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The rise of GovTech

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The rise of GovTech: Trojan horse or blessing in disguise? A research agenda

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ABSTRACT

As GovTech solutions are steadily entering the public sector, they have yet to find their way into the mainstream 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. GovTech solutions promise a superior customer journey for citizens and businesses compared to current government portals and front desks. GovTech solutions can be a blessing in disguise for governments struggling in their digital transformation journey, carrying the burden of public service innovation and replacing legacy systems with modern GovTech solutions. Yet, there are also concerns that GovTech solutions are a Trojan horse, exploiting the lack of technical knowledge at public agencies and shifting decision-making power from public agencies to market parties, thereby undermining digital sovereignty and public values. This paper develops a research agenda for GovTech based on a conceptual framework. This framework reveals four interrelated design areas for GovTech: institutional, governance, technical and human-centred design. Governments can employ the conceptual framework to further align and develop their strategies by focussing on GovTech governance, referring to the ability to manage the various interdependencies between the four design areas.

1. Introduction

Ever since governments were established, public agencies have carried the burden of designing and delivering public services, i.e. collecting taxes, providing social services, distributing welfare, maintaining security, and much more. Today, public agencies fulfil a wide array of public tasks, ranging from tax collection and social benefits allocation to the procurement of services (Lindgren & Jansson, 2013). To some extent, we can say that public agencies stood alone in designing and delivering public services in the pre-digital era. While alternatives exist like hiring technology consultants (e.g. for redesigning public services) and outsourcing public service delivery tasks to commercial service providers, public agencies remained solely accountable and responsible across the entire service lifecycle. The emergence of digital technologies in general – and GovTech in particular – contests this monopoly of public agencies. This is happening in a time when many governments are struggling to harness the potential of digital technologies to satisfy the growing demands from citizens and businesses for improved public service delivery, transparency, accountability, and participation (Dener, Nii-Aponsah, Ghunney, & Johns, 2021). Reasons for this include limited financial, human, technical, and

information resources, alongside the blurred legitimacy to deal with societal challenges (Janowski, Estevez, & Baguma, 2018). The innovation and digital transformation struggles have not gone unnoticed by innovative start-ups, scale-ups and corporations that have invested in harnessing the potential of emerging digital technologies for easy to use digital services. In Europe, many GovTech initiatives and programmes are being launched regularly to accelerate technology adoption across the full spectrum of public services (Kuziemski, Mergel, Ulrich, & Martinez, 2022; Public, 2021).

We see many examples of GovTech that radically transform how citizens and businesses interact with public agencies. Examples include cyber-trust services for authentication and secure data storage, and AI-enabled digital assistants/robo-advisors for public professionals judging applications for social benefits. Other examples include voice assistants and data wallets for citizens, allowing for more convenient interactions with public agencies. Also, consider digital twins of cities and policy simulation tools. The list of examples goes on: chatbots for citizen engagement, real-time management of the cyber-physical infrastructures using IoT, automated compliance/regulation, public records securely stored in distributed ledgers, online judicial and dispute resolution systems, and laws/statutes encoded as smart contracts (see

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for instance [Androutsopoulou, Karacapilidis, Loukis, & Charalabidis, 2019](#); [Engin & Treleaven, 2019](#)).

These examples demonstrate how innovative organisations harvest the potential of emerging, general-purpose digital technologies such as AI, facial recognition, voice assistants, data wallets and distributed computing for public sector innovations that go beyond building digital copies of current bureaucracies. More comprehensive surveys of the underlying digital technologies can be found across the literature (e.g. [Sebastian et al., 2017](#); [Vial, 2019](#)).

GovTech has a supply and a demand side, both of which are yet to be gauged more precisely. The total size of the GovTech market depends on the definition. For instance, a report by Accenture and Public estimates the global total addressable GovTech market is around US\$400 billion, while GovTech spending in Europe alone stands at \$25 billion ([Accenture, and Public, 2018](#)). Yet, to understand the GovTech market, we need to be more precise on definitions. [Section 2](#) elaborates on GovTech definitions.

Regardless of the exact definition, many public sector organisations have yet to determine how to incorporate emerging digital technologies to develop innovative approaches to policy-making, service delivery and public value creation ([Mergel, Edelmann, & Haug, 2019](#); [Ubaldi et al., 2019](#)). Those looking for guidance in the academic literature on GovTech will find little help. GovTech has remained under the radar of scholars, leaving a lack of conceptual and design knowledge on this topic. Accordingly, the objective of this paper is to offer conceptual guidance for examining GovTech, including a theory-inspired and empirically-grounded agenda for further research.

This paper proceeds as follows. First, section two provides some conceptual clarity regarding GovTech by zooming in on definitions and examples. Section three presents a conceptual framework for studying GovTech. This section reveals several research challenges and related research questions. The final section concludes this paper with a discussion on the risks of GovTech and provides some policy directions.

2. Conceptualising GovTech

2.1. What is GovTech?

In today's world dominated by tech developments, the coining of a neologism is a regular occurrence, as existing words are combined into acronyms that quickly become part of trend reports. Most of these new trends have been named by adding the -tech suffix to a prefix that usually refers to the traditional domain or segment of related activities. Hence, we can find terms like FinTech, PropTech, InsurTech, MedTech, RegTech, EdTech, CivicTech and LegalTech, all designed and operated by private businesses.

Against this backdrop, GovTech is an acronym of Government Technologies. As an embryonic development, a universal definition for GovTech has yet to emerge. Moreover, academic definitions are still scarce. A Scopus 'title-keyword-abstract' search for GovTech in November 2021 returned eight academic papers. Two are from the same author and provide the exact definition. The other papers found did not provide definitions. Grey literature offers more definitions. [Table 1](#) outlines some definitions of GovTech found in (grey) literature.

[Table 1](#) demonstrates the lack of conceptual clarity on GovTech. Some definitions highlight a scope (whole of government), while others refer to a start-up way of working. While this list of definitions is helpful, two limitations need to be considered:

1. **Conceptual ambiguity:** for instance, the definition provided by the World Bank does not clearly distinguish GovTech from Digital Government and e-Government definitions. The risk is that GovTech will become a synonym for digital government, rendering it yet another buzzword. It is important to note that scholars have proposed several concepts that overlap with the definitions listed in [Table 1](#). Examples include public service innovation ([Chen, Walker, & Sawhney, 2020](#)),

Table 1
Definitions found in (grey) literature.

	Definition	Source
1	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.	World Bank (Dener et al., 2021)
2	GovTech refers to cutting-edge technology solutions developed by various players—notably start-ups, but also medium and large enterprises, non-profits and others—that are transforming public services.	(Accenture & Public, 2018)
3	GovTech generally refers to the landscape of private-sector start-ups and small and medium enterprises (SMEs) that deliver technology products and services that can be used in public services	(Filer, 2019)
4	GovTech refers to the process of making government technology more modern, intuitive and user friendly: more in line with the technology we use in consumer and business sectors. Another way to describe it is to say that GovTech brings a 'start-up ethos' to solving public problems and delivering public services.	(Public, 2021)
5	"GovTech" (a portmanteau of the words "government" and "technology") refers to the strategy invented to increase efficiency in administration by digitalising work processes or incorporating new technological tools.	(Yoshida & Thammetar, 2021 ; Yoshida & Theeraroungchaisri, 2021)

digital transformation in government ([Gong, Yang, & Shi, 2020](#); [Mergel et al., 2019](#)), transformational government ([Tassabehji, Hackney, & Popović, 2016](#)), lean government ([Janssen & Estevez, 2013](#)), government as a platform ([Brown, Fishenden, Thompson, & Venters, 2017](#); [O'Reilly, 2011](#)) and public-private platforms ([Klievink, Bharosa, & Tan, 2016](#)). Since all of these concepts draw attention to digitalisation and innovation in the public sector, there are connections with GovTech. Drawing upon empirical examples of GovTech, we argue that GovTech is different from the classical conceptualizations of Digital Government and e-Government, carrying a new set of practical and research challenges. The critical difference is discussed in the following point.

2. **Hidden dependencies:** the definitions listed in [Table 1](#) do not acknowledge the socio-technical nature of GovTech solutions. Nor do these definitions highlight the difference between public and private components in GovTech solutions and the demand for interoperability between these components to deliver genuinely transformative and practical GovTech solutions. Distinguishing public components from private components is essential for developing effective GovTech policies. The fact that more and more of these components (see [Fig. 2](#)) are provided by private organisations remains hidden. Private organisations include start-ups, scale-ups, not for profit organisations and multinational corporations. This paper assumes that not all government system components can be replaced with commercially operated GovTech solutions. Some components such as citizen address registries, health registries and tax algorithms might be deemed 'vital', demanding exclusive government control. Or, there is no positive business case for market parties (e.g. maintaining land and building registries that are subject to open data access policies). Moreover, some components may be deemed of national security interest (e.g. cyber security monitoring tools, military planning systems and criminal records management), preventing external procurement.

The following section examines various categories and empirical examples of GovTech and their user groups (different types of citizens, businesses, and public professionals). This provides empirical grounding for synthesising a robust definition that overcomes the limitations of the definitions listed in Table 1.

2.2. Categories and examples of GovTech

Since no empirical classification schemes are readily available for distinguishing different GovTech categories, this paper starts with a theoretical lens and conceptualizes GovTech from a socio-technical systems perspective (Bostrom & Heinen, 1977; Mumford, 2006). The central tenet of socio-technical systems is that the design and performance of an artefact (i.e. GovTech solution) can only be understood and improved if both ‘social’ and ‘technical’ (or digital) components are treated as interdependent parts of a complex system. Viewed from the socio-technical lens, GovTech consists of people interacting with others via technological and institutional components. In line with the earlier definitions, more and more GovTech solution components are developed and managed by private organisations. Based on this starting point, inductive empirical observation at Digicampus¹ yields various examples of GovTech that can be categorised based on similarity in characteristics. Table 2 provides a non-exhaustive overview of GovTech examples and categories found in this way.

Conceptually, two high-level goals can be derived for the GovTech solutions listed in Table 2: (1) Citizen-centred public service delivery (the first two categories) and (2) Data-driven government (the last three categories). Contrary to what the term ‘GovTech’ may suggest, the government is not always the client. The list of potential paying customers for GovTech solutions can vary and includes citizens, businesses, national and supranational governments, federal, state and local governments, cities and regions, state departments and ministries, specialised public agencies and regulatory bodies and arguably schools, universities, hospitals, care homes, police forces and law courts. Moreover, some GovTech solutions can serve multiple customer segments (e.g. digital assistants for citizens and public professionals) with different value propositions, allowing for multi-sided business models.

Before we can define GovTech more precisely, an important question to answer is: *who designs and operates the components of GovTech solutions?* Considering the five categories listed in Table 2, an increasing amount of solution components are provided by non-state actors, particularly start-ups and scale-ups (Accenture & Public, 2018; Public, 2021). This development follows the tech entrepreneurship cultivated by national governments and supranational institutes like the EU. Moreover, specific regulations such as the ‘Electronic Identities And Trust Services Act’ (eIDAS) and the ‘General Data Protection Regulation’ (GDPR) provide a legal basis that opens new business opportunities for market parties. For example, the role of ‘qualified trust service provider’ was first introduced by the eIDAS act and has since created a market of hundreds of qualified trust service providers across Europe. Similarly, GDPR has launched a market of GovTech providers focussed on personal data management and new privacy enhancing technologies including self-sovereign identity, zero-knowledge proof and secure multi-party computation.

When we look at the category of GovTech for public service consumption, citizens can be the (paying) customers for GovTech solutions, or public agencies can cover a portion of the expenses. An example in the Netherlands is using data wallets to assist citizens with collecting the data needed for social housing application. Citizens looking for a social

Table 2
GovTech categories, characteristics and examples.

Category	Characteristics	Examples found in practice
GovTech for public service consumption	• Citizen/ entrepreneur as the end-user • Multiple business models: citizens, agencies or both pay for use • Use of sensitive personal data	• Digital identities • Personal data wallets • Self-sovereign identity wallets • Apps for requesting social services (e.g. child support, social housing) • Cyber-trust services for digital authentication and signing • Voice assistants
GovTech for public service delivery, decision support or process automation	• Public professional as the end-user • Public agency pays for use • Various: use of open data, sensitive personal data, confidential data or classified data	• AI-driven decision support assistants for public officials • Data-driven workflow management applications • AR algorithms and business rules for proactive service delivery, robotic process automation
GovTech for business-to-government interactions	• Multiple end-user groups: businesses, intermediaries, public agencies • Use of sensitive business data (historical, actual or planned data)	• Financial reporting applications • Public-private platforms • Compliance monitoring and audit analytics tools • Dashboards for monitoring the performance of large enterprises
GovTech for data-driven policy-making	• Policy-maker as the end-user • Use of aggregated open data (or data that must be opened for the public later) or citizen input (opinions, value trade-offs etc.)	• Domain/sector analytics (e.g. for residential planning or following waste streams) • Policy simulation tools (e.g. serious games) • Tools for citizen engagement and participation in policy-making
GovTech for intelligence, monitoring and supervision	• Specialised public agencies and regulatory bodies as end-user • Use of (near) real-time information	• Drones for inspecting dikes • Internet of Things solutions (Sensor and trackers) • Digital twins of public services and (smart) cities • AI-based applications for predicting infrastructure maintenance

house are willing to pay small fees for the convenience offered by these kinds of GovTech solutions. As a user, you do not have to navigate through bureaucratic government procedures, interpret data requests and collect the relevant data, check the data, print out the data and bring it to the housing corporation or upload it through a form-based portal. Instead, the GovTech solution provides an intuitive digital user journey drawing on a deep understanding of the preferences of applicants and the requirements of social housing corporations. Based on the GovTech examples and categories found in practice, this paper proposes the following definition for GovTech:

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.

This definition draws attention to the interdependence between private and public actors and components, laying a foundation for more precise discussions on the challenges and opportunities. Here components can include – yet are not restricted to – citizen data registries, algorithms and application programming interfaces (APIs). Section 3.4

¹ Digicampus is a multiple-helix partnership for public service innovation in the Netherlands. Public agencies and GovTech providers looking to co-create GovTech solutions often visit Digicampus. This paper has benefited from numerous conversations on GovTech at Digicampus, led by the author. www.digicampus.tech

provides more examples of such components. The proposed definition excludes the ongoing, in-house improvement of current digital government systems by software developers working at government agencies, even with the help of external consultants. It also excludes the conditions suggested (e.g. a start-up culture and collaboration) since these do not hold for all the different categories of GovTech illuminated in this paper. The following section focuses on the research challenges from four interrelated design perspectives.

3. Research challenges

3.1. A conceptual research framework for GovTech

Given the complexity of GovTech solutions, a common understanding requires a holistic view that accounts for relevant aspects, combining them in a conceptual research framework (see for instance Kankanhalli, Charalabidis, & Sehl, 2019). Moreover, such frameworks are handy for emerging research fields like GovTech. They suggest what is relevant to study and why (Eisenhardt, 1989) and thus help provide research direction. The socio-technical framework presented in Fig. 1 provides a conceptual framework for studying GovTech design and governance. This framework was inspired by the design framework provided by Koppenjan & Groenewegen (2005, p.243)² and has been modified in three significant ways (1) it includes a human-centred design area, the reason for this is explained in Section 3.5, (2) the original process design area has been modified to a governance design area, the reason for this is explained in Section 3.3 and (3) the design areas are structured according to typical goals, methods (design activities) and the resulting artefacts (outputs), allowing for a more parsimonious understanding of the design areas.

Like all frameworks, the proposed framework remains an incomplete abstraction of reality. The central premise is that design artefacts are developed before implementation. Ideally, the governance design is the beginning of a design process; the outcomes are the resulting human-centred, technological, and institutional designs. In the real world, design and implementation (instantiation of the design and the development of artefacts) often go hand-in-hand, leading to all kinds of interactions. Nonetheless, the framework can help in the abstraction and conceptualization of GovTech, and facilitate more comprehensive studies on GovTech. The following subsections discuss the challenges and research questions that are yet to be addressed for each design area.

3.2. Institutional design

Since the development and delivery of GovTech solutions involves many parties, coordination is necessary for the solution to function. GovTech solutions are not auto-executive – they do not work by themselves and require a social and institutional context. Hence, GovTech solutions need ‘rules of the game’ that guide and coordinate the behaviour of actors. Institutions are a system of rules that structure the course of actions that a set of actors may choose (Scharpf, 1997). These arrangements can be formulated in formal laws (e.g. the General Data Protection Act and European Public Tendering Rules). They can also be informal (like norms and attitudes towards market parties in the public sector). The rules that coordinate behaviour can be of a public or private character and include relational and contractual governance mechanisms (Janssen, van der Voort, & Wahyudi, 2017). Institutions should

ensure accountability and establish shared values, which shape and constrain stakeholder behaviour. Considering the novelty of GovTech, current institutions inadvertently contain gaps in ensuring accountability and safeguarding values. Hence the need for an institutional design for GovTech. Typical goals here include establishing which arrangements (e.g. norms, rules, laws, regulations, and policies) are available or needed for regulating GovTech design, procurement, delivery, supervision etc. Typical methods that can be employed are institutional (gap) analysis, legal engineering, negotiation, norm-setting and policy standardisation activities. Examples of outputs include trust frameworks, GovTech acceptance policies (e.g. criteria for allowing GovTech providers to collect data from public agencies), norms, rules and policies for ensuring a level playing field, audit schemes, certification programs and innovation procurement policies.

The first challenge here is the institutional void (Hajer, 2003) surrounding GovTech. GovTech is a fairly recent concept and relatively novel as a policy field. This also leads to a lack of institutions catered to the characteristics of GovTech. An essential characteristic for GovTech solutions is that mutually dependent actors (i.e. solution providers, data providers and regulators) must cooperate to establish and maintain the collection of joint provisions (e.g. shared standards and components). More precisely, most GovTech solutions require some level of collaboration between the GovTech providers (non-state actors) and public agencies that either use (procure) GovTech or regulate access to components for the GovTech solution. Examples include digital identities, citizen identifiers and citizen registries, verified household and income data, APIs for data access, data specifications and so on. Without standardisation and harmonised access conditions across various public agencies, the transaction costs can be too high for start-ups or scale-ups looking to enter the GovTech market. Suppose this happens in a situation where there are few rules. In that case, cooperation is hindered by strategic uncertainty: it is not certain whether others will participate and, if they do, whether an agreement can be reached and whether they will honour that agreement (Koppenjan & Groenewegen, 2005). Different actors might want to use the components for their own benefit (‘take’) and may not feel inclined to contribute to the necessary innovation and maintenance (‘to bring’). When appropriation and provision are not balanced, there is a risk that the common good (e.g. data registries, conversion tools or data exchange infrastructures) will be ‘exhausted’. To avoid the decay of joint provisions, formal and informal arrangements are needed to regulate the taking and bringing. An example of such an arrangement is the establishment of public-private agreement frameworks (Klievink et al., 2016), also known as trust frameworks. Trust frameworks can enhance predictability (e.g. on the acceptance criteria for GovTech), limit the strategic uncertainty in multi-actor settings, and reduce the risks of opportunistic behaviour and the costs of interactions.

Trust frameworks can also help to overcome the historically grown mutual scepticism between public and private sector actors. On the one hand: public agencies are often viewed as slow bureaucratic machines that take years to turn policies into action. On the other hand, the perception of tech firms as ‘value extractors’ (Mazzucato, 2019) solely striving for profits and a winner takes all market, does not provide a solid foundation for collaboration, leading to insufficient political and institutional buy-in, in part due to risk aversion. In GovTech ecosystems, we have yet to establish the trustworthiness of GovTech providers and solutions. Trust anchors can boost the trustworthiness of GovTech. The following trust anchors can be considered for this purpose:

- Legal certainty anchors: lay the judicial foundation for co-creating, procuring, and regulating GovTech solutions and access to components managed by public agencies. It should be clear up-front who is responsible, accountable and financially liable for what.
- Data quality and system quality anchors: relate to the transactions and data to be processed, and the technological components (e.g. algorithms) used. For various GovTech solution types, the necessary

² Note that the Koppenjan & Groenewegen framework did not result from a comprehensive survey of theoretical frameworks for analysing socio-technical systems. Instead, this framework was selected as a starting point for studying GovTech because it is (1) design oriented, (2) theoretically grounded in socio-technical systems literature and (3) transdisciplinary, making it a useful model for investigating relationships between technology, social science, public values, and private innovation by reflecting on the characteristics of GovTech.

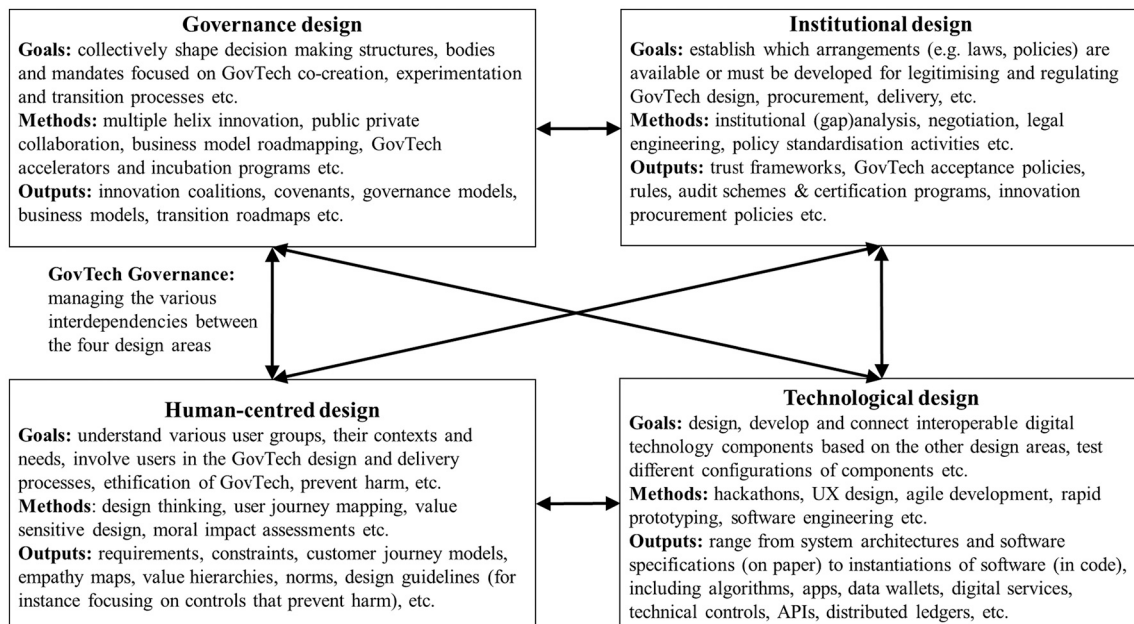


Fig. 1. A conceptual framework for studying GovTech design and governance (inspired by Koppenjan & Groenewegen, 2005, p.243).

audit and certification schemes are yet to be established, alongside the supervisory bodies that detect and respond to policy violations and enforce policy compliance.

- Cryptographic and cybersecurity trust anchors: establish the roots of trust in the digital world and enable cryptographic authentication, signing, binding and other trust functions. Cryptographic and cybersecurity trust anchors demand standards, audit and certification schemes similar to data quality and system quality anchors.

Trust frameworks for GovTech must include clear trust anchors. Future research can focus on questions like: *What are the critical aspects of trust frameworks for GovTech? Which kind of trust anchors are needed to accelerate the development and adoption of GovTech solutions?*

The second institutional design challenge stems from established procurement systems. Obwegeser and Müller (2018) argue that three distinct areas in procurement need to be considered in this light: (1) Public procurement for innovation, (2) Public procurement of innovation, and (3) Innovative public procurement. While procuring GovTech falls into the first and second category, the procurement process (third category) may need revision itself. Many procurement policies and regulations are anchored on sourcing tangible and well-defined artefacts (e.g. computer hardware) and services. When sourcing innovation or innovative (not yet mature) products and services, the limitations of procurement schemes become clear.

Moreover, the supply side of GovTech in Europe consists mainly of small and medium enterprises – SMEs (Public, 2021). Multiple factors hinder SMEs when competing with larger firms, including the strict financial and historical requirements (e.g. liability insurance and track record) in public procurement processes. Moreover, many GovTech solutions are not yet ready to deploy and require some form of co-creation and experimentation before going into production. This is a slippery slope for public agencies pursuing co-creation and experimentation. They must avoid benefiting a single party too much or creating an unsurmountable knowledge gap for the parties not involved in the co-creation and experimentation processes. While some studies demonstrate the potential of new procurement instruments like civic hackathons (e.g. Johnson & Robinson, 2014), start-up incubation and acceleration labs (e.g. Etzkowitz & Zhou, 2017), we still need to fine-tune these instruments to cater for the characteristics of the various GovTech solutions (see Table 2) and evaluate their effectivity. Future

research can focus on questions like: *What kinds of GovTech procurement systems need to be in place for cultivating a robust ecosystem of GovTech providers?*

3.3. Governance design

Governance design is about collectively setting goals, assigning decision rights and responsibilities regarding the coordination of GovTech design, implementation and operations. Koppenjan and Groenewegen (2005) refer to this as the ‘process design’. In essence, it’s about the design of decision-making and transition (change management) processes (De Bruijn, Ten Heuvelhof, & In’t Veld, 2014). To avoid confusion between the (solution) design process (e.g. agile development or rapid prototyping) and technical process designs (e.g. process flow diagrams and user-interaction models), this paper uses the term ‘governance design’. Typical goals for the governance design are to jointly specify who ought to be involved in the GovTech design and delivery processes, how actors can join or leave decision-making bodies, what kind of up-front commitment is satisfactory, what is in scope and whatnot, what auxiliary conditions must be met etc. The scope of such a design includes getting from the current situation to the desired future situation. Typical methods that can be employed include multiple helix collaboration (Leydesdorff, 2012), public-private collaboration (Klievink et al., 2016), GovTech incubation programs (Kuziemski et al., 2022), business model road mapping (De Reuver, Bouwman, & Haaker, 2013) etc. Such methods often lead to output artefacts like governance models, covenants for public-private collaboration, decision-making bodies and communication mechanisms, business model canvases, transition roadmaps etc.

The first challenge here lies in co-developing GovTech governance structures and controls that maximise the potential, yet minimise the risks of GovTech. Currently, we lack guidance in effectively steering the design and governance of GovTech solutions. This includes the installation of decision-making bodies, working groups and communication structures. Who should pick up the coordinative role? And if commercial GovTech parties take this role, the critical question for public agencies is whether to participate in the governance or not. The answer to this question depends on the level of control public agencies want to exert. Drawing on control theory (Ouchi, 1979), public agencies may want to exert control over GovTech providers through input, output,

behavioural, or normative measures (Tiwana, Konsynski, & Bush, 2010). For instance, in the case of data wallets, governments may impose conditions for who can collect personal data stored at government agencies (i.e. input control). They can also define how algorithms in data wallets should produce results or conditions for valid results (i.e. output control). Or dictate how data wallets should be developed through software development kits (i.e. behavioural control) or impose audit and certification systems (i.e. normative control). Public agencies can also exercise control through (partly) covering the costs for so-called boundary resources (e.g. application programming interfaces - APIs), which make a GovTech solution component accessible for external market applications. Future research can focus on questions like: *How can public agencies effectively co-create and govern GovTech? Which controls should be in place for maximising the potential, yet minimising the risks of GovTech?*

The second challenge here lies in the absorptive capacity (Cohen & Levinthal, 1990) of public agencies, which constitute the demand side of GovTech. The demand side requires strong in-house capabilities for examining GovTech solutions and subsequent calls for co-creation, experimentation and implementation. However, public agencies are known to lack technical knowledge and resources (OECD, 2017, 2014). For instance, resource and capacity constraints can limit the extent to which public agencies can proactively shape GovTech solutions. Moreover, the political fear of making mistakes, which can follow from experimentation, is deeply rooted in the public sector and can result in inaction or insufficient leadership commitment (Klievink et al., 2016). In a time where the media quickly pick up on administrative failures that could force ministers to resign, experimenting with GovTech may just be too risky. The perceptions of benefits and risks can be blurred by the information asymmetry between the public agencies and GovTech providers. In the case of GovTech solutions using new technologies like AI, Blockchain and IoT, the principal-agent problem can surface. Agency theory (Eisenhardt, 1989) explains that principals (i.e. public agencies) delegate decision-making authority to agents (GovTech providers). By definition, an agent uses a principal's resources (i.e. data, technical components). Agency theory assumes that the interests of a principal and an agent are not always in alignment. This is sometimes referred to as the principal-agent problem in which information asymmetries can complicate effective monitoring and regulation by the principal.

For overcoming these 'soft barriers' and stimulate the absorptive capacity at public agencies, future studies can borrow insights and good practices from collaborative innovation and change literature, including digital transformation (e.g. Gong et al., 2020), multiple-helix collaboration (e.g. Schütz, Heidingsfelder, & Schraudner, 2019), living labs (e.g. Gascó, 2017) and public-private collaboration (e.g. Klievink et al., 2016). Future research can focus on questions like: *Which policies are effective in aligning GovTech supply and demand? How can public agencies enhance their GovTech absorption capacity?*

The third challenge here lies in designing responsible business models for GovTech. As elaborated in Table 2, some GovTech solutions (e.g. digital identities, voice assistants and data wallets) are offered directly to citizens and businesses. In most countries, citizens and businesses are not accustomed to paying for tools needed to interact with government agencies. Usually, citizens, businesses, and even politicians expect such GovTech solutions to be offered free of charge to citizens – we do not pay to enter the tax office building and fill in the paper forms a public servant offers. The tension here is that designing and operating GovTech solutions carry one-off costs (e.g. designing, developing, testing and onboarding users) as well as (annually) recurring costs (e.g. for cloud storage, backups, updates). These costs must be covered somehow, and it must be completely transparent who pays for which GovTech component and who is responsible for the quality of that component. Currently, governments do not have explicit policies regarding which costs can be transferred to citizens or which part of the costs can be publicly funded. For instance, it is conceivable that public agencies reimburse some costs, like onboarding citizens and businesses

on GovTech solutions. We lack guidelines for developing responsible business models for GovTech solutions from an academic perspective. Given privacy and data protection regulations, as well as ethical concerns, business models offering 'free' GovTech in return for re-selling personal data advertisement will be politically and socially problematic to defend. Future research can focus on questions like: *What are responsible business models for GovTech?*

3.4. Technological design

GovTech solutions require a wide range of components to work. Fig. 2 provides an overview (non-exhaustive) of technological components found in GovTech solutions. These components are listed based on their functions and are described in a technology-agnostic way, meaning that the enabling digital technologies can vary. For instance, the components for data delivery can be part of a tightly coupled in-house application or part of a modular container platform allowing for remote service evocation and consumption using APIs.

The main goal for technological design should be to develop and test interoperable digital components based on the other design areas (human-centric, institutional and governance designs). Typical methods that can be employed include user experience (UX) design, agile development, rapid prototyping, software engineering etc. Note that these methods often allow for mixing conceptual design with the actual development of prototype software code that is tested in various cycles and iterations. Therefore, the range of output artefacts can be broad, ranging from more conceptual artefacts such as system architectures, process flow diagrams and software specifications (i.e. on paper), to prototype versions and instantiations of artefacts (i.e. software code) such as apps, data ledgers, algorithms, APIs, container platforms etc.

The first and perhaps most critical challenge is that of cross-component interoperability. Many of the components illustrated in Fig. 2 do not have to come from the same actor. For instance, trust service providers can provide digital identities and signing services. Public agencies can maintain the necessary digital identifiers (e.g. citizen social security numbers) and authentic registers with citizen data. And functional components such as data validation can be invoked on-demand from more specialised market parties. For all these components to work in concert, actors need to agree on the specifications of the input and output of the various components and their relations (often defined in a system architecture). Often, government agencies are path-dependent due to their legacy systems and have low flexibility in accommodating all sorts of new (web/cloud) technologies. Data availability and interoperability are often limited across public sectors as stovepiped organisations manage data within silos.

There is also a considerable lack of common/shared standards and specifications (e.g., data definitions, APIs, timestamping, and signature policies). Against this backdrop, the technologically more advanced GovTech start-ups/scale-ups need to find ways to co-develop specifications that bridge legacy systems with more advanced digital technologies, which may not yet be fully mature (i.e. there may not be enough publically available knowledge on how these technologies work and what the risks are). Governments must develop the ability to determine the right time to take risks with GovTech in experiments and pilots, and when to label a specific GovTech solution to be mature enough for it to become 'mainstream' and applied more broadly across different agencies. This is not as straightforward as it seems since some GovTech providers currently advertise their prototypes and beta-versions as mature and ready to deploy tomorrow.

Promoting the use of open standards can boost interoperability and cultivate GovTech maturity. Open standards refer to publically available specifications: formal descriptions of software, interfaces or data specifications. In open standards, "open" signifies that the standards process is open to participation and that the completed standards are available to everyone. By extension, open-source development may also stimulate interoperability and the creation of a level playing field of GovTech

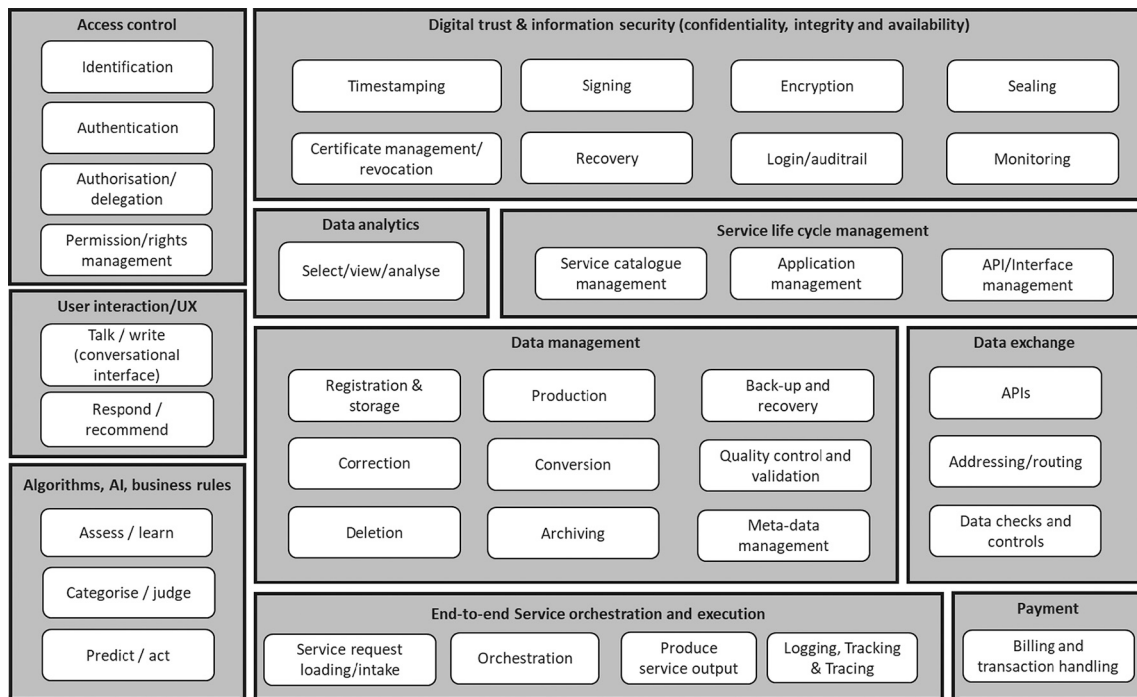


Fig. 2. Examples of technological components found in GovTech solutions.

providers. Open source refers to software whose source code is freely available to users for usage, debugging, modification, and extension.

Future research can focus on questions like: *Which digital technologies constitute GovTech solutions? How can we appraise the maturity of GovTech solutions? What kind of standardisation policies are needed to maximise GovTech interoperability?*

The second class of challenges rises from quality concerns that constantly plague inter-organisational information systems: data quality, system quality and service quality (Batini, Cappiello, Francalanci, & Maurino, 2009; DeLone & McLean, 1992; DeLone & McLean, 2003). These quality constructs are multi-dimensional and can often not be optimised in isolation, meaning trade-offs are needed. Data quality dimensions include correctness, relevancy, completeness, timeliness and reliability. System quality dimensions include availability, integrity, security, flexibility and auditability/ transparency. Service quality dimensions include usefulness, user-friendliness and responsiveness.

Regarding GovTech, regulations (e.g. the General Data Protection Act in Europe) constrain the optimisation of the various quality dimensions. For instance, privacy guidelines such as data-minimisation can lead to incomplete data sets in GovTech solutions that may require users to fill in more data manually, which decreases usefulness and user-friendliness. Citizen-centricity across various autonomous public agencies will demand a whole-of-government approach to technological design and data sharing. Furthermore, high data quality is a crucial precondition for GovTech using algorithms/AI, which sometimes is even more important than the quantity of data. Future research can focus on questions like: *Which measures need to be implemented to assure data quality, system quality and service quality in GovTech solutions?*

3.5. Human-centred design

The three designs described previously do not explicitly focus on the needs of different user groups. Most of the GovTech examples described in Table 2 are geared towards providing a superior user experience compared to the experience with existing public services. Three categories of goals here are to (1) deeply understand different user groups, their contexts and needs, allowing to develop high-quality GovTech solutions, (2) involve users in the GovTech design and delivery processes

(3) prevent harm to users by designing for values, while retaining a systems perspective. The latter relates to the ongoing trend of ‘ethification’ of digital technologies (van Dijk, Casiraghi, & Gutwirth, 2021), in which human values are infused in functional requirements (i.e. app features) and non-functional requirements (e.g. quality, cost). Typical methods for achieving these goals include co-creation (Gascó, 2017; Mergel, 2019); citizen participation (Holgersson & Karlsson, 2014), value-sensitive design (Friedman, Kahn, Borning, & Hultgren, 2013), participatory risk assessment (Roeser & Steinert, 2019), dilemma driven design (Ozkaramanli, Desmet, & Özcan, 2020), customer journey mapping and user-driven prototyping (Bharosa, Marangio, Petti, & Janssen, 2021). Corresponding output artefacts can vary and include personas, user stories and journeys, happy-and unhappy flows (what are the consequences when GovTech services do not work?), value hierarchies, norms, requirements, constraints and design guidelines etc.

The first challenge here is to realise a sufficient level of democracy, measured by the level of citizen engagement in public service innovation. One of the potential solutions is the use of multiple helix innovation models adapted for public service innovation (Bharosa & Janssen, 2020). A multiple helix joins public agencies, market parties, knowledge institutes and user groups in designing and experimenting with GovTech solutions. This can enhance legitimacy since actors can share the public value considerations and concerns up-front/before GovTech deployment in society. However, research in this area is still embryonic, and we lack insights into which methods work and under which conditions. Future research can focus on questions like: *How can we effectively involve various user groups in GovTech design and governance?*

The second challenge here is how to design for responsibility in GovTech. There are growing concerns around the challenges GovTech is creating in terms of privacy, security, fairness, and ethical issues. The first two categories of GovTech in public services (see Table 2) pose the most challenges since they work with personal data, and human values are at stake. GovTech solutions in these categories will often be situated in highly dynamic and data-rich environments where data analytics and AI applications provided or fed by various parties will thrive. A complete and fair distribution of responsibilities will not emerge just by itself (Fahlquist, Doorn and van de Poel, 2015). This perspective problematizes the distribution of responsibility – also known as the “problem of

many hands" (Bovens & Bovens, 1998). Many GovTech solutions suffer from this problem, given the usage of various digital components provided by an ecosystem of specialised parties (see Fig. 2). Accordingly, many GovTech solutions have no clear responsibility descriptions in the 'terms of use' on their websites. Currently, we lack guidelines for allocating responsibility in the design. Future research can focus on questions like: *How do GovTech solutions affect the everyday life of users (citizens, businesses and public professionals)? What kind of risks and unwanted consequences may surface from the use of GovTech? How can we prevent harm from the use of GovTech? How can we design for responsibility in GovTech?*

Table 3 outlines the connection between the four design areas proposed in Fig. 1, with respective research challenges and research questions.

The research agenda presented here is not exhaustive. This study was intended to be exploratory and draws on ongoing GovTech research by the author. A different research framework or empirical orientation would probably lead to additional research questions like: *What kind of theories and methods are needed to study the design and evolution of GovTech? How can we systematically compare GovTech engagement strategies across various countries/regions? What are barriers for GovTech adoption?*

Table 3
A GovTech research agenda.

Design area (see Fig. 1)	Research challenges	Research questions
Institutional design	Institutional void GovTech legitimisation Lack of trust anchors	<i>What are the critical aspects of trust frameworks for GovTech? Which kind of trust anchors are needed to accelerate the development and adoption of GovTech solutions?</i>
	GovTech procurement Procuring innovation from SME's	<i>What kinds of GovTech procurement systems need to be in place for cultivating a robust ecosystem of GovTech providers?</i>
Governance design	GovTech governance and controls	<i>How can public agencies effectively co-create and govern GovTech? Which controls should be in place for maximising the potential yet minimising the risks of GovTech?</i>
	GovTech supply and demand alignment: Absorptive capacity at public agencies	<i>Which policies are effective in aligning GovTech supply and demand? How can public agencies enhance their GovTech absorption capacity?</i>
Technological design	Developing responsible business models	<i>What are responsible business models for GovTech?</i>
	Safeguarding cross-component interoperability	<i>Which digital technologies constitute GovTech solutions? How can we appraise the maturity of GovTech solutions? What kind of standardisation policies are needed to maximise GovTech interoperability?</i>
	Assuring data quality, system quality and service quality	<i>Which measures need to be implemented to assure data quality, system quality and service quality in GovTech solutions?</i>
Human-centred design	Risks and long-term effects of GovTech GovTech Ethification Preventing harm to users Designing for responsibility	<i>How do GovTech solutions affect the everyday life of users (citizens, businesses and public professionals)? What kind of risks and unwanted consequences may surface from the use of GovTech? How can we prevent harm from the use of GovTech? How can we design for responsibility in GovTech?</i>
	User involvement	<i>How can we effectively involve various user groups in GovTech design and governance?</i>

Which areas of government should be excluded from GovTech solutions operated by private parties? What kind of selection criteria should GovTech solutions satisfy before getting access to government-managed components?

While the research agenda is limited in scope, it yields fertile ground for further research. The research challenges can become more concrete when analysed through specific case studies.

4. Discussion

The rise of GovTech is both promising and problematic. Innovative GovTech solutions promise seamless, proactive and engaging public services based on personalised user journeys. Yet, many of such solutions can only mature once public agencies allow for the use of government components (e.g. data registries). There are several drivers for public agencies to embrace GovTech. For public agencies that have been struggling with innovation and digital transformations from within, GovTech solutions that are developed outside the organisational boundaries can be a blessing in disguise, solving the problem of public service innovation and extending the classical sourcing dichotomy of 'make or buy' with options like combine or replace legacy systems with modern GovTech solutions. Therefore, the rise of GovTech offers a policy window for cultivating and harvesting the potential of emerging digital technologies, and go beyond building digital copies of the bureaucracies powering the existing public services. Moreover, the spill-over potential and positive network externalities to other domains such as education, finance, housing, healthcare, mobility etc. can be huge since an installed base for a user (including digital identity, voice assistant, data wallet, data specifications and data exchange protocols) can also be used in other domains in which users interact. Hence, the range of digital transformation could far exceed that of digital government.

Another driver is the growing willingness to build a more robust digital market by creating an ecosystem of SmallTech players as an alternative to BigTech companies. For a large part, the success of GovTech solutions depends on the willingness of public agencies to overcome departmental silos and allow GovTech solutions to use digital components managed by government agencies. This willingness is not a given and requires building institutionalized trust, practising new ways of working, experimenting and procuring. It also requires co-creating shared boundary resources such as technical specifications and data exchange components. Trust frameworks with clear trust anchors, quality controls, and data sharing specifications can increase transparency (e.g., requirements) and predictability for market parties, allowing them to focus their investments. We are still at the beginning of embracing GovTech as means for digital transformation. Successful completion of such transformations will also require redesigning institutions and stakeholder engagement processes such as public procurement systems. And yes, there are risks that must be mitigated along the way.

One of the risks of embracing GovTech can be summarized by the Trojan horse metaphor (in the context of Greek mythology). In this view, embracing GovTech will lure governments into an even higher level of dependencies on commercial – profit-seeking – market parties. This view is rooted in the experience societies have with BigTech companies that have disrupted and monopolised complete industries, backed by huge investments far beyond the IT budgets of public agencies. Some BigTech companies have become so dominant that they control which competitors can access citizens (customers) via the app store. This position has been strategically seized by offering superior user journeys free of charge. This is a trick because people pay with their data and attention, hence the Trojan horse analogy. Once users are on the hook, competitors can be bought or left to perish. In this view, some GovTech providers can become the next Big Tech providers that could further exploit the limited technical knowledge available at public agencies. This dependency risk can become even more significant once modern GovTech solutions replace older government components (e.g. portals, apps,

algorithms and data exchange infrastructures). This replacement of components diminishes public agencies' capability to attract and retain technological expertise. This might even shift decision-making power from public agencies to market parties in the long run. For governments, giving up sovereignty (i.e. control) to private organisations in their own country is problematic. And, giving up sovereignty to foreign entities – public or private – is (geo-)politically even more problematic. Private GovTech providers can be easily bought up by foreign entities operating in not so friendly states. In a decade in which countries seek to reduce dependence on foreign technologies, GovTech solution providers with (potential) overseas ownership are under increased scrutiny.

Last but not least, there is also the risk of doing harm to users looming over GovTech. Once implemented, GovTech solutions will affect the everyday life of users, including citizens, businesses and public professionals. These groups can experience positive and negative/unwanted consequences. For instance, the ability for citizens to collect personal data from various public agencies in a personal data wallet on the fly is great when applying for a mortgage. However, what happens if a potential employer would like to see this data to judge your financial state before employment? The prospects for 'over-asking' personal data are endless, and we still need to figure out how to prevent this.

The bottom line is that public agencies face multiple challenges and risks in embracing GovTech. They can employ two high-level strategies for dealing with the risks of GovTech: (1) ex-ante co-creation of responsible GovTech solutions, versus (2) ex-post regulation of GovTech. The first strategy requires a proactive stance towards GovTech in which public agencies act as partners in co-creation, recognizing GovTech as a social and economic opportunity. This strategy allows governments to co-design input, throughput and output norms and controls in GovTech. The second strategy suggests a more reactive stance towards GovTech adoption and usage in society. This strategy focuses on developing normative controls such as laws and regulations, seeking to correct unwanted consequences such as harm to citizens, over-asking personal data or a monopoly/winner-takes-all market.

Public agencies can employ the conceptual framework provided in this paper to develop and align their GovTech policies. This requires focussing on GovTech governance, referring to the ability to manage the various interdependencies between the four design areas discussed in this paper. Aligning the four design areas is a significant undertaking since each design area establishes different epistemic communities: people with shared knowledge, expertise, methods, beliefs, or ways of looking at the world. Effective GovTech governance will require boundary spanning across the four design areas and communities, for instance via multiple-helix innovation hubs. This provides an policy window for re-envisioning the roles governments currently play in shaping digital technologies in society, including those of policy-maker, protector of human rights and public values, market maker, data user, data provider, technology user (often the launching customer), technology provider, public service provider and supervision authority. These roles have been institutionalized in a pre-GovTech era and must be recalibrated in a GovTech era. Considering the various interactions and uncertainties underlying GovTech and the anticipated impact on societies, there is an urgent need for academic research and knowledge dissemination towards policy-makers. The research agenda compiled in this paper can function as a starting point for focussing future research.

Declaration of Competing Interest

None.

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