officers in your city plan to start wearing facial recognition glasses in order to better identify offenders. There is a consultation to ask citizens what system they prefer. Please select the option that you like the most.*

The hypothetical alternatives between which respondents are asked to choose, combine the elements displayed in Table 26 below.

Table 26. Attributes and levels relating to the security scenario.

Attributes	*Levels*
Data access	• **D1**: The data collected by these glasses is stored and analysed by the local government. • **D2:** The data collected by these glasses is stored and analysed by the local police. • **D3**: The data collected by these glasses is stored and analysed by the IT company who provides the system.
Type of data shared	• **T1:** The data regarding your face features and location are stored for two weeks and then erased if not matched with any offender in the existing database. • **T2:** The data regarding your face features and location are stored for five years.
Benefits	• **B1:** This system has been tried in other cities, resulting in a decrease in the homicide rate. • **B3**: This system has been tried in other cities, resulting in a decrease in vandalism towards public property.

Table 27. Example of a choice set for the security scenario.

Option #1	**Option #2**	**Opt-out**
DATA ACCESS	DATA ACCESS	
The data collected by these glasses is stored and analysed by the local government.	The data collected by these glasses is stored and analysed by the IT company who provides the system.	*I would prefer that none of these systems is implemented.*
TYPE OF DATA SHARED	TYPE OF DATA SHARED	

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[420] https://venturebeat.com/2020/01/15/congress-moves-toward-facial-recognition-regulation/
[421] https://www.politico.eu/article/eu-considers-temporary-ban-on-facial-recognition-in-public-spaces/

The data regarding your face features and location are stored for five years.	The data regarding your face features and location are stored for two weeks and then erased if not matched with any offender in the existing database.
BENEFITS	BENEFITS
This system has been tried in other cities resulting in a decrease in vandalism towards public property.	This system has been tried in other cities resulting in a decrease in the homicide rate.

D) Voting

The final scenario used in our experiment is based on the e-voting systems implemented in certain countries. Internet voting systems have achieved some success in Estonia, Canada, Brazil, France and Switzerland. However, experiences from Norway also point to security concerns regarding election fraud[422]. The literature reviewed in D2 reveals that the use blockchain could arguably help to address these security issues. Some work on the design of such systems has already been undertaken[423], and prototypes exist. Nevertheless, the underlying issue relating to blockchain-based e-voting systems is the fact that personal authentication must occur outside of the blockchain[424]. So far, e-voting systems have used standalone electronic voting machines (also called EVMs) or computers connected to the Internet. A group of researchers at the University of Melbourne in Australia have twice demonstrated massive security flaws in the online voting systems used in state elections in Australia – including one of the largest deployments of online voting ever, the 2015 New South Wales (NSW) state election, in which 280,000 votes were cast online[425].

Voter privacy is of utmost concern when considering which voting systems to use. The risks to internet voting include all of the dangers typically associated with online transactions. For those planning to vote in the election via the internet, a denial-of-service attack could mean the difference between being able to vote or not[426]. Such threats must be adequately addressed while maintaining the privacy of the voter to ensure the confidentiality, integrity, and availability of the voting system.

Based on the cases above, the participants were presented with the following scenario:

> *Imagine that the government is planning to implement internet voting for the next legislative elections. There is a consultation to ask citizens what system they prefer. Please select the option that you like the most.*

The hypothetical alternatives between which respondents are asked to choose, combine the elements displayed in the table below.

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[422] Warkentin, M., Sharma, S., Gefen, D., Rose, G.M. and Pavlou, P. (2018). Social identity and trust in internet-based voting adoption. *Government Information Quarterly*, 35(2), 195-209.
[423] 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 Conference on Information Systems Security Privacy* (pp. 499-505).
[424] Shen, C. & Pena-Mora, F. (2018). Blockchain for Cities - A Systematic Literature Review. *IEEE Access* 6, 76787-76819.
[425] Halderman, J.A., & Teague, V. (2015). The New South Wales ivote system: Security failures and verification flaws in a live online election. In *International conference on e-voting and identity* (pp. 35-53). Springer, Cham.
[426] Simons, B. & Jones, D. (2012) "Internet Voting in the U.S.," *Communications of the ACM,* vol. 55, no. 10, 68-77.

Table 28. Attributes and levels relating to the voting scenario.

Attributes	Levels
Data access	• **D1**: Your vote is stored and processed by the government. • **D2**: Your vote is stored and processed by an independent electoral authority[427]. • **D3**: Your vote is stored and processed by the private company providing the IT system.
Type of data shared[428]	• **T1:** Your vote is encrypted and cannot be linked to your personal identification. • **T2:** Your vote is not encrypted.
Benefits	• **B1:** This system reduces greatly your voting time. • **B2**: This system increases turnout.

Table 29. Example of a choice set for the voting scenario.

Option #1	Option #2	Opt-out
DATA ACCESS	DATA ACCESS	
Your vote is stored and processed by the government.	Your vote is stored and processed by the private company providing the IT system.	*I would prefer that none of these systems is implemented.*
TYPE OF DATA SHARED	TYPE OF DATA SHARED	
Your vote is not encrypted.	Your vote is encrypted and cannot be linked to your personal identification.	
BENEFITS	BENEFITS	
This system reduces greatly your voting time.	This system increases turnout.	

3.4.2.2 Implementation and distribution of the sample

The online experiment was conducted in Germany and Spain, 23-30 September 2019. In total, 1,400 participants (700 per country) were recruited from a nationwide panel of internet users, with each group being representative of the general population of the country.

The table below shows the socio-demographic breakdown of the sample overall and by country. The two panels were relatively similar in terms of gender, age groups, occupation, and self-reported social status[429] – although there was a larger share of retired participants

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[427] International IDEA. Electoral management design database. Glossary. Accessible at: https://www.idea.int/data-tools/data/electoral-management-design

[428] Based on Robinson et al. (2015).

[429] Self-reported social status was measured by asking respondents, based on their income, where they would position themselves from a scale from 0 to 10.

in Germany than in Spain. In terms of education, however, there was a large difference between the two countries. Many of the German panel had not attended university, while we observed a high level of university degrees in Spain. Our interpretation of this difference is that the German educational system encourages students who do not wish to continue their academic studies to obtain early technical (i.e. vocational) training, enabling them to gain employment and earn income at an early age.[430] Spain, on the other hand, encourages its citizens to attend higher education in order to improve their employment opportunities. Table 30 simplifies the classification of participants' education into three levels (Level 1 = no university; Level 2 = university degree; Level 3 = post-graduate), where these country differences can be observed. Lastly, we observed a significant higher share of urban residents in Spain compared with Germany, which is in line with the general population statistics of the two countries.

More interestingly, in line the literature on trust and privacy presented in Section 3.4.1, we segmented the respondents based on their responses to the post-experimental questionnaire on privacy and trust. First, based on the type of the responses received, and partially following Taylor (2003)[431], we divided the respondents in three groups: those whose concerns about privacy were high (28%), medium (64%) and low(8%). Based on the responses received on our distrust index, we divided the respondents into another three groups, following Westin and Harris (1994)[432]: high level of distrust (21%), medium (66%) and low (11%). This further segmentation has proved to be particularly useful in interpreting some of the results of the experiment.

Table 30. Socio-demographics of survey sample (N=1,400).

Variable	Total sample (%)	Germany (%)	Spain (%)
Gender (female)	49.79	50.43	49.14
Age group			
18-24	12.57	12.57	12.57
25-54	56	54.14	57.86
55-74	31.43	33.29	29.57
Education[433]			
Level 1	47.51	63.72	31.29
Level 2	43.28	29,57	57
Level 3	9.21	6.71	11.71
Occupation			
Self-employed	8.21	6.57	9.86

[430] https://www.cleanenergywire.org/factsheets/how-germanys-vocational-education-and-training-system-works

[431] Taylor, H., (2003).'Most People Are "Privacy Pragmatists" Who, While Concerned about Privacy, Will Sometimes Trade It Off for Other Benefits: The Harris Poll No. 17'. Available online at http://www.harrisinteractive.com/harris_poll/index.asp?PID=365

[432] Kumaraguru, P. & Cranor, L.F. (2005). Privacy indexes: A survey of Westin's studies, Pittsburgh: Institute for Software Research International, Carnegie Mellon University, CMU-ISRI-5-138.

[433] Education levels were defined as follows: Level 1 education refers to those who reported "no official education", "primary school" or "high school" – of which, the last two partly include vocational/technical training; Level 2 refers to those who attended "some years of university (not completed)" or had completed a university degree; Level 3 reported having post-graduate level education.

Managerial position	11.43	9.43	13.45
Other white collar[434]	29.71	31.29	28.14
Manual worker	14.14	13.43	14.86
Unemployed	5.79	4.29	7.29
Retired	14.21	19	9.43
Student	8.79	8.71	8.86
Non-employed[435]	7.71	7.29	8.14
Residence			
Urban	62.64	49	76.29
Suburban	18.14	24	12.29
Rural	19.21	27	11.43
Social status scale			
Social scale: 1-2	5.22	7.14	3.29
Social scale: 3-4	17.43	20.43	14.43
Social scale: 5-6	42.71	40.43	45
Social scale: 7-8	31.86	29.28	34.43
Social scale: 9-10	2.78	2.72	2.86
Distrust level			
Low	11.5	14.71	8.29
Medium	66.57	60.29	72.86
High	21.93	25	18.86
Privacy concern level			
Low	8	10.29	5.71
Medium	64	62.86	65.14
High	28	26.86	29.14

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[434] e.g. customer support, market research, engineer, etc.
[435] e.g. disabled, stay-at-home persons, not in education, employment or training.

3.4.3 Results and discussion

In this chapter, we present the results of the experiment, along with a description of the type of analyses conducted. A discussion of the results in the light of the literature reviewed and the conceptual framework is then provided in Section 4. In Box 13 below, we provide a very brief summary of the main findings of this case study.

Box 13. Main findings of Case Study 3: online experiment (Germany and Spain).

- **The results show that trust plays a key role** in the introduction of new digital services that rely on the use of personal data. Most of respondents were strongly opposed to private companies processing their data. However, our evidence also shows that those respondents who are generally more distrustful and privacy-concerned tend to prefer having their data processed by independent organisations rather than public authorities and governments. Therefore, the public sector cannot consider itself immune from the concerns of citizens in relation to privacy.

- **Participants were not willing to make trade-offs** when it came to personal data and privacy. When presented with the choice, irrespective of the type of benefits, the respondents preferred to provide anonymised data, and for it not to be processed by private companies. Moreover, the results call into question the general view that citizens are more willing to adopt new digital services when they receive more personalised benefits.

- **There is a new potential form of digital divide** shown by the results, which is not simply linked to a lack of accessibility or skills. The majority of respondents who decided not to adopt the new digital services were either old or possessed lower level of education and lower socio-economic status. The level of trust among these groups of people was generally much lower, confirming that digital transformation may leave out those who tend to distrust the institutions and so do not adopt new services.

The analysis of the results presented in this chapter followed a number of steps, each of them enriching the results of the previous.

First, we sought to understand the values that respondents placed on the level of attributes for each of the four dimensions. This provided us with an initial understanding of the preferences of the participants for each attribute. For instance, from the first analysis, we immediately observed that in terms of type of organisation, respondents preferred having their data processed either by a public authority (transport and security) or by an independent organisation (health and participation). Furthermore, in all domains, the majority of respondents expressed a preference to share only anonymised or basic data when given the choice. This first level of analysis is presented below, divided into each of the four domains and showing for each attribute the level of preference among respondents.

Second, we segmented the population using the responses given to the socio-demographic questions and the questions relating to trust and privacy, to see if any significant differences could be found. As expected, we observed that the higher the level of distrust, the higher the preference of respondents for anonymised data. Conversely, respondents who were not particularly concerned about privacy were more inclined to share their data with a private company. Lastly, it was observed that older participants were more likely to be concerned over privacy, while respondents with higher self-reported social status reported lower levels of privacy concerns.

Third, we analysed the results to detect a potential 'country effect' in the responses. Slight differences were found between the two countries in each of the four dimensions. In Spain, people were more inclined to prefer the societal benefits stemming from the introduction of digital services (transport and health). In the security domain, a strong preference for having personal data stored for a shorter period was evident in Germany, while in Spain it was preferred by a more limited margin.

Fourth, we analysed the levels of adoption of the four hypothetical digital services by observing the number of participants who chose the opt-out option, i.e. respondents who preferred not to adopt the new service, irrespective of the conditions of data access and benefits. This produced some interesting results. For instance, as expected, older people, those with a high level of distrust, and those from lower socio-economic brackets were more likely to opt out. Furthermore, in terms of the domains, we observed that the security and participation domains were the ones in which the highest number of respondents chose to opt out. This coincides with the finding reported in the literature that people are generally sceptical about facial recognition technologies and e-voting solutions.

Lastly, we conducted further analysis to explore the trade-offs in terms of attributes that participants implicitly made by choosing one option over another. It is important here to mention that our analysis only provides correlations between preferences, from which we cannot infer a causal link. Having said that, the results were interesting. For instance, with regard to health, the small number of respondents who indicated a preference for private companies appeared to be indifferent to the types of data (basic or sensitive) shared. Furthermore, among those respondents who were willing to allow private companies to access their data, we observed no significant differences in preferences as to the benefits received. Finally, we found that trust plays an important role in distinguishing those participants who favour an independent organisation processing their data (low level of trust), and those who favoured public authorities.

In the next section, we describe in greater detail the types of analysis conducted, and the results in quantitative terms.

3.4.3.1 Modelling results

Our analysis used a multinomial logistic regression, which was performed using the software 'R', to determine the stated preferences of respondents in Spain and in Germany, while taking into account their various socio-demographic characteristics as well as behaviours or biases. In reporting our results, we present four model fit statistics, as described in the table below, for each sector.

Table 31. The four models.

Model	Description
Model I	A multinomial logistic regression using attributes only, to analyse the levels of each attribute.
Model II	Same model as model I, with control variables included (socio-demographic characteristics and level of trust and privacy).
Model III	Model I applied to respondents in Germany only.
Model IV	Model I applied to respondents in Spain only.

In interpreting the coefficient values presented in Tables 32-35 below, the following points should be considered:

- A **positive coefficient** (reported as "*ESTIMATE*") implies that the level has a positive impact on utility, and so reflects a higher probability of choosing the alternatives to which it is applied to. In other words, it implies that the feature is preferred to the base category.
- A **negative coefficient** signifies that the level has a negative impact on utility, and so reflects a lower probability of choosing the alternative to which it is applied. In other words, the attribute is less preferred than the reference category.
- The p-value indicates the statistical significance of the estimate. In our tables, three levels are reported next to the estimates: *** is significant at the 0.01 level[436]; ** at the 0.05 level; and * at the 0.10 level. A p-value ≤ 0.05 is a common threshold

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[436] In other words, it represents a 1% chance of being wrong.

for researchers and indicates strong evidence[437]. In other words, the estimate is shown to be statistically significantly different from zero at a 95% confidence level.

- Attribute coefficients, as categorical variables, reflect the total increase or decrease in utility for that variable, relative to a reference category (or a base situation). The rows in italics in each of the tables below represents the reference categories for each attribute.
- If the odds are lower than 1, the feature is less preferred than the reference category.
- The R^2 of the model is included as a goodness-of-fit measure for the linear regressions.

A sector-specific analysis follows, analysing respondents' choices in relation to each of the four sectors under Dimension 1 separately; namely, transport, health, security and participation. We include a breakdown by country and a specific analysis of the privacy and distrust indices. The next section looks into socio-demographic features of specific profiles.

A) Transport

The results of the **transport domain** choice experiment revealed that respondents preferred to have their data stored and analysed by the local authority rather than by a private company or an independent research group on urban planning. In addition, they strongly preferred the option of having the data regarding their trips anonymised. This strong aversion to de-anonymised data is captured in the statistics. When presented with the option between two potential benefits of the systems, there is evidence that participants prefer the option to reduce emissions (indirect or societal benefit) over reducing their own travel time (direct benefit). In sum, the data showed that respondents value the anonymisation of their data much more than which entity accesses this data, or than the benefits received from data sharing. In other words, respondents prefer their transport data to remain anonymised and to be accessed only by local authorities.

Further analysis did not show any significant results. In fact, none of the additional control variables (i.e. socio-demographics) are significant when included into the model (See Model II), and the sign and significance of the attribute levels remained unchanged. While the sign and significance also remained unchanged in the country breakdown, it revealed several context-specific characteristics. Germany appears to strongly favour local authorities over private IT companies for the management of transport data. In terms of benefits, participants in Spain were found to prefer the reduction of emissions (indirect benefit) more strongly than the German respondents. Overall, however, the key finding that respondents display a stronger preference for the anonymisation of their transport data, as compared to all other attributes, remains the same across both countries.

Next, we included the **levels of distrust** into the model by stratifying the sample into three levels. As expected, the findings were consistent with the literature. In fact, the preference for sharing anonymised data over personalised data increases with the level of distrust. An additional analysis was also carried out by stratifying respondents according to the **privacy index**, i.e. participants' level of concern regarding privacy. The model was applied separately to those with a low, medium and high level of concern for privacy in relation to the transport sector. As expected, those with a higher level of concern over privacy were more strongly opposed to sharing data that can be linked to personal identification, with everything else held constant. Furthermore, the privacy index score does not appear to affect the utility stemming from direct or indirect benefits, with all estimates having a positive and significant estimate. In other words, irrespective of their level of privacy concern, respondents in the transport sector preferred reducing emissions (indirect benefit) over reducing their travel time (direct benefit)[438].

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[437] Hair, J.F. Jr., Black, W.C., Babin, B.J. & Anderson, R.E. (2009). Multivariate Data Analysis. 7th Edition, Prentice Hall, Upper Saddle River, NJ.
[438] The associated estimate increases from 0.28 for those with a Low level of privacy concern to 0.35 for those with a High level of privacy concern.

Table 32. Transport sector: main results of the discrete choice experiment (n=350).

Attributes and Levels		Model I ESTIMATE (SE)	ODDS	Model II ESTIMATE (SE)	ODDS	model III (DE) ESTIMATE (SE)	ODDS	Model IV (ES) ESTIMATE (SE)	ODDS
Data access	The data is stored and analysed by the private company in charge of the IT system. (D3)	-0.46 *** (0.06)	0.63	-0.47 *** (0.06)	0.63	-0.52 *** (0.08)	0.60	-0.41 *** (0.08)	0.66
	The data is stored and analysed by a research group on urban planning. (D2)	-0.18 *** (0.06)	0.84	-0.17 *** (0.06)	0.84	-0.18 ** (0.08)	0.84	-0.17 ** (0.08)	0.84
	Reference category: The data is stored and analysed by the local authority. (D1)								
Type of data shared	The system collects data on your trips linked to your personal identification. (T2)	-1.08 *** (0.04)	0.34	-1.07 *** (0.04)	0.34	-1.08 *** (0.06)	0.34	-1.08 *** (0.06)	0.34
	Reference category: The system collects data on your trips in an anonymised way (i.e. the tap on and tap offs cannot be linked and your individual trips cannot be identified). (T1)								
Benefits	The system manages to cut emissions. (B2)	0.29 *** (0.04)	1.34	0.29 *** (0.04)	1.34	0.19 *** (0.06)	1.20	0.39 *** (0.06)	1.48
	Reference category: The system manages to reduce your travel time. (B1)								
	Intercepts		-	-0.11	-		-		-
	Controls	No		Yes		No		No	
	Pseudo-R^2	0.35				0.61		0.58	

*** Significant at the 99% level; ** significant at the 95% level

B) Health

The results from the **health** choice experiment (see Table 33) advance a different narrative. Provided that all other attributes are held constant, as with other domains, respondents strongly preferred for their health data to be stored and analysed by public authorities rather than by the private company in charge of the IT system. However, participants prefer the option of an independent medical research foundation over the public authorities, when presented with this alternative choice set. In terms of the type of data shared, respondents once again tended to choose to share only basic health data and not more sensitive data (e.g. disabilities, cancer, mental health, sexual health and addictions). However, in contrast to the previous choice experiment, there is no evidence that participants prefer either direct or indirect benefits (p-value=0.21). In other words, there is no significant difference in preferences between a system that is able to personalise individual treatments, or a system that helps to advance health care research, signifying that these attributes are equally relevant and/or important to respondents.

When conducting the second analysis, as shown in Model II, we found that none of the control variables was significant. The size and magnitude of the estimates of the attributes are consistent with those of Model I, meaning that socio-demographic characteristics have no particular impact on the results. In terms of the country break-down, several country-specific differences were found. Participants in Spain were indifferent to whether data was held and analysed by the public authority or by a medical research foundation. In both countries, however, participants were strongly opposed to their health data being held by private companies. Similarly, to the findings for the transport sector, in Germany participants favoured the anonymisation of their health data more strongly than in Spain. Lastly, in terms of benefit, participants in Spain slightly favoured a system that would help to advance health care research (indirect benefit), whereas Germans were showed no clear preference between societal or personal benefits.

When looking at the **distrust index**, participants' level of distrust did not seem to affect their opposition to data access by a private company. However, as might be expected, those with a high level of distrust prefer data linked to their health to be held by an independent medical research foundation. We ran a regression on the **privacy index** for the health sector. Respondents placed less utility on choice sets that included data access by private companies than on choice sets in which public authorities access the health data, with an estimate of -0.81 at the 0.01 level. In addition, those with a medium level concern over privacy preferred the collection of basic data rather than sensitive data, with everything else held constant (-0.20). Those with a high level of privacy concern significantly preferred a system in which health data is held by a medical research foundation, and are strongly opposed to sharing sensitive health data. It appears that the more concerned with privacy is the participants were, the more they preferred access by independent organisations, and the more reluctant they are to share sensitive data. It does not, however, appear to have a bearing on the type of benefit preferred.

Table 33. Health sector: main results of the discrete choice experiment (n=350).

Attributes and Levels		Model I ESTIMATE (SE)	ODDS	Model II ESTIMATE (SE)	ODDS	Model III (DE) ESTIMATE (SE)	ODDS	Model IV (ES) ESTIMATE (SE)	ODDS
Data access	The data is stored and analysed by the private company in charge of the IT system. (D3)	-0.85 *** (0.05)	0.43	-0.87 *** (0.05)	0.42	-0.91 *** (0.08)	1.48	-0.81 *** (0.07)	0.45
	The data is stored and analysed by a medical research foundation. (D2)	0.17 *** (0.05)	1.19	0.17 *** (0.05)	1.19	0.39 *** (0.08)	0.40	-0.01 (0.07)	0.99
	Reference category: The data is stored and analysed by the public authority. (D1)								
Type of data shared	The system collects data related to your health conditions, including disabilities, cancer, mental health, sexual health, and addictions. (T2)	-0.25 *** (0.04)	0.78	-0.22 ** (0.04)	0.80	-0.32 *** (0.06)	0.73	-0.19 *** (0.05)	0.83
	Reference category: The system collects data related to your basic health: blood group, allergies, diabetic group, etc. (T1)								
Benefits	The system helps advance healthcare research. (B2)	0.05 (0.04)	1.05	0.04 (0.04)	1.04	-0.01 (0.06)	0.99	0.09 * (0.05)	1.10
	Reference category: The system manages to personalise the treatments that you are receiving. (B1)								
	Intercepts		-	-0.43	-		-		-
	Controls	No		Yes		No		No	
	Pseudo-R^2	0.10				0.61		0.50	

*** Significant at the 99% level; ** significant at the 95% level.

C) Security

The results of the discrete choice experiment on the **security sector** are presented in Table 34. Here, respondents strongly preferred for their data (i.e. facial images and geo-localisation) to be managed by the local government rather than by the IT company providing the system. However, when comparing the local government against the local police, they showed a preference for their data to be managed by the local police. Respondents also preferred for their data to be stored for two weeks and then erased if it did not match any offender in the existing database, compared to alternative of longer storage for five years. In terms of benefits, in the security sector respondents favoured direct benefits instead of indirect benefits. Namely, they choose a system that results in a decrease in homicide rate (personal benefit) over a system that decreases vandalism towards public property (societal benefit).

For the further analysis presented in Model II, we observed again that none of the control variables were significant and that the sign and significance of the attributes remained unchanged. This again reveals that socio-demographic variables did not have a significant impact on choice outcomes. The country breakdown reveals several differences between Germany and Spain. German respondents appeared to be indifferent between data being accessed by the local police or by local government, but were strongly opposed to data access by private companies. In contrast, Spanish respondents favoured local police over local government at a significant level, while showing a similar but less pronounced opposition to data access by private companies. In terms of the type of data shared, data anonymization was preferred by both groups, i.e. shorter storage of data in this particular sector, although Germany reveals a stronger preference for this feature (-0.90) than Spain (-0.57), as captured by the magnitude of the estimates. The preference for direct benefits (decrease in homicide) over indirect (decrease in vandalism) is consistent across both countries, as it is in the model for the total sample.

We did not find significant results when conducting the **distrust index** analysis for this particular sector, meaning that the level of trust does not have a significant influence in this context. Similar to other sectors, the **privacy index** analysis for the security sector reveals that for a higher level of privacy over concern corresponds with an increased preference for sharing encrypted rather than unencrypted data, when all other factors are equal. Respondents with a high level of concern over privacy report a stronger preference (-0.59) for receiving the direct benefit, i.e. a decrease in homicide rate. Those with a low and medium level prefer this too, but to a lesser extent. While those who scored low in the privacy index are indifferent to who accesses their data, those scoring medium and high are strongly opposed to data access by private companies. Furthermore, those with a high level of concern over privacy significantly preferred for the local police to store and analyse the data collected by the facial recognition glasses, rather than local government (0.23).

Table 34. Security sector: main results of the discrete choice experiment (n=350).

Attributes and Levels		Model I		Model II		model III (DE)		Model IV (ES)	
		ESTIMATE (SE)	ODDS	ESTIMATE (SE)	ODDS	ESTIMATE (SE)	ODDS	ESTIMATE (SE)	ODDS
Data access	The data collected by the glasses is stored and analysed by the IT company who provides the system. (D3)	-0.55 *** (0.06)	0.58	-0.56 *** (0.06)	0.57	-0.64 *** (0.09)	0.53	-0.48 *** (0.07)	0.62
	The data collected by the glasses is stored and analysed by the local police. (D2)	0.13 ** (0.05)	1.14	0.13 ** (0.05)	1.14	0.08 (0.08)	1.08	0.17 ** (0.07)	1.19
	Reference category: The data collected by the glasses is stored and analysed by the local government. (D1)								
Type of data shared	The data regarding your facial features and location are stored for five years. (T2)	-0.71 *** (0.04)	0.49	-0.69 *** (0.04)	0.50	- 0.90 *** (0.06)	0.41	-0.57 *** (0.05)	0.56
	Reference category: The data regarding your facial features and location are stored for two weeks and then erased if not matched with any offences in the existing database. (T1)								
Benefits	The system has been tried in other cities resulting in a decrease in vandalism towards public property. (B2)	-0.40 *** (0.04)	0.67	-0.41 *** (0.04)	0.67	-0.42 *** (0.06)	0.66	-0.39 *** (0.06)	0.68
	Reference category: The system has been tried in other cities resulting in a decrease in the homicide rate. (B1)								
	Intercepts		-	0.20	-		-		-
	Controls	No		Yes		No		No	
	Pseudo-R^2	0.12				0.63		0.50	

*** Significant at the 99% level; ** significant at the 95% level.

D) Voting

The results for the **participation** scenario are presented in Table 35 and align strongly with the responses from the Health scenario, except in terms of benefits. Similarly to the previous scenarios (with the notable exception of that relating to the transport sector), participants showed an inclination toward a system in which votes are stored and processed by the government rather than by a private IT company. However, given the choice, they revealed an overall preference for a system in which votes are managed by an independent electoral authority, rather than by the government. As expected, a strong preference for encrypted votes was clearly captured in the statistics. Respondents appeared to strongly prefer a system in which votes are encrypted and cannot be linked to their personal identification. As in the health scenario, respondents showed no preference between direct and indirect benefits. This indicates that they attribute equal importance to a system that reduces the time it takes to vote as they do to a system that increases turnout.

When looking at socio-demographics, none of the control variables were found to be significant, and the signs and magnitudes of the estimates under Model II are consistent with those from Model I. Instead, some differences exist between the two country groups. Respondents in Spain were indifferent to whether the voting system was run by the government or by the private sector – although the sign remains negative. It appears that for the data access attribute, Spanish respondents only show a significant preference for an independent electoral authority–more so than their German counterparts. Participants in Germany were found to value vote encryption more strongly than those in Spain. No significant results were found for either country in terms of preferred benefits.

Lastly, according to the **distrust index** analysis, all respondents favour the encryption of their votes; however, those with a high level of distrust also strongly prefer voting data to be handled by an independent electoral authority rather than by the government. In addition, analysis of the **privacy index** reveals some interesting insights in this scenario. Overall, the preference for the type of data shared is consistently in favour of encrypted votes, but it is much stronger (-2.31) among those with a rated high on the privacy index, as compared to those with a low privacy index (-1.47). In terms of data access, those who were not greatly concerned with privacy (low privacy index) were indifferent to which type of entity accessed their data (p-value $\geq$ 0.05), while those that were concerned with a medium or high level of concern over privacy favoured data access by an independent electoral authority, with estimates of 0.34 and 0.66 respectively.

Table 35. Participation sector: main results of the discrete choice experiment (n=350).

	Attributes and Levels	Model I ESTIMATE (SE)	Model I ODDS	Model II ESTIMATE (SE)	Model II ODDS	model III (DE) ESTIMATE (SE)	model III (DE) ODDS	Model IV (ES) ESTIMATE (SE)	Model IV (ES) ODDS
Data access	Your vote is stored and processed by the private company providing the IT system. (D3)	-0.15 ** (0.07)	0.86	-0.17 ** (0.07)	0.85	-0.26 ** (0.12)	0.77	-0.06 (0.09)	0.94
	Your vote is stored and processed by an independent electoral authority. (D2)	0.35 *** (0.07)	1.42	0.34 *** (0.07)	1.41	0.33 *** (0.11)	1.38	0.37 *** (0.09)	1.45
	Reference category: Your vote is stored and processed by the government. (D1)								
Type of data shared	Your vote is not encrypted. (T2)	-1.69 *** (0.05)	0.18	-1.67 *** (0.05)	0.19	- 1.91 *** (0.08)	0.15	-1.53 *** (0.07)	0.22
	Reference category: Your vote is encrypted and cannot be linked to your personal identification. (T1)								
Benefits	The system increases turnout. (B2)	0.06 (0.05)	1.06	0.05 (0.05)	1.05	0.10 (0.08)	1.11	0.03 (0.07)	1.03
	Reference category: The system reduces greatly your voting time. (B1)								
	Intercepts			0.16 (0.39)	-		-		-
	Controls	No		Yes		No		No	
	Pseudo-R^2	0.35				0.74		0.62	

*** Significant at the 99% level; ** significant at the 95% level

3.4.3.2 Further results

We ran a linear regression of the scaled **distrust index** on the socio-demographic variables, both for the sample overall and for each country individually, to identify any of these factors could be determinants of the distrust level. In other words, we wanted to understand whether the respondents' socio-demographic characteristics and the country they came from had an impact on the level of distrust. In the overall sample, both gender and education were significant, where the gender variable correlates positively with distrust, implying that females were more likely to be distrustful of organisations seeking their personal information. In Germany, education was significant at the 0.05 level with an estimate of -0.124, implying that education correlates negatively with distrust. In other words, people who had attained a higher level of education had a tend to show greater trust. In Spain, the results were similar but slightly more significant. When the country variable is used instead as a regressor, Spain was found to be positively related to distrust, and all other socio-demographic variables became insignificant. This implies that the between-country difference in distrust is much greater than the within-country difference.

Table 36. Regression on distrust index results.

Variable	Linear regression	Spain	Germany	Country regressor
Gender	0.203	0.274	0.137	-0.032
Education	-0.120	-0.124	-0.122	-0.002
Age	0.003	0.006	-0.000	0.001
Country (Spain)	-	-	-	0.192
Intercept	5.600	5.426	5.787	5.537

As expected, among those respondents who were in favour of the government managing their data, the level of trust was higher. In addition, a two-sample t-test was performed to determine if a significant difference existed in the average level of distrust (i.e. the mean) between respondents who selected a system managed by an independent organisation (mean=5.44) and those who selected a system run by the government (mean=5.11). From the analysis, we found that respondents who preferred an independent organisation were, on average, less trusting than those who favoured the government.

We then analysed the levels of adoption among the sample of the four hypothetical digital services, by observing the characteristics of the preferences for the opt-out option, i.e. respondents who preferred not to adopt the new service, irrespective of the conditions regarding their data, and of the benefits of the service. To analyse this, we regressed the **opt-outs** on individuals' socio-demographic information. In the overall sample, age, levels of distrust, and the security and participation dimension all correlate positively with the preference of opting-out. Hence, older respondents and those with a low level of trust were more likely to opt out. For the opt-out analysis, we include the sectors as a regressor to understand which dimensions respondents were more likely to opt out from. The results suggest that the participation and security dimensions correlate positively with opting out, meaning that respondents are on average more reluctant to adopt new digital services in these domains. Then, we also controlled the level of opt-out for the different countries to see if there was a country effect. In Germany, distrust is highly significant, implying that a high level of distrust correlates with a high frequency of opt-outs. Self-reported socio-economic status was also significant in Germany, with people in lower socio-economic brackets more likely to opt out. In Spain, the distrust index and self-reported social status had the same effects on opting out, although with slightly smaller magnitudes.

Furthermore, age was also found to be significant and positively related to the frequency of opt-outs, indicating that older participants were more likely to opt out. Running a linear regression with the country variable as a regressor instead, we found that the variable for Spain has an estimate of -2.80; in other words, people in Germany are more likely to opt out. The other significant variables are in line with those from the general regression.

Table 37. Regression on opt-out results.

Variable	Linear regression	Spain	Germany	Country regressor
Distrust Index	0.60 ***	0.45 **	0.68 ***	0.60 ***
Education	-0.13	-0.15	0.49	0.24
Age	0.03 **	0.05 **	0.01	0.03 **
Health sector	0.08	-0.41	0.61	0.12
Security sector	1.34 **	0.60	2.03 **	1.37 **
Participation sector	1.74 ***	1.26	2.21 **	1.76 ***
Self-reported social status	-0.56 ***	-0.44 **	-0.61 ***	-0.56 ***
Country (Spain)	-	-	-	-2.80 ***
(Intercept)	3.73	2.46	3.08	3.79

*** Significant at the 99% level; ** significant at the 95% level.

Next, we regress the **privacy index** on the socio-demographic variables for the overall sample, as we did for the distrust index. From the analysis, we found that age, self-reported social status and distrust level are all significant. In particular, older participants are more likely to be concerned over privacy (0.05), while higher self-reported social status correlates with lower privacy concerns (-0.44). When performing the regression individually for each country, social status has a significant estimate of -0.091 in Germany and -0.135 in Spain. Higher self-reported status correlates lower concern over privacy. Another linear regression was run, including a country variable (Spain) as a regressor. Here, we find a significant estimate of 0.19, which suggests that respondents in Spain are, overall, more concerned about privacy than those in Germany.

Table 38. Regression on privacy index results.

Variable	Linear regression	Spain	Germany	Country regressor
Gender	-0.049	0.021	-0.121	-0.053
Education		0.032	0.053	0.042
Age	0.067	0.003	-0.003	-0.000
Health sector	-0.000	-0.093	0.177	0.040
Security sector	0.042	-0.186	0.081	-0.053
Participation sector	-0.051	-0.298	0.149	-0.075

Self-reported social status	-0.074	-0.135 ***	-0.091 **	-0.109 ***
Country (Spain)	-0.109 ***	-	-	0.192 **
(Intercept)	-	6.424	5.967	6.068

*** Significant at the 99% level; ** significant at the 95% level.

Cross-attributes analysis

Lastly, we conducted further analysis to explore specific profiles by analysing which other attributes they would favour. We first analysed the attributes preferred by those indicating a preference for **private companies**. In the health sector, these respondents appeared to be indifferent as to the type of data they shared, whether basic or sensitive. However, in all other areas, they had a strong preference for anonymisation of the data or shorter-term storage. In terms of benefits, there were no significant results in the area of health and transport, indicating that respondents were indifferent to what type of benefits (personal or societal) received from a system run by private companies. However, for participation (voting) and security, respondents who favoured private companies preferred direct benefits, i.e. reduced voting time and reduced homicide rates, respectively. We then turned to respondents who indicated a preference for their data to be handled by **independent authorities**. Overall, these participants were in favour of encrypted data being used in all sectors, but to a less degree than those who preferred the private sector. This may be due to their higher level of trust in independent authorities. Interestingly, in the areas of health and security, respondents who opted for the **government** to handle data were indifferent to the type of data they shared, whether sensitive or generic.

Second, we analysed whether those respondents who preferred an independent organisation over government has particular level of trust. To do this, we performed a two-sample t-test to determine if there is a significant difference in the average (mean) level of distrust between respondents who favoured independent organisation, and those who favoured the government. From this analysis, we found that the level of trust is higher among respondents who favour the government. In terms of the data they were willing to share, respondents who opted for data to be handled by the government were indifferent to the type of data shared in the health and security sectors, with no significant estimates. In the areas of transport and participation, this respondent profile significantly favoured sharing only encrypted data; this preference was stronger in the area of participation, as expected.

Third, we found that respondents who were willing to share **personalised data** were indifferent as to whether the public administration or non-profit organisations should handle this data. These results were similar across all domains. However, these respondents appeared more willing to provide personalised data to public authorities than to private companies, particularly in the area of health. These respondents appear indifferent to the type of benefit received (direct/personal versus indirect/societal) in the areas of transport and participation. Direct benefits are favoured in the area of security and health (namely reduced homicide rates and personalised treatment, respectively). This may imply that when providing personal data, respondents want to see a direct benefit from the service.

Lastly, in the security example, we see that most respondents favoured a shorter period of storage for data. Respondents who preferred **lengthier data storage** were also indifferent as to whether this data was handled by local government or by an independent, non-profit organisation. However, they preferred to provide data to the government when faced with the choice between local government and a private company. They also favoured the direct benefit of a reduced homicide rate over the indirect (societal) benefit of reduced vandalism against public property.

3.5 Case Study 4: Kids Go Green (Italy)

3.5.1 Introduction

3.5.1.1 Description of the context

This case study[439] analyses the impacts of Kids Go Green, a project designed and implemented by Fondazione Bruno Kessler[440] (hereinafter 'FBK') in the schools of the city of Trento, the autonomous province of Trento, and the city of Ferrara. The project consists in a tech-based educational game that involves the school, the children and their families in an education adventure around the world and promotes more sustainable mobility. After kickstarting the project, FBK now plays the role of technology provider and monitor, while providing research and evaluation capacity rather than management. Initial funds to develop Kids Go Green came from the EIT programme Climate-KIC[441], but a self-supporting model is currently being developed.

'Gamification' has shown its potential as a strategic socio-technical technique to increase participation and engagement, and to promote sustainable behaviours such as ethical, social, environmentally friendly, or healthy habits[442]. Serious games, persuasive games as well as gamified interactions have all proven themselves to be useful tools not only for raising awareness about a topic or issue, but also to promote changes in attitudes or behaviours. The key idea behind gamification is to increase people's motivation take certain decisions or to carry out certain tasks which are instrumental to achieving certain desired objectives, by turning them into fun and rewarding experiences. Environmental sustainability is an area in which gamification has been widely applied. Examples range from energy savings[443] and sustainable mobility[444] to other environmental issues, such as community-wide environmental missions[445], the participatory governance of urban neighbourhoods[446], or educational city discovery[447].

The use of gamification for environmental awareness and sustainability has proven successful in several such cases; however, its impact is often transient and tends to diminish with time[448] unless it is reinforced with opportune motivational prompts[449], along

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[439] The study was written by Michele Benedetti (Polimi), Irene Vanini (Polimi), Giancarlo Vecchi (Polimi)

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with corresponding elements of game design and mechanics[450]. The recognition of the role of education as a key enabler for sustainable development has grown steadily, leading to its prominence in the 2030 Agenda for Sustainable Development and the Paris Climate Change Agreement. However, despite the considerable efforts and relevant steps made in recent years (with many frameworks, programmes, and policies put in place at international and national levels), both schools and local authorities encounter hurdles in promoting the systematic adoption and implementation of environmental education[451].

Gamification can therefore play a key, threefold role in this context: supporting the long-term sustainability of environmental education initiatives; promoting engagement of the community at large; and fostering creativity and active participation. Gamification has been successfully used to promote healthy and sustainable lifestyles among children and their parents[452]. However, there are still few examples of gamification approaches that specifically target children's environmental education, the aim of Kids Go Green. ECOMobile for instance, applies a situated learning approach for learning about ecosystem science. This can be used to organise playful augmented-reality field trips for children to local pond environments[453]. Its combination of a gamified, augmented-reality experience with environmental probeware has proven to be very effective in fostering children's understanding and interpretation of water quality measurements.

3.5.1.2 Description of the innovation

The Kids Go Green project[454] (hereinafter 'KGG') was launched by the city of Trento, in partnership with FBK, as part of CLIMB[455] – a wider programme relating to children's sustainable and autonomous mobility. KGG involves the creation of a cooperative, playful experience that involves schools, children and families in an adventure to discover the world while incentivising new green mobility practices. The game targets children attending primary school, involving them in an explorative game in which their progress depends on the mobility practices they perform on their daily route to school. The game was designed to ensure an intuitive and motivating experience, with an attractive and modern interface to promote innovative teaching. Furthermore, the flexibility of the game allows parents and teachers to customise the experience in accordance with their objectives.

The CLIMB programme is based on an open source technology platform developed by FBK that comprises: an Internet of Things (IoT) layer that manages information derived from multi-channel and multi-protocol data collection from sensors and devices; a data layer to process data; and a service layer for services and APIs. The platform offers an extendable set of enabling components, providing both generic and domain-specific functionalities at different layers[456]. One such component is the gamification engine used to develop and implement KGG.

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Offsetting up a KGG experience involves three key steps:

1. Creating the journey. Using the web app, teachers can plan a virtual journey, featuring different places of the world. These represent intermediate 'stage goals' that children can reach using the kilometres they collect by sustainably travelling to school each morning. When they reach these virtual locations, they can access multimedia content that the teacher has as teachers uploaded for each stage. Children do not collect kilometres individually, but rather as a school or cohort. Journeys are tailor-made by teaching staff, according to the educational needs and the grade-specific teaching plan. The length of the journey (both in terms of its physical distances in kilometres its duration across the school year), as well as the disciplines involved, optional after-school activities and other optional experiences, are all decided by the teachers. Some journey examples include: (a) across Europe; (b) from one school to a girl's school in Kangole (Uganda) with which the school was twinned as part of a solidarity project; (c) following the journey of the Greek hero Ulysses; (d) travelling across the countries of origin, for children with migrant backgrounds.

2. Updating the Mobility Journal. Once children arrive at class, their teacher logs in to the platform using the LIM (interactive multimedia whiteboard), so that children can fill in their Mobility Journal. This consists of reporting how they travelled from home to school. Different forms of mobility are given different colours. In this way, children can easily record and track their contribution. The sustainable kilometres each child covers (on foot, by *pedibus*, by bike, by school bus) advance the group along its defined journey. To maintain interest, as well as helping the group to cover long distances, the game includes bonuses (e.g. kilometres by train or hot-air balloon), which can be earned by braving bad weather or winning collective mini-challenges (e.g. no cars for a week).

3. Stage goals. Once a stage goal has been reached, the multimedia content uploaded by the teacher are unlocked. Here, the choice of interesting content is critical to keeping children motivated to complete the journey. For example, the children who travelled across Europe got to earn about the phenomenon of the *aurora borealis* and Santa Claus (thanks to the participation of a grandfather) in Finland; Tchaikovsky's music in Moscow; the Sacher Torte in Vienna; John Paul II in Krakow; Galileo Galilei and the scientific method (grade I-II) and the Fibonacci sequence (grade V) in Pisa; the *tarantella* folk dance in Apulia; the Riace bronzes in Calabria; and the Archimedes techno-park in Sicily. Children who journeyed through their classmates' origins, thanks to the robust participation by both foreign-born and Italian parents, familiarised themselves with the culture, language and culinary habits of Romania, Ukraine, Moldova, Kosovo, Albania, Poland, Pakistan, Morocco, Tunisia and Ecuador.

3.5.1.3 Objectives

From its inception, KGG has been designed to focus on mobility and changing habits/behaviours in relation to young citizens' lifestyles. As a programme, it is thus conceived to respond to the undesirable phenomenon of the "backseat generation": the tendency for children to be driven to school, rather than walking. This has been proven to have a number of negative impacts, including: (a) increased pollution and traffic, affecting the safety of roads surrounding the school; (b) accustoming children to a sedentary lifestyle (increasing the risk of health conditions such as childhood obesity); (c) obstacles to the children's personal and social growth, as they have less access to their surroundings. Together these circumstances trigger a mechanism by which parents are less willing to let their children walk around the school neighbourhood, affecting parent-child trust and pushing families to provide children with mobile phones for safety purposes[457].

KGG provides a solution to this combination of context and behaviour, by using a digital-based classroom game that involves all pupils. The game can be played in conjunction with the *pedibus* (a form of transport that multiple children power by pedalling), as well as by occasionally involving children's families in school activities. KGG is always supervised by

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[457] Marconi, A., Schiavo, G., Zancanaro, M., Valetto, G., Pistore, M. (2018). Exploring the world through small green steps. *Proceedings of the 2018 International Conference on Advanced Visual Interfaces - AVI '18*.

the teaching staff, even after the preliminary planning and coordination phases. The main objectives KGG seeks to achieve are: (a) to commit children to walking for the time-span of the game (usually a little less than a school year) in order to encourage more active and sustainable mobility practices, hopefully leading to the forming of a longer-term habit; and (b) to integrate with ordinary educational activities during school time. The implementation of KGG revealed, however, that it not only has impacts on the mobility of children and families, but also potential a multitude of other effects that this case study aims to better explore, such as: (a) engagement with the game (collecting kilometres); (b) interest in the educational subject matter that unfolds at each stage of the journey via the multimedia content chosen; (c) educational value, through exposing children to multicultural experiences, a reality also in the close surroundings of children themselves; and (d) cooperation and team building among the teaching staff[458].

Given the richness of results reported over recent years through the implementation and monitoring of the program, the general ambition of this case study is to pave the way for the future observation and measurement of all impacts of KGG. This will be achieved by highlighting its transformative capacity as well as its as-yet-unexplored potential, casting particular light on the effects obtained thanks to the use of gamification and through its innovative approach to service delivery.

3.5.2 Approach and methodology

3.5.2.1 Methodological strategy

The case study will be analysed via a combination of theory-based evaluation (using realistic evaluation and the theory of generative mechanisms), and a process-tracing approach.

Theory-based evaluation (often referred to as 'theory of change' or 'programme theory') seeks to identify and, more specifically, constructs, one or more theories explaining the change that is expected to be brought about by a programme. The theory is a tool to investigate the programme's capacity to achieve all of the expected goals in terms of implementation and results, while also putting forward possible explanations for the programme's success or failure. It originates from an understanding of what determines or contributes to an undesirable state of affairs (inappropriate/suboptimal behaviour, discriminatory practices, social inequalities and imbalance, etc…) and moves on to speculate on ways in which these patterns can be altered. Changes in patterns of behaviour, systemic practices or conditions are then generated by bringing fresh inputs into the system in order to achieve a new and desirable *status quo*. In this sense, programmes are theories incarnated[459]. Applying theory-based evaluation means breaking down the hypothetical causal chain (intended to be inherent to a programme) into a series of potential triggers that are capable of explaining to what extent, for whom, and why the programme may or may not be achieving its goals[460]. Realistic evaluation can be considered a specific method of theory-based evaluation[461], insofar as it explores programmes using causal mechanisms (generative causation).

Process tracing, on the other hand, recognises that not all traces are equally informative. Consequently, it focuses on assessing the quality, strength, power or probative value that selected pieces of evidence hold in support of or against the causal mechanism[462]. One of the advantages of process tracing is that it allows a clear distinction to be made between *absence of evidence* (which has little or no inferential power and adds little value to what

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458 Marconi, A., Schiavo, G., Zancanaro, M., Valetto, G., Pistore, M.
459 Pawson, R., Tilley, N. (2001). Realistic Evaluation Bloodlines. *American Journal of Evaluation*, 22(3).
460 Funnell, S.C., Rogers, P.J., Jossey-Bass (2011). Purposeful program theory : effective use of theories of change and logic models. San Francisco: Jossey-Bass A Wiley Imprint.
461 Pawson, R., Tilley, N. (2001). Realistic Evaluation Bloodlines. *American Journal of Evaluation*, 22(3).
462 In order to assess the probative value of collected evidence, process-tracing resorts mainly to a battery of tests. A useful shorthand list of alternative evidentiary tests in process tracing includes: the Hoop test, the 'Smoking Gun' test, the 'Straw-in-the-Wind' test, and the 'Doubly-Decisive' test. See Bennett & Checkel, Process Tracing; Van Evera, Guide to Methods for Students of Political Science.

the researcher already knows), and *evidence of absence*, which on the contrary can be used to strongly challenge a hypothesis (if it contradicts the observable implications that stem from it)[463].

The added value in tackling the analysis by making use of causal mechanisms is that this approach looks into the causal 'black box' that links a programme and its implementation context with the observed results. Mechanisms are theoretical constructs, conceived to bring to bear causal power within a programme and hence enable its outcomes. Their epistemic function is therefore to explain the process by which a programme can modify, within a certain context, the initial situation – and, as such, to explain why the pattern of outcomes turn out as they do. A mechanism explains how the outcome pattern is generated, hence the term "generative causation".

This approach enables us to understand how the programme works by interpreting its intermediate outcomes (which are understood as segments of the path leading from the programme's implementation to its expected final outcome). When separately applied to the contexts and target types, as well as the hypotheses relating to the intervening causal mechanisms, their effectiveness can be evaluated and tested against empirical evidence, enabling a rich hypothesis about the programme's capacity to succeed.

3.5.2.2 Implementation and data gathering

The hypotheses formulated within this case study are not tested through empirical work in an independent and unconnected way. They are instead combined into target-mechanism-outcome (TMO) theoretical architectures, the robustness of which is evaluated against both interviews and surveys, in order to fully understand the functioning of the intervening mechanisms and define the limits of their validity (and hence the extent to which these observations can be generalised). Thus, case study seeks to answering not only what works, but also for whom, how, and in what circumstances.

Figure 36 below represents the rationale explained above. The problem that the programme seeks to address is pictured at time t_0: a situation in which certain mechanisms exist that affect types of actors, and which trigger the undesirable outcomes targeted by the programme. The programme is designed to change this state of affairs via actions that trigger new mechanisms that preventing the original set of mechanisms from operating, by modifying the volitions, ideas, interests and objectives of the target population. Hence, the implementation of the project is expected to lead, at time t_1, to the consolidation of a new configuration of causal mechanisms that generate desirable outcomes. Particular attention must be paid to the contexts in which TMOs exist, in order to account for possible biases and distortions they might produce.

Figure 36. Diagram of methodological strategy.

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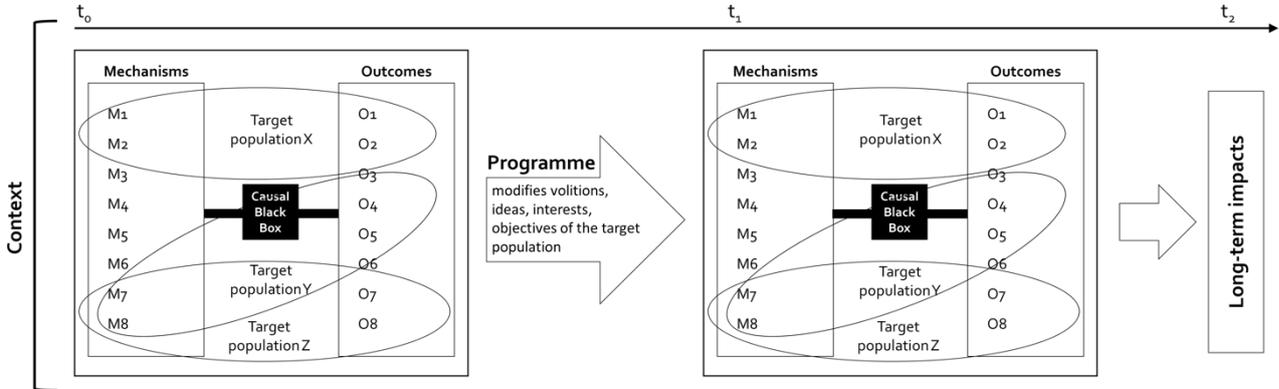
[463] Befani, B., Stedman-Bryce, G. (2016). Process Tracing and Bayesian Updating for impact evaluation. *Evaluation*, 23(1), 42–60.

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Data for the case study are collected via the following methods:

- Semi-structured interviews with teachers involved in the project (during the current and previous school years)
- Survey of teachers involved in the project in the past and in the upcoming school year
- Survey of teachers who are getting involved in the project for the first time
- Survey of parents whose children have taken part in the project in previous school years
- Survey of parents whose children are taking part in the project for the first time
- Access to databases of information relating to the project compiled by FBK over previous school years

Interviews with teachers were used to frame the context of the project, to collecting feedback about teachers' experiences, and to refine the surveys. Together with the literature review and previous studies on KGG[464], the interviews allowed the definition of TMO configurations that function as hypotheses for the case study, by confirming the expected impacts on mobility and bringing to the surface other potential impacts. Moreover, interviewees spontaneously shared observations about the spectrum of programme beneficiaries and proved to be very aware of the context in which the programme operates. We were thus able to systematise KGG's targets, the variety of contexts in which KGG is implemented, along with its expected outcomes and impacts. However, in order to test our hypotheses by the means described in the methodological diagram, they needed to be operationalised, and hence translated into variables. To this end, mechanisms served to construct independent variables, while the detailed outcomes serve as dependent variables and are operationalised according to target, and corresponding to the expected impact. The surveys were then written in order to look for correlations between the identified constructs of the mechanisms (independent variables) and the outcomes, as well as to collect data on the recipients' (teachers' and families') perceptions of the programme[465]. Databases compiled by FBK cover a window of time starting in 2017, and were in their turn based on surveys (distributed *before* and *after* the project began) that aimed to test whether or not the short-term commitment to walk, which was expected to induce more active and sustainable mobility practice, was also leading to a long-term habit.

3.5.2.3 Expected impacts and outcomes

The DigiGov-F conceptual framework broadly defines impacts as long-term results in terms of the following: the creation of value; changes in public organisations; improved democratic dynamics; general environmental benefits; social inclusion and participation[466].

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[464] Marconi, A., Schiavo, G., Zancanaro, M., Valetto, G., Pistore, M. (2018). Exploring the world through small green steps. *Proceedings of the 2018 International Conference on Advanced Visual Interfaces - AVI '18*; Farella, E., Schiavo, G., Ferron, M., Giovanelli, D., Leonardi, C., Marconi, A., Massa, P., Murphy, A.L., Nori, M., Pistore, M. (2020). CLIMB: A Pervasive Gameful Platform Promoting Child Independent Mobility. *IEEE Pervasive Computing*, 19(1), 32–42.

[465] Note that these surveys were issued *pre-* (and will be issued *post-)* the running time of the project, and thus fall beyond the scope of this case study. The results reported here come from the survey distributed before the programme started (i.e. once schools had completed their deliberations over taking part in the programme. A different set of questions will be distributed at the end of the project, possibly coinciding with the end of the school year, to capture hypotheses of behavioural changes as well as the target response. The initial survey, distributed during November 2019, aimed to draw the baseline, hence it was built upon the expected outcomes. The final survey, to be distributed at the end of the school year 2019-2020 will capture the presence of both mechanisms and outcomes. Both results will be tested against the baseline.

[466] European Commission 2018, 'Impact Assessment on the Review of the Directive 2003/98/EC on the Reuse of Public Sector Information'; 'Alford, J., O'Flynn, J. (2009). Making Sense of Public Value: Concepts, Critiques and Emergent Meanings. *International Journal of Public Administration*, 32(3–4), 171–191. In this sense, no major changes are expected to be achieved in the way schools are organised , and neither is an immediate impact (in terms of epistemic steps) on the strength of democracy, unless of course we o consider any improvement of the education system as an investment on the future.

We identified six dimensions of impacts, specified and detailed by a list of expected outcomes. As explained in our methodology, in order to formulate complete hypotheses, these outcomes are then associated with categories of targets, and a hypothesis developed about the intervening causal mechanism.

Table 39. Dimensions of impact and contexts.

Dimensions of impacts	Contexts
Mobility – sustainability **Mobility** – lifestyle **Inclusion** – community creation **Inclusion** – learning process - Innovation in **teaching approach** **Digital skills**	- City centre / outskirts and suburbs / countryside - Close-knit community / unbounded neighbourhood - Multicultural neighbourhood / mostly Italian and gentrified neighbourhood - Large school / small school (number of children)

Table 40. Targets of the programme.

Beneficiaries	*Categories of beneficiaries*
School children	- Grade (age range): I-II; III-V - Migrant background - Language barriers (possibly associated with migrant background) - Learning difficulties (disabilities and /or behavioural obstacles) - Physical disability (mobility impairment)
Families	- Migrant background - Engagement and cultural background[467]
Teachers	- KGG coordinator for the school / simply involved - Intrinsic commitment to the values promoted by KGG - Collaborative attitude towards other teaching staff - Willingness to involve families in school activities - Willingness to explore new means or methods of teaching

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[467] The first round of interviews highlighted a meaningful categorisation amongst children and families based on the richness of their cultural background, in a way that is independent of economic or social capacity.

Figure 37. Application of methodology.
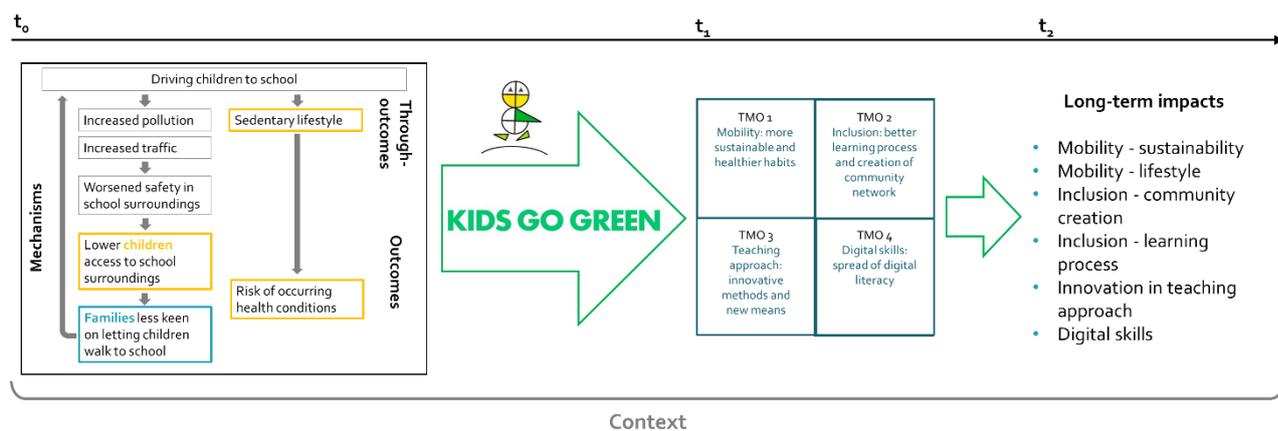
As explained above, the six dimensions of impacts are grouped in four main sets of target-mechanism-outcome (TMO). These are presented in the Tables 41-44. Each of these tables includes a list of expected outcomes.

Table 41. TMO 1 – Mobility: healthier and more sustainable habits.

Target	Mechanism	Outcome
School children	• *Stimulus*: realistic self-challenge. • *Stimulus*: competition with other classes/schools • *Avoidance of blame*: effort to meet peers' expectations. • *Focus*: other public programmes contribute to the habit (e.g. PedibusSmart). • *Motivation*: the game provides a reason to want to go to school. • *Deadline effect*: the goal of completing the journey by the end of the school year strengthens the effort. • *Novelty*: the game captures children's attention at the outset, but this fades over year. • *Value endorsement*: the game stimulates thinking about sustainability, leading to its acknowledgement as a value *per se.*	• Development of sustainable habits. • Improved ecological awareness. • Development of ecological conscience. • Improved awareness about a healthy lifestyle. • Development of healthier habits. • Adopting of a safer behaviour as pedestrians.
Families	• *Additional effort*: walking children to school takes more time and organisation than driving them. • *Identity development*: the requirement of the game (sustainable mobility) provides the conditions for children to develop a role within their families. • *Legitimation* of children's autonomous mobility, based on acquired capabilities.	• Development of sustainable habits. • Development of healthier habits. • Improved trust relationship with children. • improved involvement with school and school-related activities (*pedibus*)

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Table 42. TMO2 – Inclusion: better learning process and the creation of a community network.

Target	Mechanism	Outcome
School children • (Grades III-V)	• *Confidence building*: the game offers the opportunity to play a role in the class. • *Earning 'brownie points'*: acquiring reputation among peers. • *Opportunity* to become familiar with the urban surroundings of the school and people from the local community.	• Improved inclusion of children of foreign origins. • Improved inclusion of children with learning or physical impairment. • Improved bonding among fellow school children. • Improved multicultural awareness. • Increased liveliness of the school surroundings: it becomes apparent to the neighbourhood that school children are part of the same community.
School children • Migrant background • Learning difficulties • Physical disability	• *Blending in/belonging*: opportunity to take part in activities relating to the game. • *Blending in/belonging*: logging in to the platform each morning, and the unveiling of multimedia content, allow participation that is not based on faster or more refined learning ability (which is usually the case in traditional teaching). • *Reciprocity*: exchange of opinions, knowledge and experiences between children. • *Identity recognition/affirmation*: the unfolding of material at each stage of the journey creates the conditions for children to bring their thoughts and experiences into the discussion. • *Opportunity* to become familiar with the urban surroundings of the school and people from the local community. • *Encouraging collaboration*: logging in to the platform each morning stimulates a shared/joint effort (e.g. a system of shifts).	
Families • Migrant background	• *Bandwagon effect*: if a critical mass of families takes part in activities, others will join. • *Brokerage*: connecting actors who are given a common goal within the programme. • Repeated/systematic interactions. • *Opportunity:* the game provides a social platform to introduce knowledge about one's own culture.	• Creation of new interpersonal networks. • Increased awareness of multiculturalism/diversity. • Improved mutual knowledge and respect. • Mutual trust building.
Families • Engagement and cultural background	• *Opportunity* to engage in social activities and perform roles relating to civic responsibility and participation.	• Creation of transport networks. • Increased cooperation between schools and families.

Table 43. TMO3 – Teaching approach: innovative methods and new means.

Target	Mechanism	Outcome
School children • Language barriers • Learning difficulties	• *Blending in/belonging*: logging in to the platform each morning becomes the responsibility of children and allows participation that is not directly based on knowledge transmission. • *Accessibility* of multimedia content, together with a moment of more passive learning, eases the process of memorisation. • *Encouraging collaboration*: logging in to the platform each morning stimulates a shared/joint effort (e.g. a system of shifts)	• Better retention of learnt notions. • Improved attention and interest. • Creating a connection between learnt notions and experience (e.g. travelling with families to the places seen during the KGG journey). • Improved results.
Teachers	• *Opportunity*: KGG provides a formal framework for pushing forward a commitment to innovation. • *Opportunity*: KGG provides a formal framework for pushing forward a commitment to one's own beliefs. • *Leadership*: KGG coordinators lead the whole of the teaching staff in a shared effort and shared results. • *Student-led planning*: integration of the KGG experience with mandatory ministerial plans. • *Focus* on aspects of teaching that go beyond the transmission of knowledge, i.e. striving for social, emotional, relationship effects on children. • *'Free-rider' behaviour*: avoiding the use of the platform or of putting effort into collecting and uploading content. • *Resistance to change*: avoiding the use of the KGG platform, perceiving it as a loss of time for more institutionally traditional activities.	• Improved cooperation among teaching staff. • Exploring new ways of delivering lectures. • Spreading innovation culture throughout the school staff.

Table 44. TMO4 – Digital skills: spread of digital literacy.

Target	Mechanism	Outcome
School children **Teachers** **Families**	• *Developing habits*: the platform (accessed in the classroom and accessible from home) becomes an occasion to use digital means. • *Stimulus*: the context of the platform and interest in the content stimulate the use of software to produce outputs. • *Opportunity*: access to a digital tool other than a smartphone or tablet, usually a means for entertainment rather than education. • *Supervision*: time spent using digital means is limited in a top-down manner and controlled.	• Improved digital skills. • More frequent use of LIM (interactive multimedia whiteboard.

3.5.3 Results and discussion

In this section we present the results of the case study, as well as describing how the approach was operationalised. As previously mentioned, the results presented here refer to the two academic years, 2017-18 and 2018-19, when the surveys were conducted. The programme has also been monitored during the current academic year (2019-20) and new surveys will be conducted by FBK at the end of the year to compare the results we present here.

The results are structured as follows. First, we present a table with all the independent and dependent variables measured. Each of these is linked with the target-mechanism-outcome (TMO) of reference, i.e. mobility (TMO1), inclusion (TMO2), teaching approach (TMO3) and digital skills (TMO4). Then, after this presentation of the operationalisation, we present the results in section 3.5.3.2 and the conclusions in the following section. However, the discussion of the results in light of the literature reviewed and the conceptual framework is finally provided in Chapter 0, next to the other case studies. In Box 14 below we provide a very brief summary of the main findings of the present one.

Box 14. Main findings of Case Study 4: Kids Go Green (Italy).

- **The project generated new types of relationships** between school actors, deepening the involvement of families in school-promoted activities, and of the teaching staff with each other and with the management. In other words, the results show that the project has changed the relationships between the institution and the citizens involved, for the benefit of the users, i.e. children.

- **The results show further potential for the inclusion** of disadvantaged groups. On the one hand, all families were engaged equally by the programme, instead of limiting interactive initiatives to the most proactive parents. On the other hand, according to teachers the programme's digital content and teaching methods have proved, more effective than traditional methods, particularly in relation to less able clusters of pupils.

- **The case study clearly shows a change towards more sustainable lifestyles,** as families have shifted towards choosing more sustainable transport modalities. Moreover, the programme has stimulated debate about environmental issues among children and families**.**

3.5.3.1 Operationalisation

Table 45. Independent and dependent variables.

TMO	*Independent variables* *(based on mechanisms)*	*Dependent variables*	
		Outcomes	*Impacts*
1	Stimuli and motivations to walk to school: • Realistic self-challenge and competition with other classes/schools • Effort to match peers' expectations • Participation in PedibusSmart programme • Playing the game to reach the goals within the journey	School children develop/improve sustainable habits	Mobility – sustainability Survey of: families
1	Engagement with the PedibusSmart programme and/or putting in additional effort to walk children to school.	Families develop/improve sustainable habits	

1	Value endorsement: the game stimulates thinking about sustainability, leading to its acknowledgement as a value *per se*.	School children and their families develop/improve: • ecological awareness • ecological conscience	
1	Stimuli and motivations to walk to school: • Realistic self-challenge and competition with other classes/schools • Effort to match peers' expectations • Participation in PedibusSmart programme • Playing the game to reach the goals within the journey	School children develop/improve: • awareness about a healthy lifestyle and healthier habits • safer behaviour as pedestrians	Mobility – lifestyle Survey of: families
1	Families are stimulated to keep focusing on walking to school, as this may involve some additional effort from them. Hence, children develop a role within their families and, step by step, gain autonomy in relation to walking in the city.	Families develop/improve: • relationship of trust with children • involvement with school and school-related activities	Children's autonomous mobility Survey of: families
2	The morning activities of walking to school and logging in to the platform provide: • the opportunity to play a role within a peer group • the opportunity to take part in easy and accessible activities (related to the game) The unveiling of multimedia content allows: • participation that is not based on faster or more refined learning ability • the conditions for children to bring into the discussion their own thoughts and experiences • hence, exchange of opinions, knowledge and experiences among children	Improved inclusion: • children of migrant background • children with learning or physical disabilities This, in general: • deepens the bond among school children • improves their multicultural awareness	Inclusion – learning process Survey of: families, teachers
2; 3	Teachers manage KGG's processes and contents in order to: • encourage children to cooperate during each morning's logging-in to the platform, joining forces to share effort (e.g. a system of shifts) • providing children with multimedia content, which is naturally more accessible and eases the process of memorisation • allowing participation that is not based on faster or more refined learning ability (sharing thoughts and experiences does not require	School children, especially those facing linguistic barriers or learning difficulties, experience: • better retention of notions learnt	Inclusion – learning process and Innovation in teaching approach Survey of: teachers

	children to master correct notions or solutions)	• improved attention and interest • a connection between notions and experience • hence, improved results	
2	Children's participation in the game on the way to school provides them and their families with: • an opportunity to become familiar with the urban surroundings of the school and people from the local community • a connection with other families, thanks to a common goal – hence, an incentive to join • the habit of interacting with other children and parents within a peer group Children's participation in the game during school activities (reaching stage goals within the journey) provides them and their families with a platform to: • share knowledge about one's own culture • engage in performing ideas relating to civic responsibility and participation	Children and their families experience: • improved liveliness of the school surroundings • mutual knowledge, and hence respect and trust, leading to: • new interpersonal networks • multiculture awareness / awareness of diversity • greater cooperation between schools and families	Inclusion – community creation Survey of: families, teachers
3	The programme provides an occasion to revise the governance of teaching, in several ways: • pushing forward a commitment to innovation • leadership dynamics among teaching staff • cooperation dynamics for a shared effort and result • 'free-rider' behaviour compared with more engaged colleagues • resistance to change The programme provided a framework for thinking about the phase of teaching delivery, in several ways: • integration of the KGG experience with mandatory ministerial plans • going beyond the transmission of knowledge, i.e. striving for social, emotional, relationship effects on children. • push forward a commitment to one's own beliefs, embodied in the programme (e.g. ecological conscience)	Teachers experience: • better cooperation with colleagues • innovative ways of delivering • innovation culture in their work environment	Innovation in teaching approach Survey of: teachers

4	At school, the programme provides an opportunity for children to: • develop the habit of using digital devices other than a smartphone or tablet • develop the habit of using digital devices for education • use software to produce outputs for their education, independently or with their parents • spend time using digital devices in a supervised (and hence regulated) manner	Children and teachers engage in wider use of LIM (interactive multimedia whiteboard) and improve their digital skills. Families become familiar with digital devices.	Digital skills Survey of: families, teachers

3.5.3.2 Results

A) Historical data on mobility: sustainability, lifestyle, autonomy

The KGG pilot took place during the school year 2017-2018, and the project has continued to grow since then. Given that KGG is framed in terms of mobility policies, FBK conducted research in both 2017-2018 and 2018-2019 in relation to children's mobility habits and lifestyle, as well as their autonomous mobility. Data were collected via a total of four surveys, all targeted at families. These were delivered at the beginning (initial surveys) and at the end (final surveys) of the school year. Initial surveys were intended to draw a baseline based on habits and opinions; final surveys captured families' level of satisfaction with the project and their perception of its impacts.

Surveys were distributed on paper and FBK provided the authors of this case study with a raw database containing the results of these surveys, compiled via manual data entry. The following actions were performed to clean the database:

– deleting empty lines

– deleting incomplete answer sets

– identifying and accordingly deleting invalid items (data entry mistakes, invalid answers, duplicates)

As a result of this cleaning, the final samples comprised:

– 2017-2018 initial (*pre*): 400 respondents

– 2017-2018 final (*post*): 318 respondents

– 2018-2019 initial (*pre*): 753 respondents

– 2018-2019 final (*post*): 578 respondents

The children whose families completed the survey all attended elementary school and were aged between 6 (grade I) and 11 (grade V). During the school year 2017-2018, six schools took part to the project, all of them in Trento; during the school year 2018-2019, 12 schools took part to the project – 10 in Trento, two in Ferrara.

The graphs that follow illustrate the means of mobility used by children to get from home to school:

– Figure 38 shows a comparison between the beginning of the school year (*before* KGG began) and the end of the school year (that is, *after* the treatment for the year 2017-2018). Note that the numbers of children travelling by bike and public transport are very low (respectively 1 and 1 in the initial survey; 4 and 4 in the final survey)

– Figure 39 shows the same comparison for the year 2018-2019. Note that in the initial survey, no respondent declared that their child travelled to school by public transport.

– Figure 40 and Figure 41 unpack the before / after treatment comparison for school the years 2017-2018 and 2018-2019 by grade, based on the same data presented in Figure 38 and Figure 39.

Note that the label "mixed" denotes those cases in which respondents indicated more than one means of mobility, despite the survey question asking for the *main* means. However, the number of such cases suggested the need to consider these answers not as invalid, but rather to treat them as a category of their own.

Figure 38. Means of transport before and after treatment, 2017-18.
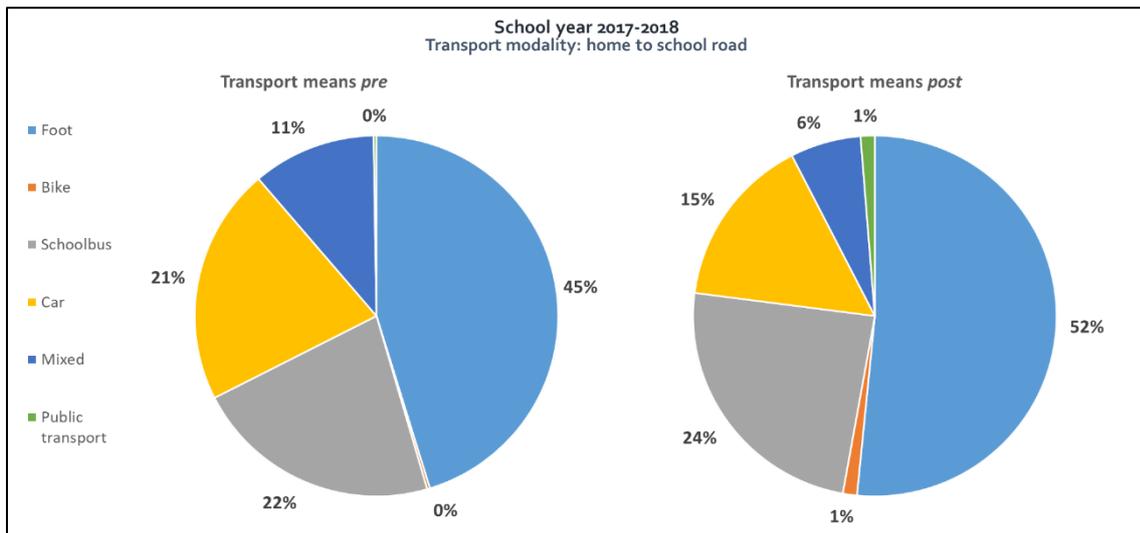
Figure 39. Means of transport before and after treatment, 2018-19
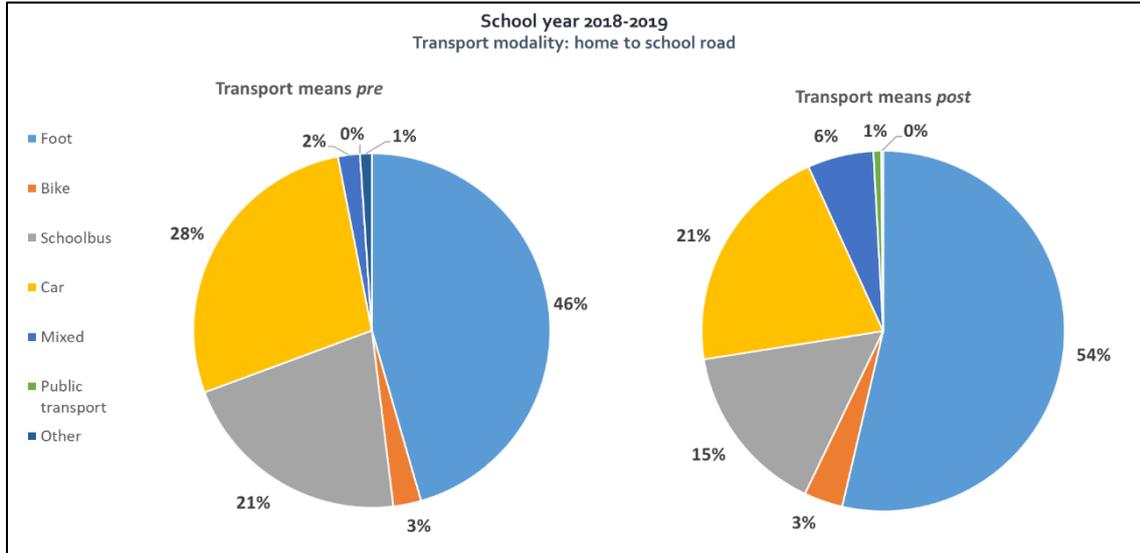
Figure 40. Means of transport 2017-18: segmentation by grade.
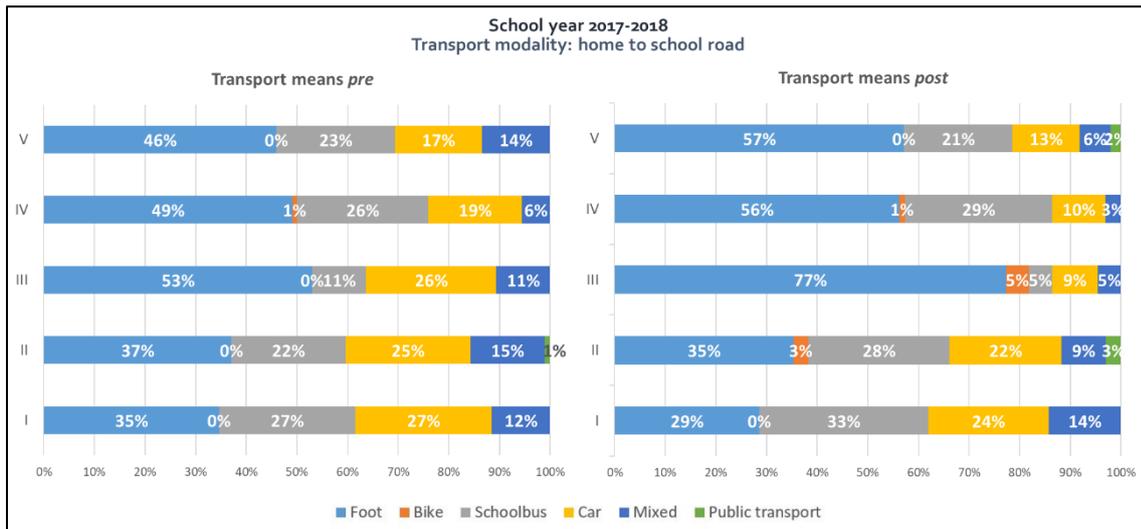
Figure 41. Means of transport 2018-19: segmentation by grade.
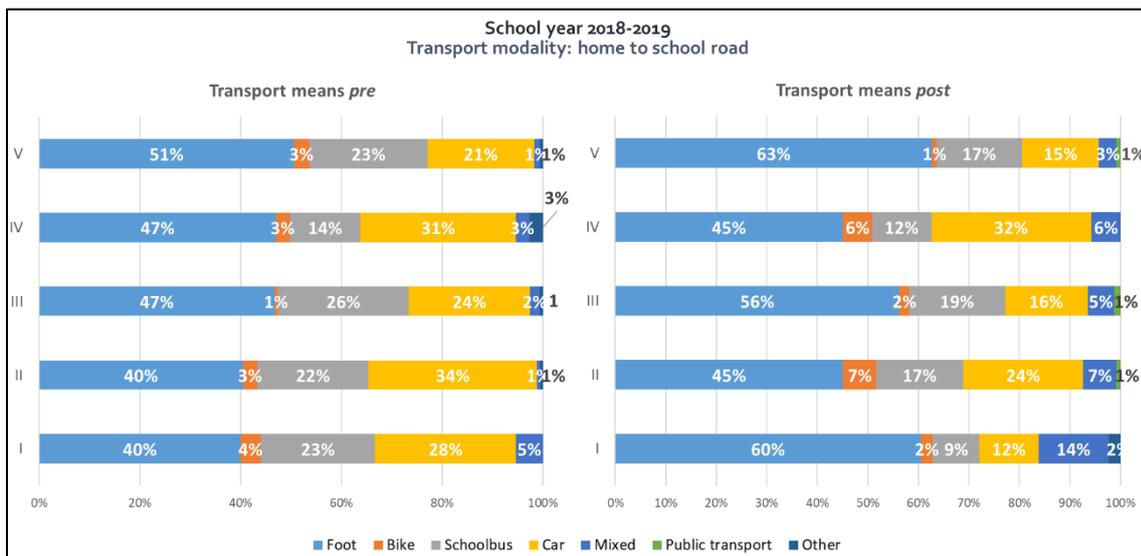
In 2018-2019, the survey questions relating to the means of mobility also contained double options in relation to travel on foot or by bike, with the purpose of ascertaining whether children did so in a supervised manner or on their own, hence assessing their autonomy. In order to conduct a specific analysis, shown in Figure 42, these answers were counted independently of the means of transport, and were based instead on the type of company/supervision children usually relied on when travelling to school. Here, children counting as going "Alone" are either walking or cycling on their own; "Supervised" label denotes children who travelled under supervision on foot, by bike or car in a privately organised way; while "Schoolbus/Pedibus" denotes children who travelled to school within a system organised and managed by the school, the CLIMB framework, and/or an institutionalised groups of volunteers. "Unclassified" denotes mixed means of mobility, public transport or other means.

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Figure 42. Autonomy of children travelling to school, 2018-19.
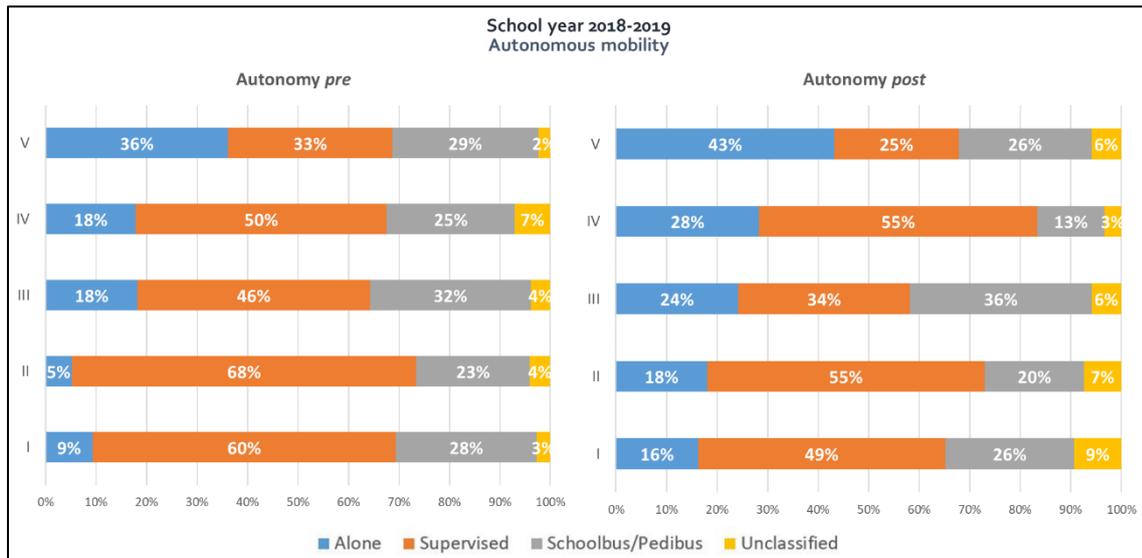
Understanding children's mobility and the potential drivers or obstacles affecting KGG requires an understanding families' motivations and constraints in organising their children's daily routine. Thus, the final survey for the school year 2017-2018 and the initial survey for the school year 2018-2019 asked parents about their reasons for choosing their children's of means mobility:

– Figure 43 presents parents' responses to such questions. Note that in 2017-2018, respondents were offered multiple choices, while in 2018-2019 a Likert scale was used (1 = not at all; 6 = a lot). Also, in 2018-2018 the sample was limited to those respondents whose children had already taken part in KGG during the 2017-2018 school year.

– Figure 44 cross-compares data concerning the reasons for mobility, choices against parents' awareness of KGG, measured by a Likert scale (*To what extent do you know about KGG?* 1 = not at all; 6 = a lot).

– Figure 45 crosses-compares data concerning the reasons for mobility choices against the level of interest children have shown interest in KGG, measured by a Likert scale (*Did your child tell you about KGG over the past months?* 1 = not at all; 6 = a lot)

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Figure 43. Reasons for parents' mobility choices.
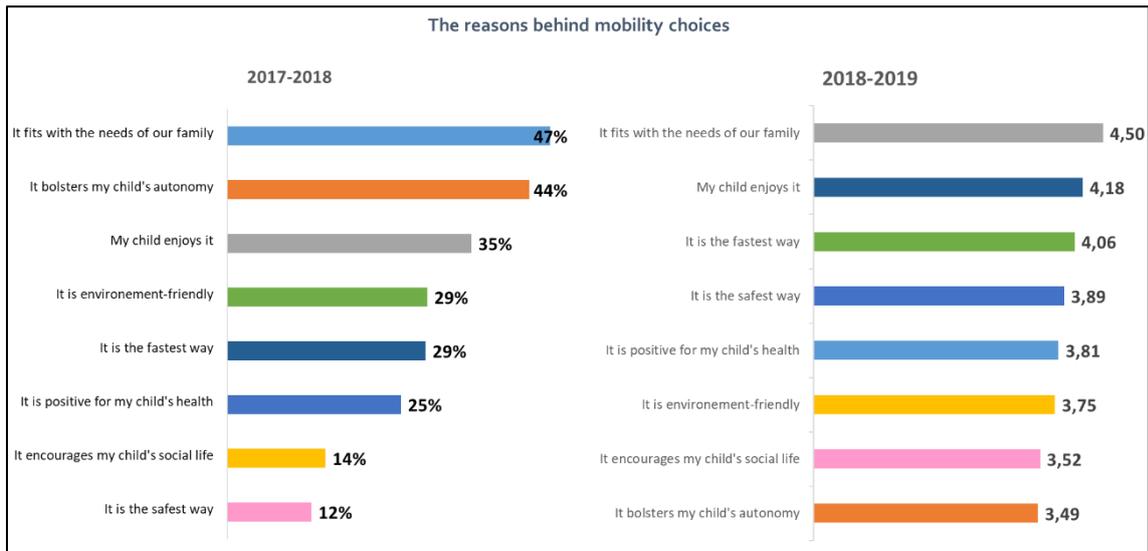
Figure 44. Mobility choices: segmentation by family awareness.
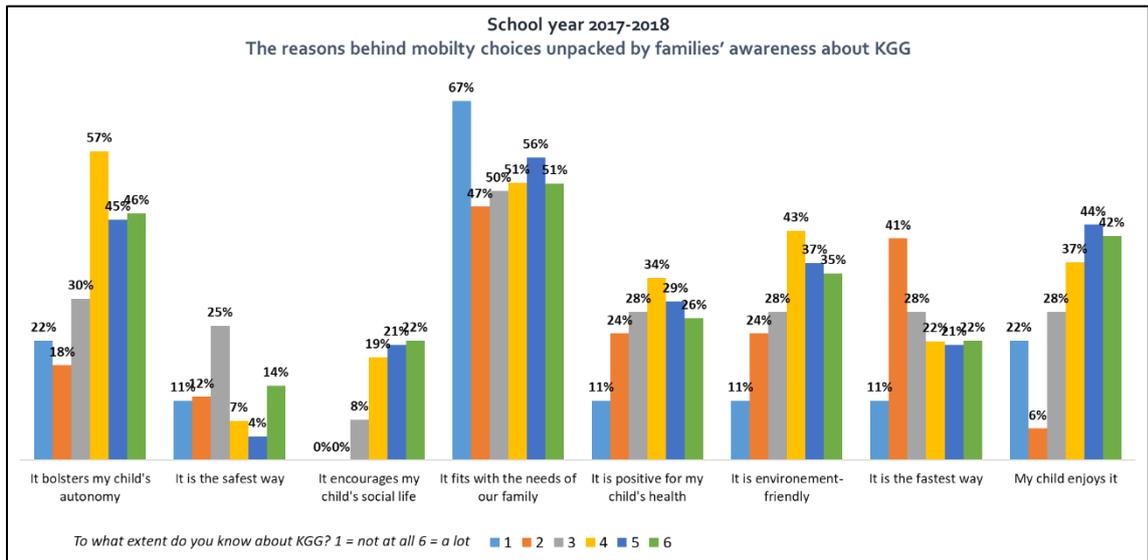
Figure 45. Mobility choices: segmentation by children's engagement.
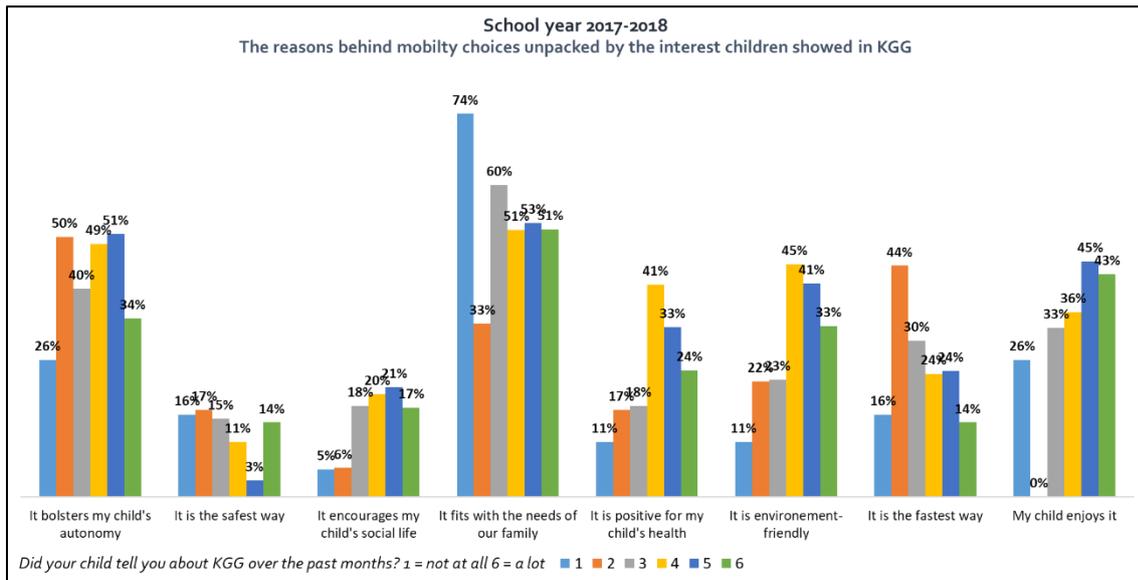
Lastly, both final surveys asked parents about changes they have perceived in their own and their children's behaviour that they explicitly attribute to their participation in KGG. In both cases, the question was structured using a Likert scale (1 = not at all; 6 = a lot). The results are reported in Figure 46 and Figure 47.

Figure 46. Perceived effects of KGG on the behaviour of children.

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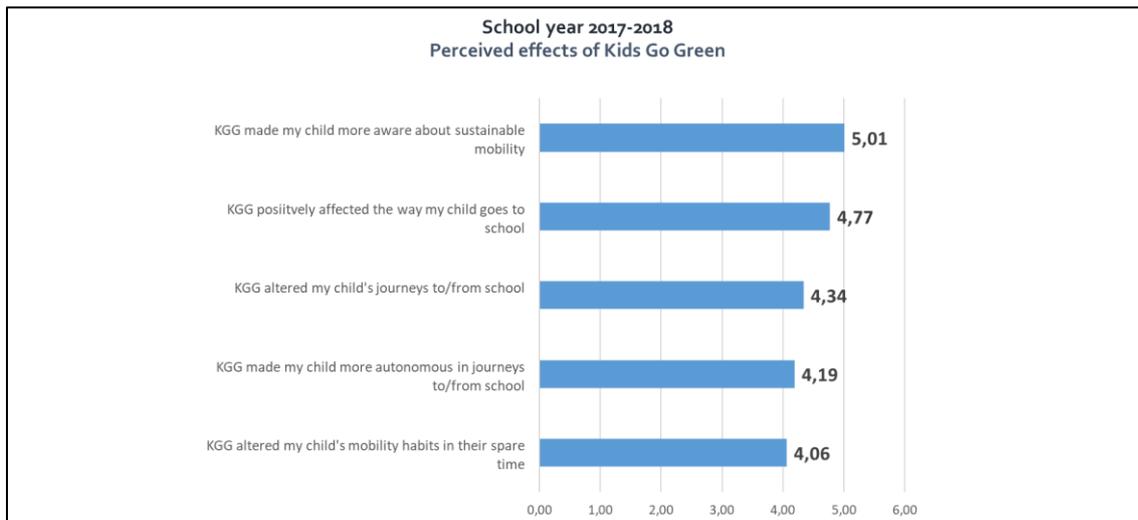
Figure 47. Perceived effects of KGG on parents' behaviour.
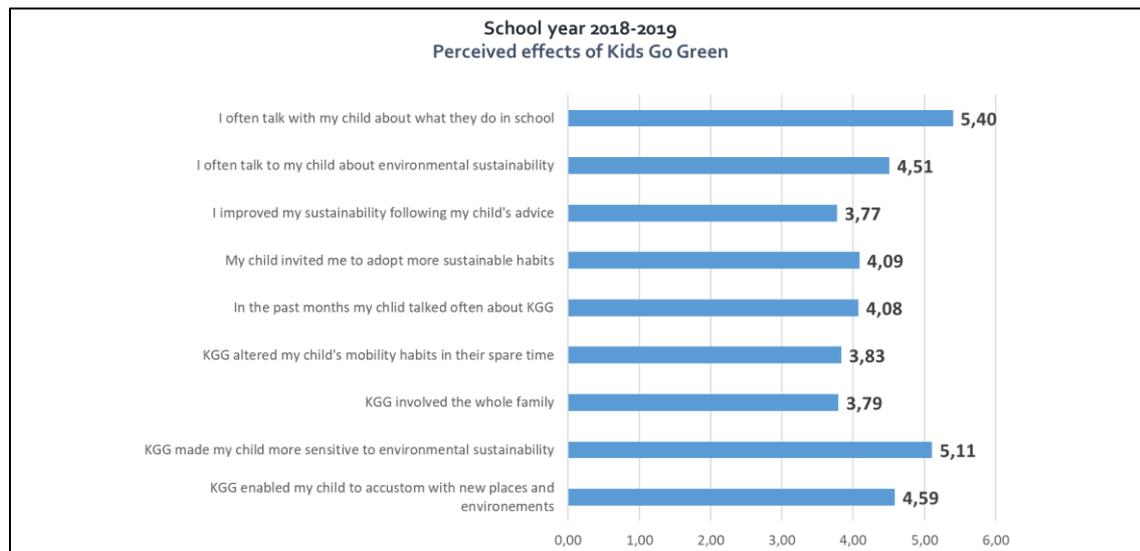
B) Newly collected data: testing the hypotheses on teachers

Before the KGG project began again in school year 2019-2020, a new survey designed by PoliMi was conducted. The survey was composed of two parts, each of which was sub-divided into two sections. The first main part concerned teachers' habits in their everyday job, both during and outside class. The questions focused on teaching style, relationship with pupils and the use of digital tools. The first half of these questions targeted all responding teachers, while the second targeted teachers who had taken part in the KGG programme during previous school years. These latter questions aimed to identify how teachers' habits had been transformed (or not) during their involvement in the project, as well as their perceptions of the effects of KGG. The second part aimed to capture teachers' view of the programme's effects on pupils. Similarly, the first half of these questions were targeted at all teachers, to draw a baseline; the second half were addressed to teachers whose pupils had already taken part in KGG during previous years. This last section of the survey could be reiterated in order for teachers to answer in relation to up to three cohorts of pupils they had taught. Respondents were asked to indicate their age and number of years in teaching, the grade of the pupils about whom they were answering, and the school/district in which they work(ed).

Most responses took the form of a Likert scale, with the obvious exception of descriptive answers and multiple choices concerning the adoption of digital tools. Where meaningful, data analysis was performed through unpacking the answers by context (whether in the city of Trento or Ferrara), or by age (a line was drawn at the birth year 1975). Altogether, sample comprised 27 teachers, distributed equally (in absolute numbers) between Trento and Ferrara, of whom 19 had already participated in KGG during previous years. The hypotheses formulated were tested throughout all sections of the survey, with the results being presented according to the TMO they measured, rather than according to the survey structure.

TMO 2, which focuses on social inclusion, learning processes and the creation of community. Questions to teachers helped to measure their perceptions in relation to the attainment of the following outcomes:

–   improved inclusion of children with migrant backgrounds

–   improved inclusion of children with learning or physical disabilities

–   improved bonding among fellow school children

–   improved mutual knowledge and respect

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- greater cooperation between schools and families

- improved attention and interest

- creating a connection between notions and experience

- improved academic achievement

The results are presented as follows:

- Figure 48 presents data on the opinions of all teachers on various aspects of inclusion.

- Figure 49 presents data on the opinions of teachers who had already participated in KGG during previous school years. Scores represent teachers' perceptions of the effectiveness of unlocking content when children reach each stage of their journey.

- Figure 50, based again on the sample of teachers with previous experience of KGG, presents teachers' perceptions of the general effects of KGG on inclusion.

Figure 48. Teachers' perspectives on inclusion (all teachers).
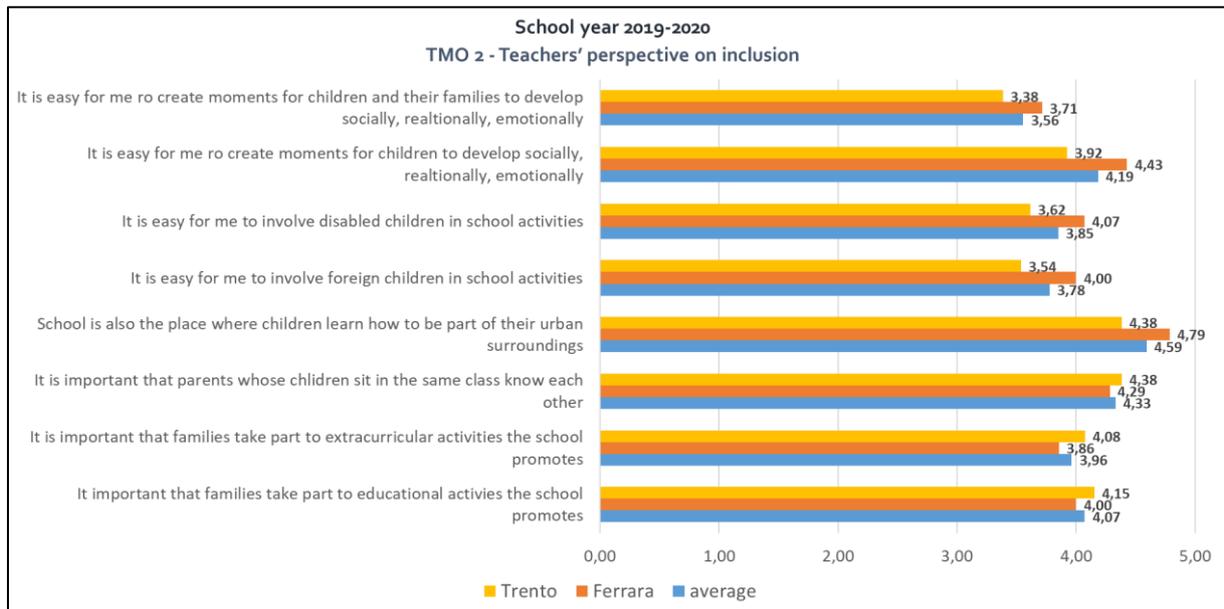
Figure 49. Perceived effects of KGG on inclusion (1)

School year 2019-2020
TMO 2 – KGG perceived effects on inclusion

When we reach a new place on our KGG journey...
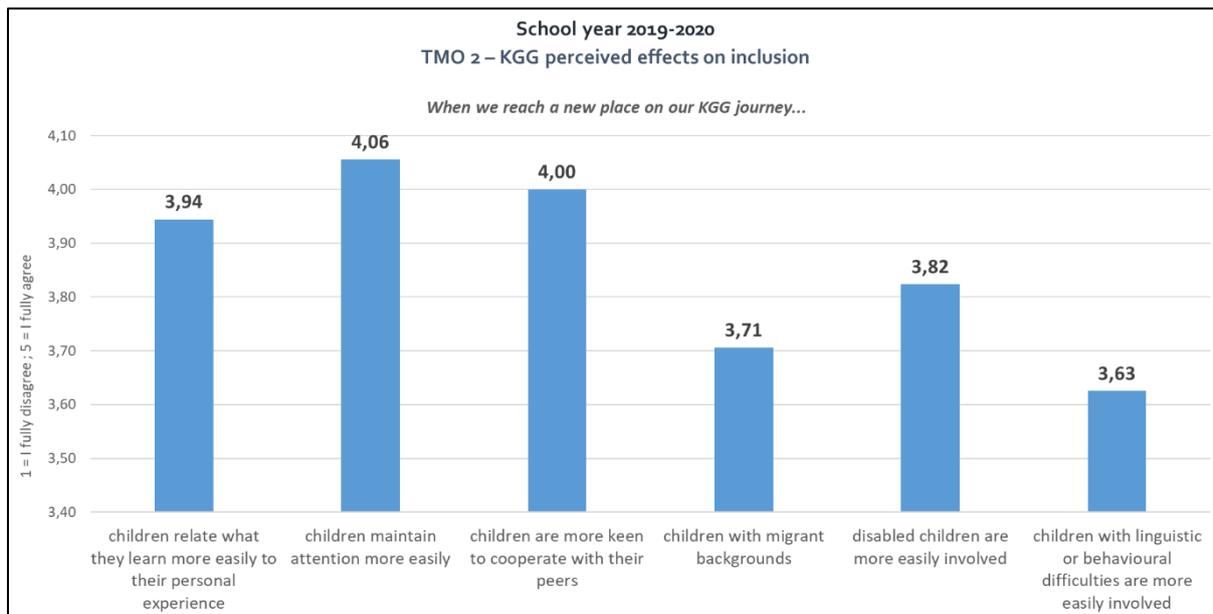
Figure 50. Perceived effects of KGG on inclusion (2)

School year 2019-2020
TMO 2 – KGG perceived effects on inclusion

Thanks to activites planned via KGG...
(graph by grade)
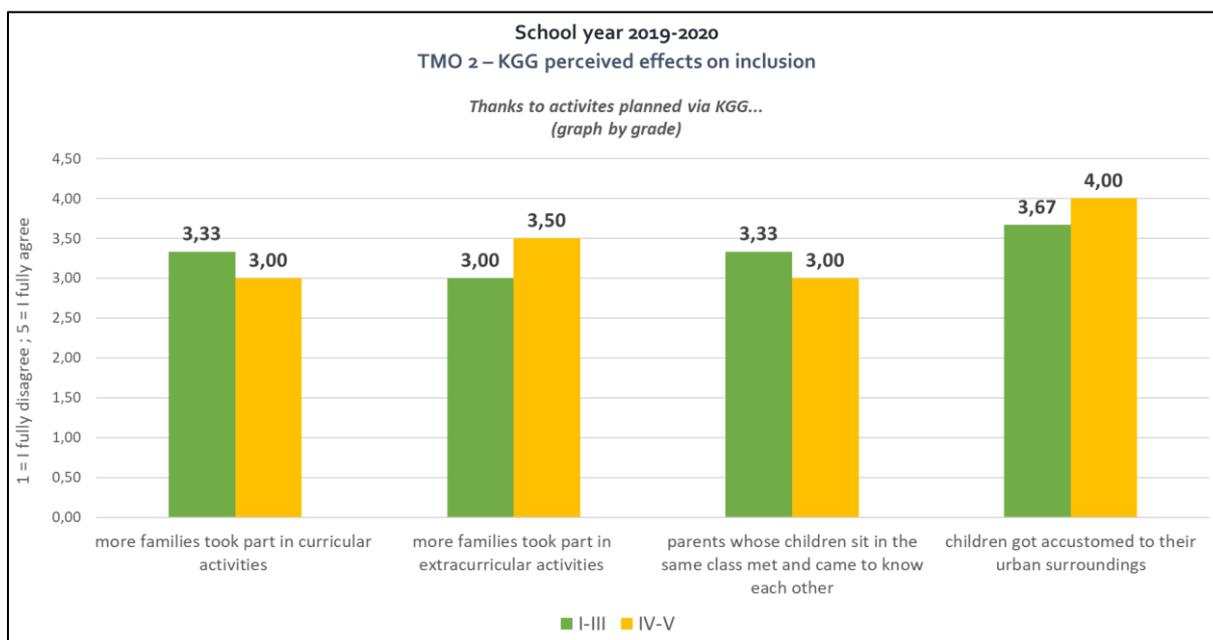
TMO3 was employed to hypothesise on changes in teaching methods and school governance. The following graphs illustrate results for the following expected outcomes:

– Improved cooperation among teaching staff.

– Exploring new ways to deliver lectures.

– Spreading a culture of innovation throughout the whole school staff.

Specifically:

– **Figure 51** illustrates teachers' opinions concerning vertical and horizontal approaches to the management of teaching (based on the whole sample.)

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– **Figure 52**, based on the sample of teachers who had already taken part in KGG during previous school years, illustrates teachers' perceptions of the effects of the project on the vertical and horizontal management of teaching delivery.

Figure 51. Teachers' perspectives on the management of teaching
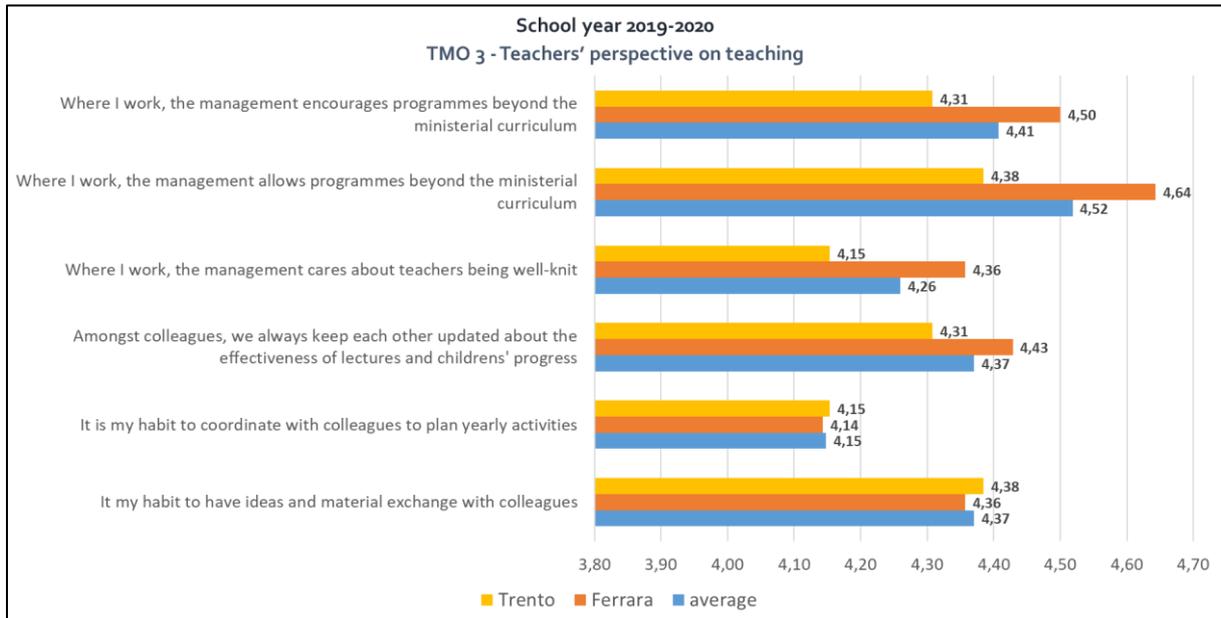
Figure 52. Teachers' perceptions of the effects of KGG on teaching governance.
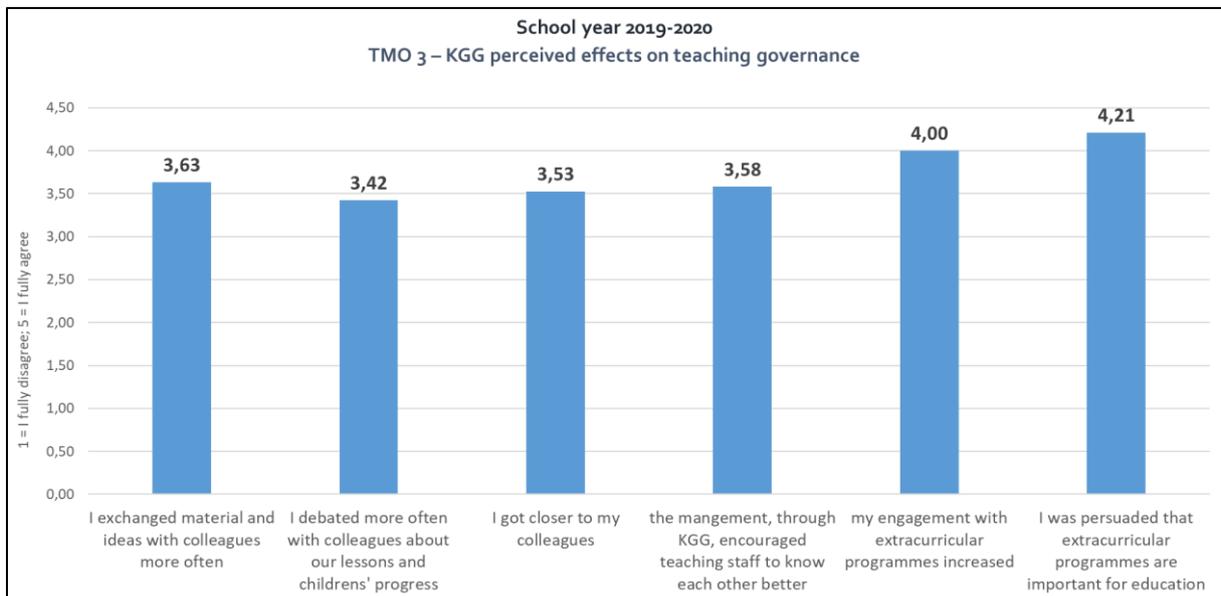
Finally, the survey explores the use of digital means during classes/lectures and in teachers' other everyday work-related activities, as a proxy for their digital skills level, as well as their engagement in transmitting digital skills to their pupils. Data are presented as follows:

– Figure 53 presents teachers' habits in relation to the use of digital devices and the most common software, together with the extent to which teachers perceive that KGG has improved their use of such tools.

- Figure 54 presents teachers' habits in relation to the use of digital sources of information, together with the extent to which teachers perceive that KGG has improved their use of such sources.

- Figure 55 compares the customary usage of digital tools and content during teaching delivery in the classroom, with the extent to which teachers perceive that KGG has improved their use of such tools.

Note that each of these figures, the graph on the left is based on the whole sample, while graph on the right is based on the smaller sample of teachers who had already participated in KGG.

- Figure 56 unpacks by context (schools located in Trento or Ferrara) teachers' perceptions of the effects of KGG had on their skills, and those of their pupils, as well as its effect on pupil performance.

Figure 53. Teachers' use of digital devices and software (and effect of KGG).
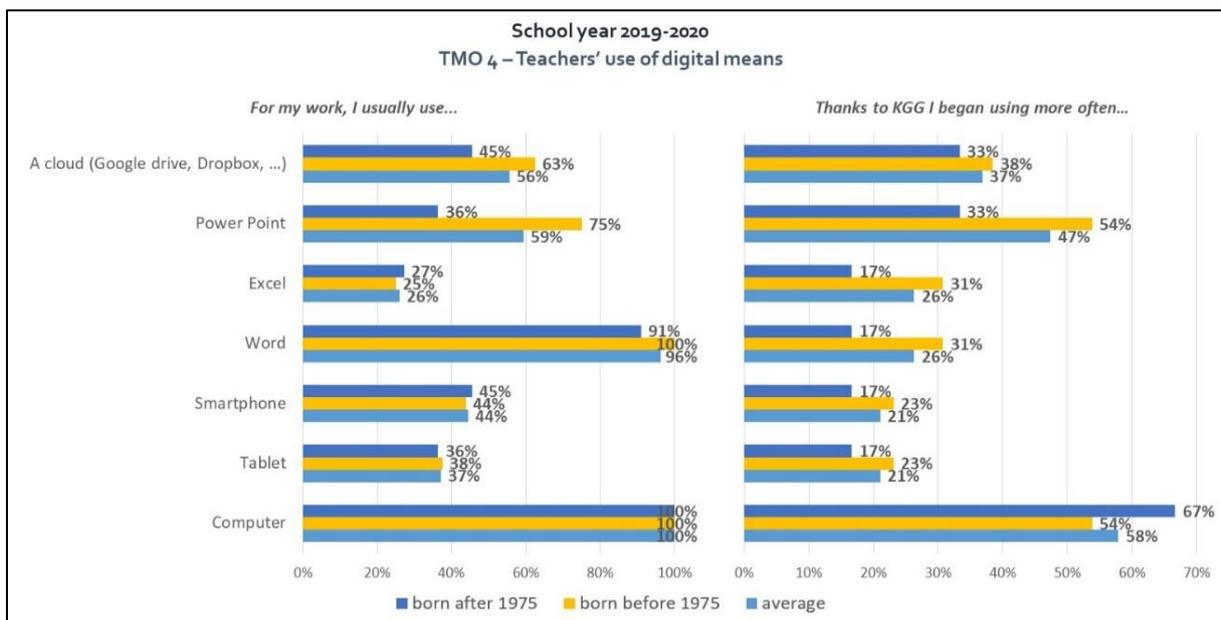
Figure 54. Teachers' use of digital information sources (and effect of KGG).
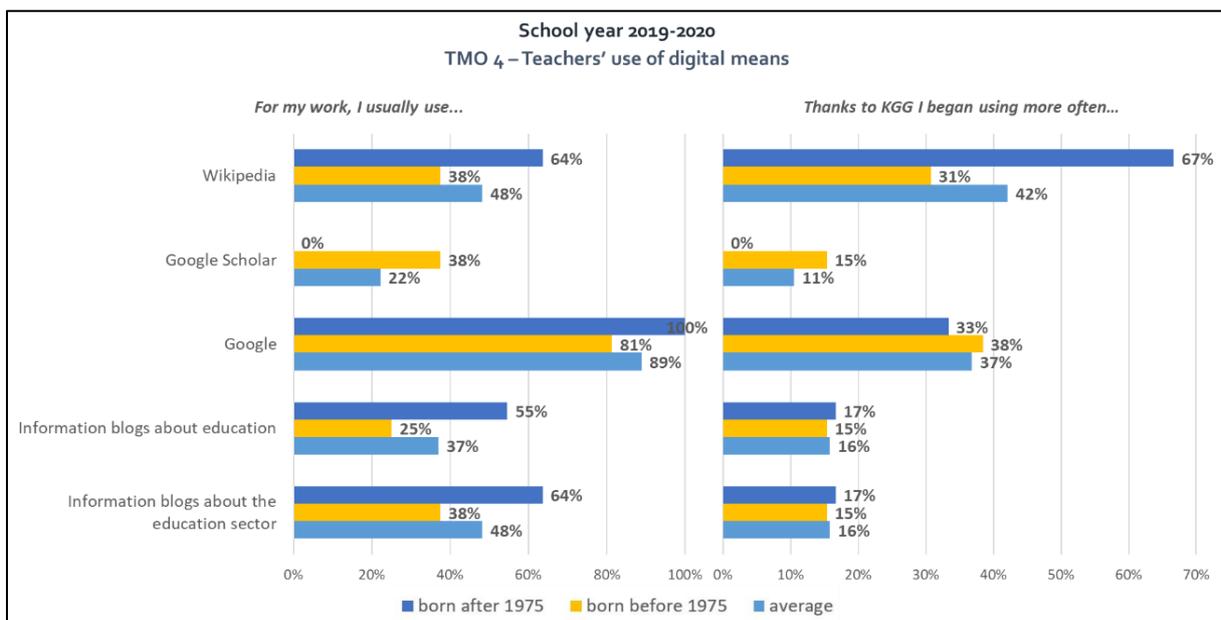
Figure 55. Use of digital devices and software in class (and effect of KGG).
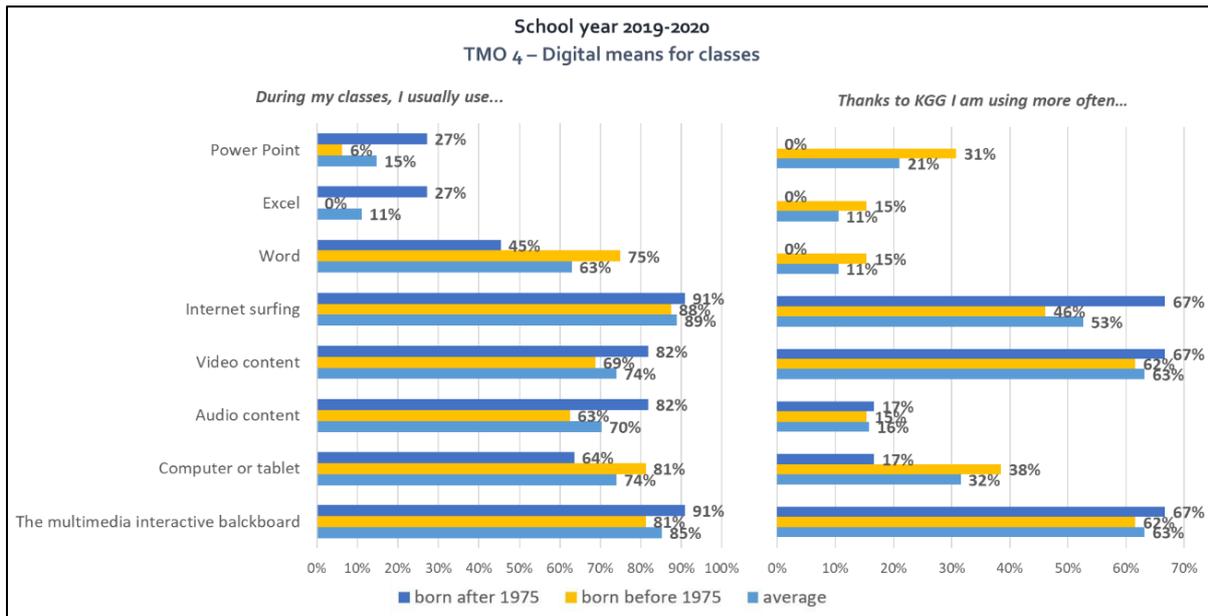
Figure 56. Perceived effects of KGG on digital skills
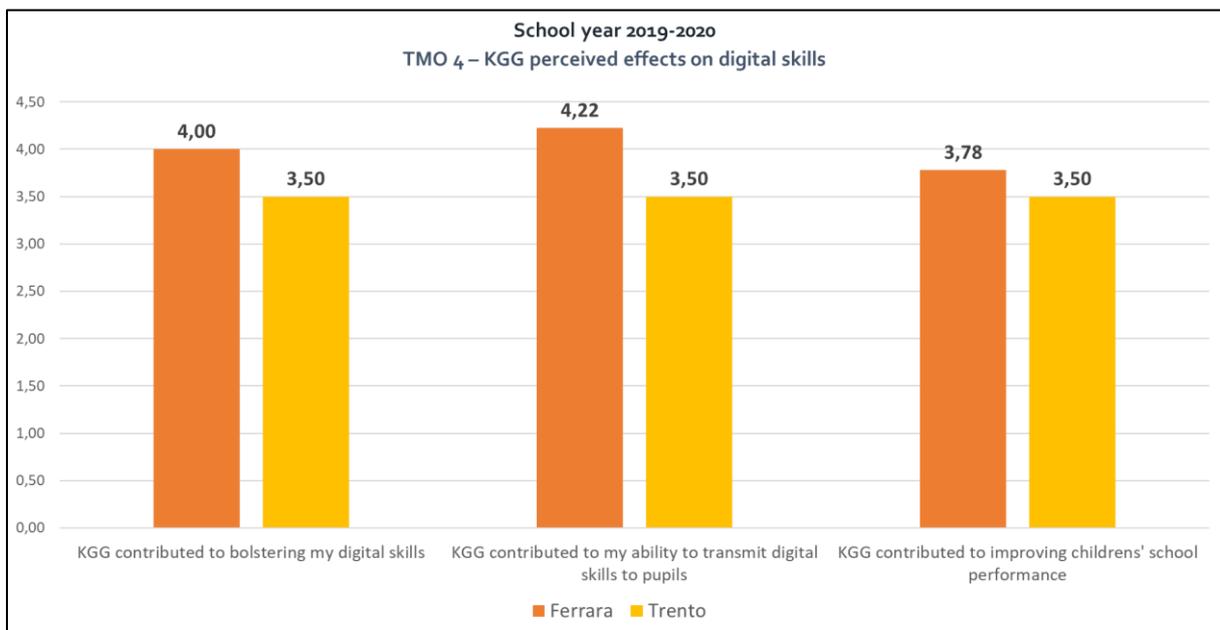
3.5.3.3 Conclusions

KGG's initial aim was to change mobility practices towards healthier and more sustainable habits, as well as increasing children's autonomy in relation to *mobility*. However, as the project has progressed, the actors involved have noticed that it also appears to: (a) foster inclusion, improving the learning process and creating a community network *(inclusion)*; (b) modify the teaching approach, offering new and innovative methods (*teaching approach*); (c) improving the *digital skills* of both children and teachers.

Evidence collected in relation to *mobility* appears to show a shift towards the use of more sustainable transport modalities. In fact, the overall data shows a rise in children travelling to school on foot, and a consequent reduction in the number of children travelling by car. Moreover, the level of families' awareness and knowledge about KGG and the level of children's involvement appears to influence mobility choices, shifting parents' attention towards sustainability as well as children's needs (autonomy and amusement).

KGG also appears to have had effects on *inclusion.* In particular, from the perspective of the teachers, the interactive and playful way of learning promoted by KGG is helping to maintain children's attention and foster cooperation between peers. The hypothesis in relation to the inclusion of the disadvantaged children appears not to be verified, with lower impacts being perceived. Moreover, KGG's 'going to school' game helps children to become accustomed to the surrounding urban architecture, with evidence for this appearing more robust among older children.

The project also appears to have had an effect on *teaching approach*. In particular, it has helped to increase awareness of the importance of extracurricular activities, and the willingness of teachers to participate in such activities. Although to a lesser extent, a majority of respondents agreed that KGG also had positive effects on fostering a collaborative environment amongst teachers. Finally, teachers reported an overall increase in the use of digital tools, especially during lectures. They also recognised an improvement in their *digital skills*.

4 Conclusions: reflecting empirical results into DigiGov-F 2.0

4.1 Key implications of the case studies

The results presented in the case studies address many aspects of the DigiGov-F conceptual framework. We have discussed in depth the effects of the introduction of this innovation, in terms of the outcomes of efficiency, effectiveness and inclusion and legitimacy. Here, we propose a final discussion of these main outcomes and implications for future research and policy, together with other relevant issues such as the need for digital investments, the shift from eGovernment to Digital Government, and the need to protect privacy and personal data.

Case Study 1: Tvarkau Vilnių (Lithuania)

The evidence from the case study shows that simply using the Tvarkau Vilnių platform does not directly enhance a person's trust in municipal government, although there is some evidence linking the way people perceive the accessibility and effectiveness of municipal institutions with their perceptions of the municipality's response to reports submitted using Tvarkau Vilnių. In other words, as corroborated by open responses to our surveys, it is important whether users consider the municipality's response to be standard/vague or specific/to-the-point, and whether or not the issue was fixed. This is in line with some of the literature on accountability and co-production, and is pertinent both to the development of ICT-based public services and to broader discussion of the use of digital government to address systemic issues. In essence, our study shows that citizens are willing to play their part in joined-up service delivery; however, a systemic effect in terms of, for example, higher trust and legitimacy, is only likely if participants can monitor its implementation and feel that their contribution makes a difference.

> *This finding resounds perfectly with many socio-economic and socio-technical scientific works that have analysed previous waves of eGov investments: namely, that technology by and of itself does not produce expected outcomes. It is not sufficient to provide a smart application to increase engagement and/or trust, unless users can monitor and are informed about what happens after their contribution. Unless we expect all citizens to become experts in Big Data experts, a lot of important work still requires direct human interaction*.

Another angle from which the example of Tvarkau Vilnių can be used to discuss trust is the question of reporting issues anonymously vs. revealing personal details. The use of the platform increased significantly after anonymous reporting was introduced in 2017. Most respondents (62%) in our research group opted to submit their reports anonymously, and one-third of respondents said they would not use the app if they were required to log in. Also, we find that those who lack trust in the municipality would be less likely to submit reports if they had to provide their name. This reveals several things. First, as demonstrated by numerous articles, the level of trust within Lithuanian society is low (this trend is common in most CEE countries). In this context, platforms such as Tvarkau Vilnių are all the more important if they can increase trust by helping to fix issues, as discussed in previous paragraph. However, such trust may easily be breached due to, for example, legal complications concerning anonymity, as was the case in Vilnius. Personal data management is an increasingly sensitive issue and may undermine even the most well-meaning ICT-based solutions, if not handled properly. If privacy is compromised, an ICT-based platform may become a factor undermining legitimacy rather than contributing to it.

> *The issues of trust and privacy, already prominent in earlier stages of government digitalisation, are becoming even more salient given both the great potential and great risks presented by the use of AI.*

The case study also aims to contribute to the discussion as to whether platforms such as Tvarkau Vilnių provide sufficient opportunity for meaningful civic engagement – or, on the other hand, they foster a more individualistic, client-provider relationship between citizens and public institutions. According to our evidence, when asked to make a choice between deliberative engagement on the one hand and the straight provision of inputs on the other, people choose a point somewhere in-between. In other words, they are not necessarily eager to engage in discussion with others, but they support functionalities that would allow them to help the municipality select the most urgent issues (e.g. through voting), or would allow them to engage in more direct contact with the public officials (e.g. the ability to respond to the municipality's response). This does not necessarily cancel out the argument in favour of community engagement; however, based on the findings of this and other studies, meaningful engagement requires significant effort, while people naturally differ in their propensity to offer the necessary commitment. In addition, the effect of engagement depends greatly on the process and facilitation. It can be argued that platforms such as Tvarkau Vilnių offer a favourable setting for testing out engagement, but this depends less on the technology itself (as the relevant functionalities may be added relatively quickly), but more on the administrative capacity and priorities of the organisation running the platform.

> *The above is an important finding that helps to moderate the claims and promises heralded by supporters of open governance, coproduction and civic engagement. While an active portion of citizens will benefit from new technological possibilities, civic disengagement and lower political participation are secular trends in advanced democracies that cannot be reversed simply by deploying new and more potent technological means*.

We also considered the Tvarkau Vilnių app from the perspective of efficiency, which is often the starting point for consideration of most ICT-based solutions. Our study shows clear efficiency gains (e.g. in the form of reduced administrative burden) from the perspective of city residents, as it enables them to report an issue relatively quickly, pin-pointing the exact location. From the perspective of the municipality, the evidence is mixed. In the past, receiving complaints and requests from city residents was certainly more complex and cumbersome. Nonetheless, Tvarkau Vilnių has not become a 'one-stop shop' for reporting issues. It has been developed as a useful and convenient way for citizens to provide their inputs, but the municipal administration now has to deal with more input channels than it previously did. Next, the quality of reports tends to be low, especially since anonymous reporting was introduced, and includes numerous instances of duplicates as well as spam.

> *Again, we stumble into evidence that has been available for some time: ICT investments produce productivity effects with a time lag, and only when combined with complementary organisational and cultural changes, which in our framework are termed 'reframing'. Furthermore, in the short to mid-term, the duplication of efforts and the stratification of delivery channels may increase rather than decrease efforts and costs on the part of public administrations*.

In view of these issues, various solutions are being considered, including the introduction of machine learning and AI to help the municipality to prioritise issues, assign responsibilities and react more quickly. In line with the conceptual framework of this study, this means that Tvarkau Vilnių platform is moving from the realm of eGovernment to Digital Government. The study also provided some pertinent evidence concerning the practicalities of such a shift. Firstly, the key driver can in fact be the administrative complexities, inefficiencies and lessons learned from previous eGov solutions. Secondly, the need for upfront investment is significant and difficult to obtain – not least because it is not easy to provide a convincing, evidence-based case for the cost-effectiveness of such a solution. Finally, the familiar argument of AI-based solutions leading to redundancies and thus being unfeasible politically, was also brought up in some interviews. However, previous rounds of automation by the municipality have not led to workers being laid off, with employees instead being assigned to other tasks.

> *The considerations above both corroborate, and call for integration into, our framework. This corroboration comes from the fact that reframing is important to achieving results, because the shift from eGovernment to Digital Government entails a number of practical issues pertaining to the implementation process, and to the corresponding antecedents highlighted in our framework. Our reference to possible integration relates to the need for greater emphasis to be placed on efforts and investments, and for a feed-back loop to be built into the framework to take into account the dynamic and iterative process of Digital Government Transformation. This case study shows that once a service is up and running, new needs may emerge, requiring new investments and thus a new iteration may become necessary to improve the service.*

Our research leads to a number of policy pointers and recommendations that could enhance the use of ICT-based solutions to address systemic issues.

First, the impact of ICT-based solutions is less about the sophistication of the technology itself and more about proving to the users that it will help to fix issues and get things done. It is therefore important to ensure users can easily monitor the progress of their inputs. People should be informed when their report has been solved – this will both potentially enhance trust and reduce the number of duplicate reports. If users' contributions are not acted upon in full, the reasons for this must be explained in clear and plain language. The public or (non-governmental) sector could also aim for better civic engagement and joined-up responsibility rather than a client-provider relationship. While an ICT solution to achieve this can be designed relatively quickly, the key challenge is to ensure the process is well-facilitated, open to various inputs, and conducive to finding common ground in face of conflicting interests.

> *The above recommendations once again underscore the importance of reframing, adding an additional focus on adoption that is implicit in our framework, but could be given greater salience in the next revision.*

Second, trust-building starts with the protection of privacy and personal data at the level of the ICT-based solution. Anonymous communication is always an option at the beginning. Nevertheless, it is important that at some point the users are encouraged to identify themselves and provide inputs using their real names. This adds to the quality of submissions and is more likely to lead to a responsible dialogue. The personal data that results with this switch to non-anonymous communication must be treated (a) transparently (i.e. every user must know what data is being collected and how it may be used); and (b) with caution (i.e. data must only be collected and used to the extent that it is necessary in order to have a meaningful engagement). As demonstrated in the case study, cases will occur in which different streams of legislation, such as personal data protection law and administrative law, will come into conflict with each other. In such a case, legislative action is necessary to update the legislation and ensure that public trust is not breached.

> *Again, the trust and privacy that were important in previous waves of eGov, are now becoming increasingly strategic. This is already underscored in our framework, but could possibly be given greater salience.*

Finally, it may be difficult (especially at the beginning) to make the case for the cost-effectiveness of an ICT-based solution – particularly if it operates alongside other, more traditional channels of public service provision. As demonstrated by the case of Tvarkau Vilnių, the initial, experimental initiative may come from the voluntary sector, which shows that public officials should be open to such cooperation and engage in partnerships through hackathons, eGov labs and other formats. At some point, however, the public sector must become fully involved and make the ICT-based solution an integral part of its operations. Further and more substantial investment into Digi Gov initiatives may be difficult to justify

given that innovative solutions are always subject to risk and uncertainty, and may be developed through trial and error. Nevertheless, as demonstrated by the Vilnius case, the status quo may become untenable – due in part to the success of the ICT-based solution, as an increasing number of submissions may leads to backlogs. This creates pressure for further innovation, such as the introduction of AI-based solutions. In order to justify this, however, a more fundamental revision of internal procedures is necessary. This may include streamlining the organisation's public service channels, with savings being used to fund the introduction of the innovation.

Case Study 2: Body-worn cameras in policing (UK)

This case study examines the direct and indirect implications of (potential) digital transformation in policing in the UK using body-worn cameras (BWCs), as well as the drivers and barriers to implementation. We have drawn lessons from a series of experiments carried out in the UK to test the effectiveness of digital transformation in policing using BWCs. We have also considered, where possible, developments in a small selection of other EU Member States that have recently piloted or implemented BWCs.

As noted in Section 3.3.3, the three 'effects' of digital transformation in terms of outcomes are defined in the DigiGov-F conceptual framework as productivity and efficiency; effectiveness, inclusion and sustainability; and legitimacy. Our analysis in this case study explores the organisational and administrative consequences of using BWCs in policing with specific reference to these three outcomes. Here, we offer some concluding remarks in relation to these outcomes. We also summarise some of the main drivers and barriers to the use of BWCs in policing.

The effects on productivity and efficiency of the introduction of BWCs in the UK context are not straightforward. It is perhaps best to think of BWCs in the UK context not as an *automating* technology (which is usually understood as driving productivity gains by reducing costs/increasing outputs), but an *augmenting* one. BWCs currently 'automate' one thing very well – namely, recording visual data for use in evidence processing, comparable to the previous task of incidents being written up by a human scribe. However, it cannot currently automate the *full* process in and of itself: there are aspects of this process (e.g. the interpretation of context and reasoning) which must currently be carried out by a human. Therefore, many of the processes involving a camera – such as the generation of evidence – still require a human process (such as supplying a statement) to operate alongside. As highlighted by researchers in the context of BWCs, "*machines are replacing police manual labour with more powerful sensory capacities than human beings. The machines never tire and have infinitely greater memory, search, data-processing, data-linking and analytical capacities. In other instances, to paraphrase Arendt, machines are guiding the hands of the police, transforming the nature of policework such that human beings and machines work together seamlessly.*"[468]

> *From a different angle, this case – like the previous one – demonstrates that not every task can be automated. Hence, strictly defined productivity and efficiency gains are not as linear and straightforward as one might expect.*

There is, however, some evidence relating to the potential for BWCs to speed up specific processes. These include taking witness statements, reducing the overheads relating to complaints, and decreasing court time thanks to an increase in early guilty pleas. However, these relationships are not clear-cut or well-evidenced at present (particularly in relation to other criminal justice stakeholders), and some interviewees tended to focus on more effective policing outcomes as the key driver in comparison to cost-benefit analyses (and, indeed, cost remains an often-cited barrier to the wider use of BWCs). Similarly, because these effects are felt at system level (including the wider criminal justice system) rather than at organisation level (e.g. individual police forces), understanding overall productivity

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[468] Bowling, B. & Iyer, S. (2019). Automated policing: the case of body-worn video. *International Journal of Law in Context* 15(2), 140-161.

gains is complex. Therefore, it could be reasonable to assume that BWCs will lead to efficiency gains with regard to some specific processes. However, the nature of policing as an iterative public service means that such efficiency gains may not necessarily translate into the other outcomes often associated with digital technology, such as the ability to reduce human work hours, costs and throughput. In the future, more advanced functions– such as integration and use of facial recognition – may bring further efficiency gains.

> *It is also important to stress, as a possible item to be given salience in the framework, that sectoral gains may not be visible but may contribute to system-level impacts. It is also clear that the importance of reframing, as defined in our framework, is corroborated by the considerations above, and by the more detailed analysis of this case presented in Chapter 3 of this report.*

Stronger evidence exists in relation to the potential impact of BWCs on the effectiveness of policing. While it is difficult for experimental research to explore specific outcomes relating to crime and justice, there is evidence that BWCs are able to produce better-quality evidence than before, although norms surrounding the use of such evidence may not be fully developed at this stage. BWC use in training may also improve service delivery by developing officers' skills. Future capabilities such as the linking of data and live streaming may also enable more effective policing in this regard, by enabling analytics in relation to BWC footage.

> *Effectiveness gains appear more prominent, but there is still a lack of knowledge and capacity to measure them.*

Compared with the first two outcomes (productivity and efficiency; effectiveness, inclusion and sustainability), a stronger, clearer link exists between the use of BWCs and legitimacy goals. One of the main mooted benefits of BWCs is their ability to act as a check on the behaviour of police officers ('guarding the guardians') and therefore, in theory, encourage better application of the law by ensuring officers follow and are accountable to legal protocols. This is unsurprising, as such a hypothesis is at the heart of any surveillance – although questions remain regarding the extent to which this kind of surveillance is legitimate in the context of policing, and this may not be consistent across EU countries. For example, an observational study of the implementation of BWCs in a US police department found that use of BWCs strengthened what they termed the "people-processing" aspects of policing practice, by encouraging greater adherence to processes and policies, and making processes (such as the complaints procedure) more efficient. However, BWCs had less impact during the study period on what they termed the "people-changing" aspects, such as new forms of training, supervision or behaviour, as the BWCs did not alter the overarching structures (such as performance measurement processes) to incentivise this.

Conversely, BWCs may also strengthen accountability in the opposite direction, by changing citizen behaviour and, as hoped by some interviewees, enabling greater understanding on the part of the public about the reality of police work. However, key ethical questions remain about the future use of technologies such as facial recognition. The way in which these are used and introduced to the public may be a key factor in the future impact of BWCs on police legitimacy. As noted by researchers placing BWCs in the context of future, deeper automation: "*The integration of video cameras into police uniforms provides an indication of how police robots will function and offers an opportunity to think about public awareness and perceptions of automated policing and the mechanisms that are required to regulate it.*"[469]

> *Currently, BWC appear to contribute to the important outcome of increasing legitimacy through better policing behaviour and better accountability; however, the prospect of further automation will need to be well conceived if it is to avoid creating new concerns and distrust.*

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[469] Ibid.

Case Study 3: Privacy and trust in new digital public services (Germany and Spain)

This case study examines the relationship between privacy and trust as regards the introduction of new digital public services. We addressed this key issue in Digital Government Transformation through an analysis of the demand side. In contrast to the other three case studies, this investigation was conducted as an online experiment in two countries (Germany and Spain), focusing on the introduction of new technologies to improve public services in four different policy domains (i.e. transport, health, security and voting). We collected primary data from 1,400 respondents, applying stated preference techniques to the challenge of trying to understand the trade-offs that people may make when confronted with choices about their privacy. Here, we aim is to link the objectives and results of the case study to the main elements of the conceptual framework that are addressed.

> *This case study relates to some key aspects of the DigiGov-F conceptual framework. The framework outlines three main 'effects' of digital transformation in terms of outcomes, namely: productivity and efficiency; effectiveness, inclusion and sustainability; and legitimacy. In addition, the framework incorporates the potential negative effects or side-effects that digital innovations may produce. Our analysis of this case study specifically addresses the potential privacy issues experienced by citizens when new technologies relying on the extensive use of personal data are introduced in order to improve public services. As already explained, beyond efficiency and effectiveness, the search for legitimacy and trust represents an important dimension for governments to consider when introducing service innovations. On the one hand, this can represent a significant barrier to digital transformation, while on the other, it constitutes one of the potential positive effects that new technologies can produce, beyond efficiency and effectiveness.*

The four hypothetical scenarios presented to the participants in the experiment all fall under the definition of what we term, in the first part of this report, "service innovation". This refers to the creation of new public services or products[470], or significant improvement to an existing service[471]. At the core of the digital innovations considered in this study is what the OECD defines as a Data-Driven Public Sector (DDPS)[472]. Figure 57 below identifies the value chain in a non-linear, recursive manner, with feedback loop within the necessary steps, and involving the creation of public value. After the first two steps is a loop that goes between sharing and using/re-using data which, once launched, can retroactively positively feed and reinforce the first two steps. For the digital transformation promise of a DDPS to be realised, intensive work is required to make use of the available data. However, other prerequisites are also extremely important – and the lack of these may significantly hinder the promised transformation and the related positive outcomes.

[470] 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. doi:10.1111/padm.12209

[471] Windrum, P. (2008). Innovation and entrepreneurship in public services. In: Windrum, P. & Koch, P. (eds.), Innovation in Public Sector Services. Cheltenham: Edward Elgar.

[472] van Ooijen, C., Welby, B. & Ubaldi, B. (2019). A data-driven public sector: Enabling the strategic use of data for productive, inclusive and trustworthy governance. OECD Working Papers on Public Governance No. 33. Paris.

Figure 57. Value chain for the Data-Driven Public Sector.
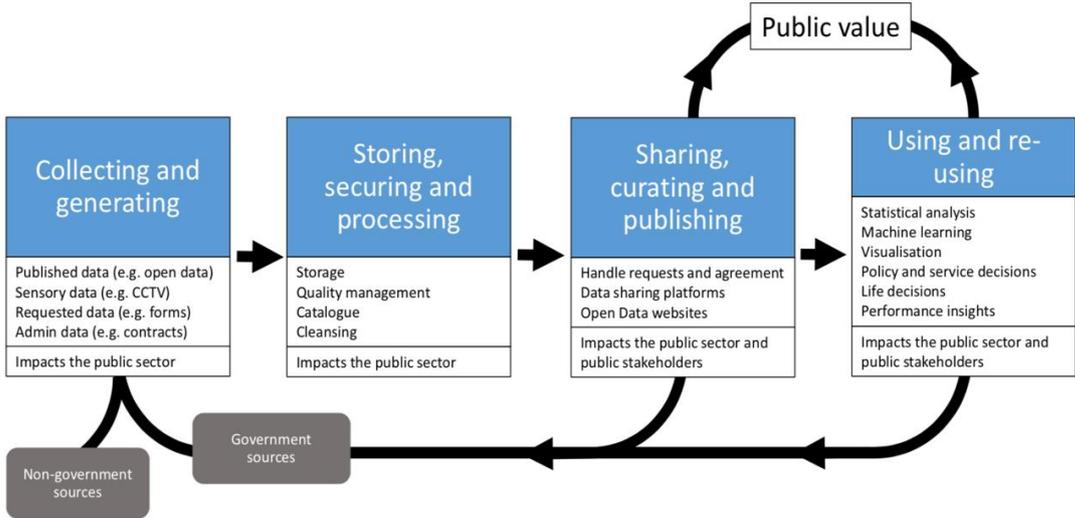
Source: van Ooijen, Welby & Ubaldi (2019), p. 11.

In line with the conceptual framework, we explored one of the four essential prerequisites for digital transformation: legitimacy and public trust concerning the ethical use of data by public sector organisations, as well as privacy, transparency and the risks of which governments and citizens need to be aware. More specifically, our experiments aimed to: (a) understand what role trust in the public sector plays in the adoption of such services; (b) identify under what conditions citizens are willing to adopt new digital public services; and (c) explore the trade-offs citizens make between privacy and the benefits that stem from the use of new digital public services in various domains.

The results of the experiment show that trust plays a key role in the introduction of new digital services that rely on the use of personal data. The most direct effect is on the type of organisations that process the data. Overall, respondents were strongly opposed private companies processing their data. This becomes relevant given that, as presented in the Conceptual Framework, the literature on AI-enabled public services shows that the private sector plays a leading role in the development and delivery of public services, which often involves the processing of data. An extremely low level of trust in private companies may become problematic once citizens realise their involvement in delivering digital public services promoted by the government. The basis for these concerns is clearly shown in the example of the Danish Ministry of Tax, which admitted in 2014 to having no control of over more than 200 systems that used machine learning algorithms for policy making that directly affect citizens. However, our evidence shows that those respondents who were generally more distrustful and concerned with privacy also tend to prefer having their data processed by independent organisations rather than public authorities or government. This trend was particularly significant in relation to two sensitive domains: health and voting. This evidence shows that governments cannot consider themselves immune from citizens' concerns over privacy. It may be that governments and public authorities are sometimes perceived by the public as being not entirely reliable in managing their data, thus raises pressing questions of accountability.

Any AI enabled digital transformation of public services should therefore carefully take into account the perceptions of citizens and, where necessary, raise awareness and build trust not just through regulation, but also via direct consultations and education campaigns.

The results also show that participants were unwilling to make trade-offs when it comes to personal data and privacy. When given the choice, irrespective of the type of benefits offered, the respondents preferred to provide anonymised data, and not to have their data processed by private companies. Moreover, the general view that citizens are more willing to adopt new digital services when they receive more direct and personalised benefits was not borne out by our results. In terms of the benefits that stem from new digital services, in the domain of health an equal number of participants demonstrated preferences for personalised treatments (direct benefit) and advances in health research (an indirect, societal benefit). Somewhat surprisingly, in the domain of transport, participants showed a preference for a societal benefit, the reduction of emissions, compared to the individual benefit of reduced travelling time.

> *The assumption that users are willing to trade off privacy and personal data in return for receiving services should be reconsidered. This may be the case for services such as social media, to which users have become accustomed and are therefore unwilling to give up, but is not necessarily true for other types of service.*

When it comes to privacy and the processing of personal data, what appears to be relevant is not the type of benefit provided by the improved services, but the level of trust citizens have in the type of organisation that accesses their data. In the current context of declining trust in both government and democracy[473], governments need to do much more to increase their legitimacy and accountability in processing personal data to improve public services. This aspect seems to be more important to many respondents than the impact that any new services may have on citizens' wellbeing.

> *Transparently engaging stakeholders and citizens in the debate on privacy and data protection is therefore crucial to achieving good outcomes.*

The results of the case study also provide some interesting insights into the adoption of public sector innovations that involve new technologies. First, there are two signals from the results that reveal a potential new form of digital divide. Similar challenges have previously been documented in the literature, such as the potential exacerbation of existing disparities in the accessibility of health care[474] due to the digital divide[475]. However, our results suggest something different from a digital divide in terms of access and skills[476]. We observe that those who reported the highest level of distrust at the same exhibit the lowest level of adoption (measured by the 'opt-out' preference in the experiment). This group, group contained older people, who may be not be comfortable with these new digital services, as already observed by another survey[477]. But the group also includes those with a lower level of education and with lower socio-economic status, confirming that trust is lower among disadvantaged groups. Interestingly, we noticed that the two domains in which hypothetical adoption is lower (i.e. there are more opt-outs) are security and voting. This means, as reported by the literature, that people are generally wary about the use of facial recognition technologies and e-voting solutions.

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[473] As reported in Richardson & Emerson (2018), the 2017 World Values Survey documented a worrying shift in attitudes toward democracy. While in the 1960s around three-quarters of respondents said it was essential to live in a democracy, less than one-third of millennials believe this today; OECD data on citizens' trust in government across its member states show that the level in 2014 was just at 41.8%, compared to 45.2% in 2007 (http://www.oecd.org/gov/trust-in-government.htm)

[474] 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).

[475] 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.

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

[477] 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

> **The issues of adoption, and of a potentially new form of digital divide, should be given greater prominence in the revised version of the framework.**

These last results on the adoption of new technology-enabled services confirm what has been previously discussed: that governments and other organisations must address legitimacy and trust in order to deliver beneficial outcomes. On its own, the promise of potential efficiency gains stemming from the introduction of new technologies is probably not enough where these new services rely heavily on the use of personal data. Citizens – in particular those who are disadvantaged ones – are more likely to provide their data in exchange for improved public services, if they perceive the institution to whom they give the data to be trustworthy.

> **Despite the potential positive effects that stem from the use of technologies to deliver public services and improve operations, some important challenges need to be addressed in relation to trust and legitimacy. Clear and transparent communication concerning the nature of new, data-centric technologies used by government, public agencies and officials is the starting point for building trustworthy relationships with citizens in the era of digital transformation. It can be concluded that legitimacy and trust are simultaneously an important process-level prerequisite, and an end outcome.**

Case Study 4: Kids Go Green (Italy)

This case study examines the impacts of Kids Go Green (KGG), a project designed and implemented by Fondazione Bruno Kessler[478] (hereinafter 'FBK') in the schools of the city of Trento, the autonomous province of Trento, and the city of Ferrara. The project uses a tech-based educational game that involves the school, the children and their families in an educational adventure around the world, and promotes more sustainable mobility. The case study employed a mixed approach, which combined theory-based evaluation (using realistic evaluation and the theory of generative mechanisms) with process-tracing, and used target-mechanism-outcome (TMO) theoretical architectures, whose robustness was evaluated through both interviews and surveys. The case study therefore analysed not only what works, but also for whom, how, and in what circumstances.

As noted in Section 3.5.3, the results of this case study can be mapped against some of the outcomes of the DigiGov-F conceptual framework. The results of KGG that the project (a) fosters inclusion, improving learning process and creating a community network *(inclusion)*; (b) modifies the teaching approach, offering new and innovative methods (*teaching approach*); (c) improves the *digital skills* of both children and teachers. These results are particularly important in relation to two main outcomes of the conceptual framework: the second pillar (inclusion and sustainability), and the third pillar (trust and legitimacy) in terms of the change of governance.

> **This is an unusual sector, seldom considered in traditional eGovernment research, and demonstrating potentially promising results with respect to two important outcomes. It suggests that the framework should be presented as being widely applicable to the entire public sector, and as the starting point for future refinements and operationalisation into the different verticals of which the public sector is comprised.**

Among KGG's outputs, the programme provides a new outlook on processes and governance. The use of gamification to incentivise children's journey from home to school, and its link to the teaching programme and learning experience, has fundamentally altered the way in which this journey is thought about. Once their carers drop them off in the

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[478] https://www.fbk.eu/en/

morning, children fall within the legal responsibility of the institution (the school). From that moment, the school is in charge of both children's safety and their education and personal development. While KGG has not extended the scope of schools' responsibility, by turning the journey to school into the focus of teaching activities, it has broadened the time and space in which the institution interacts with its community. While KGG is in operation, the planning of educational activities, integration into ministerial programmes and the involvement of families and the community, all depend *de facto* on the school managing (without additional legal burden) the way its users reach its gates.

> ***From the point of view of governance, the results show that KGG generated new dynamics among the interested actors, by deepening the involvement of families in school-promoted activities, and increasing the cooperation of teaching staff with each other and with the management. In these two senses at least, KGG has changed the relationship between the institution and the actors involved with it, for the benefit of the users of its main service – namely, the children.***

Looking at the outcomes that gamification has triggered (and which it is expected to trigger), the results point to the need for deeper investigation of KGG's success in bolstering inclusion and sustainability. The case study highlights the project's potential improve the inclusion of more disadvantaged groups of citizens and users. On the one hand, all families are engaged equally by the programme, instead of participation being limited to the most proactive parents. On the other hand, the secondary output of the programme (i.e. the content and methods of teaching) has proved, according to teachers, more effective than traditional methods in relation to disadvantaged clusters of pupils. And in relation to sustainability, the case study results show that, in the perceptions of families, KGG has brought about an adjustment in mobility habits towards a more sustainable lifestyle, as well as stimulating debate about environmental issues.

In conclusion, despite the impossibility of statistically testing the hypotheses (due to the limited number of respondents), the case study shows some positive effects. This provides new evidence on the way in which new digital technologies, if properly implemented and adapted to context, can be a useful instrument for improving the overall school experience and creating benefits for all the actors involved.

4.2 Lessons learned from cross-case analysis

As explained in the introduction to this report, four case studies alone are not sufficient to draw generalised conclusions. Nevertheless, they provide interesting suggestions and hypotheses that can be further explored in future studies, and which will be incorporated into the recommendations and prospective exercise that will be the core of the Final Report of this study.

In the previous four sections we have highlighted the main points of relevance in around 20 boxes. Now we group these highlights into seven major lessons learned. Some of which corroborate our framework, while others point to the need for further integration/revision.

More space is devoted to discussing the first of these seven themes, which concerns the limits of automation and of immediate productivity gains. This is for three reasons. First, because a rich literature of labour economics exists that can be applied indirectly and by analogy to the context of the public sector. Second, because it confirms evidence accumulated over decades of scientific work on the impact of ICT in general, and on the public sector in particular. Third, because it challenges common hype and rhetoric, and helps to introduce a very healthy dose of realism.

(1) The limits of automation and of immediate productivity gains

The case studies looking at the Tvarkau Vilnių platform and at body-worn cameras (BWCs), while in different domains, converge in pointing out that there are limits to automation using AI; that the achievement of results still requires human interaction; and that, as has been known for decades, ICT productivity gains occur with a time lag and only when combined with changes in organisation and culture –what is referred to in our framework as 'reframing'. Furthermore, they underscore that at times, outcomes difficult to isolate at sectoral level and should be considered instead at system level. To infuse the current narratives about AI and other new technologies in the public sector with a dose of realism, we delve a little further into the issue of the limits to automation using insights from labour economics. As illustrated by Arntz et al.[479], technology experts tend to overestimate the potential of new technologies. Technological capabilities do not always or automatically translate into possibilities. Technologies must be embedded into socio-economic settings, which may delay and/or limit their full deployment. The extent to which human wisdom and pattern recognition can be really dispensed with and embedded instead into machines is still debated, and often overstated. According to Bessen, it is too simplistic to think that simply because computers can perform some tasks, jobs will be eliminated[480]. As an example of the opposite, he notes that during the 1990s, the number of automated teller machines (ATMs) installed across the USA increased enormously, reaching more than 400,000. Following a technologically deterministic argument, one would expect a large reduction in the number of human bank tellers; instead, these have grown consistently into 2000s. In Bessen's analysis, this happened because banks increased their number of branches, and because those tasks that could not be automated became more valuable: "as banks pushed to increase their market shares, tellers became an important part of the 'relationship banking team'". Many bank customers' needs cannot be handled by machines – particularly those of small business customers. Tellers who form a personal relationship with these customers can help to sell them high-margin financial services and products. This analysis is still valid, despite the more recent shift of banking services to the internet. A more recent paper published by the same author shows that today's technologies may cause some industries to decline and others to grow[481].

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[479] Arntz, M., Gregory, T. & Zierahn, U. (2016). *The Risk of Automation for Jobs in OECD Countries: A Comparative Analysis*. Paris: OECD.
[480] Bessen, J. (2015). Toil and Technology. *Finance & Development* 52(1), 16-19.
[481] Bessen, J.E. (2017). Automation and jobs: When technology boosts employment. Boston Univ. School of Law, Law and Economics Research Paper (17-09).

Automation might not cause mass unemployment, but it may well require workers to make disruptive transitions to new industries, requiring new skills and occupations. In the example above, the skills of the teller changed: cash handling became less important, while human interaction became more important. This can be also understood from the taxonomy in Figure 58 below, which summarises the 'Routine Biased Technical Change' (RBTC) hypothesis, rooted in the seminal work of David Autor and colleagues[482]. It clearly shows that full automation is possible only under certain circumstances.

Figure 58. Typology of task and task model prediction.

Tasks

	Tasks	
	Routine	**Non-routine**
Analytic and interactive	• Record keeping • Calculation • Repetitive customer service (e.g. Bank teller) *Computer impact: substantial substitution*	• Forming/testing hypothesis • Medical diagnosis • Legal writing • Persuading/selling • Managing others *Computer impact: strong complementarities*
Manual	• Picking or sorting • Repetitive assembly *Computer impact: substantial substitution*	• Janitorial services • Truck driving *Computer impact: Limited opportunities for substitution or complementarity*

Source: elaborated by the authors.

Autor himself, has recently presented a more realistic approach to the problem of automation by asking the question: why there are still so many jobs?[483]. According to Autor, one of the effects of automation on the labour market is also that of increasing the value of the tasks that workers uniquely can supply. This points to both substitution and complementarity between labour and machines, and the current polarisation of the labour market may not continue into the future. Aside from the implication that concerns over jobs losses may be exaggerated, the main implication for digital government transformation is that the promise of automating entire public sector processes and reaping huge productivity gains may simply be the product of hype and consulting companies' glossy brochures. Such benefits are likely only in very delimited and vertical routine circumstances such as those illustrated in D3 in the municipality of Trelleborg in Sweden, where robotic process automation (RPA) of processes relating to welfare support (such as home care applications, sickness, unemployment benefits, tax and duties) has entirely substituted human labour (see D3, Box 4, p. 45). As regards the measurement of productivity and efficiency gains, the cases also suggest that the framework should emphasise the fact that gains may not be visible at sectoral level but that digital initiatives may contribute to system-level impacts.

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[482] See among others: Autor, D. (2008). *The Economics of Labor Market Intermediation: An Analytic Framework*. Cambridge, Mass: Cambridge, Mass. National Bureau of Economic Research; Autor, D., Levy, F. & Murnane, R. (2003). The Skill Content of Recent Technological Change: An Empirical Exploration. *The Quarterly Journal of Economics 118*(4), 1279-1333; Autor, D. H. & Dorn, D. (2013). The Growth of Low-Skill Service Jobs and the Polarization of the US Labor Market. *American Economic Review 103*(5), 1553-1597. doi:10.1257/aer.103.5.1553; Autor, D.H., Katz, L.F., & Kearney, M. S. (2006). The Polarization of the U.S. Labor Market. *American Economic Review 96*(2), 189-194. doi:10.1257/000282806777212620
[483] Autor, D. (2015). Why Are There Still So Many Jobs? Journal of Economic Perspectives *29 (3),* 3–30.

(2) The importance of investments and of a dynamic perspective in the framework

Cases show that in the short to mid-term, duplication of efforts and stratification of delivery channels may increase, rather than decrease, the efforts and costs of public administration. When services are up and running, new needs emerge that require new investments, and so a new iteration is necessary to improve the service. The implication for a possible integration into our framework is that greater emphasis should be placed on efforts and investments, and that a feed-back loop should be built in to take into account the dynamic and iterative process of Digital Government Transformation.

(3) Corroboration of the 'reframing' perspective adopted in our framework

The cases studies corroborate the importance of reframing as defined in the DigiGov-F framework, both as part of implementation and as one dimension of our taxonomy. The move from eGovernment to Digital Government is a steady process involving a number of practical issues that pertain to the implementation process and to the corresponding antecedents highlighted in our framework.

(4) The strategically important and twofold nature of legitimacy and trust

The Tvarkau Vilnių case shows the potential of technology to increase trust, but also demonstrates that such trust may be breached due to reasons internal to the public administration. The management of personal data, in particular, is an increasingly sensitive issue. In such situations, an ICT-based platform may actually become a factor undermining legitimacy rather than contributing to it. Situations will always arise in which different streams of legislation, such as personal data protection and administrative law, will contradict each other. In such cases, legislative action is necessary to update the legislation and ensure that public trust is not breached. Thus, the issues of trust and privacy, already prominent in earlier stages of government digitalisation, are becoming even more salient given the great potential – and great risks – that AI entails. In this respect, the finding of this case study is corroborated and fully resonates with the more in-depth analysis carried out through our online experiment, which focused on privacy and trust in public services.

The search for legitimacy and trust, beyond efficiency and effectiveness, is an important dimension for governments to consider when introducing service innovations. On the one hand, legitimacy and trust can represent a significant barrier to digital transformation; on the other, they constitute potentially positive effects that new technologies can produce, beyond efficiency and effectiveness. Following the conceptual framework, we explored legitimacy and public trust in various settings, including the ethical use of data by public sector organisations, privacy, transparency, and the risks that governments and citizens need to be aware of. More specifically, through our experiments we tried (a) to understand what role trust in the public sector plays in the adoption of such services; (b) to identify under what conditions citizens are willing to adopt new digital public services; and (c) to explore the trade-offs that citizens make between privacy and the benefits that stem from the use of new digital public services in various domains. Any AI-enabled digital transformation of public services should therefore carefully take into account the perception of citizens and, where necessary, raise awareness and build trust not only through regulation but also through direct consultations and education campaigns.

We should reconsider the assumption that users are prepared to trade off privacy and personal data in return for services; this may be the case for services such as social media, to which users have become accustomed and are therefore unwilling to give up, but this is not necessarily the case for other services. Transparently engaging stakeholders and citizens in the debate on privacy and data protection is therefore crucial to achieving good outcomes.

Despite the potentially positive effects that stem from the use of technologies to deliver public services and to improve operations, some important challenges need to be addressed in relation to trust and legitimacy. Clear and transparent communication on the nature of new, data-centric technologies used by government, public agencies and officials is the starting point for building relationships of trust with citizens in the era of digital transformation. It can be concluded that legitimacy and trust are, simultaneously, an important process-level prerequisite, and an end outcome.

(5) Greater focus is needed on user adoption and potential new forms of digital divide

Both the Tvarkau Vilnių case and the online experiment, from two different angles, highlighted the issue of user adoption as a specific focus for attention that will not come automatically merely through the adoption of the best AI applications. In fact, these new technologies may generate new forms of digital divide, as evidenced in the online experiment. This once more underscores the importance of reframing implicit in our framework – in this case, with regard to conceptual and cognitive routines – to better focus on adoption. It also suggests that the issue of adoption, and of potentially new forms of digital divide, should be given more salience in the revised version of the framework.

(6) Realism about engagement, open governance and co-production

The Tvarkau Vilnių case suggests that the claims and promises heralded by the supporters of open governance, coproduction and civic engagement should be approached with caution. While an active portion of citizens will benefit from new technological possibilities, civic disengagement and lower political participation are secular trends in advanced democracies that cannot be reversed simply by deploying new and more potent technological means.

(7) The importance of non-monetary effects

Both the BCW Kids Go Green cases confirm the importance of outcomes beyond productivity and efficiency gains - first and foremost, they emphasise effectiveness and legitimacy. Effectiveness gains appear to be more prominent in the BWC case, where they appear to contribute to the important outcome of increasing legitimacy through better policing behaviour and better accountability. The results of the Kids Go Green study show that the project (a) fosters inclusion by improving the learning process and creating a community network (inclusion); (b) modifies the teaching approach by offering new and innovative methods (teaching approach); (c) improves the digital skills of both children and teachers. In terms of the change in governance, these results are particularly important in relation to two main outcomes of the conceptual framework: the second pillar (inclusion and sustainability) and the third pillar (trust and legitimacy). Although it must be stressed that the KGG programme relates to an unusual sector seldom considered in the traditional eGovernment research; it shows potentially promising results. This suggests that our framework should be presented as being widely applicable to the entire public sector and as the starting point for future refinements and operationalisation into the different verticals of which the public sector is comprised. Finally, it must be stressed that, exactly as we have stated in the various versions of our framework, we are still far from having reliable and robust indicators for the evaluation and measurement of these domains. There is still a clear lack of knowledge and capacity to evaluate and measure them.

4.3 DigiGov-F 2.0

Overall, the results of the four cases corroborate the good fit of the proposed Digi-Gov-F.

The main adjustments that are presented in this section thus concern:

- Giving greater prominence to inputs (efforts / investments): a new box relating to input has been added into the graphic snapshot of the new version.

- Introducing a dynamic feed-back loop between implementation, service in production, first results and following iterations. A new box labelled "delivery", denoting that either the provision of a new service or the application of a new policy, has been added into the new version's graphic snapshot, together with a new arrow notation aimed at conveying the dynamic of possible multiple iterations.

- Giving greater prominence to user adoption: a new box relating to adoption has been added into the new version's graphic snapshot.

- Further underscoring the issue of trust and legitimacy, not only as outcomes but also as drivers and facilitators; this is done discursively.

These four changes are partially rendered graphically and partially added in the textual comments to the new version of DigiGov-F.

Figure 59 below integrates in a syncretic manner the analysis of innovation antecedents, institutional settings and technology presented earlier, with the organisational change perspective applied to the ICT-enabled transformation of government, and with the perspective of the role played by external factors.

Figure 59. From antecedents to internal and external change factors.
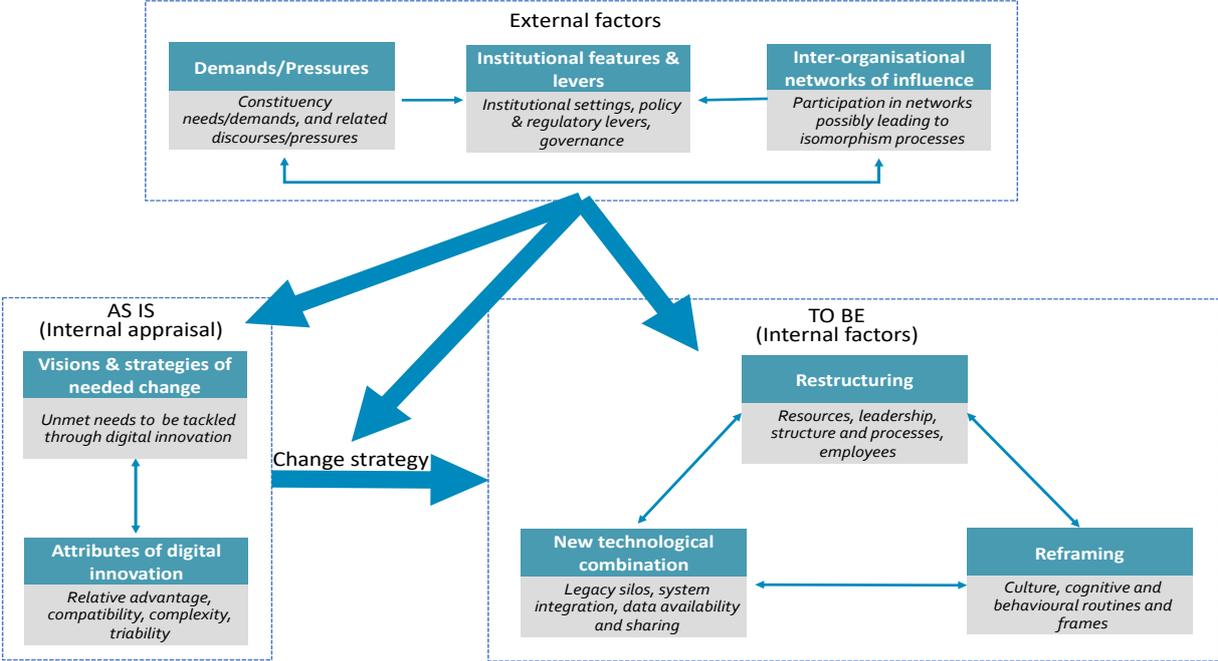
Source: elaborated by the authors.

When considering a hypothetical public agency, the appraisal of the current situation as being not fully satisfactory is considered as the starting point. Based on internal vision and strategy, a certain need of a given constituency may be identified as being not fully met. More generally, the agency may decide to become more responsive to its user base by reorganising itself from siloed functions to demand-driven horizontal task forces and also pursuing the reduction of costs and efficiency gains. The internal vision and strategy will certainly be based on evidence, but will inevitably be influenced by external factors such as pressures from media and politicians, and/or in response to policy/ regulatory directives and levers. The decision to change could also be fostered by networks of influence, leading to processes of convergence toward what other similar organisations are doing, and what a consulting company says the organisation should do. The strategic appraisal leading to a strategy for change entails the consideration of the factual or perceived attributes of digital innovation (relative advantage, compatibility, etc.), including some kind of *ex-ante* vision as to how it can contribute to achieving the desired transformation (the 'to be' state), with improved performance. An important motivating factor when considering an innovation's attributes, will be how the innovation might improve the public's perception of the organisation. In this respect, external pressures and influence may shape both the appraisal of the innovation's attributes and the strategy for change selected by the agency. Should the relative advantage not be clear and supported by evidence, this could lead to the moral hazards of under- or over- investment.

Given the lessons learnt from the cases, the strategy should also carefully consider, plan, and steer three important aspects:

- The allocation of adequate resources in terms of the personnel and money needed for the relevant technological investments (broadly defined input).

- It should start from users' demands and needs, and define actions that may increase adoption and avoid new forms of digital divide.

- It should define key strategic actions aimed at building trust in AI and other new technologies that touch upon privacy issues and require the use of personal data.

The latter two points will also be influenced by external factors, but they also concern design, implementation, and delivery and should be concretely followed both in the choice of technology and in the process of internal reframing of the organisation, and of the actions taken to interact with its constituency.

On the other hand, policy and governance levers (incentives and top-down mandatory directives) can have a positive impact on agency motivation and offset the risk of moral hazard. Political leadership and public administration norms and values (to be considered as part of institutional settings), together with the presence of champions from previous successful experiences (organisational readiness), are also important factors. Networks and influence-shaping public discourses on innovation can increase the perceived legitimacy of an innovation, which can lead to its adoption as a result of institutional isomorphism. Strong societal demands and needs have a clear impact on how the relative advantage of an innovation is framed and, subsequently, evaluated.

When the innovation is adopted and the process of implementing change begins, internal factors come to the fore. Assuming that the starting point is a siloed organisational structure and fragmented information systems and data storage, the challenging job of redesigning organisational processes and structure redesign will have to go hand in hand with the integration of IT, as well as the engineering and structuring of data sources. This is even more challenging when the digital innovation is not self-contained within a single public agency, but involves other actors within government, and possibly also non-governmental actors and data sources. In this scenario, policy and regulation levers, together with governance mechanisms, are a strategic external input to provide both incentives for sharing and collaborating, and the regulatory and ethical framework for the use of personal data. The availability (or lack) of slack resources, leadership, and committed and skilled employees can function as a driver (or barrier) to these processes.

Aside from the tangible internal factors described above, equally important are changes in organisational culture towards sharing and collaboration and, in particular, to the organisation's cognitive and behavioural frames and routines. We refer here to the introduction of new concepts, as well as to the normative and cognitive routines concerning the internal functions and external environment. These help to reframe the definition of the problems and their solutions, leading to new ways of thinking that change the assumptions or behavioural intentions underlying the development and deployment of policies and services. This can lead to improvements in the identification of the needs of constituents, as well as shorten the time required to develop, test, implement and diffuse a policy, and promoting the adoption of new languages, concepts and new methods to influence behaviour.

This reframing is important, since the digital transformation of government will only occur when: (a) there is access to a constellation of different sources of information that can be linked together; and (b) new analytical techniques are employed with new and appropriate frame of mind. This is to say that the transformative potential of new technologies is linked to the introduction of new concepts and new ways of thinking that challenge the assumptions that underlie processes, services and products. It also involves a change in the behavioural intentions than underpin policy development. For example, Big Data must be handled using new analytical techniques that require a change in the culture of modelling and entail extensive algorithm-based analysis (Veltri, 2017). Previous research into citizens' needs, attitudes and behaviours has been based on limited sample methods, most of which (except experiments) relied on self-reported information that could suffer from biases. Big Data now provides real time information about what people *really* do (e.g. transactional and activity-generated data) or think (social media). New analytical and data processing techniques can improve policy implementation by better targeting different audiences and combining the power of Big Data analytics with insights from behavioural economics and the 'nudge' approach. To take advantage of this, the public sector must develop a new culture of data gathering and engineering (alongside improvements in its internal analytical capacity and a restructuring of the underlying sourcing and storing processes). There is also a need for a paradigm shift in the way new insights are sought and used. This must be combined with new approaches to data governance that ensure security and privacy.

Finally, cognitive change is also required in relation to the way governments view collaboration and co-creation in order to advance beyond hype and rhetoric. This entails creating trust and opening up to insights and contributions from outside government. More generally, maximising adoption and avoiding the emergence of a digital divide, while building trust regarding relation to privacy and personal data, require both savvy technological choices and a cognitive and communication reframing. However, digital government transformation requires a two-sided reframing, which includes tangible (organisations and processes) and intangible (conceptual and cognitive) aspects. Reframing is therefore not limited to cognitive/communication issues, but should also involve the redesigning of the institutional-organisational models governing how government functions. As noted in the first part of this report, the tangible aspects that should be redesigned involve both changes to the internal functioning of public administration (refitting government functions, reorganising administrative structures, reengineering processes) and also changes to external relationships with citizens and other stakeholders (i.e. governance mechanisms).

Figure 60 below presents a graphical representation of the DigiGov-F 2.0 framework, and condenses all of the discussion presented in the first part of the report, together with the changes suggested by the case studies and summarised at the beginning of this section. As such, it requires only a very concise narrative illustration highlighting a few key points.

Figure 60. Graphical representation of DigiGov-F 2.0.
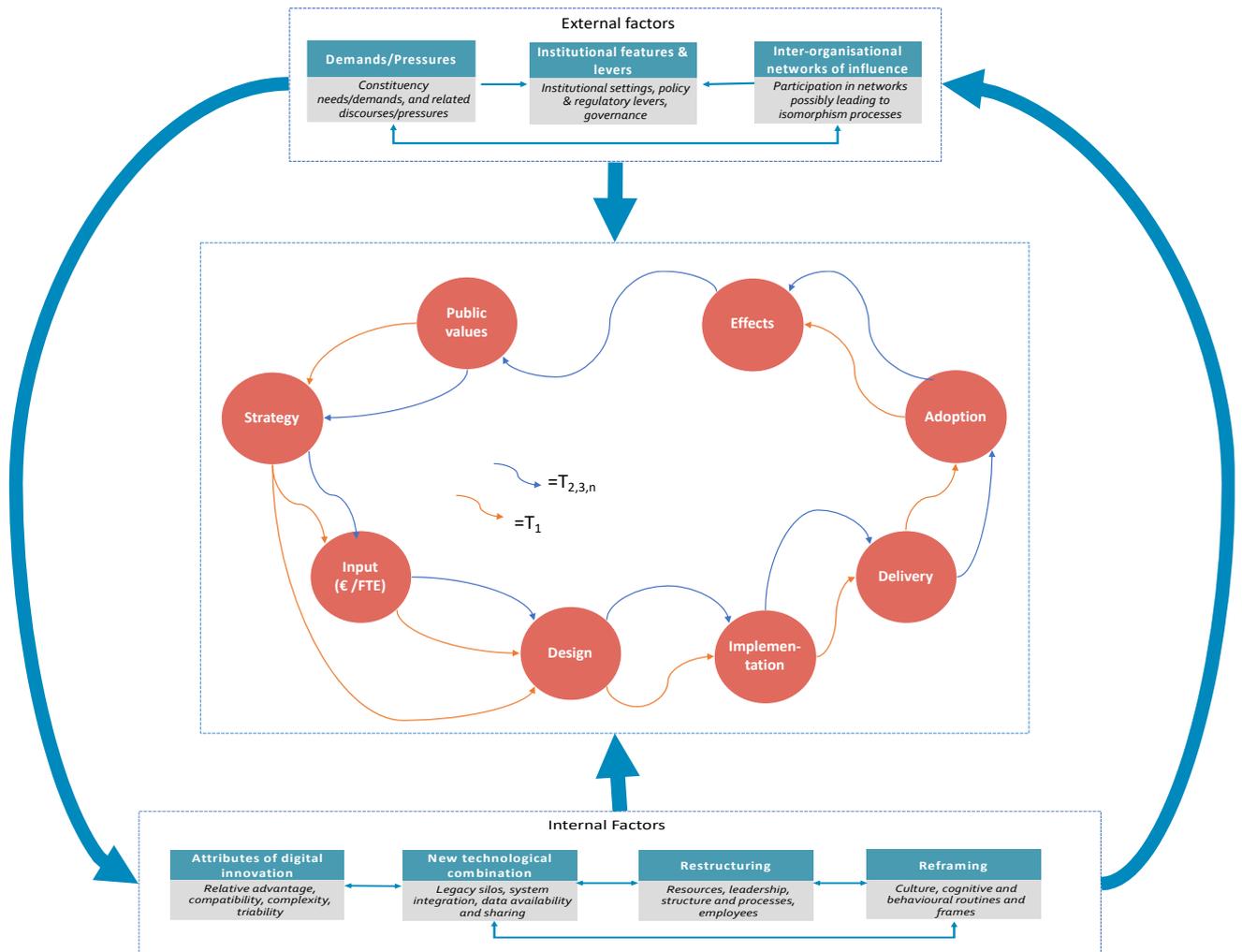
Source: elaborated by the authors.

First, it is not a linear and prescriptive framework, and does not present a theory of causation connecting all factors following a deterministic logic. In Figure 59 we have simply mapped the elements presented in the previous proposal of the framework that merit attention when considering Digital Government Transformations, noting probabilistic relations between them.

These elements are included in the graphical representation of the conceptual framework, with only an illustrative indication of the possible lines of influence. The red circles at the centre of Figure 60 show the steps involved in digital government initiatives. Above them are external factors; below, internal ones. Once a strategy for change has been decided, we assume that the public values to be sought are the first priority to be set. From these flow the strategic objectives, allocation of resources, design, implementation and eventually, delivery and adoption.

Once the initiative is embedded into 'business as usual', we can observe its effects. The two differently coloured lines aim to convey the dynamic nature of the process of Digital Government Transformation, and the various iterations that may take place. In particular, following the insights from the cases, we convey the idea that after a given time period, depending on the final effects, changes may be decided at both the level of public values and of strategy. These changes may entail the decision to increase investment in human resources and in technology to improve delivery, increase adoption and, as consequence, eventually produce more desirable effects, and avoid negative side-effects.

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