How design thinking can support the establishment of an EU GovTech ecosystem

Mortati, Marzia[a]; Mariani, Ilaria*[a]; Rizzo, Francesca[a]

[a] Department of Design, Politecnico di Milano, Milano, Italy
* ilaria1.mariani@polimi.it

GovTech is a relatively new domain of joint interest for public administrations and the private sector. It is recognised to bring social, economic and environmental benefits to (i) the government by driving administrative efficiency, (ii) to citizens by improving quality of services, and to (iii) business by creating the conditions for start-ups growth. In order to provide services that more effectively satisfy citizens' needs and expectations while also complying with government regulations, the GovTech sector is currently exploring how to embrace design thinking and approaches for effective citizen engagement. Building upon the triangulation of knowledge from the existing body of scientific and grey literature, the paper explores how design thinking can support the establishment of an EU GovTech ecosystem. It reports on the methodology developed in the context of the GovTech Connect project that combines (i) design thinking with (ii) co-design and (iii) service design with an experiential learning process. As a result, it points out how design thinking principles and phases can be adapted and adopted to set up a better collaboration between the GovTech actors (public administrations, start-ups and SMEs, nonprofits, and research centers). Ultimately, it discusses the implications for organisational learning to reconnect DT, learning, and organisational change.

Keywords: GovTech; design thinking methodology; experiential learning framework; organisational

1   Introduction

Digital transformation has been a catalyst for revitalising the public sector over the last two decades. It arose from the need to modernise governmental structures and procedures, which faced challenges stemming from new complexities such as immigration, increased ethnic diversity, and a multitude of demands from the population. Moreover, recent unforeseen events like natural disasters induced by climate change and the Covid pandemic have further highlighted the need for such transformation. Today, governments are exploring ways to embrace digital opportunities and, more recently, advancements in technologies like Artificial Intelligence, virtual reality, and blockchain. Despite having supporters and critics, recent literature suggests that digital transformation might provide answers to the increasing demands for better public services, including increasing their efficacy and effectiveness,

enabling personalization, anticipating public issues, and overall improving transparency, accountability, and participation (Dener et al., 2021; Bharosa, 2022). In this landscape, GovTech is a more recent research focus still lacking theoretical and practical exploration. Our study intends to explore how design methods and approaches can contribute to filling some of the current gaps related to GovTech as highlighted in the following.

The context is inherently complex and poses multiple challenges. With a focus on leveraging technology to significantly enhance public service implementation and delivery, GovTech has emerged as a response to the difficulties faced by public authorities in harnessing digital technologies alone. The concept of GovTech emphasizes the centrality of public-private partnerships, forming networks that are better equipped to transform established processes and achieve successful digital transformation. GovTech holds the potential to bring social, economic, and environmental benefits: driving administrative efficiency for the government, improving the quality of services for citizens, and creating conditions for economic growth for businesses. The pandemic-driven need for remote service delivery, coupled with the influx of recovery funds dedicated to digital transition and new models of start-up financing and procurement, has considerably accelerated the adoption of GovTech solutions. Consequently, an increasing number of GovTech projects are reshaping how people and businesses interact with governments. Notable examples include AI-enabled digital assistants, cyber-trust services for authentication, real-time management of cyber-physical infrastructures, automated compliance/regulation, online judicial and dispute resolution systems, and more.

Despite the increasing number of initiatives recently launched in Europe (Kuziemski et al., 2022; Public, 2021), GovTech is still largely in a nascent phase. Several theoretical and practical challenges continue to hinder its development. From a theoretical standpoint, scholars have largely overlooked the notion of GovTech to date (Bharosa, 2022), resulting in limited literature available to define the term and comprehend its applications and implications. From a practical perspective, several barriers are linked to adoption and implementation. These barriers encompass the availability of competencies (e.g., insufficient technological expertise and retention of tech personnel), inadequacy of public procurement mechanisms (e.g., inappropriate purchasing systems and prolonged buying decisions), challenges in private-public relationships (e.g., long-standing agreements and partnerships with IT companies and overreliance on a few 'champions' of digitization), and overall organizational structures and cultures that discourage experimentation and foster a fear of losing control. Regarding implementation, roadblocks mainly stem from the contrasting nature of public administrations and start-ups (process-driven, slow, silo-based, and risk-averse versus fast, agile, and risk-prone).

One approach recently suggested to overcome these issues is the creation of a GovTech ecosystem. Drawing from the conceptualisation provided by Granstrand and Holgersson (2020, p. 3), an innovation ecosystem can be defined as "the evolving set of actors, activities, and artefacts, and the institutions and relations, including complementary and substitute relations, that are important for the innovative performance of an actor or a population of actors". Applied to GovTech, developing a dedicated innovation ecosystem might facilitate the establishment of fruitful relationships among the actors needed to adopt and implement digital technologies in public services. Rooted in public service innovation, the hypothesis is that the development of GovTech solutions could be enhanced by multiple helix collaborations (Carayannis & Campbell, 2009; Schütz et al., 2019), involving public administrations and public authorities/agencies, academia, industry, start-ups, non-profit and citizens.

Such an ecosystem could benefit service users by providing more convenient, user-centric, and efficient public services, while also positively impacting the economy and society as a whole, leading to increased employment opportunities and improved living conditions overall. Given the complexity of the notion of GovTech ecosystem, a holistic viewpoint that considers pertinent factors is necessary to provide a better understanding of the areas of intervention. In this study, we build on the socio-technical framework proposed by Bharosa (2022) (Figure 1), which identifies four main areas to study the effective design and governance of GovTech solutions: (1) Governance design pertains to adapting decision-making structures to allow co-creation; (2) Institutional design looks at the necessary arrangements to legitimise GovTech procurement and delivery; (3) Human-centred design highlights the necessity to co-create solutions involving various user groups and centring development of their needs; (4) Technological design serves all other areas looking into using interoperable technological components. By adopting this comprehensive framework, we aim to gain deeper insights into the effective design and governance of GovTech solutions.
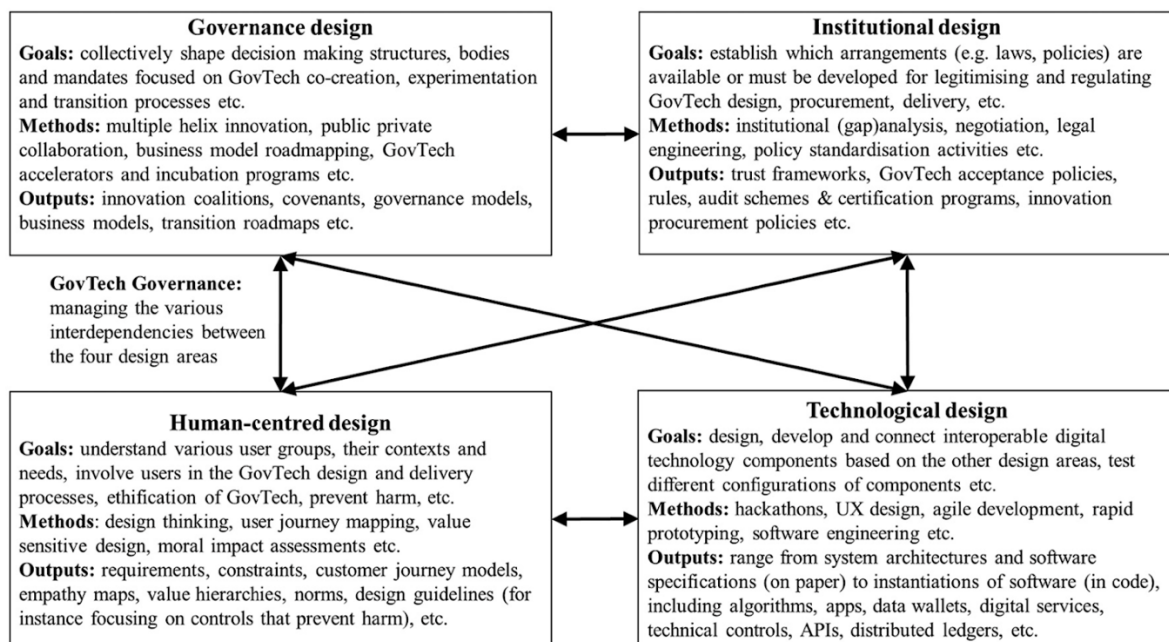

Governance design
Goals: collectively shape decision making structures, bodies and mandates focused on GovTech co-creation, experimentation and transition processes etc.
Methods: multiple helix innovation, public private collaboration, business model roadmapping, GovTech accelerators and incubation programs etc.
Outputs: innovation coalitions, covenants, governance models, business models, transition roadmaps etc.

Institutional design
Goals: establish which arrangements (e.g. laws, policies) are available or must be developed for legitimising and regulating GovTech design, procurement, delivery, etc.
Methods: institutional (gap)analysis, negotiation, legal engineering, policy standardisation activities etc.
Outputs: trust frameworks, GovTech acceptance policies, rules, audit schemes & certification programs, innovation procurement policies etc.

GovTech Governance: managing the various interdependencies between the four design areas

Human-centred design
Goals: understand various user groups, their contexts and needs, involve users in the GovTech design and delivery processes, ethification of GovTech, prevent harm, etc.
Methods: design thinking, user journey mapping, value sensitive design, moral impact assessments etc.
Outputs: requirements, constraints, customer journey models, empathy maps, value hierarchies, norms, design guidelines (for instance focusing on controls that prevent harm), etc.

Technological design
Goals: design, develop and connect interoperable digital technology components based on the other design areas, test different configurations of components etc.
Methods: hackathons, UX design, agile development, rapid prototyping, software engineering etc.
Outputs: range from system architectures and software specifications (on paper) to instantiations of software (in code), including algorithms, apps, data wallets, digital services, technical controls, APIs, distributed ledgers, etc.

Figure 1. A conceptual framework for the GovTech design and governance (Bharosa, 2022).

In our study, we centre our attention on the area of human-centred design to analyse how the use of design thinking methods can effectively engage different service users and enhance the development of GovTech solutions, fostering the emergence of a thriving, collaborative, and transparent GovTech ecosystem. Our theoretical hypothesis is that adopting multiple helix innovation models can facilitate effective public service innovation (Bharosa & Janssen, 2020), wherein public agencies, market players, knowledge centres and user groups are directly involved in the design and experimentation process, thus enhancing legitimacy and accountability. Given the nascent stage of research in this area, our primary research question is: how can design methods and approaches be adapted to effectively involve various user groups in the design and governance of GovTech solutions?

The main contributions of this study are twofold: (i) the systematisation of existing literature showcasing the relevance of design methods for GovTech, and (ii) insights derived from the early

implementation of a collaborative EU-funded research project that is actively contributing to shaping the European GovTech ecosystem. Drawing from the analysis of the literature, we present a Design Thinking methodology that combines co-creation, service design, and co-design. This methodology was developed to engage citizens, stakeholders, businesses, and the public sector in collaboratively developing GovTech solutions.

The paper commences by proposing a systematisation of the relevant notions of GovTech. Subsequently, it delves into the depiction of the relevance of design methods and approaches to both private and public sectors through an examination of grey and academic literature, outlining the most pertinent characteristics, principles, and phases for GovTech solutions. These initial sections provide the theoretical landscape against which our methodology was developed. The methodology outlines how design thinking principles and phases can be adapted and adopted to foster better collaboration among GovTech actors, including public administrations, start-ups, SMEs, non-profits, and research centres. The final discussion analyses the implications for organisational learning, aiming to reconnect design thinking, learning, and organisational change.

2   Theoretical background

2.1   GovTech definition

A universal definition of "GovTech" (or Government Technologies) has yet to emerge. Despite limited academic literature dedicated to exploring and developing the field, the recent attention of the European Commission and related knowledge centres has led to an increasing amount of grey literature attempting to describe what the term might entail. According to recent research proposed by the JRC, GovTech refers to situations in which "the public sector engages with start-ups and SMEs to procure innovative technology solutions, for the provision of tech-based products and services, in order to innovate and improve existing public services" (Kuziemski et al., 2022; Mergel et al., 2022). As shown in Table 1, the majority of available definitions comes from the grey literature (6 out of 8) and still presents a variety of focus. One clear limitation is the conceptual ambiguity portrayed by these definitions. The excessive focus on technology might create confusion between the notions of GovTech, eGovernment, and Digital Government, thus leading to unnecessary replications. Further, GovTech should be clearly differentiated from concepts linked exclusively to public-private partnerships that have been extensively discussed in the literature (e.g. Klievink et al., 2016) as the idea that this new concept wants to promote goes beyond establishing effective partnerships. These partnerships have often led to contracts with major technology firms, resulting in a stable presence of a limited number of large technology providers in many countries. While this approach has its benefits, it also exhibits limitations, such as the monopolistic position of a small slate of technology providers. GovTech seeks to overcome these limitations by proposing an approach that neither solely relies on technology-push innovation models nor exclusively focuses on the support and benefits that the private sector can provide to technological applications in the public sphere.

Table 1. Dominant GovTech definitions in the academic and grey literature

	Typology	Definition	Source
1	Scientific literature	GovTech refers to socio-technical solutions – that are developed and operated by private organisations – intertwined with public sector components for facilitating processes in the public sector.	Bharosa (2022)
2	Grey literature	The term GovTech refers to the use of emerging technologies and digital products and services by government from start-ups and SMEs - instead of relying on large system integrators. There are many - oftentimes competing - definitions of the term GovTech. Despite this diversity, most definitions share the following three common elements: the public sector engages with start-ups and SMEs to procure innovative technology solutions, for the provision of tech-based products and services, in order to innovate and improve public services.	JRC (Mergel et al., 2022)
3	Grey literature	Companies (especially SMEs and startups), which use innovative technologies to deliver products to the public sector, which are specifically designed to address its needs.	Civocracy & Wavestone (Anbouba et al., 2020)
4	Grey literature	GovTech is a whole-of-government approach to public sector modernization that promotes simple, efficient, and transparent government, with citizens at the centre of reforms.	The World Bank (Dener et al., 2021)
5	Grey literature	GovTech refers to cutting-edge technology solutions developed by various players— notably start-ups, but also medium and large enterprises, nonprofits and others— that are transforming public services.	Accenture & Public (2018)
6	Scientific literature	GovTech refers to the strategy invented to increase efficiency in administration by digitalising work processes or incorporating new technological tools.	Yoshida & Thammetar (2021)
7	Grey literature	Govtech is understood as the ecosystem in which governments collaborate with an innovative private sector, particularly startups with experience in data, digital technology and pioneering methodologies; in order to solve public problems. As such, Govtech is an essential tool which accelerates public innovation, improving policies and public services. Moreover, Govtech also functions as a strategy for economic development, leading to a redirection of public spending into technology and towards local digital startups and small to medium businesses; which possess a higher added value and aid in boosting productivity.	CAF (Zapata, 2020)
8	Grey literature	GovTech is an emergent innovation ecosystem in which private-sector start-ups and innovative small and medium enterprises (SMEs) deliver technological products and services, often using new and emerging technologies, to public sector clients. Many GovTech companies work on challenges presented by emergent policy areas, or on problems where no solution was previously imagined as technically possible. The priorities of the GovTech ecosystem include improved efficiency and greater accountability in the public sector and its interactions with citizens. Building trust across the diverse stakeholders in the ecosystem is crucial for developing a thriving GovTech industry to serve the domestic public sector and to contribute to national economic growth.	Filer (2019)

Therefore, the GovTech approach emphasises three main dimensions:

- Outward-facing dimension: This dimension focuses on citizen-centricity in the conception, development, and accessibility of public services, ensuring they cater to the needs of the end-users.

- Inward-facing dimension: This dimension involves a change in organizational culture, which is essential for substantial transformation in governmental processes and procedures.
- Network dimension: This dimension regards the creation of necessary collaborations to simplify, enhance efficiency, and promote transparency within government systems.

While technology, including disruptive ones like artificial intelligence, machine learning, and cloud computing, is an important element, it is not the sole focus. The ambition of GovTech is to provoke a broader societal transformation, inspiring new behaviours in citizens and businesses, such as leveraging public data platforms to facilitate value creation. This complements the idea of digital government proposed by the OECD (2019) (see Figure 2). To address GovTech correctly, adopting a socio-technical lens (Bostrom & Heinen, 1977; Mumford, 2006) is crucial. This lens revolves around the understanding that the effectiveness and value of a GovTech solution can only be appropriately assessed when both social and technical dimensions are considered. A socio-technical system perspective applies an understanding of social structures, roles, and rights to inform the design of systems that involve communities of people and technology. By adopting this lens, GovTech can be described as the set of people and organizations interacting with one another through technological and institutional arrangements that modify underlying behaviors from both technical and social perspectives.
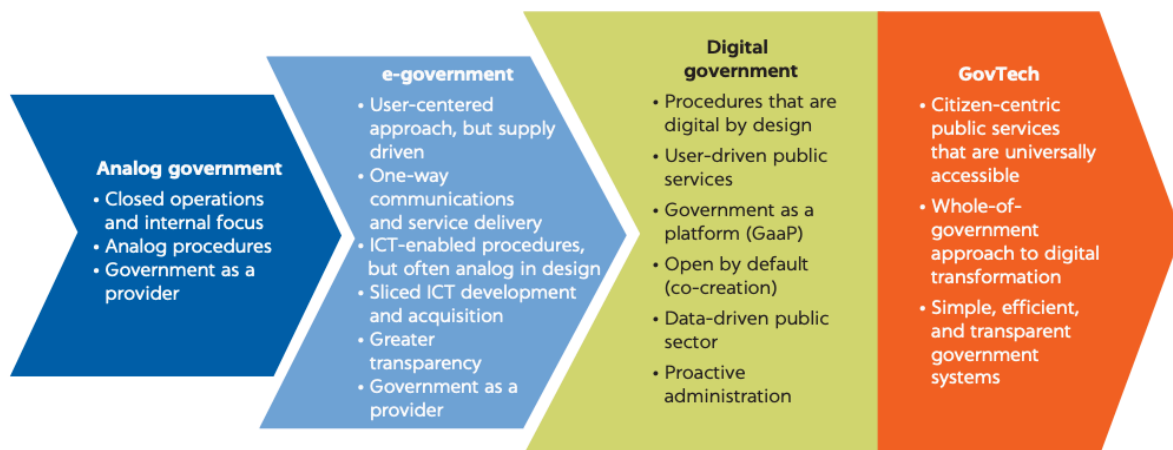

Figure 2. Phases of Government digital transformation according to World Bank (2019, p.3).

2.2 GovTech ecosystem

Given the complexity of GovTech solutions, it is essential to provide concrete examples of focus areas that can help delineate the diverse components of the GovTech ecosystem. The GovTech focus areas are outlined in Table 2, based on references identified by the World Bank (2019) and the study conducted by Bharosa (2022).

Table 2. GovTech focus areas (synthesis of the areas proposed by World Bank (2019) and Bharosa (2022)).

	Area	Description
1	Core Government systems	GovTech solutions focus on modernising government systems, fostering data-driven and data-informed policy making. This might include Internet of Things solutions, digital twins of public services and cities, AI-based applications for infrastructure maintenance and more. It also includes developing a digital transformation strategy and a set of principles to foster the effective use of digital platforms and data.
2	Public service delivery and consumption	GovTech solutions support the design of human-centred digital public services that are built putting people's needs first. Examples might include digital identities, voice assistants, AI-driven decision support assistants for public officials and more.
3	Citizen engagement in governmental processes	GovTech solutions foster the better inclusion of the population in governmental processes and decision making. Examples of initiatives might include the collection of citizens' feedback and complaints, tools to increase accountability

1	Core Government systems	GovTech solutions focus on modernising government systems, fostering data-driven and data-informed policy making. This might include Internet of Things solutions, digital twins of public services and cities, AI-based applications for infrastructure maintenance and more. It also includes developing a digital transformation strategy and a set of principles to foster the effective use of digital platforms and data.
2	Public service delivery and consumption	GovTech solutions support the design of human-centred digital public services that are built putting people's needs first. Examples might include digital identities, voice assistants, AI-driven decision support assistants for public officials and more.
3	Citizen engagement in governmental processes	GovTech solutions foster the better inclusion of the population in governmental processes and decision making. Examples of initiatives might include the collection of citizens' feedback and complaints, tools to increase accountability and monitoring mechanisms, and overall tools that improve government transparency.
4	GovTech enablers	GovTech enablers include all those drivers relevant to foster a digital transformation that is socio-technical in its nature. These include digital skills in the public sector, conducive regulatory environment, investments in digital projects and an organisational culture that is receptive to innovation.

These complex sets of strategies, initiatives, and projects are developed using a multiple helix innovation model. According to this model, the GovTech innovation ecosystem depicts the dynamic interactions between organizations, individuals, resources, and technologies involved in shaping GovTech solutions (Filer, 2019). Figure 3 portrays the typologies of actors engaged in this ecosystem, clarifying the varying roles required to make GovTech an effective socio-technical innovation.
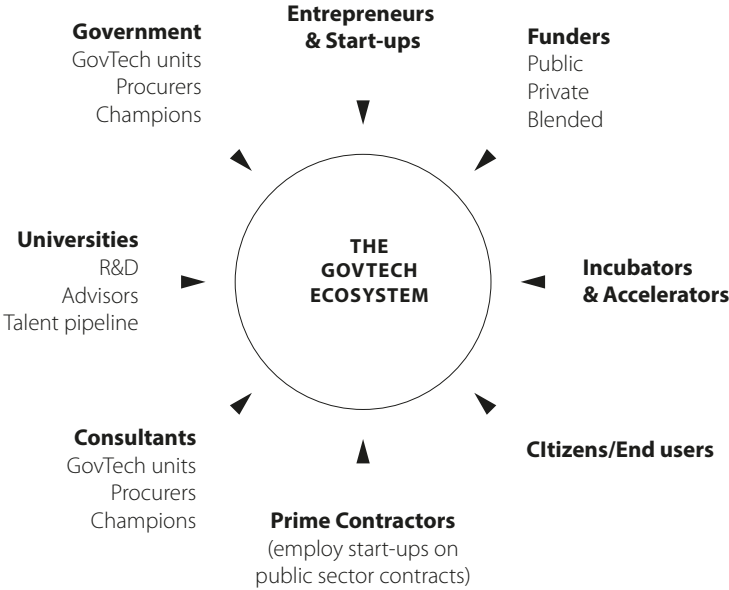

Figure 3. GovTech Innovation Ecosystem (Filer, 2019).

Despite the increasing interest in GovTech's potential to foster economic growth and innovation in government and public services, these ecosystems are still in their emergent stages. Clarity is lacking on how they concretely work, and further research and experimentation are needed to develop the best conditions and methodologies for effective collaboration among all stakeholders. One critical gap is linked to the level of adoption and satisfaction of digital public services by citizens. For instance, in Europe, only 43% of the population made digital transactions with governments in 2021 (European Commission, Eurostat, 2023), and only 46% of Europeans consider public services in their country satisfactory (European Commission & Directorate-General for Communication, 2021). Therefore,

focusing on citizen engagement to foster the emergence of a thriving GovTech ecosystem is a relevant research focus that we address in the remainder of the paper.

2.3   Design thinking (DT) and citizen engagement in the public sector

The product-oriented and provider-centric perspective adopted thus far to foster digital transformation in public services has resulted in four major mistakes: (i) the conversion of current offline processes to digital ones while ignoring the effects that digitalisation would have on internal organisational structures; (ii) the lack of careful consideration of service users' needs and expectations; (iii) the lack of integration of user experiences between public and private service offerings; (iv) the neglect of the context in which digital public services are accessed and used, hindering their usability and acceptance. The necessity to overcome these barriers, coupled with the growing demand of citizens for smarter and better services and the spreading of a culture of open innovation, has generated increasing interest in adopting new agile and responsive approaches to design and implement digital public services (Mergel, 2016; Szkuta et al., 2014). Recently, principles of user-friendliness, security, accessibility, and efficiency have been emphasized to offer citizens personalised and more efficient services (Tallinn Declaration, 2017). This has fuelled a constant and systematic exploration of how design – as a discipline and practice offering an approach to tackle ill-defined issues (Buchanan, 1992) by putting people's needs at the centre – can support public organisations to rethink existing procedures, ensuring the development of citizen-centred policies and services (Junginger, 2013; Mintrom & Thomas, 2018). Against this backdrop, DT has been acknowledged as a strategy to stimulate innovation, act as a catalyst for change, and create long-term competitive advantage. With this ethos, DT has been described through a few main principles, as shown in Table 3.

Table 3. The main DT principles.

Principle	Description	Reference
Abductive reasoning	Adoption of abductive reasoning as the main thought process to tackle challenges. This is distinguished from deductive and inductive logics , and is further explained through the notions of "framing and reframing", emphasising the identification of novel perspectives to tackle issues	(Dorst, 2011; Drews, 2009)
Human centricity and co-design	Innovation develops through an in-depth understanding of the needs of service users and their direct involvement as experts in the innovation process	(Brown, 2009; Holloway, 2009)
Centrality of prototyping	Experimentation is pivotal to learn-by-doing in iterative cycles. In DT, solutions are tested through "quick and dirty" prototyping, facilitating early assessment	(Dorst & Cross, 2001)
Experimentation in real contexts	Prototypes are used and assessed by end-users in real contexts to assess their features against expectations and contexts of use	(Evans & Terrey, 2016; Trischler et al., 2019)
Iterative and non-linear process	Early and fast prototyping through iterative development and testing cycles with end-users and other actors are fundamental for fast learning and consequent improvement of solutions	(Rizzo et al., 2018)

	their features against expectations and contexts of use	(Mueller et al., 2015)
Iterative and non-linear process	Early and fast prototyping through iterative development and testing cycles with end-users and other actors are fundamental for fast learning and consequent improvement of solutions	(Rizzo et al., 2018)
Experiential Learning	Learning-by-doing and learning-through-making are the preferred ways to explore problems and kick-start the innovation process	(Deutschmann & Botts, 2015; Kolb, 1984b, 1984a)

Building on these principles, DT is depicted as having great potential to prompt innovators to develop creative competence and hone skills in applying iterative decision-making, reframing problems, identifying novel sources of value creation (Glen et al., 2014; Orlandi, 2010), and finding new possibilities for addressing ill-defined issues (Welsh & Dehler, 2013, p. 773). Given the contrast between this approach and the traditional way innovation is typically carried out in the public sector, there is increasing research dedicated to investigating the efforts of governments and public administrations to use DT in support of modernisation efforts. The literature documents a high number of initiatives, programs, and projects. One area of experimentation that has been particularly documented is the spread of Public Sector Innovation (PSI) labs. With over 60 PSI labs in the EU member states (Fuller & Lochard, 2016; Puttick, 2014, pp. 6–7), these "islands of experimentation" (Tõnurist et al., 2017, p. 7) have been considered the evolution of New Public Management's 'hidden public service' (Craft & Howlett, 2013, p. 188). In a study of 20 PSI labs (McGann et al., 2018), about half of the labs were classified as design-led, with DT recognised to be prevalent in labs inside public administrations or those funded by the government, with co-design being a widely used tool to engage users. In her study of the UK Policy Lab, Kimbell (2015) found that applying DT to the public sector helped shift the focus to people, re-ordering evidence based on real lived experiences, temporarily flattening hierarchies to provide space for collective exploration of problems, and enabling collaboration among people inside and outside government by establishing a shared language and equal participation. The Policy Lab's movement has shown how adopting DT approaches can contribute to radically changing the culture of public administration (Bailey & Lloyd, 2016; Kimbell, 2015), overcoming an established way of thinking that is highly context-dependent and risk-averse while persuading around the validity of different types of evidence (Cairney, 2017; Cairney & Kwiatkowski, 2017). The literature has also documented how, in the public sector context, DT is relevant to discuss different notions of value creation (Osborne et al., 2021; Strokosch & Osborne, 2020, 2021; Wetter-Edman et al., 2014). In this context, value tends to be defined in socioeconomic terms. However, DT can help focus on more qualitative societal benefits, disrupting the existing public governance paradigm, challenging the command-and-control logic of hierarchical organizations, and the linear logic of policy-making.

3   Study methodology

Building upon the challenges and gaps identified in the previous paragraphs, this study addresses the research question: How can DT be adapted to effectively involve various user groups in the design and governance of GovTech solutions?

As an answer to this question, the study proposes a DT methodology as a structured approach to support the emergence of a European GovTech ecosystem that can foster innovative digital public services. Specifically, the DT methodology has been developed as part of the activities of the EU-funded GovTech Connect project (https://joinup.ec.europa.eu/collection/govtechconnect) delivered jointly by the Department of Design of Politecnico di Milano, Intellera Consulting, Lisbon Council, and Public, aimed at supporting the European Commission in creating a European GovTech ecosystem.

The development of the DT methodology relies on knowledge triangulated from three main streams:

- A review of the academic literature pertaining to both DT and GovTech to analyse fundamentals, relevant topics, challenges, and existing frameworks.
- Relevant papers detailing DT for innovation and its phases (Beckman & Barry, 2007; Dzombak & Beckman, 2020; Gruber et al., 2015).
- A review of the grey literature of the projects Co-VAL, Big Policy Canvas, CoSIE, AI4GOV, SCALINGS, easyRights, SISCODE, which contributed to developing a comprehensive approach to how DT can support public sector innovation and effective citizen engagement (Annex A).

This initial analysis has stressed the need to understand when, how, and why to engage citizens and service users in the co-creation of digital public services. In the GovTech context, this is essential to guide start-ups and businesses in conducting direct research with citizens, involving service users as innovators rather than only as consumers. Indeed, working in experimental and participatory settings is considered a prerequisite for a fertile GovTech ecosystem, as it activates dynamics of knowledge exchange, capacity building, and cross-fertilisation. Thus, this study also builds on the idea that co-creation, co-design, and hands-on activities can be considered small-scale experimentations to give businesses and government the opportunity to interact directly with service users and develop more effective proposals for new GovTech solutions.

4 A DT methodology for GovTech

This paper presents a methodology that combines (i) DT with (ii) co-design and (iii) service design to support the establishment of an EU GovTech ecosystem that builds on the involvement of various user groups to enhance the design and governance of GovTech solutions.

The methodology is built on the principles of DT, as presented in Table 3. Additionally, it integrates co-design as a specific approach for the direct and active involvement of citizens and other stakeholders throughout design processes (Deserti et al., 2019; Evans & Terrey, 2016; Trischler et al., 2019). This approach engages them as "experts of their experience" (Sanders & Stappers, 2008) and leverages their expertise to create value (Steen, 2013). Furthermore, it incorporates service design due to its systemic and dynamic understanding of solutions. Service design provides methods to transform institutional structures and study the interdependencies that affect the results of the interplay within multi-actor systems (Vink et al., 2021).

Embracing the systemic conceptualisation proposed by service design, the DT methodology aims to be a comprehensive approach that combines the citizens' desired experience with the necessity to transform the organisation's internal processes (Deserti & Rizzo, 2015, 2019). However, considering the dependence on the organisation's culture and structure to integrate DT into established processes, the methodology is currently developed for application in small-scale experimentation settings. These settings serve as more controlled environments where public agencies, start-ups, and SMEs can experiment with the development of GovTech solutions directly involving service users. A central tenet is that GovTech solutions need to be designed as socio-technical systems (Mumford, 2006), recognising the interdependence of the "social" and "technical" components (Bharosa, 2022). Based on these premises, our proposed approach recognises the value of including citizen engagement as a crucial pillar for the development of GovTech solutions, aiming to render the "social" component a

central concern throughout the process. The DT methodology relies on the core principle that learning, organisational change, and innovation are inextricably linked. As such, it intertwines human-centred service development with a learning framework (Rizzo, Deserti, & Cobanli, 2017; Rizzo, Deserti, & Pous, 2017), locating the initial adoption of the approach in a learning environment where start-ups, citizens, public institutions and other relevant stakeholders can co-design and experiment together. Experience-based learning (Hmelo-Silver, 2004; Andresen et al., 2020) constitutes another foundational principle, identifying direct experimentation with service users and stakeholders as central sources of knowledge to foster innovation. Within the context of small-scale experimentations, working on innovative projects such as the development of new services or the redesign of existing ones stimulates the interaction with internal and external knowledge and resources, supports the fruitful interaction among the GovTech actors and fosters the establishment of a transformative environment for the entire ecosystem.

Based on these premises, the DT methodology integrates two frameworks in an iterative process of experimentation and learning (Figure 4):

- The DT process (Brown, 2009) is used to identify the phases that lead to co-creating GovTech solutions;
- The experiential learning process (Kolb, 1984b) is integrated to depict how the new knowledge needed for transforming practices and institutional arrangements is acquired.
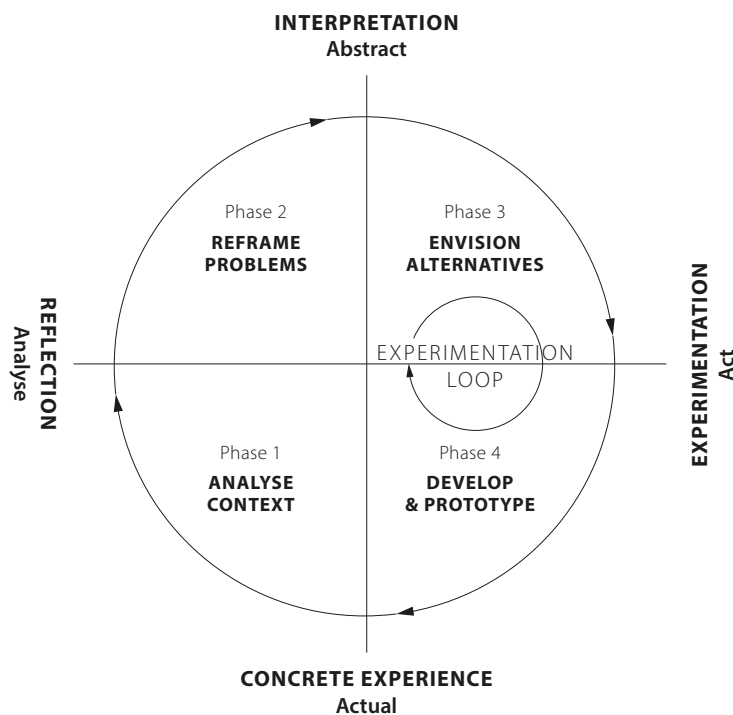

Figure 4. The DT methodology experiential learning framework.

In the following paragraph, we detail the phases of the DT methodology (par. 4.1) and how they are intertwined with the experiential learning framework (par. 4.2).

4.1 The DT methodology phases: principles and functioning

The DT methodology consists of four main phases, each corresponding to overarching activities that highlight the value of applying this approach to the development of the GovTech ecosystem (Table 4).

Table 4. The DT methodology phases.

	Phase	Description
1	*Context analysis*	It is dedicated to observing and analysing the context and its multiple actors to identify their needs and guide the following design process
2	*Problem framing & reframing*	It involves making sense of the data collected to better frame and reframe the problem initially identified
3	*Envision alternatives*	It regards the generation of ideas as possible alternatives to address the problem, constituting a shift from the analytical to the synthetical
4	*Prototyping and testing*	It concerns the development of solutions using prototypes to be tested iteratively

The phases listed in Table 4 constitute the backbone of the design process to be run in the setting of small-scale experimentations, to support start-ups and SMEs to apply DT and benefit from effectively engaging citizens. This approach aims at transforming how citizens, private, and public sectors interact, moving beyond traditional approaches that hire technology consultants to redesign existing services or outsource tasks to commercial service providers.

4.1.1 Context analysis

Situating a problem within its environment and understanding its constitutive elements are fundamental to grasp the specific context of operation, including its features and challenges. To achieve this, a thorough context analysis and user research are essential, considering actors, their needs, behaviours, activities, and the overall dynamics and interactions. This initial phase involves precise mapping of service users and their values, as well as understanding the broader ecosystem of actors linked to the solution, such as frontline employees, decision-makers, and budget holders in the government. Start-ups can enhance their comprehension by considering further contextual layers, such as physical surroundings, language, culture, values, and relevant past events. In addition to quantitative data related to technology and market dynamics, qualitative data for context analysis can be derived from observation, ethnographic methods, and conducting interviews with citizens and relevant stakeholders. This approach provides contextual data rich in meaning, such as local identity and culture, and offers valuable opportunities for start-ups to interact with relevant actors. By focusing on such meaning-based needs, start-ups can move beyond understanding users' immediate needs, such as accessing a service faster and more efficiently, and gain a more comprehensive awareness of needs within specific context conditions. Furthermore, it is crucial to analyze the operating environment as a complex ecosystem with multiple intertwined variables, including external sources such as laws, regulations, statistics, and trends.

4.1.2 Problem framing & reframing

Building upon the data, evidence, and understanding obtained from researching the context and conducting user research, the initial challenge involves framing and reframing. This phase is centerer

on questioning the design assumptions that start-ups might have, aiming to conduct reasoning free of prejudice and identify the deeper "whys" of users' behaviour. By identifying models and patterns in the data, along with underlying factors that shape the context, start-ups can synthesise this information for strategic planning and gain insights into the most relevant aspects for citizens. This process allows them to spot promising opportunities and orient the design of the solution effectively. Framing requires adopting the optimal perspective on the problem to identify the value that should be provided for the service users. Achieving a holistic comprehension of the problem during the framing process is crucial for appropriate reframing of the initial challenge. This supports start-ups in identifying novel perspectives to approach the development of the solution. To support the framing and reframing process, specific methods and tools can be utilised to focus precisely and progressively on specific aspects of the context and its actors. For instance, defining the 5Ws (i.e., What, Whom, Why, When, and Where) of the problem on a canvas can assist in comprehensively and consistently framing the issue and promote a better understanding of its components. Additionally, dissecting and breaking down a complex issue into its foundational facets and dimensions can foster discussion, suggest fresh directions of exploration, organize thoughts, and spark ideas, while avoiding becoming overwhelmed by the multitude of aspects that need to be regarded and tackled. In this phase, different types of co-creation sessions provide a fertile setting for the direct involvement of citizens, laypeople with a high-level scholarship of the topic, and experts. Engaging end-users and other relevant stakeholders in framing and reframing the problem can generate valuable knowledge about their experiences and pain points, nurturing in-depth understanding and offering novel perspectives to address the challenges.

Overall, this phase aims to transform a problematic situation into an opportunity for creating innovative solutions.

4.1.3 Envision alternatives
Framing and reframing the problem trigger the definition of value propositions that can satisfy user needs, marking the transition from the initial analytical phases to the synthesis part of the process. This phase aims to diverge and generate a variety of ideas as potential alternative solutions before converging on sound concepts. The envisioning of alternatives is prompted by identifying the main benefits that end users can gain from the solution, leading to the outline of a high-level vision for the potential solution. Start-ups should leverage the information and knowledge obtained during research to inform concept generation, involving the generation of multiple ideas covering possible alternatives. This phase is extensively documented and discussed in the design domain, offering a rich array of supporting methods and tools. Brainstorming, for example, enables participants to formulate and express ideas, fostering diverse perspectives and fruitful collaboration. Additionally, transforming findings from user research, such as interviews and focus groups, into aspirational questions. "How Might We…" questions are a valuable manner to reinterpret well-known difficulties based on the knowledge gained and foster out-of-the-box thinking. The purpose is to prompt start-ups to generate multiple ideas to be discussed, clustered, and combined to produce innovative concepts. In this phase, any idea should be taken into consideration, including seemingly impossible once, as they can contribute, to some extent, to developing feasible concepts. Clustering and ranking the potential alternative solutions help identify the most promising ones to be pursued and converged upon in the next phase. This phase can yield multiple outcomes with varying levels of detail, such as full user experience descriptions, core feature definitions, and process explanations. Additional tools can be

used to spark discussions on ethical and inclusive perspectives, often overlooked matters like the role and influence of technology. Early consideration of these topics can further support start-ups in developing innovative solutions that are more desirable and responsible.

4.1.4   Prototyping and testing

The knowledge acquired throughout the process culminates in the prototyping of the innovative solution. Prototyping takes various forms and formats, offering valuable opportunities to test hypotheses and determine whether a concept should be further developed. Testing is essential to ensure that the concept is both valid and functional. Through a constructive iterative process, the concept evolves into a prototype, leaving the realm of abstraction and becoming tangible for evaluation by designers and co-designers, including citizens and stakeholders who actively participated in the process (Sanders & Stappers, 2014). Involving multiple actors enables the exploration of novel situations and circumstances, fostering focused discussions and interactions. Prototyping and testing present extensive and fundamental opportunities for direct experimentation and research with citizens and other stakeholders. The benefits of prototyping and testing are evident from the early stages of the process. Fundamental understanding can be inputted by citizens and other relevant actors if allowed to be effectively engaged in experiencing and validating the solutions. Start-ups should prioritise early prototyping and testing involving end-users, as this enables the identification of necessary adjustments while the solution is still flexible, before its full implementation. Testing can also involve experimenting with multiple options of specific aspects to achieve the most effective combination. To maximise the results, start-ups should focus on acquiring feedback and insights, which will inform careful and thoughtful analysis. In addition to quantitative measurements for usability, qualitative tools such as questionnaires, follow-up interviews, and focus groups can be used to collect end-users' feedback, allowing for better alignment of the solution with citizens' needs.

In an iterative cycle, the revised prototype should enter a new testing phase in the real environment, further refining the solution and ensuring its suitability for implementation.

4.2   The DT methodology learning perspective

The DT methodology intertwines learning, innovation, and organisational change, drawing upon Kolb's (1984b) experiential learning framework, which has been extensively linked to the design process (Beckman & Barry, 2007; Elsbach & Stigliani, 2018; Rizzo, Deserti, & Cobanli, 2017), showing how it can be set up and piloted within organisations. According to Kolb, learning is a process of knowledge creation through the transformation of experience (Kolb, 1984b, p. 41), fostering better collaboration among multiple actors (Hmelo-Silver, 2004; Andresen et al., 2020) and promoting transformative practices. Kolb identifies four "learning styles", explained in Table 5.

Table 5. Kolb's (1984b) learning styles and their application to the DT phases.

	Learning style	Description
CE	*Concrete Experience*	It relies on first-hand experience and the feelings and emotions it triggers. It identifies the learning that derives from direct experience. This learning occurs in the phase of Context Analysis when start-ups engage with citizens to gain a direct understanding of their concrete experience, nurturing the identification of their needs and the problems they encountered when going through the experience at stake
RO	*Reflective Observation*	It regards the observation and reflection on the experiences from multiple and complementary points of view. It concerns the learning that is gained through observation and analysis. This learning occurs when shifting from Context Analysis to Problem Framing & Reframing
AC	*Abstract Conceptualization*	It concerns creating theories and concepts to explain experiences. This learning is associated with logical reasoning and analysis. It spurs new ideas and theories based on

CE	*Concrete Experience*	It relies on first-hand experience and the feelings and emotions it triggers. It identifies the learning that derives from direct experience. This learning occurs in the phase of Context Analysis when start-ups engage with citizens to gain a direct understanding of their concrete experience, nurturing the identification of their needs and the problems they encountered when going through the experience at stake
RO	*Reflective Observation*	It regards the observation and reflection on the experiences from multiple and complementary points of view. It concerns the learning that is gained through observation and analysis. This learning occurs when shifting from Context Analysis to Problem Framing & Reframing
AC	*Abstract Conceptualization*	It concerns creating theories and concepts to explain experiences. This learning is associated with logical reasoning and analysis. It spurs new ideas and theories based on previous observations and reflections. This learning takes place when start-ups move from Problem Framing & Reframing to the synthetical phase of Envision Alternatives
AE	*Active Experimentation*	It is the process of learning through trial-and-error experimentation. It concerns applying and testing what is learned in new contexts and circumstances to gain further experience. This learning phase is related to the phase of Prototyping and Testing, and is spurred by the development of prototypes

Through the DT framework, these four learning styles are reconnected to the DT phases (par. 4.1, Figure 4): (i) Actual/Concrete experience, which involves learning from direct experiences; (ii) Analyse/Reflection, focusing on reflecting and analyzing observations; (iii) Abstract/Interpretation, where observations are interpreted to envision alternatives; (iv) Act/Experimentation, involving learning from active experimentation and testing (see Figure 4). This iterative process continues as the new solution is introduced, leading to further observations and learning.

These learning styles can be visualised as interacting along two bipolar axes, forming learning dimensions (Figure 5): (i) Abstract/Interpretation and Actual/Concrete experience, which pertain to different approaches in understanding experiences; and (ii) Act/Experimentation and Analyse/Reflection, which address problem-solving approaches and the transformation of experiences. Integrating these learning styles with the DT phases creates an experiential learning framework based on a continuous loop of understanding, designing, and re-designing.
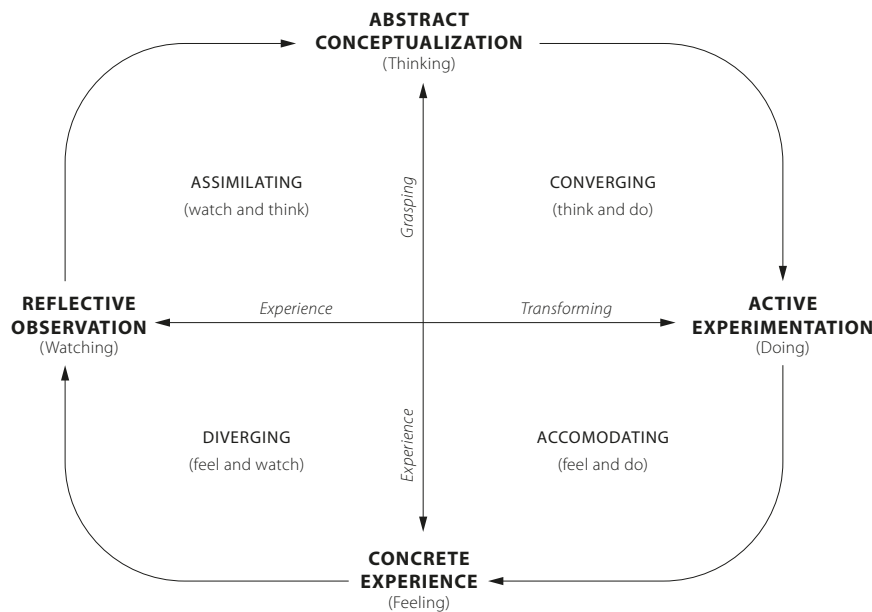

Figure 5. Kolb's learning styles (1984b) as quadrant and their learning dimensions.

The model depicted in Figure 5 serves as the foundation for the proposed DT methodology in the context of GovTech (Figure 4). The relationship between the model and DT phases is as follows:

- The process begins in the diverging quadrant (CE-RO), corresponding to Context Analysis, where the context and its actors are analysed to understand their needs.
- It then moves to the assimilating quadrant (RO-AC), connected to Problem Framing & Reframing, involving a reflective process to make sense of the observed experiences.
- Next, it progresses to the converging quadrant (AC-AE), linked to Envision Alternatives, where the understanding gathered is synthesized, leading to the generation of multiple ideas as potential solutions.
- It further moves to the accommodating quadrant (AE-CE), corresponding to Prototyping and Testing, where envisioned alternatives are transformed into prototypes for experimentation and validation.
- The process then iteratively restarts, allowing for continuous learning and refinement of the GovTech solution.

5 Discussion: organisational learning

The DT methodology presented in this paper aims to establish a consistent, human-centric approach to developing innovative digital public services and fostering the emergence of the GovTech ecosystem. Considering the complexity of nurturing such ecosystems and the barriers discussed in par. 2.1 and 2.2, it is essential to examine the relevance of applying our methodology to GovTech in terms of organizational change and learning, as these broader transformations are necessary for achieving sustainable results beyond mere experimentation.

To address this point, we briefly analyse Argyris and Schön's (1978) organizational learning model, although primarily linked to design management (Wolff et al., 2016), as this already attempts to reconnect DT, learning, and organisational change.

When applying DT in the public sector through participatory settings, attention should be given to two main elements: "(1) the [relationship] between the context of the problem to be addressed and the design of the network that will co-produce the solution; and (2) the [experimentation] of different configurations of that network until […] a robust partnership is individualised and established [into an] institutional form" (Rizzo, Deserti, & Cobanli, 2017, p. 130). Creating and institutionalising these networks is a crucial first step towards making meaningful change within an organisation, going beyond short-term experiments.

For learning to be effective, it must permeate through different layers and departments of a public organisation. This process can be supported by recognizing the experiential nature of learning in broader transformations and implementing iterations between "doing" and "reflecting". This nurtures a process of reflection in action (while doing) and reflection on action (after doing) (Argyris & Schon, 1978). The reflection in action involves identifying and revising organisational processes and procedures, seeking improvement and efficiency. The reflection on action entails a higher level of reflection on what the organisation is doing and how it can change to improve. Iterating between these phases encourages the organisation to question and challenge established mindsets, leading to a culture revision and the embedding of new practices like DT and direct experimentation with citizens.

This type of learning underlies fundamental organizsational change, promoting a shift from the status quo towards new models and conditions. As such, the reflection in and on action refers to the transfer of learning results from the design process to the organisation (start-ups) and how those learning outcomes might impact its culture at two different scales.

To foster innovation, public institutions are increasingly adopting DT and co-creation practices (Deserti & Rizzo, 2015), recognizing design as a facilitator of sociocultural and political transitions necessary for citizen engagement (Kimbell, 2015). However, implementing DT techniques requires significant cultural and organisational changes (Deserti & Rizzo, 2015; Elsbach & Stigliani, 2018) at all institutional and governance levels. Therefore, to trigger the emergence of a GovTech ecosystem and drive sustainable development, learning-by-doing and experimentation are crucial practices that can be introduced through our proposed methodology. By enabling activities like co-creation, co-design, co-production, prototyping, and experimentation with citizens (Coughlan et al., 2007), DT can ensure effective participation and create public value. Moreover, by enhancing the capacity and capabilities of individuals and institutions, DT and citizen engagement can become ingrained in start-ups and SMEs, resulting in a long-lasting transformation of innovation processes. From an institutional standpoint, acknowledging and disseminating this learning is critical for promoting reflexivity and changing existing mindsets, culture, institutional policies, practices, and processes (Beckman & Barry, 2007; Geraldi & Söderlund, 2016).

6   Conclusions and future developments

GovTech is still in its nascent phase, and further research is required to establish a clear differentiation from existing notions such as eGovernment and Digital Government. Additionally, there is a need to understand how favourable conditions can be created to nurture a thriving GovTech ecosystem. To bridge the gap between theory and practice, this paper provides a systematisation of existing literature, describing the concept of GovTech and its ecosystem. Concrete examples of key focus areas for GovTech solutions are presented, and we propose studying them through a socio-technical lens to avoid a technocratic approach and emphasise the social dimension. Based on these foundations, the paper explores how the adoption of design methods and practices can drive the emergence of GovTech. DT is recognised as an innovative approach capable of aligning economic, societal, and cultural needs. By grounding innovation in human-centricity and participation, DT aims to develop better solutions and steer innovation in complex settings through iterative cycles of design, prototyping, and testing.

In the context of the GovTech Connect project, we have developed and outlined a DT methodology that will be experimented with and refined through activities with start-ups, SMEs, and public agencies. Over the next two years, the project plans to conduct several training sessions, including boot camps, workshops, and co-creation sessions, where our methodology will be shared and adopted to involve citizens directly in the design and implementation of GovTech solutions. Through these transformative environments, we hope to foster learning, innovation, and new collaborations. By extending the learning beyond individual organizations and embracing a process of experiential learning, we aim to catalyse wider organisational change. Involving citizens directly in the work of start-ups can bring new value, offer crucial insights, and support the development of more desirable solutions. Ultimately, this participatory approach will contribute to the growth and success of GovTech initiatives.

References

Accenture & Public. (2018). *GovTech. Europe's next opportunity*. Accenture & Public. https://www.accenture.com/content/dam/accenture/final/a-com-migration/manual/r3/pdf/pdf-90/Accenture-GovTech-POV.pdf

Anbouba, J., Chiarelli, F., Christiaens, A., Kudzmanaite, B., Moreau, F., Peigna, L., & Zamboni, A. (2020). *European GovTech radar*. Civocracy & Wavestone. https://joinup.ec.europa.eu/collection/innovative-public-services/news/current-trends-govtech-startup-ecosystem

Andresen, L., Boud, D., & Cohen, R. (2020). Experience-based learning. In *Understanding adult education and training* (pp. 225–239). Routledge.

Argyis, C., & Schon, D. (1978). Organizational Learning, Addition-Wesley. *Reading, MA*.

Bailey, J., & Lloyd, P. (2016). The introduction of design to policymaking: Policy Lab and the UK government. *Proceedings of DRS 2016, Design Research Society 50th Anniversary Conference*, *1*, 3619–1635. https://doi.org/10.21606/drs.2016.314

Beckman, S. L., & Barry, M. (2007). Innovation as a Learning Process: Embedding Design Thinking. *California Management Review*, *50*(1), 25–56. https://doi.org/10.2307/41166415

Bharosa, N. (2022). The rise of GovTech: Trojan horse or blessing in disguise? A research agenda. *Government Information Quarterly*, *39*(3), 101692. https://doi.org/10.1016/j.giq.2022.101692

Bharosa, N., & Janssen, M. (2020). Digicampus—Preliminary lessons from a quadruple helix ecosystem for public service innovation. *Ongoing Research, Practitioners, Posters, Workshops, and Projects of the International Conference EGOV-CeDEM-EPart*, *2797*, 195–203. https://ceur-ws.org/Vol-2797/paper19.pdf

Bostrom, R. P., & Heinen, J. S. (1977). MIS Problems and Failures: A Socio-Technical Perspective. Part I: The Causes. *MIS Quarterly*, *1*(3), 17–32. JSTOR. https://doi.org/10.2307/248710

Brown, T. (2009). *Change by Design*. HarperCollins.

Buchanan, R. (1992). Wicked problems in design thinking. *Design Issues*, *8*(2), 5–21.

Cairney, P. (2017). Evidence-based best practice is more political than it looks: A case study of the 'Scottish Approach.' *Evidence and Policy*, *13*(3), 499–515. https://doi.org/10.1332/174426416X14609261565901

Cairney, P., & Kwiatkowski, R. (2017). How to communicate effectively with policymakers: Combine insights from psychology and policy studies. *Palgrave Communications*, *3*(1), 37. https://doi.org/10.1057/s41599-017-0046-8

Carayannis, E. G., & Campbell, D. F. J. (2009). "Mode 3" and "Quadruple Helix": Toward a 21st century fractal innovation ecosystem. *International Journal of Technology Management*, *46*(3–4), 201–234. https://doi.org/10.1504/IJTM.2009.023374

Coughlan, P., Suri, J. F., & Canales, K. (2007). Prototypes as (Design) Tools for Behavioral and Organizational Change: A Design-Based Approach to Help Organizations Change Work Behaviors. *The Journal of Applied Behavioral Science*, *43*(1), 122–134. https://doi.org/10.1177/0021886306297722

Craft, J., & Howlett, M. (2013). The dual dynamics of policy advisory systems: The impact of externalization and politicization on policy advice. *Policy and Society*, *32*(3), 187–197. https://doi.org/10.1016/j.polsoc.2013.07.001

Dener, C., Nii-Aponsah, H., Ghunney, L. E., & Johns, K. D. (2021). *GovTech Maturity Index: The State of Public Sector Digital Transformation*. The World Bank. https://doi.org/10.1596/978-1-4648-1765-6

Deserti, A., Eckhardt, J., Kaletka, C., Rizzo, F., & Wascher, E. (2019). Co-design for Society in Innovation. In J. Howaldt, C. Kaletka, A. Schröder, & M. Zirngiebl, *Atlas of Social innovation 2nd volume: A world of new practice* (pp. 91–96).

Deserti, A., & Rizzo, F. (2015). Design and Organizational Change in the Public Sector. *Design Management Journal*, *9*(1), 85–97. https://doi.org/10.1111/dmj.12013

Deserti, A., & Rizzo, F. (2019). Embedding design in the organizational culture: Challenges and perspectives. In G. Julier, M. N. Folkmann, N. P. Skou, H.-C. Jensen, & A. V. Munch (Eds.), *Design culture: Objects and approaches* (pp. 39–51). http://doi.org/10.5040/9781474289856.0009

Deutschmann, M., & Botts, M. (2015). Experiential Learning through the Design Thinking Technique. In V. Taras & M. A. Gonzalez-Perez (Eds.), *The Palgrave Handbook of Experiential Learning in International Business* (pp. 449–463). Palgrave Macmillan UK. https://doi.org/10.1057/9781137467720_26

Dorst, K. (2011). The core of 'design thinking' and its application. *Interpreting Design Thinking*, *32*(6), 521–532. https://doi.org/10.1016/j.destud.2011.07.006

Dorst, K., & Cross, N. (2001). Creativity in the design process: Co-evolution of problem–solution. *Design Studies*, *22*(5), 425–437. https://doi.org/10.1016/S0142-694X(01)00009-6

Drews, C. (2009). Unleashing the Full Potential of Design Thinking as a Business Method. *Design Management Review*, *20*(3), 38–44. https://doi.org/10.1111/j.1948-7169.2009.00020.x

Dzombak, R., & Beckman, S. (2020). Unpacking capabilities underlying design (thinking) process. *International Journal of Engineering Education*, *36*(2), 574–585. https://escholarship.org/uc/item/2jr445h8

Elsbach, K. D., & Stigliani, I. (2018). Design Thinking and Organizational Culture: A Review and Framework for Future Research. *Journal of Management*, *44*(6), 2274–2306. https://doi.org/10.1177/0149206317744252

European Commission & Directorate-General for Communication. (2021). *Public opinion in the European Union: Report*. European Commission. https://doi.org/10.2775/841401

European Commission, Eurostat. (2023). *Individuals using the internet for interaction with public authorities, by type of interaction [Data set]*. http://data.europa.eu/88u/dataset/8juqmyqtrsifjyhyyaw4a

Evans, M., & Terrey, N. (2016). Co-design with citizens and stakeholders. *Evidence-Based Policy Making in the Social Sciences: Methods That Matter*, 243.

Filer, T. (2019). Thinking about GovTech A Brief Guide for Policymakers. *Bennett Institute for Public Policy. University of Cambridge*. https://www.bennettinstitute.cam.ac.uk/wp-content/uploads/2020/12/Thinking_about_Govtech_Jan_2019_online-1.pdf

Fuller, M., & Lochard, A. (2016). *Public policy labs in European Union members states* (Other LB-NA-28044-EN-N). Publications Office of the European Union. https://doi.org/10.2788/799175

Geraldi, J., & Söderlund, J. (2016). Project studies and engaged scholarship: Directions towards contextualized and reflexive research on projects. *International Journal of Managing Projects in Business*, *9*(4), 767–797. https://doi.org/10.1108/IJMPB-02-2016-0016

Glen, R., Suciu, C., & Baughn, C. (2014). The Need for Design Thinking in Business Schools. *Academy of Management Learning & Education*, *13*(4), 653–667. https://doi.org/10.5465/amle.2012.0308

Granstrand, O., & Holgersson, M. (2020). Innovation ecosystems: A conceptual review and a new definition. *Technovation*, *90–91*, 102098. https://doi.org/10.1016/j.technovation.2019.102098

Gruber, M., de Leon, N., George, G., & Thompson, P. (2015). Managing by Design. *Academy of Management Journal*, *58*(1), 1–7. https://doi.org/10.5465/amj.2015.4001

Hmelo-Silver, C. E. (2004). Problem-Based Learning: What and How Do Students Learn? *Educational Psychology Review*, *16*(3), 235–266. https://doi.org/10.1023/B:EDPR.0000034022.16470.f3

Holloway, M. (2009). How tangible is your strategy? How design thinking can turn your strategy into reality. *Journal of Business Strategy*, *30*(2/3), 50–56. https://doi.org/10.1108/02756660910942463

Junginger, S. (2013). Design and innovation in the public sector: Matters of design in policy-making and policy implementation. *Annual Review of Policy Design*, *1*(1), 1–11.

Kimbell, L. (2015). *Applying design approaches to policy making: Discovering policy lab*. University of Brighton.

Klievink, B., Bharosa, N., & Tan, Y.-H. (2016). The collaborative realization of public values and business goals: Governance and infrastructure of public–private information platforms. *Government Information Quarterly*, *33*(1), 67–79. https://doi.org/10.1016/j.giq.2015.12.002

Kolb, D. A. (1984a). Experience as the source of learning and development. *Upper Sadle River: Prentice Hall*.

Kolb, D. A. (1984b). Experiential learning as the science of learning and development. *Englewood Cliffs NPH*.

Kuziemski, M., Ulrich, P., Mergel, I., & Martinez, A. (2022). *GovTech Practices in the EU* (JRC Research Reports No. JRC128247). Joint Research Centre. https://EconPapers.repec.org/RePEc:ipt:iptwpa:jrc128247

McGann, M., Blomkamp, E., & Lewis, J. M. (2018). The rise of public sector innovation labs: Experiments in design thinking for policy. *Policy Sciences*, *51*(3), 249–267. https://doi.org/10.1007/s11077-018-9315-7

Mergel, I. (2016). Agile innovation management in government: A research agenda. *Open and Smart Governments: Strategies, Tools, and Experiences*, *33*(3), 516–523. https://doi.org/10.1016/j.giq.2016.07.004

Mergel, I., Ulrich, P., Kuziemski, M., & Martinez, A. (2022). *Scoping GovTech dynamics in the EU* (No. JRC128093; JRC Research Reports). Joint Research Centre. https://publications.jrc.ec.europa.eu/repository/handle/JRC128093

Mintrom, M., & Thomas, M. (2018). Improving commissioning through design thinking. *Policy Design and Practice*, *1*(4), 310–322. https://doi.org/10.1080/25741292.2018.1551756

Mumford, E. (2006). The story of socio-technical design: Reflections on its successes, failures and potential. *Information Systems Journal*, *16*(4), 317–342. https://doi.org/10.1111/j.1365-2575.2006.00221.x

OECD. (2019). *Government at a Glance 2019*. OECD Publishing. https://doi.org/10.1787/8ccf5c38-en

Orlandi, A. E. C. (2010). Experimental experience in design education as a resource for innovative thinking: The case of Bruno Munari. *Innovation and Creativity in Education*, *2*(2), 5039–5044. https://doi.org/10.1016/j.sbspro.2010.03.817

Osborne, S. P., Nasi, G., & Powell, M. (2021). Beyond co-production: Value creation and public services. *Public Administration*, *99*(4), 641–657. https://doi.org/10.1111/padm.12718

Public. (2021). *The State of European GovTech. Key Themes and Players in the European GovTech Ecosystem*. https://www.public.io/report-post/the-state-of-european-govtech

Puttick, R. (2014). Innovation Teams and Labs: A practice guide. *London: NESTA*, *12*. http://www.nesta.org.uk/publications/innovation-teams-and-labs-practice-guide

Rizzo, F., Deserti, A., & Cobanli, O. (2017). Introducing Design Thinking in Social Innovation and in Public Sector: A design-based learning framework. *European Public & Social Innovation Review*, *2*(1), 127–143.

Rizzo, F., Deserti, A., Crabu, S., Smallman, M., Hjort, J., Hansen, S. J., & Menichinelli, M. (2018). *Co-creation in RRI practices and STI policies* (D1.2; SISCODE Deliverables). Cordis. https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5bedc3 a0d&appId=PPGMS

Rizzo, F., Deserti, A., & Pous, M. (2017). Report on SIC Learning Principles and Processes. *Deliverable 4.1-Social Innovation Community EU Project*. https://www.siceurope.eu/sites/default/files/field/attachment/d4.1_report_on_sic_learning_principles _and_processes_final_24012017.pdf

Sanders, E. B.-N., & Stappers, P. J. (2008). Co-creation and the new landscapes of design. *CoDesign*, *4*(1), 5–18. https://doi.org/10.1080/15710880701875068

Sanders, E. B.-N., & Stappers, P. J. (2014). Probes, toolkits and prototypes: Three approaches to making in codesigning. *CoDesign*, *10*(1), 5–14. https://doi.org/10.1080/15710882.2014.888183

Schütz, F., Heidingsfelder, M. L., & Schraudner, M. (2019). Co-shaping the Future in Quadruple Helix Innovation Systems: Uncovering Public Preferences toward Participatory Research and Innovation. *She Ji: The Journal of Design, Economics, and Innovation*, *5*(2), 128–146. https://doi.org/10.1016/j.sheji.2019.04.002

Steen, M. (2013). Virtues in Participatory Design: Cooperation, Curiosity, Creativity, Empowerment and Reflexivity. *Science and Engineering Ethics*, *19*(3), 945–962. https://doi.org/10.1007/s11948-012-9380-9

Strokosch, K., & Osborne, S. P. (2020). Co-experience, co-production and co-governance: An ecosystem approach to the analysis of value creation. *Policy and Politics*, *48*(3), 425–442. Scopus. https://doi.org/10.1332/030557320X15857337955214

Strokosch, K., & Osborne, S. P. (2021). Co-production from a Public Service Logic Perspective. In E. Loeffler & T. Bovaird (Eds.), *The Palgrave Handbook of Co-Production of Public Services and Outcomes* (pp. 117–131). Springer International Publishing. https://doi.org/10.1007/978-3-030-53705-0_6

Szkuta, K., Pizzicannella, R., & Osimo, D. (2014). Collaborative approaches to public sector innovation: A scoping study. *Special Issue on : Selected Papers from the 10th Conference in Telecommunications, Media and Internet Techno-Economics*, *38*(5), 558–567. https://doi.org/10.1016/j.telpol.2014.04.002

Tallinn Declaration. (2017). *Tallinn Declaration on eGovernment at the Ministerial Meeting during Estonian Presidency of the Council of the EU on 6 October 2017*. https://ec.europa.eu/newsroom/document.cfm?doc_id=47559

Tõnurist, P., Kattel, R., & Lember, V. (2017). Innovation labs in the public sector: What they are and what they do? *Public Management Review*, *19*(10), 1455–1479. https://doi.org/10.1080/14719037.2017.1287939

Trischler, J., Dietrich, T., & Rundle-Thiele, S. (2019). Co-design: From expert- to user-driven ideas in public service design. *Public Management Review*, *21*(11), 1595–1619. https://doi.org/10.1080/14719037.2019.1619810

Vink, J., Koskela-Huotari, K., Tronvoll, B., Edvardsson, B., & Wetter-Edman, K. (2021). Service Ecosystem Design: Propositions, Process Model, and Future Research Agenda. *Journal of Service Research*, *24*(2), 168–186. https://doi.org/10.1177/1094670520952537

Welsh, M. A., & Dehler, G. E. (2013). Combining critical reflection and design thinking to develop integrative learners. *Journal of Management Education*, *37*(6), 771–802.

Wetter-Edman, K., Sangiorgi, D., Edvardsson, B., Holmlid, S., Grönroos, C., & Mattelmäki, T. (2014). Design for Value Co-Creation: Exploring Synergies Between Design for Service and Service Logic. *Service Science*, *6*(2), 106–121. https://doi.org/10.1287/serv.2014.0068

Wolff, F., Capra, A., Dutra, F., & Borja de Mozota, B. (2016). Double-loop design management model. *20th DMI: Academic Design Management Conference*, 1–11.

Yoshida, M., & Thammetar, T. (2021). Education Between GovTech and Civic Tech. *International Journal of Emerging Technologies in Learning (IJET)*, *16*(04), 52–68. https://doi.org/10.3991/ijet.v16i04.18769

Zapata, E. (2020). *The GovTech Index 2020. Unlocking the Potential of GovTech Ecosystems in Latin America, Spain and Portugal*. CAF – Development Bank of Latin America & Oxford Insights. http://scioteca.caf.com/handle/123456789/1580

About the Authors:

Marzia Mortati: Ph.D in Design, Associate Professor at Politecnico di Milano, Department of Design. She teaches Service Design, Innovation, and their connection with Artificial Intelligence and the public sector. She is also one of the Executive Directors of the European Academy of Design, and Deputy Director of the International Master in AI for Public Services.

Ilaria Mariani: Ph.D. in Design, Researcher at the Department of Design, Politecnico di Milano. Her background intertwines communication, interaction, and service design. Her research addresses complex interactive systems for communication and design-driven social innovation in the public sector, investigating the ability of design to support processes of digital transformation.

Francesca Rizzo: Ph.D. in Computer Science, Full Professor in Interaction Design and Users Studies, and Rector's delegate for European Research Projects. She researches on the application of Design Thinking in public sector innovation and how co-design triggers organisational changes. She coordinated and partook in many EU projects and authored several national and international publications on the topic.

Annex A

Project	Relevant resources	Relevance for GovTech DT methodology	Other relevant knowledge
Co-VAL	D2.1 Mapping and instruments providing data on the co-creation of public services D4.3 Toolbox report on service design approaches to co-creation of public value D5.2 Report on strategic case studies D5.3 Report on participatory stakeholder model D6.1 Fourth empirical approach to value co-creation in public services: structural transformations	Co-VAL examines the co-creation of value and its integration to transform PA services and processes. Through its deliverables, the project provides multiple pivotal resources. D4.3 clarifies critical terms and concepts that can help navigate the broader literature, providing a shared understanding of several terms. It gives an overview of crucial service design methods and tools. The list of methods and tools is particularly comprehensive. Each tool is briefly introduced, and then links to valuable resources are presented: description, templates and more detailed step-by-step guidance on specific methods. D2.1 presents the stages for using co-creation with users as: 1. Research on customer needs, including ethnographic research on how customers use services. 2. Ideation, where preliminary ideas for an innovative service are developed, drawing on the research results. 3. Development and design activities, resulting in a prototype. 4. Testing and other work to develop a prototype into an innovation. 5. Pilot testing. 6. Post-implementation research. This serves as a base for the definition of the DT methodology phases. D5.2 presents the outcome of in-depth case studies of how living lab approaches are used for co-creation and co-innovation. Co-creation emerges as a critical aspect in living labs, being outlined as mindset and methodology. The cases point out that co-creation with users/citizens requires maturity and an understanding of what co-creation should support. D5.3 present a theoretical framework for participatory engagement to enable value co-creation based on the co-innovation of public services. Although focused on living lab, interesting data emerge on the role of the public sector as both the maina initiator and beneficiary, and cross-	Co-VAL vets into the value created in PA through citizen and civil servants' engagement, discussing how to integrate co-creation to transform public administration services and processes. It analyses innovative ways for designing (a) service models for PA processes, presenting cases where service providers and users (citizens and organizations)are the key actors, and (b) bottom-up supply chains promoting voluntary and active participation of society in the PA transformative efforts. Such transformative innovation is measured and monitored. By presenting case studies, D6.1 reasons on types and processes of innovation, innovation networks, drivers and barriers, and institutional factors favouring or preventing effective value creation. Although situated in the social innovation domain, the cases provide first-hand evidence of co-creation that engaged stakeholders and the public sector.

		sectorial collaboration either based in or outside the public sector.	
Big Policy Canvas	D2.1 Identified Stakeholders and Networking Activities Planning v2.0 D2.2 Stakeholders engagement v1.0	From a methodological perspective, BPC significantly engages relevant stakeholders throughout its activities. Stakeholders have been engaged to validate, enrich and refine BPC results according to their needs, resulting in a natural assimilation of such information. The project offers a strategy and implementation plan for engaging stakeholders (D2.1 and D2.2), providing a key reflection on the impact that the application of the plan achieved. Three pillars sustain the engagement strategy: approach, engage and maintain, aiming at involving people for the collective generation and transfer of the project's knowledge (on policy and decision-making among the different fields of the Public Sector). Among the others, the project organised workshops to grant stakeholders' participation and mutual interaction. This project explains stakeholders' relations were managed and the close monitoring and assessment activities (and their revision over time) by means of an excel file and an internal methodology. The project presents lessons learnt on multiple topics. Among the others: 1) Their use of social media for creating awareness, and how direct email with personalised content results more effective. 2) Members registered on the portal often do not engage in the thread of discussion on the portal. 3) the portal content was generated and tailored to the interests of the different stakeholders, supporting their engagement. 4) offline activities have resulted in being much more effective than online activities: people interviewed or that participated in focus groups expressed their interest in becoming part of the stakeholders list.	BPC provides a comprehensive Knowledge Base as a state-of-the-art knowledge on the public sector's barriers and challenges, PA needs, trends impacting policy making and public sector assets against the application domains (12 public policy domains). Specifically, BPC maps and delivers an overview of potential inter-relations among needs, trends, and assets. This knowledge serves as a base for framing current challenges in the public sector (Context Analysis phase), such as those related to the emergence of a distributed governance model, the need to generate high involvement of citizens in policy-making, the issue of identifying "good ideas" and innovative solutions to long-standing problems, ensuring long-term thinking, the key challenge is encouraging all stakeholders to comply with regulations or follow the recommendations, among the others.
CoSIE	Policy Brief III: A New Agenda for Co-Creating Public Services	The CoSIE project builds on the idea that public sector innovations can be best achieved by creating collaborative exchanges or partnerships between service providers (i.e. public sector	Among the most relevant aspect, the project highlights the key role of reflective practice and continuous learning, the need to include

	[Toolkit: Working with lived expeirence sorytelling as a tool for co-creation](#) [Guidelines for Social Hackathon Events](#) [D7.1: Towards a Roadmap for Co-creation: Practical Ideas and Useful Tools](#)	agencies, third sector organizations, and private companies) and citizens who benefit from services either directly or indirectly. Co-creation in CoSIE is a collaborative and power-balancing activity that aims to enrich and enhance the individual and collective value in public service offerings at any stage in developing new service and during its implementation. It is manifested in a constructive exchange of different kinds of resources (ideas, competencies, lived experience, etc.) that enhance the experienced value of public service. The project presents a Toolkit for "Working with lived experience storytelling as a tool for co-creation", with tools for collecting insights, stimulating dialogue, triggering reflection, and reasoning on Who, How, and Why. The toolkit is complemented with some case studies showing the application of the tools. It also contributes with guidance and tools for supporting co-creation: Guidelines for Social Hackathon Events, Practical Ideas and Useful Tools for supporting co-creation (community reporting, diagrammatic representations such as conversational models which map roles and responsibilities, process-oriented models representing processes, buffers and flows).	vulnerable groups in co-creating processes, focusing on barriers preventing their participation, the central role of lived experiences of people who use services to co-create better solutions. It is discussed how the promotion of bottom-up Initiatives encourages stakeholders to contribute to solving their problems while identifying agents of change which can support innovation and its adoption. It acknowledges how local ideas can be scaled in the broader ecosystem and up to a wider scale. Co-creation is recognised to add value for people with different needs and vulnerable/minority groups. The project highlights the benefits of operating across systems rather than within organisations. The CoSIE project gives five recommendations on how social innovations can be created through multi-stakeholder collaboration, which can be relevant to consider: 1) Support self-organisation and enable emergence, 2) Cultivate the ecosystem of social innovation, 3) Tackle uncertainty by providing small wins, 4) Ensure diversity by promoting feedback and sense-making, 5) Enrich interaction through digital technology.
SCALINGS	[D9.4 Bootcamp on Innovation and Co-creation in cross-cultural settings](#)	SCALINGS includes developing and implementing training boot camps, as that on "Innovation and Co-creation in cross-cultural settings", targeting other European consortia. In D9.4, it is presented how the project engaged in a series of activities involving multiple organizations from the academic ecosystem and beyond. For this purpose, it developed a collaboration tailored to the needs and interests of	SCALINGS provides fundamental knowledge on how co-creation relates to unique contexts, and it is interested in learning the conditions under which co-creation practices can scale up across regional and technical domains. The project presents the result of an in-depth analysis of

		academia and a start-up incubator, answering the growing interest and demand for co-creative education. The curricula and activities of the boot camps are described, providing a base for developing the DT methodology and its phases. Different boot camps reasoned on co-creation, ethical and responsible innovation, and social needs engaging multiple actors, such as consortium partners, but also technology start-ups from a local accelerator. Relevant insights come from using digital collaborative tools for co-creating during boot camps.	different case studies that involve leading co-creation practitioners, conducted through qualitative methods. Each consortium partner focuses on cases located in its geographical proximity. Comparing how different actors use co-creation instruments across multiple and different local and technological contexts provides a fundamental reflection on similarities and differences, best practices or failures.
AI4GOV	Knowledge hub Toolkit AI4GOV DT methodology applied to project work	The AI4GOV Toolkit aims to foster a human-centred and systemic perspective towards the development of public services that integrate AI meaningfully supported by the application of a sound DT methodology. The world-class master's program AI4GOV is pioneering a multidisciplinary approach to educate functional specialists in applying AI to public services. The master is delivered according to the project-based learning (PBL) teaching approach. PBL is a comprehensive approach to classroom teaching and learning that engages students in an investigation of authentic and novel problems. In PBL, the project is the focus of the teaching strategy where students learn and grasp the central notions of what is being taught. In the context of this master, PBL is applied to train participants in a project environment. For these reasons, the AI4GOV project and its master are particularly aligned with the scope of the GovTech bootcamps, providing a relevant source of knowledge regarding methodology and toolkits applied. In this context, the AI4GOV Toolkit offers a methodology and the specific tools for its application in real public sector projects, considering the technology not an end but a means for reaching broader strategic objectives, particularly the meaningful adoption of AI to solve real societal needs. The tools proposed in the toolkit span	The project is currently at its 2nd edition of the master. In each edition, multiple Project Works include classes of 40 people in tackling real challenges, often with real clients from the public or public-related domains who enter the project work with tasks related to ongoing projects, while experimenting with DT from direct user engagement (user research) to prototyping and testing.

		throughout four main phases of the design process: (1) Context analysis, (2) Envisioning solutions, (3) Idea development, and (4) Testing, also providing prototyping tools that can be transversal to those phases. In addition, the toolkit is particularly significant because it is designed to guide both experts and non-experts in design and AI working in Governments and public administration with different roles (decision-makers, civil servants, policy officers, external consultants) throughout the entire design process of envisaging, planning for, and testing AI-infused solutions.	
easyRights	D5.1 Triple Loop Learning Mechanisms D2.1 & D2.2 Report on Pilot Co-creation and Governance Activities D5.2 User Analysis D3.1 Hackathon Guidelines	easyRights co-designed innovative solutions in ecosystems that engage migrants, NGOs, public authorities, and ICT developers, also engaging policymakers to provide support further to reach the project aim of easing migrants' access to public services. Though its experimentation, the project shows how the interaction among different actors, such as civil servants, members of the hosting communities and migrants, can provide a better understanding of each other's needs, primary aims, and effective constraints. It provides evidence of how to run engagement of end-users and relevant stakeholders to build better services. The project presents reports on pilot co-creation and governance activities. Through its deliverables (D2.1 & D2.2) easyRights presents a detailed explanation of the work carried out in/by the pilots, describing how migrants were engaged along the process, from how they contributed to design and redesign the challenge to address, how they impacted the design of the solution, up to how they participated in the testing and validation of the solutions developed within the project (11 solutions in total, of which 8 co-created). D5.2 focuses on user analysis specifically, presenting the monitoring and evaluation of ICT projects involving (im)migrants and a general introduction to user analysis, defining	D5.1 explores the Triple loop learning mechanisms, which occur whenever people realise what is required to achieve effective change. In easyRights, the observation regarded the learning dimensions within the Quadruple Helix stakeholders composing the pilot sites – Academia, Business, Civil Society, and Government representatives – covering societal (collective and legal), organisational (town hall related) and behavioural (individual migrants related) aspects.

its key characteristics, benefits and opportunities concerning the easyRights project. It also presents the easyRights evaluation framework, showing how engagement was measured and contributed to the final outputs. As such, it provides relevant knowledge to consider for the assessment framework.

D3.1 focuses on providing guidelines for the two hackathon cycles held in each of the 4 pilot sites of the project. The relevance of the project against the DT methodology resides in the operational suggestions that can facilitate the work of pilot managers in order to support the design of co-creation settings.

Ultimately, the project organised multiple co-creation and co-design workshops and applied several collaborative tools to support them. As such, it provides significant knowledge in terms of practices, methodologies, and tools.

| SISCODE | SISCODE Interactive Guidebook

D5.2 Interactive Guidebook

SISCODE Learning Hub

D3.5 Assessment Framework

D5.1 Models of co-creation ecosystem | SISCODE stimulates co-creation and DT methodologies in policy design, using bottom-design-driven methodologies to pollinate Responsible Research and Innovation and Science Technology and Innovation Policies. The SISCODE Interactive Guidebook (https://siscodeproject.eu/guidebook) explores the fundamental knowledge and valuable know-how gained by several projects and activities.

The interactive guidebook is an instrument that transforms SISCODE's results and insights into concrete support for those who want to make their initiatives and processes more responsible through co-creation. It guides the user through a general structure on how to set up a co-creation process.
The user can individually design a co-creation process by choosing the methods and tools adequate for the specific project and context. In so doing, the guidebook supports practitioners and researchers in engaging users and stakeholders in a | The project presents a learning hub for policymakers to support them in gaining a better knowledge of co-creation and its application, from the reason why to apply it to tools and methodologies for effective implementation. The learning hub contains various relevant thematic areas with informative videos, lectures, case studies, scientific publications and practical tools.

Acknowledging the context dependency and variations of co-creation ecosystems according to the cultural, organisational and regulatory conditions under which co-creation is applied, the project discusses how small-scale experimentations as ecosystems evolve and function. Drivers and barriers in terms of static factors are presented through a multi- |

learning process by choosing the most suitable ones for the specific project from various possible approaches, methods and tools according to a learning framework divided into different phases. The guidebook presents an overall process of solution development that goes through a set of phases: 1. Context analysis, 2. Problem framing, 3. Ideation, 4. Prototyping and testing, 5. Dissemination and sustainability. Ultimately, specific attention is given to measuring impacts, especially in the context of society, presenting approaches, methods and tools. Additional tools are presented in the SISCODE learning hub, targeted for policymakers to support them in gaining a better knowledge of co-creation and why to apply it.

The project set up an assessment framework with data collection and evaluation tools. The set-up and development of the assessment framework allowed for measuring and evaluating the results of the experimentation conducted with the frame of pilots as small-scale experimentation. It is designed to monitor and assess the direct and indirect effects of the pilot experimentation and anticipate potential long-term impact beyond the project's duration and, therefore, the monitoring period itself.

The framework investigated three different levels and typologies of results: 1) Outputs as direct results in terms of prototypes in the shape of products or services. 2) Outcomes as the changes triggered by the applied methodology in a learning-by-doing process and the prototype itself considering the longer-term and indirect outcomes as the uptake of new knowledge and learning processes triggered. 3) Impacts as long-term changes like a shift in organizational culture or processes of decision making). D3.5 presents the overall assessment framework and the set of tools specifically developed to support the process, considering all aspects of the experimentation to effectively

level scale that goes from the micro- to the macro level describing organisational, administrative, technical, human-resource and procedural changes needed for and triggered by the effective application of co-creation. Moreover, it establishes a maturity scale associating specific factors, states and characteristics to the single degrees of maturity and finally describes the dynamics that may transfer co-creation ecosystems from one level of maturity to another.

derive multi-level considerations. The project's relevance relies on its toolkit and Assessment framework, which are fully aligned with the scope and aims of the DT methodology, and can serve as a fundamental base for the development of the phases and tools.